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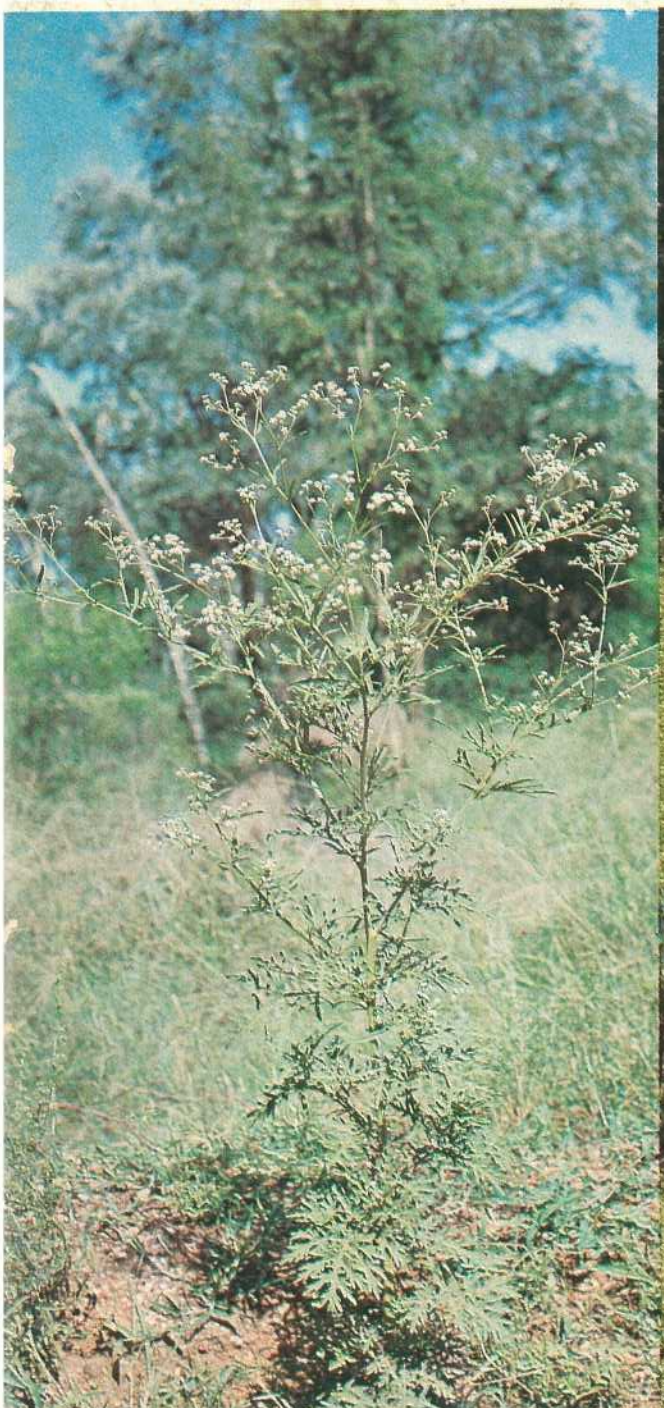

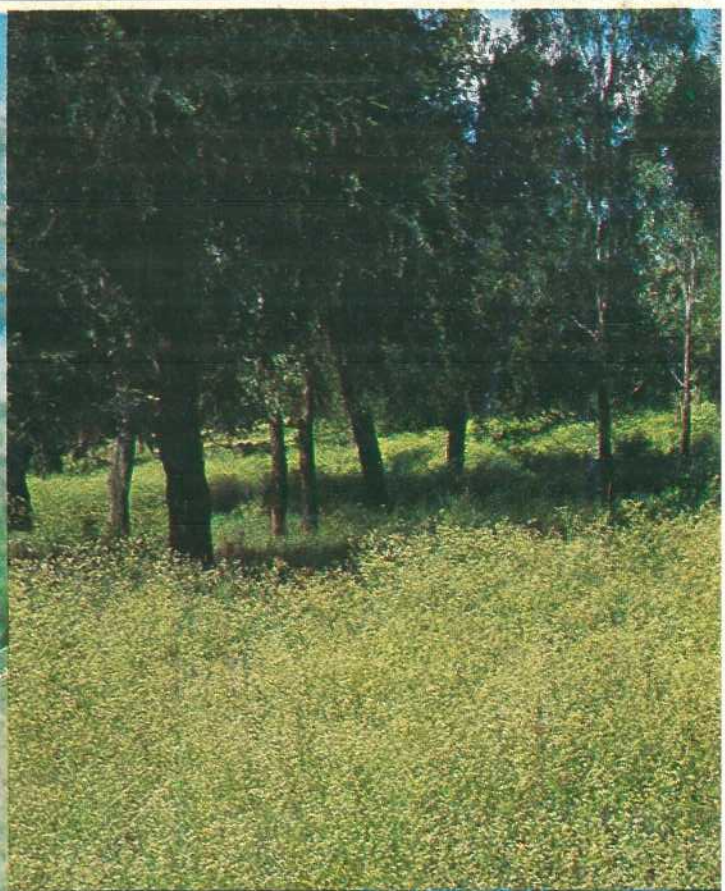

Illustrated on our cover

PARTHENIUM WEED

IN the Central Highlands, particularly around Clermont, a weed known locally as 'ragweed' or 'white-top' is causing great concern to landholders and local authorities because of its extremely rapid rate of spread and its tendency to take possession of roadsides and pulled scrub country.

The plant is not a geniune ragweed. It is *Parthenium hysterophorus* and the best common name to use would be PARTHENIUM WEED so as to avoid confusion. It is a short-lived annual with erect stems, sometimes growing to a height of 2 m. The lower leaves are deeply dissected into narrow, pointed lobes, the upper leaves are smaller, narrower and less dissected. Leaves and stems are covered with soft fine hairs and the leaves are dull green in colour.

Individual flowers are very tiny and are compacted into white rounded heads about 10 mm across each at the tip of a slender branch that is part of an open, much branched flower cluster (panicle) at the top of the plant. Each flower head usually contains about four tiny black seeds with thin white concave appendages, one on each side. The ripe seeds are shed freely and appear to be capable of germinating at almost any time of the year. In favourable seasons, four or more successive crops of seedlings may come up on the same site. The precise seasonal conditions needed for germination and growth are still under investigation. Field experience and the history of the spread of the plant in central Queensland suggest that favourable seasons are those with good rain in both summer and winter.

The plant was first reported in the Central Highlands from a property near Twin Hills in 1964. It remained fairly static on this and some neighbouring properties until 1973. In the second half of 1973, following good winter rain, it suddenly appeared in large amounts along roadsides north of Clermont. During the good seasons of 1974, 1975 and early 1976 it continued to spread along roads at a frightening rate. In some areas it invaded scrub country that had been sown to grass or where water ran in the wet, or the surface soil had been disturbed.

The small seeds are sucked up by passing motor vehicles and deposited further along the roads where, if the soil is suitable and rain falls at the right time, they germinate and start another patch. The seeds can also be carried by water and quite a number of infestations have been noted along gullies and drainage flats in gidyea and brigalow scrubs over a very wide area from north to Twin Hills to east and south of Rolleston.

Data from North and South America where the plant is native and widespread but not particularly troublesome and from India, where it has been introduced during the last 20 years and behaves as a weed in a manner similar to that in Queensland, suggest that it is likely to become aggressive only in a region within about 2 degrees north and south of the Tropic of Capricorn, in slightly elevated inland country with rainfall between 500 and 800 mm (20–32 inches) a year. Outside this region it comes up occasionally in waste places but it is not aggressive.

Studies on control measures are incomplete but preliminary work indicates that the plant is susceptible to 2,4–D amine and Tordon 50–D. Most people prefer to use Tordon 50–D because it is said to give some residual effect and to kill new seedlings that emerge after the older plants die. Precise recommendations cannot be made until the present series of experiments is complete. However a thorough spraying with 2,4–D amine at 2–4 kg per hectare (2–4 lbs per acre: 5–10 litres per hectare or 2/5–4/5 gallon per acre of 50% 2,4–D amine concentrate) or with Tordon 50–D at 10 litres per hectare (1 gallon per acre) appear to be effective.

The actual volume used will depend on the machinery available but it appears that high volumes (2 000 litres per hectare or 200 gallons per acre) gives more consistent results than moderate or low volume spraying.

If isolated plants or patches are located in new localities, it is safer to spray them without disturbance rather than to pull them up and run the risk of spreading the seeds.

Pictures and story by Selwyn L. Everist, Government Botanist.

QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES.
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Contents

QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES

Of particular interest

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

BROOD DISEASE OF BEES

SWIFT action by Department of Primary Industries advisers seems to have brought under control a small, but serious, outbreak of European Brood Disease in beehives in the Inala, Brisbane, area.

The outbreak was a limited one and the disease occurred only occasionally in honeybees in Queensland.

The last outbreak was located in Rockhampton in 1969.

In the Inala area, it has been detected in one hive and at no other apiary to date.

Some 200 colonies have been examined in the area and inspectors are continuing their check.

There was no known cure for the disease, which infected larval stages of the honeybee.

The method of control adopted was by burning infected material. Honeybees and bee frames from the infected colony had been destroyed and bee boxes sterilised.

He emphasised that the bacteria involved in this disease were completely harmless in honey used for human consumption.

I ask all beekeepers in the Inala area to carry out brood inspections as soon as possible and report any unusual symptoms to the Bee-keeping Section at the Animal Research Institute at Yeerongpilly, Brisbane.

The Avenel Sheep crush

by LLOYD DUNLOP, Sheep and Wool Advisor, Charleville, with Mr. LEX STEPHENSON, "Avenel Park", Cunnamulla.

Mr. Stephenson using the Avenel Sheep Crush.

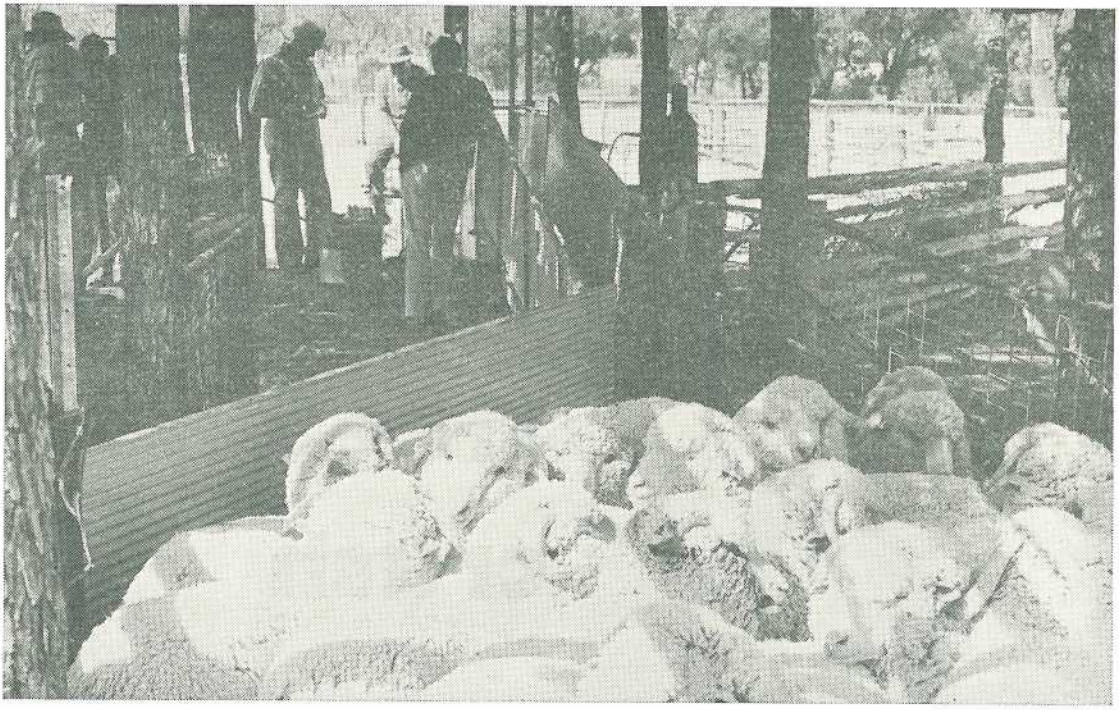
INCREASING costs provided the incentive for Mr. Lex Stephenson of "Avenel Park", Cunnamulla to design a race so he could do his own crutching.

Mr. Stephenson said, "The first Avenel Sheep Crush was built in 1970 as an easy method of cleaning up sheep for slaughter".

"I started with a prototype crush on a small mob of sale sheep, discarded some ideas, and added others and early in '71 crutched 5,000 sheep."

The race, which is now being marketed commercially won the Rural Aids award at the 1971 Orange Field Day.

It enables sheep to be brought to the operator one at a time for crutching, wigging and pizzling.



The operator's side is of corrugated iron while the weldmesh on the opposite side allows the penned sheep forward and sideway vision.

It is fast and simple to use and takes the hard back bending work out of crutching. Mr. Stephenson is able to crutch 50 sheep an hour by himself and claims one man with the help of a dog or a child can easily handle 40 to 60 sheep an hour.

The System

The unit comprises a forcing pen, an elevating race, a holding box and a tipping table upon which the sheep is restrained for crutching.

Sheep in the race always have forward vision so that they will follow one another up the race.

After crutching, the sheep is dropped back onto its feet and acts as a decoy when it runs away to draw the next sheep into the crutching area.

Forcing Pen

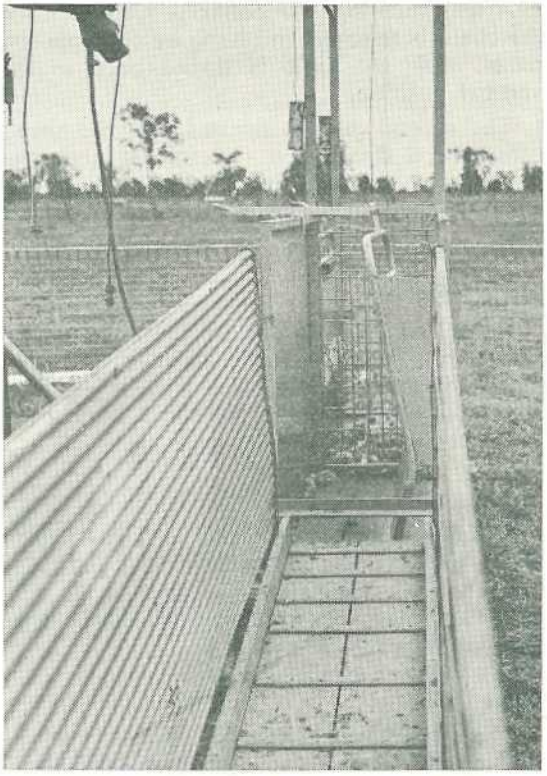
This pen behind the race holds 50 sheep. The panel on the operator's side is of light corrugated iron while the opposite could be of weldmesh or pipe rails so as to enable the penned sheep forward and sideways vision.

The Race

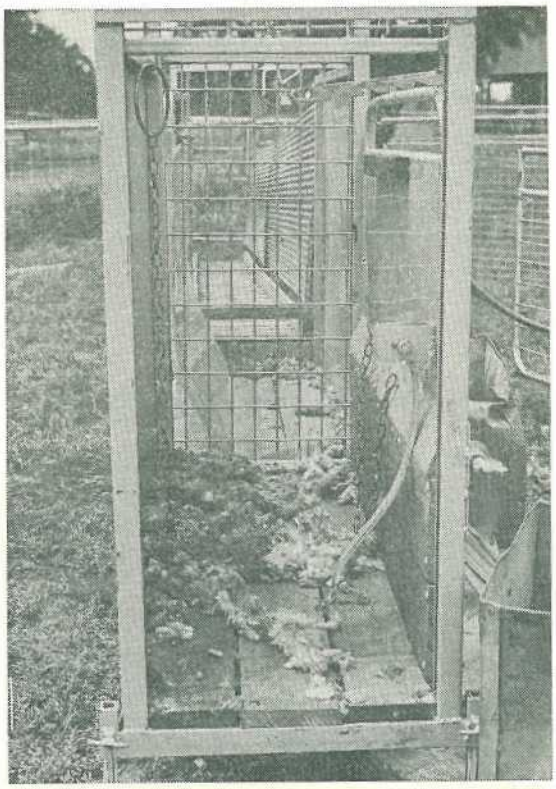
From the pen the sheep are fed into an elevating race which is 5·4 m (18 ft.) long and rises 0·53 m (21 in). This height can be adjusted to suit the height of the operator.

Again the operator's side is corrugated iron while the opposite side is weldmesh.

Mr. Stephenson said, "The aim is that sheep feed themselves from the forcing pen into and up the race. A dog on a wire on the off side or weldmesh side can keep the sheep



A hinged panel allows ewes and lambs to be crutched without having to draft off the lambs.



The chain is attached to two points at the bottom of the table and when not in use is hooked to the opposite panel.

moving from the forcing pen up the race. A pull up gate at the entrance to the race can be worked from the crutching unit."

The Holding Box

This box holds one sheep awaiting crutching.

Its floor level is 0·20 m (8 in.) below the end of the race. Because it is higher the end of the race acts as a hock bar to prevent backward movement of the sheep.

The panels are of sheet iron. The panel opposite the operator is hinged at the bottom so that it can be drawn towards the other panel. The effect is to prevent lambs turning around. Thus ewes and lambs can be crutched without having to draft off the lambs.

Gates

The crush has two counterbalanced vertically lifting gates at either end of the crutching table. These are operated by pulling the counterbalance down.

The Table

The tipping table which forms one side of the crush has a head-restraining device and a flank chain.

The chain is secured at two points at the bottom of the table and when not in use its free end is hooked to the opposite panel.

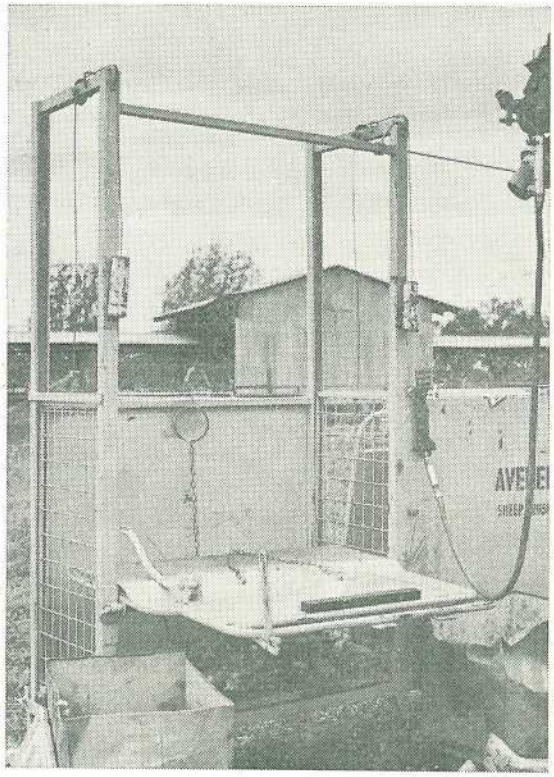
The Operation

One man can crutch and pen up with this unit though a second man would speed up the operation and could piece pick.

The sheep is loaded by opening the gate from the holding box. The sheep steps over the chain with its front feet and is stopped by the second gate.

The free end of the chain is pulled over the sheep's flank and secured in a notch at the top of the table. The table is tipped easily on its side as the centre of gravity is above the pivot of the table. The sheep's head is then restrained in the adjustable collar.

The sheeps head is restrained in this adjustable collar.



After crutching, the collar is released then the chain is released and hung on the opposite panel while the table is tipped back to the vertical position.

The second gate is opened and the sheep runs into a decoy pen. Before it finds the hidden exit behind, the crutched sheep has already acted as a decoy for the following sheep.

Hock Bars

Hock bars are useful in the race. Mr. Stephenson prefers 1 cm ($\frac{3}{8}$ in.) steel rod mounted across the race 0·20 m (8 in.) above the floor. Four or five hock bars could be placed in the elevating race.

Repeatability

Mr. Stephenson said, "In '71 I was asked about my chances of getting sheep into the unit the following year. *Would it be like plunge dipping—once bitten twice shy?* After five years I can say it is not.

Other Jobs

The crush lends itself to other tasks such as classing, fleece sampling, feet trimming, drenching, marking and mulesing big straggler lambs and cleaning up sheep for abattoirs.

It may also be used for dehorning rams particularly with the adjustable head restraint.

"We mules at lambmarking but mules stragglers in this unit as they are crutched", said Mr. Stephenson. "Mr. John Arnold of "Wongamere" has mulsed 800 in one of these units. He says he was crutching and mulesing at the rate of 30 per hour."

"I don't claim excessive speed but I do claim you can catch and crutch a sheep with minimum physical effort and consequently keep it up five days a week without getting as sore as a boil," he said.

Castrating calves

by M. A. BURNS,
Beef Cattle Husbandry Branch.

In this article, the author looks at the equipment needed for the various methods of castration. The actual methods of castration are discussed in detail in the supplement "Castrate Calves Successfully" in the issue November–December, 1975.

EXCEPT for male animals selected for breeding it is normal practice in both the beef and dairy industries to castrate male calves produced in breeding herds. Castration is performed mainly as an aid to herd management as the running of large numbers of bulls on a property renders animal control very difficult.

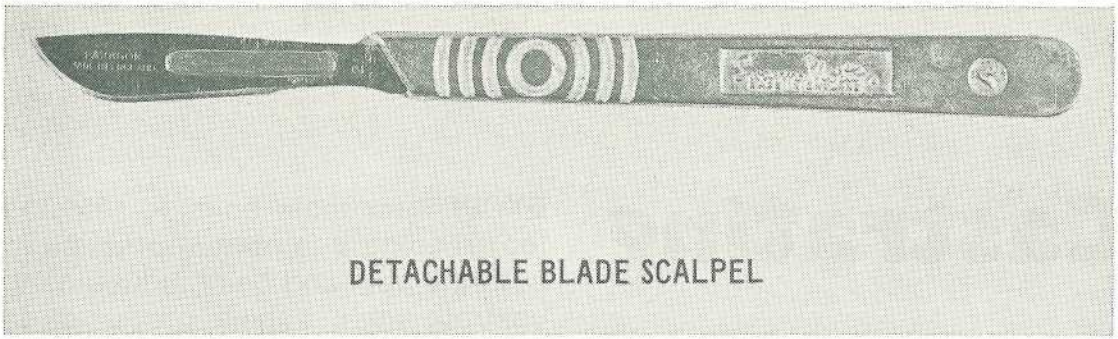
Then, too, market demand is greatest for beef from castrated males than for bull beef, particularly as most cattle for slaughter are marketed in Australia at ages beyond the yearling stage after which time bull beef is less acceptable to the domestic trade.

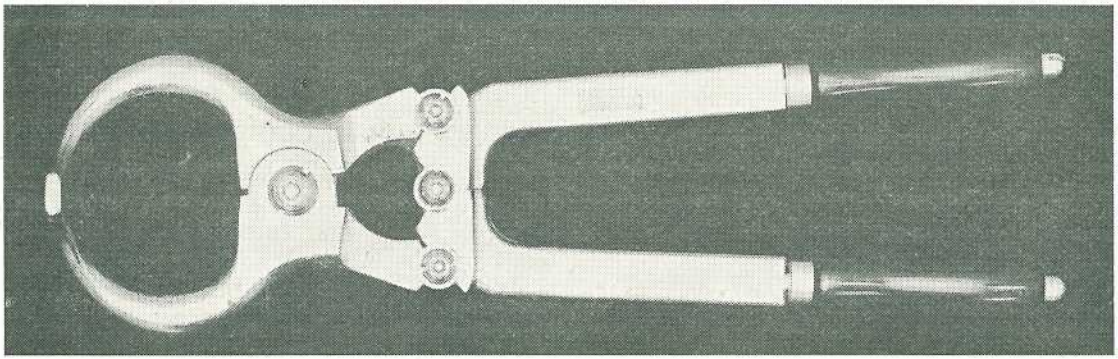
Castration does not increase the rate of liveweight gain by animals. In fact, bulls gain weight at about 10 per cent higher rate than steers.

Age of Castration

Animals can be castrated at any stage of their life but are normally done during the first year of life. Ideally the younger the animal the better, as castration is then less shock to it and the setback to its growth is lessened. However, from the practical viewpoint on beef cattle properties, marking operations, which include castration, earmarking, dehorning, vaccination against Blackleg and fire branding, are best performed at the same time to avoid double handling of calves.

Because of the difficulty of applying a firebrand on small calves, the most suitable time for marking is when the calf is three to four months of age by which time it is still easy to handle and is big enough to facilitate branding. In most beef herds where calves are born over a period of several months the age range of calves at branding is often two to six or seven months.





Equipment for castration—The top picture shows the recommended detachable blade scalpel, the bottom picture is an illustration of Burdizzo pinchers for bloodless castration.

Methods of Castration

There are three commonly used methods of castrating calves. These are:—

- Open Castration.
- Elastration.
- Bloodless Castration with "Burdizzo" Pinchers.

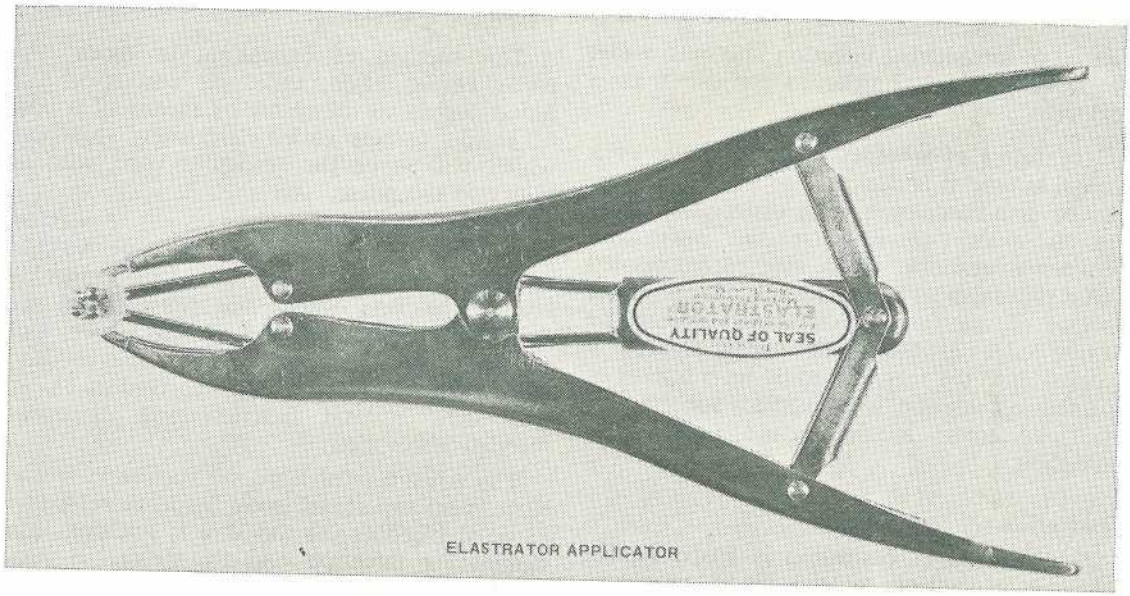
Open Castration

This is the oldest and most commonly used method of castration, particularly in the beef cattle industry. Open castration is performed with a sharp blade and involves the excision of the testes from the scrotum or purse. Open castration has the advantage that castration is completed at the time of the operation and if properly performed is 100 per cent effective.

It has the disadvantage that there is greater chance of infection to the calf and possible greater set-back, with the occasional calf dying from post-operative infection. However, the danger of this eventuating is not great provided the necessary attention is paid to cleanliness and correct operative procedure.

The main equipment required for open castration is a good, sharp knife. However, I prefer a detachable blade scalpel with a No. 4 handle, and a No. 21 blade. The advantages of a scalpel are that it is easier to sterilise and the blade can be readily replaced when it becomes blunt.

A pocket knife has the disadvantage that the blade has to be sharpened when it becomes blunt, thus holding up operations, and there is always a tendency for the knife to be also used for purposes other than castration thereby



ELASTRATOR APPLICATOR

ELASTRATOR MARKING RINGS

Equipment for elastration includes the specially designed "Elastrator" pliers and antiseptic "Elastrator" rings.

becoming contaminated and increasing the chance of introducing infection into cuts made. A pocket knife is harder to sterilise than a scalpel.

Regardless of whether a pocket knife or a scalpel is used it is desirable to have a shallow tray or dish containing some disinfectant solution in which to immerse the instrument between operations. It is also recommended that a thin layer of cottonwool be placed in the bottom of the tray to safeguard against the cutting edge of the blade being blunted if dropped into the tray. In addition, a bucket of disinfectant solution is convenient for washing the operator's hands before and after castration.

Elastration

This method of castration is based on the principle of cutting off the blood supply to the purse and the testes contained therein causing them to slough off. This is done by placing a small, strong rubber ring around the neck of the purse close to the body of the calf. Elastration has the advantage that the operation can be performed quickly and simply and does not require the same degree of skill as for open castration. The method is thus very suitable for use by the less experienced operator.

Disadvantages of elastration are that it takes some weeks for the purse and testes to slough off and in the meantime fly strike is possible if adequate precautions are not taken to repel flies. Then too, since the purse is completely removed the fat steer shows no "cod" fat and this often detracts from the appearance of the "finished" steer. However, this should have no economic importance and is hardy a valid argument against elastration.

Elastration equipment comprises specially designed "Elastrator" pliers and antiseptic rubber "Elastrator" rings. A specially designed ring dispenser may also be used and is an advantage where large numbers of animals are to be treated.

Bloodless Castration

This method of castration, or more correctly emasculation, relies on cutting-off the blood supply to the testes by means of a pair of sturdy clamps called "Burdizzo" pinchers which will sever the testicular cord without injury to the purse.

The principle of the operation is based on the difference in resistance to pressure between the skin of the purse and the testicular cord. The skin resists the pressure of the Burdizzo pinchers while the blood vessels and the spermatic ducts of the cord are crushed and obliterated. The testes, deprived of blood, stop their normal function and disappear through absorption.

The advantage of Burdizzo castration is that there is no superficial wound, and therefore no external bleeding, as the skin is not cut, thus eliminating infection and fly strike. If properly performed, castration is fully effective, but a small percentage of failures do occur where adequate care is not taken.

Calf Restraint

Castration may be carried out with the calf either in the standing position held in a race or in a veterinary crush fitted with a head bail, or alternatively cast on its side on the ground or in a branding cradle.

The method of restraint depends on individual operator choice, but where large numbers of calves are marked at one time, as is usually the case on beef cattle properties, a calf crush and branding cradle is considered the best form of restraint, being time saving and generally causing less stress to the calf.

This method of restraint is most commonly used on beef cattle properties. However, where only a few calves are to be done, the cost of constructing a calf crush and the installation of a cradle is hardly warranted.

Where "Burdizzo" pliers are used for castration, the operation is performed easiest with the animal standing. However, the operation can be effectively performed with the animal cast on its side.

Identifying insects

Termites
(Order *Isoptera*)

by I. D. GALLOWAY, Entomology Branch.

TERMITES and their invasion of timber were known to the world long before the advent of man. It was only when man discovered the many uses of timber that he and the termite became competitors.

The association of the common name "white ant" is rather a paradox since with the exception of their social habits termites possess few of the characteristics of the true ant. Ants pass through the well defined stages of egg, larva, pupa and adult while the young termite on hatching from the egg is a miniature of the adult and grows by a series of moults.

The termite colony

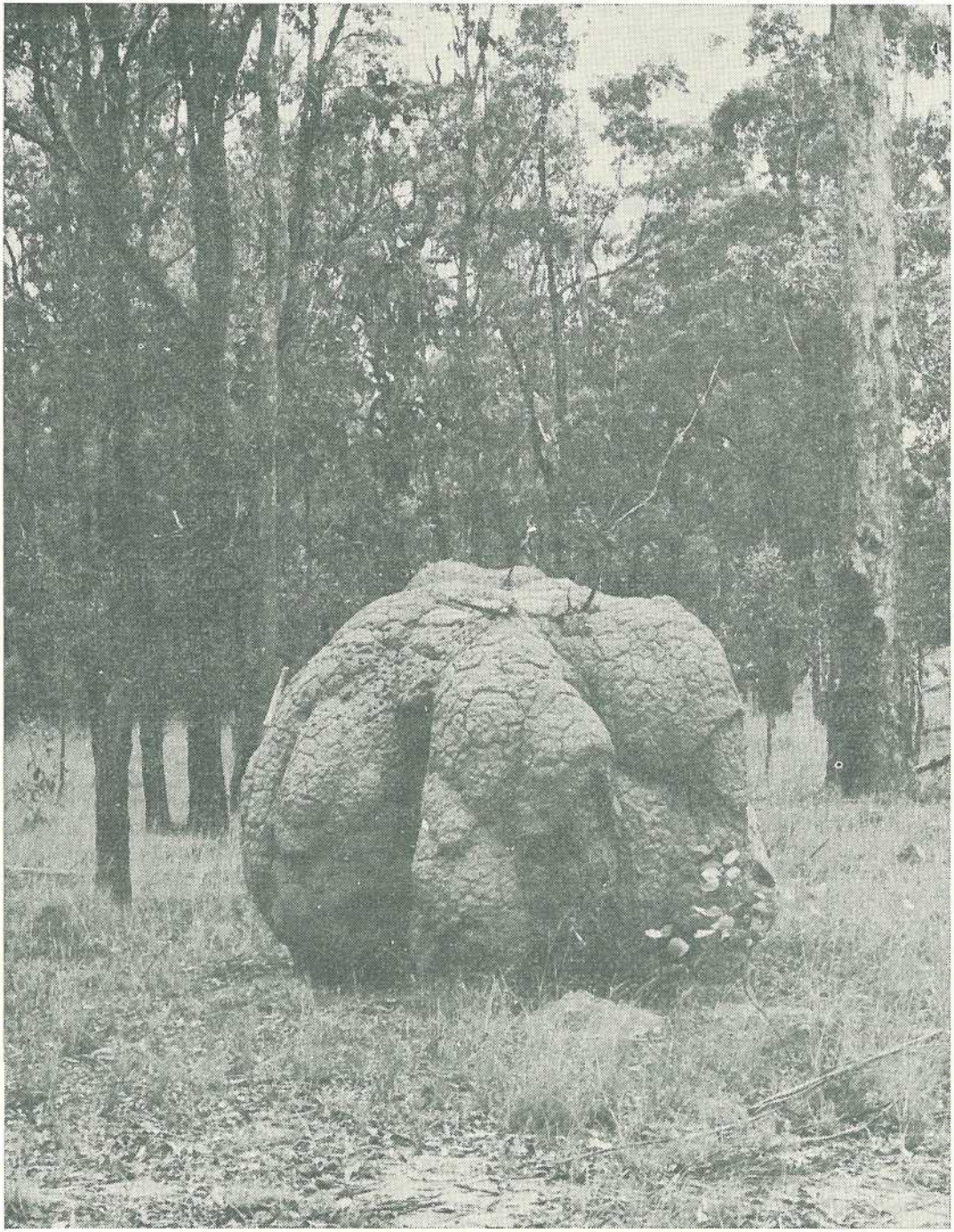
Though considered to be one of the more primitive races of insects, termites have developed a high degree of social organization. Mutual co-operation has welded weak and vulnerable individuals into a strong cohesive society. As in most co-operative societies there is a division of labour with groups of individuals adapting to perform specific tasks.

In a termite colony this is expressed by a number of physically distinct forms or castes, namely workers, soldiers, and juvenile forms. The reproductive function is restricted to a few individuals, often a single pair referred to as the king and queen. At certain times of the year alates or winged forms are also present in the nest. These are the potential kings and queens of future colonies.

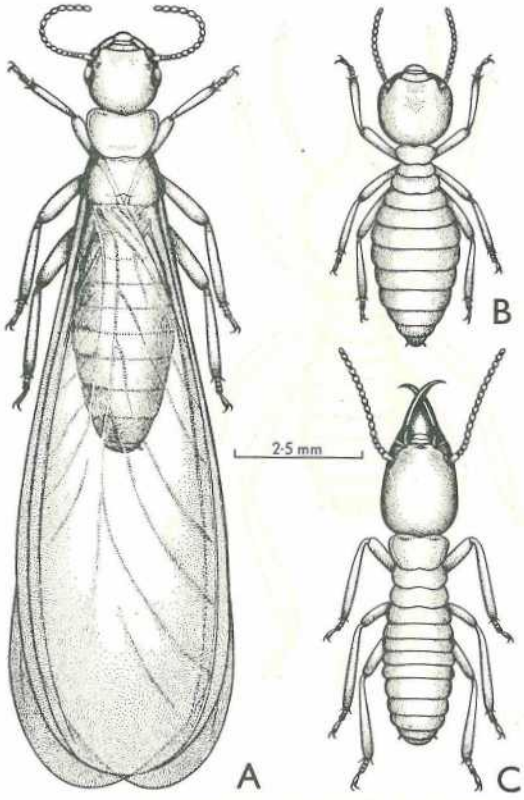
The worker caste dominates the population of a termite colony. They are blind, wingless, sterile individuals with pale coloured heads and soft unpigmented bodies. This caste is most aptly named as it is responsbile for all the day to day chores in the colony. They build and maintain the nest, locate and gather the food, tend the young and feed and care for the royal pair. These busy little creatures are indispensible members of the termite community but to man represent the agents of destruction which destroy his forests, buildings, wharves and furniture.

The security of the colony and the protection of foraging parties are maintained by the soldier caste. Like the workers these individuals are wingless, sterile and blind but can be readily distinguished by their darker, frequently large, brown heads. Most soldiers have long sickle-like jaws which are an effective weapon against an intruder.

In some groups of termites the soldier has been adapted for chemical warfare. These defenders are known as nasute soldiers as their heads are drawn out into a snout or "nasus". Through this slender beak an irritating or offensive fluid can be ejected with considerable force.



A mound of a grass-eating termite in North Queensland.



Castes of the subterranean termite (Coptotermes acinaciformis)

A. winged reproductive or alate.

B. worker.

C. soldier.

(Illustration reproduced with the kind permission of C.S.I.R.O., Division of Entomology and Melbourne University Press).

The inveterate enemies of termites are ants. Sightless and slow moving in the open, termites are usually no match for these fierce creatures but in a nest or gallery can frequently keep them at bay. If the outerwall of a nest is breached during an attack the soldiers immediately swarm into the gap and confront the enemy with a living wall of armoured heads and threatening jaws. As the danger passes workers are allowed through the ranks of soldiers and the hole is quickly repaired.

Alates or winged forms are quite different in appearance from the workers and soldiers. Their bodies are very much darker and they possess well developed compound eyes and two pairs of wings. It is from these wings, which are similar in size and venation, that we derive the name Isoptera from the Greek "isos" equal and "pteron" a wing. When the alates complete their colonizing flight these wings are deliberately removed as such appendages would only be a hindrance in their future confined life.

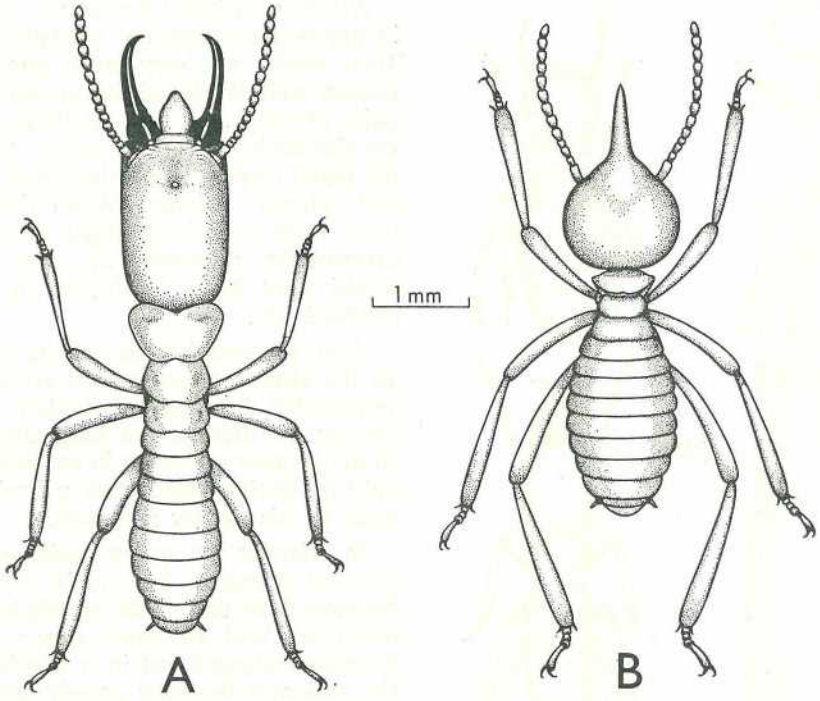
Atop the social ladder of the termite colony sit the king and queen who are usually solely responsible for the production of offspring. During his lifetime the king alters very little in appearance and even in an older colony can only be distinguished from a freshly de-alated male by his stouter abdomen.

In contrast the queen undergoes a marked physical change as her ovaries enlarge and she becomes little more than an efficient egg laying machine. With all termite queens the abdomen becomes enlarged but in a number of species the abdomen becomes grossly distended. Such queens are said to be phytogastric and because of their size are incapable of movement. A phytogastric queen and her king are usually accommodated in a specially constructed royal cell where they are attended by a retinue of soldiers and workers.

In times of need it is possible for supplementary or emergency reproductives to be produced. These are nymphs which develop functional reproductive organs without becoming alates or leaving the parent colony. These forms appear in a colony to either augment the decreasing output of a failing queen, or to enable a colony to continue when the true king or queen has died. As a supplementary queen is not as fecund as the true queen a number are usually developed, and operate in the colony at the same time.

Formation of a new colony

The colonizing flight of the male and female alates from the parental nest takes place during the summer months usually following rain. In preparation for this mass exodus the workers cut openings in the nest which are guarded by the soldiers until flight time arrives.



The soldier caste.

A. a mandibulate soldier.

B. a nasute soldier.

(Illustration reproduced with the kind permission of C.S.I.R.O., Division of Entomology and Melbourne University Press).

In some species the alates are weak fliers and seldom travel far before dropping to the ground. The alates of many species, however, can remain aloft for many hours and could easily be carried long distances by the wind. Upon landing the alates shed their wings and pair off. The female runs off over the damp ground with her male suitor in hot pursuit. Eventually a suitable nesting place is found and the royal pair excavate a chamber and carefully block the entrance. This is the beginning of a new nest.

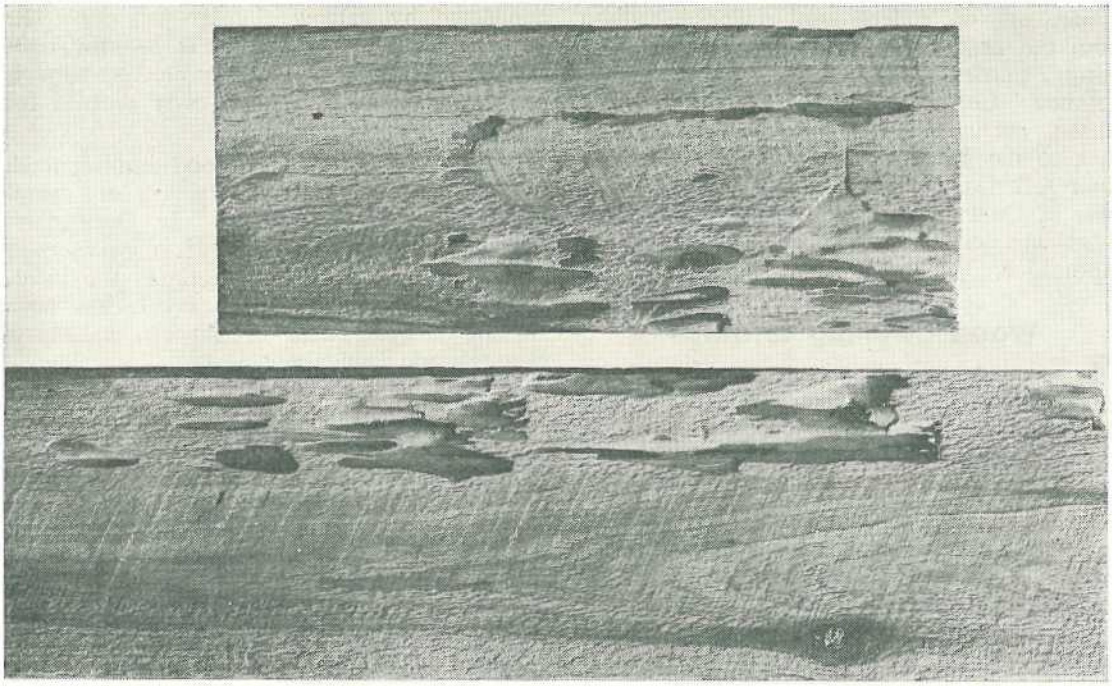
Within a few weeks the first eggs are laid from which soldiers and workers emerge. This first brood is fed and cared for by the parents until they are old enough to undertake the work of the new colony. The queen then devotes herself to the task of egglaying, her nourishment and grooming now the responsibility of the workers. The enlargement of the colony now goes forward without interruption.

Different types of termites

Termites can be conveniently placed into two well defined groups—the wood dwelling and soil dwelling forms.

Soil dwelling termites

The great majority of Australian termites are soil dwellers. Many of these termites, however, feed on wood at a considerable distance above the ground but always maintain a ground connection so that foraging parties have a direct pathway back to the centre of the colony. A number of soil dwelling termites construct no proper nest but live and breed in rambling underground galleries. Such termites play a significant role in soil renova-



Cypress pine damaged by dry wood termites.

tion by permitting the penetration of air and water to the deeper soil layers. Where a nest is formed it may be entirely underground, raised above the surface or even attached to the trunk or limb of a tree. All arboreal nests have a connection with the ground and are formed as a secondary adaptation only after the subterranean nest has been established for a number of years.

From an economic point of view the most important group of soil dwelling termites in Queensland is the genus *Coptotermes*. Species belonging to this genus attack living trees, timber in service, and even subterranean electric cables. One species in particular, *Coptotermes acinaciformis,* commonly called the subterranean termite, has acquired a fearsome reputation through the severe nature of its attack and its extraordinary success in adapting to a city environment.

The presence of *Coptotermes* in timber is frequently revealed by their habit of bringing clay into their above ground workings. When the sapwood of a post or stump has been eaten away the cavity between the outer shell left by the termites and the less damaged true wood will ultimately be filled with clay.

In terms of sheer destructive power, however, all termites pale before the giant termite (*Mastotermes darwiniensis*). Although this termite normally lives in logs and branches of living and dead shrubs and trees it is capable of causing sever damage to constructional timber and is the most important economic species in tropical Queensland. The giant termite is readily distinguished by its subterranean habits and its winged adults which at 35 mm long are larger than any other Australian termite.

Not all soil dwelling termites include wood in their diet. A number of species depend on grass as their main source of protein. Grass harvesting termites with their large conspicuous mounds have become a dominant feature of the sub-coastal forests and woodlands of North Queensland. Many of these mounds are monumental structures attaining a height of over 4·5 metres and a diameter of 3·5 metres.

A network of underground galleries radiate from the nest which permit the nightly foraging parties to harvest grass some distance from the main colony. The grass is cut into short lengths and transported back to the mound where it is stored in the outer galleries. It is only in the lower rainfall areas of Queensland that grass harvesting termites are considered to be of economic importance.

Wood dwelling termites

In contrast to the former group of termites, wood dwelling termites live and breed within galleries excavated in wood. No nest is formed and no ground connection is required.

Included in this group are the dry wood termites which live indefinitely in seasoned timber and other timber with a low moisture content. Dry wood termites are characterized in the soldier caste by a short truncated head which is hardly longer than wide and very dark in colour. Damage by dry wood termites is quite distinctive.

Wide flat irregular chambers are excavated between the growth rings of the wood and connected by narrow circular galleries. The peculiar head of the soldier is just the right size to block one of these connecting tunnels and it is believed to have been evolved for this particular purpose.

Another indicator of drywood termite attack is their habit of extruding dry powdery excrement from their workings. In Queensland the most important species is *Cryptotermes primus* but in more recent times the introduced species *Cryptotermes brevis* has been causing a great deal of concern in Maryborough and Bundaberg.

Termite identification

The specific determination of termites requires the assistance of a specialist. When submitting a sample for identification it is important that wherever possible all castes should be collected and then placed in a vial of 80% alcohol, or methylated spirits, along with a pencilled label recording locality of capture, date and collector's name. It is essential that soldiers are present in this sample for a reliable identification cannot be made without first examining this caste.

Brand Directories

NEW editions of the Horse and Cattle Brands Directory and Sheep Brands and Earmarks Directory are now available.

The price for the Horse and Cattle Brands Directory, compiled to 30th June 1971, is $45. Due to steep increases in labour, printing and paper costs, it has not been possible to approve the sale of this directory at a lower price—this price is set almost at cost.

Superseded copies of the Horse and Cattle Brands Directories are still available to the public. These are priced as follows:—

- to 31st December 1962 . . . . . $1.50

The Sheep Brands and Earmarks Directory, compiled to 31st December 1974 is priced at $5.00.

All prices include postage.

Any person who wants to buy any of these Directories should forward the required amount and advise the relevant details to the Registrar of Brands, Department of Primary Industries, William Street, Brisbane, 4000.

Insect pests on passion fruit

by D. A. H. MURRAY,
Entomology Branch, Nambour.

SEVERAL major insect pests attack passion fruit in south-east Queensland. These not only cause fruit blemishes but also reduce plant vigour, thereby decreasing the productivity of a passion fruit plantation.

To implement control procedures correct identification of the insects attacking passion fruit is important. Indiscriminate spray applications may be detrimental to beneficial insects which control several of the pest species. They will also incur extra cost to the grower.

The major insect pests of passion fruit are the Queensland fruit fly, red scale, passion vine mite and citrus mealybug. Pests of lesser importance are soft brown scale, passion vine bug and green vegetable bug.

QUEENSLAND FRUIT FLY

Queensland fruit fly is the most important insect pest of passion fruit. It causes disfiguration of the fruit by laying eggs in the rind.

Quarantine restrictions due to fruit fly and their implementation against fruit grown in Queensland makes marketing in southern states extremely difficult. Fruit fly damaged fruit is readily distinguishable by marketing inspectors. Each year losses are experienced by growers as a result of fruit being condemned and destroyed at the markets.

The adult fly is wasp-like in appearance, about the size of a house-fly and has one pair of transparent wings each bearing a dark band on the front margin. Bright yellow patches interrupt the general reddish-brown body colour.

The female fruit fly lays several pale cream, elongate eggs beneath the skin surface of the fruit. Creamy maggots may emerge from the eggs in two to three days and tunnel within the fruit while feeding.

During warmer weather the larval stage (maggot) is completed in about two weeks. In the latter stages of larval development, the fruit falls to the ground. The mature larva then leaves the fruit to burrow into moist soil to pupate for a further two weeks, after which adults emerge.

Very few eggs laid in immature passion fruit produce adult flies. The development of woody tissue around eggs deposited in the rind of the fruit prevents some eggs from hatching, or when hatching occurs causes high mortality of young larvae. Egg hatching in ripe fruit is mostly unaffected since the fruit has ceased growing and does not form the woody tissue around the eggs.

Passion fruit increase rapidly in size during the first 10–15 days after setting. During this period the skin of the fruit is turgid and easily punctured by the egglaying apparatus of the female fly. This results in the characteristic skin blemishes which occur on immature passion fruit. The woody tissue which forms around the eggs develops a hard raised area around the puncture mark.

Egglaying or stinging often causes young fruit to shrivel and drop from the vine. Several stings may be found on one fruit.

In mature fruit, egglaying is more difficult because of the harder skin. Although these fruit are less attractive to the egglaying female, they are still occasionally stung. Puncture marks are difficult to detect in ripe fruit. After a few days the presence of larvae within such fruit may cause wrinkling and breakdown of the fruit.

Fruit fly is most active during the months September to April. High temperatures plus spring and early summer rains usually increase fly activity. Large fluctuations in populations are often experienced during a season.

Trapping can provide a reliable indication of fruit fly activity. Commercial lures, for example Dak Pot, are available. These attract only male flies.

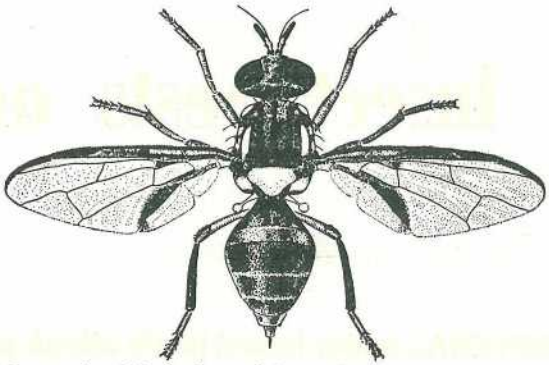
Control

The use of traps, such as the Dak Pot, in early spring is helpful in determining the initiation of fruit fly control following the winter months and to indicate when fly sprays can be discontinued in autumn. Spraying in the cooler months from May to August is not normally required.

Dimethoate 0·03% will satisfactorily control fruit fly when applied regularly as cover sprays. An added advantage is its suppression of mealybug infestations.

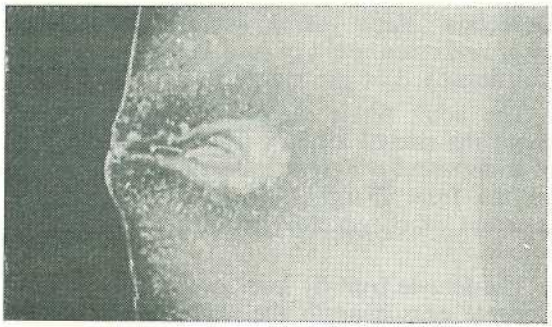
Applications should be made at 10–14 day intervals, with the shorter frequency during warm, overcast weather. Thorough coverage, especially of sheltered fruit, is essential for good control.

Research is progressing on the development of alternative fruit fly control using maldison protein hydrolysate bait sprays.



Queensland fruit fly, adult.

Characteristic "sting" produced on passion fruit by Queensland fruit fly.

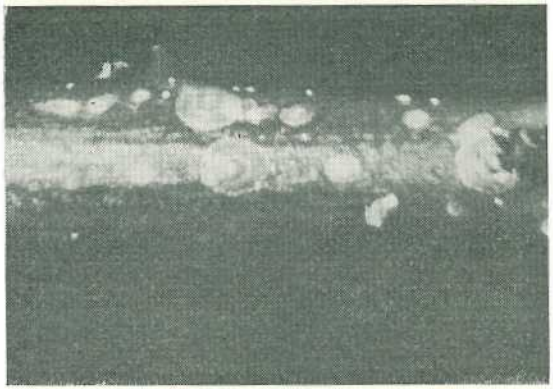


Section of a Queensland fruit fly sting showing eggs in a cavity beneath the outer skin surface of the passion fruit.

RED SCALE

Occurrence of red scale is common on older passion fruit vines. The female scale is dull-red in colour, circular and approximately 2 mm in diameter. It has flattened margins with a slightly raised centre. The male scale is more elongate and lighter in colour. Within the protection of the scale the male moults to form the pre-pupa and pupa, finally emerging as a fragile, two-winged adult. The female does not undergo these pupal transformations and remains wingless throughout her life.

The female red scale bears living young (crawlers). A peak of hatching occurs in the months of December and January. After leaving the protection of the parent scale, the crawlers quickly settle and moult twice. About two months are needed to reach maturity during warmer weather.



Red scale adults on passion vine.

Red scale is commonly found on vines 1–2 years after planting. Older leaders are first infested, and as the scale population increases, plant vigour is reduced and the scale can spread onto younger sections of the vine. A severe infestation may cause death of the vine. Fruit can also become encrusted with red scale.

Control

Seasonal conditions determine the incidence of red scale. Hot, dry weather favours an increase in scale populations. Moist conditions allow the development of an entomogenous fungus which may cause high scale mortality.

Several small wasps parasitize red scale and exert some degree of control over this pest.

Red scale is readily controlled with 1:60 oil spray. The crawler stage is the easiest to control. One spray should be applied in December followed by a second spray 4–6 weeks later. Thorough coverage is essential with particular attention given to older canes.

White oil can cause plant injury if used during hot weather or when plants are under stress from moisture lack. Avoid winter applications of oil.

PASSION VINE MITE

The passion vine mite is a common pest of passion fruit throughout coastal Queensland. Bright red adult mites measure only 0·25 mm in length. The female mite lays bright red, spherical eggs which hatch into six legged nymphs which are less vividly coloured than the adults. Nymphs grow through a succession of moults to the eight legged adult stage. All stages of development are usually evident in a colony. Under favourable conditions passion vine mite completes its development from egg to the adult stage in about 4 weeks.

Mite infestations are usually most severe during the warmer summer months. The mites, which are almost invisible to the naked eye, appear as minute red specks on the undersides of leaves especially near the main veins. Heavily infested vines take on a reddish colour, this being due to extremely large aggregations of mite.

Attack by passion vine mite can occur at any age of the vine and even young plants may show severe injury if growing conditions are unfavourable to the plant. Severe defoliation can occur over the greater part of the vine, leaving it bare except for the terminal growth. Buds fail to develop or produce only yellowish, stunted growth. Weaker laterals may die back to the main leader.

A moderate attack may produce loss of vigour, and under persistent attack, death of the vine can occur. Damaged vines may partially recover during late autumn following a sever attack. This recovery is short lived as mite populations again become heavy during the following summer.

Fruit injury is encountered only in a heavy infestation. At first, damage is restricted to the stalk end of the fruit, especially under and around the calyx. As the mites spread over the surface, their feeding produces dull brown surface blemishes on the fruit.

When inspecting vines for mites, leaves and leaf axils immediately ahead of bare sections should be examined. Rarely are the mites found on the older portions of the vine, nor are they found on the tips of growing terminals. The mites are commonly found densely congregating in leaf axils, along groves in the leaders and leaf stalks, and along main veins on the underside of leaves.

Control

Effective chemical control can be achieved with cyclosulfyre 0·03% or dispersible sulphur 0·3%. Two sprays may be required with an interval of two weeks

between sprays. Thorough coverage is essential to contact mites on the underside of leaves. Repeated applications may be necessary if mite attack is persistent during periods of adverse plant growth. It should be noted that plant damage may result if oil and sulphur applications are made within any period of less than three weeks.

CITRUS MEALYBUG

The citrus mealybug is a small, oval-shaped sucking insect commonly found on passion fruit. A white, mealy powder covers the upper surface of the insect. Wax strands radiate from the body with slightly longer strands posteriorly.

Females are wingless and vary in length from 3–4mm. The males are fragile, two-winged insects, 2 mm in length with two long white filaments extending from the end of the abdomen. The female is active and feeds throughout its life. The male feeds only in the first stage.

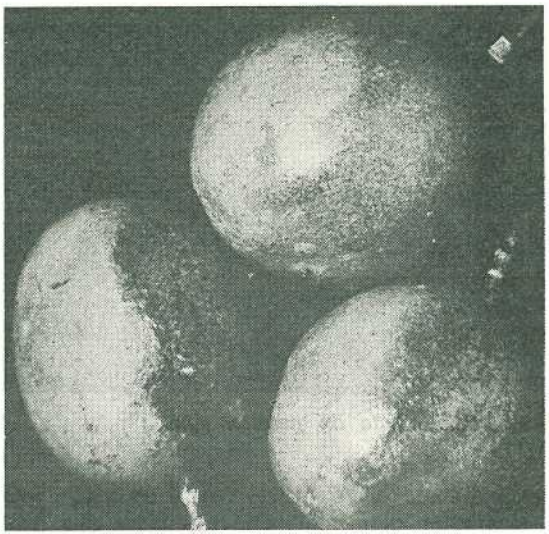
After mating, the female deposits up to 500 yellowish eggs in a loose cottony mass or ovisac and then dies. Crawlers emerge from the eggs in 3–9 days and moult several times until the adult stage is reached, there being three moults in the female and four in the male. Approximately four weeks are required for completion of the life cycle during warmer weather.

Mealybugs characteristically aggregate on the vine, especially on leaf nodes and under dead leaves and trash. Aggregations may also occur under dried flower bracts.

Secretion of a sugary solution from the mealybugs promotes growth of a black fungal mould on the fruit and leaves. Ants are often found tending mealybugs for this secretion. If a severe infestation occurs, loss of vigour, leaf drop and fruit malformation may occur. Unchecked, an infestation may cause death of the vine.

Control

Natural control is important in maintaining mealybug populations below damaging levels. Ladybirds, especially the mealybug ladybird, substantially reduce mealybug numbers. Of secondary importance are small wasp parasites and lacewing larvae.



Scarafied tissue (light areas) on skin of passion fruit resulting from passion vine mite attack.

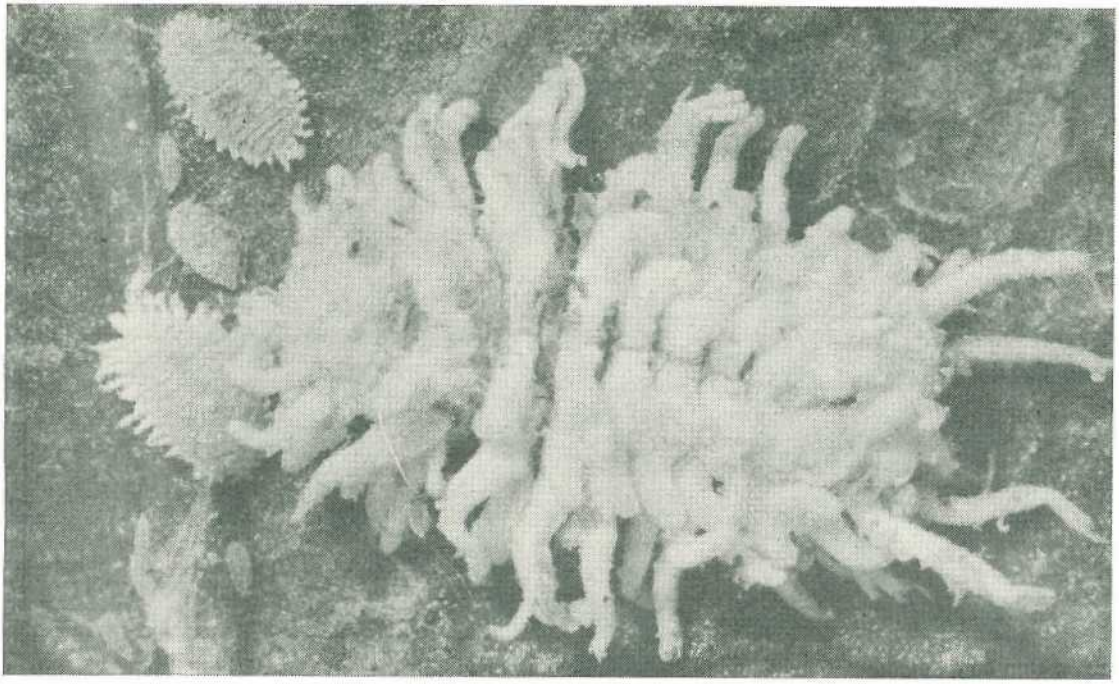
Clusters of mealybugs under dead leaves and trash are well protected from the insecticide sprays and little control will be achieved unless vines are cleaned thoroughly to allow spray penetration. Pruning may enhance the effectiveness of the spray, however this is often impractical as laterals to be pruned are generally bearing fruit.

Dimethoate, as recommended for fruit fly control, will also control citrus mealybug and should be used for both pests where the latter is a recurring problem.

Occasional outbreaks of this pest are best controlled by two sprays of 1:60 oil or methidathion 0·05% combined with 1:100 oil two weeks to a month apart. The 1:60 oil is preferred as methidathion is highly toxic to the mealybug's natural enemies. For good control, thorough coverage is essential.

SOFT BROWN SCALE

Soft brown scale may occasionally infest leaves and canes of passion fruit vine. The adult insect is approximately 3 mm in length and covered by a brown, oval, dome shaped scale. A sweet sticky secretion produced by the soft brown scale promotes growth of sooty mould on the fruit and leaves. Ants also tend the scale for this secretion.



Citrus mealybugs (left) being attacked by larger mealybug ladybird larva.

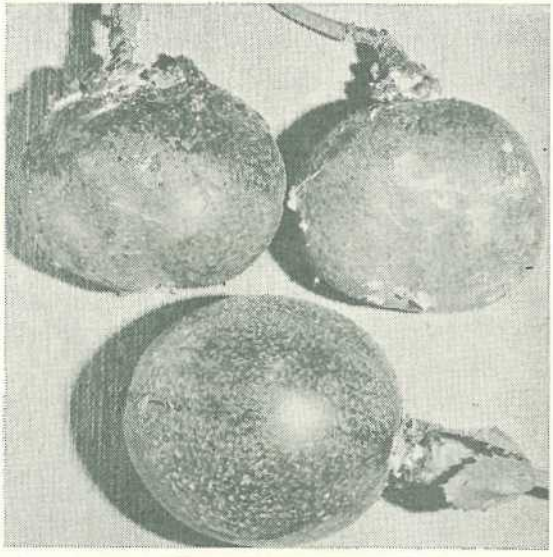
Control

Chemical control is not often required since parasitization by small wasps substantially reduce populations. Should chemical control be necessary, a 1:60 oil spray will be satisfactory.

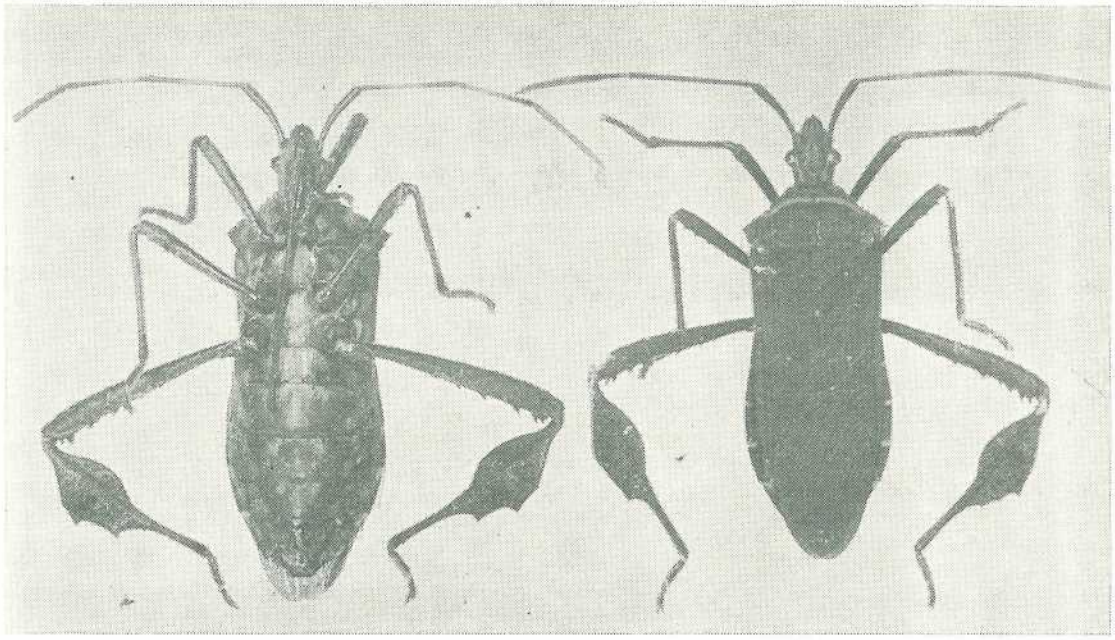
PASSION VINE BUG

The adult bug is elongate, approximately 20 mm in length, dull black in colour with orange spots on the underside of the body. Passion vine bugs migrate from surrounding scrub to infest passion fruit plantations. Neglect of vines can allow populations of the bug to build up.

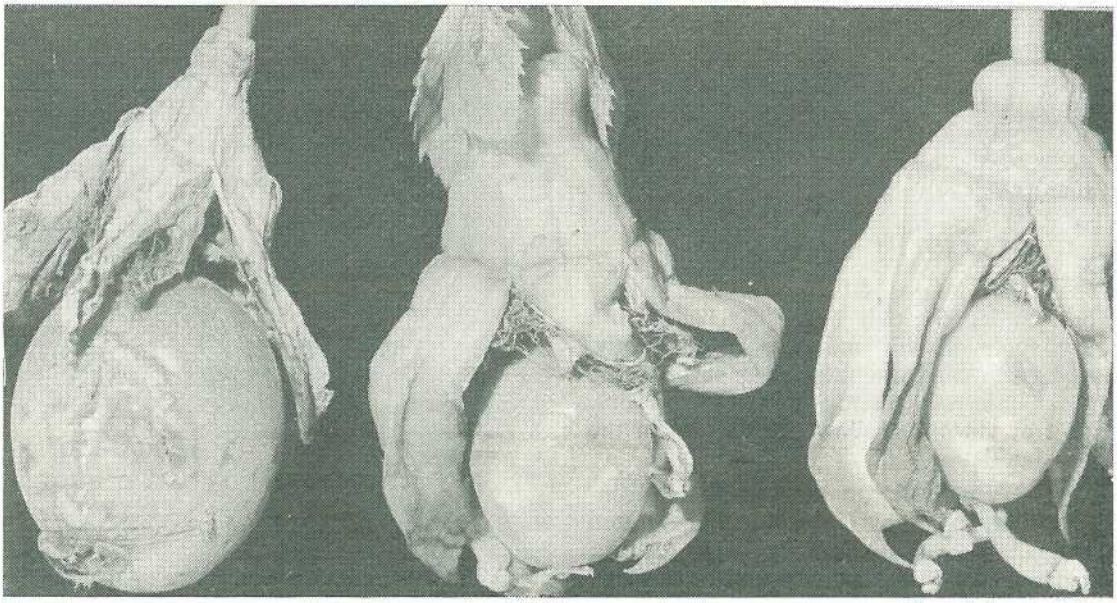
Feeding usually occurs on flowers or green-mature fruit. Nymphs (immature bugs) often cluster on fruit when feeding. Damage to mature fruit is not pronounced, however, young fruit develop dimple-like surface blemishes at the feeding sites.



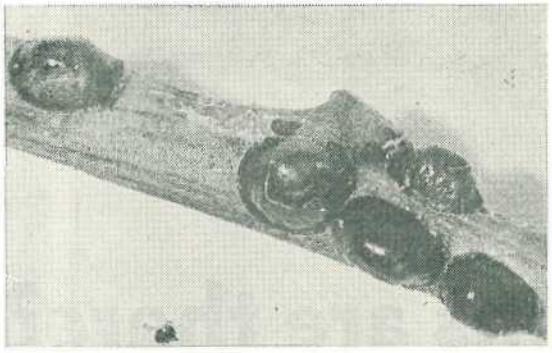
Mis-shapen fruit (upper) resulting from heavy citrus mealybug attack.



Passion vine bug, adults.



Green vegetable bug damage to passion fruit. The white areas on younger fruit (right) result in distortion as the fruit grows.



Soft brown scale adults on passion vine.

Control

Regular inspection during summer months is necessary to detect any build-up of these bugs. Should an infestation require control, trichlorfon 0·05% or endosulphan 0·07% is adequate.

GREEN VEGETABLE BUG

The green vegetable bug is a green, shield-shaped bug about 15 mm in length which feeds by sucking sap from the plant. Nymphs often cluster on young fruit causing malformed areas at feeding sites.

Control

As for passion vine bug.

POLLINATION OF PASSION FRUIT

Pollination of passion fruit is performed by the honey bee, although other insects visit the flowers and pollinate them to a lesser extent. When pollination is inadequate, both the number of fruit that set and the pulp content of the fruit are reduced.

The pollinating insects are most active in the field when the passion fruit flower opens. Since the purple passion fruit blooms in the morning from 7 a.m. to early afternoon, pollinators are found in greatest numbers during that period.

To prevent destruction of pollinating insects, sprays should be applied in the late afternoon.

Under normal conditions many of the insect pests of passion fruit are satisfactorily controlled by natural predators and parasites. Interruption of this natural control by indiscriminate use of insecticides may enhance pest activity. For this reason, the application of toxic, broad spectrum insecticides should be minimized wherever possible.

It is inevitable that toxic materials must be used at some stage during passion fruit development. By minimizing their use greater reliance may be placed upon natural regulation of the passion fruit insect pest complex.

Queensland fruit fly	*Dacus* (*Strumeta*) *tryoni* (Froggatt)
Red scale	*Aonidiella aurantii* (Maskell)
Wasp parasites of red scale	*Comperiella bifasciata* (Howard) *Aphytis chrysomphali* (Mercet)
Passion vine mite ..	*Brevipalpus phoenicis* (Geijskes)
Citrus mealybug ..	*Planococcus citri* (Risso)
Mealybug ladybird	*Cryptolaemus montrouzieri* (Mulsant)
Lacewing predator	*Chrysopa* sp.
Soft brown scale ..	*Coccus hesperidum* (Linnaeus)
Passion vine bug ..	*Leptoglossus australis* (Fabricius)
Green vegetable bug	*Nezara viridula* (Linnaeus)

QUANTITY OF MATERIAL PER 100 LITRES OR 100 GALLONS TO OBTAIN RECOMMENDED SPRAY CONCENTRATION

Insecticide (common name)	Percentage Concentration Active Constituent	Strength of Produce (no particular company's formulation is favoured)	Quantity per		Withholding Period (Days)
			100 litres	100 gallons	
cyclosulfyne ..	0·03	30% dispersible powder ..	100 gm	16 oz	7
dimethoate ..	0·03	30% emulsifiable concentrate ..	100 ml	16 fl oz	7
endosulfan ..	0·07	35% emulsifiable concentrate ..	200 ml	1 pt 12 fl oz	7
methidathion ..	0·05	40% emulsifiable concentrate ..	125 ml	1 pt	21
summer oil ..	1·0	..	1 000 ml	8 pt	1
	1·66	..	1 666 ml	13 pt 6 fl oz	..
trichlorphon ..	0·05	80% soluble powder	62·5 g	10 oz	2
		62·5% emulsifiable concentrate	80 ml	13 fl oz	..
white oil ..	1·0	..	1 000 ml	8 pt	1
	1·66	..	1 666 ml	13 pt 6 fl oz	..

How many horns are there?

by *W. R. RAMSAY, Meat Quality Officer.*

HORNS cause bruising in cattle. Bruises on carcasses cost money. While most graziers accept this, many do not realise that if hornless cattle going for slaughter are mixed with horned ones then the hornless also show markedly increased bruising.

How many horned cattle are there going forward for slaughter? Recently a survey was conducted to find a reasonably accurate answer to this.

Departmental and Australian Meat Board officers set out to count horns at major selling centres, drawing cattle from state wide sources. At Cannon Hill five sales were surveyed. Results of this and the overall figures are set out in the table below:

—	No. of Cattle	In Mobs where All were Horned or Hornless		In Mobs where Horned and Hornless were Mixed	
		Horned	Hornless	Horned	Hornless
Queensland Cannon Hill ..	11,430(100%)	1,372(12%)	1,372(12%)	4,343(38%)	4,343(38%)
All States Combined	41,255(100%)	4,950(12%)	7,839(19%)	13,201(32%)	15,265(37%)

(Round Figures)

From this it seems that about 50% of Queensland cattle marketed are horned. Over all the Eastern States the figure is about 44%.

Another fact that comes out of study of this table is that of the 50% of cattle which were hornless about three quarters (38%—underlined in the table) were in mobs with horned cattle and so would show increased bruising.

So because there were so many horns in the mob, someone's good work in having hornless cattle was undone.

Feed year programmes—what's involved?

by C. W. HINTZ and R. T. J. GILLILAND, Dairy Field Services Branch.

In this article, the authors outline the steps involved in compiling a feed year programme, and report on how a programme has worked in an on-farm situation on the Darling Downs.

THE amount of milk a cow produces is governed by the quality and quantity of feed she receives both before she calves and during her lactation. So it is essential that some thought be given to planning her feed supply. To rely on luck is not good enough. Planning gives a much better chance of providing a continued feed supply. One means of doing this is to draw up a feed year programme.

The aim of a planned feeding programme is to provide adequate amounts of good quality feed for the herd all the year round. By good quality feed, we mean feed that contains the essential energy and proteins for high milk production, the growth of young stock and the conditioning of dry cows. Proteins are body building materials, while energy is the "fuel" for milk production and other body functions such as movement and breathing.

Feed year planning is sometimes criticised as being too unrealistic because of changeable weather conditions. For this reason alone, a feed year plan should be programmed so that alternatives can be considerd to cover any adverse periods caused by seasonal upsets.

This puts the farmer in a much better position to assess the situation and make necessary adjustments quickly before production falls.

Planning feed requirements in advance improves the position to estimate the quantity of supplementary feed to be bought in. Purchases may be made when there is less demand and prices are consequently lower.

The programme should be flexible so changes can be made to suit seasonal conditions and other circumstances as they arise. Allowances must also be made with regard to land utilisation.

Feed Year Programmes can be as simple or complex as the farmer wants. They will vary from year to year, and from farm to farm, depending on requirements.

Planning the feed year

There are several methods used to work out feed year plans, Stock or Milking Cow Units, Carrying Capacities, or Beast Months Grazing (B.M.G.). All these methods relate the available feed supply (usually in terms of Dry Matter (D.M.)) to animal requirements.

In our feed year programme, B.M.G.'s are used. A B.M.G. is a term of measurement based on the fact that an average mature cow of 450 kg (1 000 lb.) will eat approximately 13·6 kg (30 lb.) of dry matter daily. Therefore in one month she will eat 400 kg D.M., thus one B.M.G. = 400 kg of D.M.

As pasture production and weather conditions vary from month to month, this means that the B.M.G. is a convenient means of estimating requirements. However, it must be remembered that the productivity of the B.M.G. will vary according to the quality of the feed, i.e. young growth stage, or matured.

As all estimation methods (including B.M.G.'s) are based only on dry matter yield, we must keep quality in mind, i.e. palatability, energy and protein values, as these vary with the type of crop and maturity. Soil fertility, the use of fertilizers, and land preparation will also have a major effect on the nutritive value and yields of crops and pastures.

To illustrate the point, one B.M.G. of young pasture or forage crop would supply all or most of a cow's requirements while one B.M.G. of mature crop would be deficient in both energy and protein.

Knowing the number of cows to be fed during the year, the total animal feeding requirements can be expressed in B.M.G.'s and by knowing the anticipated D.M. yields of the various crops and pastures available the number of B.M.G.'s that can be supplied from these given areas can be calculated. By matching the cow's requirements and the feed supply in any one month, it can be seen whether there is sufficient feed to meet the herd's needs. Changes can be made to ensure these requirements are met.

For some large breeds, e.g. Friesian, or larger animals within a breed, where animals

Oats provides most of the winter feed on the Basaltic Uplands.

Cows grazing Dolichos Lab Lab and Sugar Drip. Recommended for summer and autumn grazing, particularly valuable during autumn and early winter.

will exceed the standard 450 kg (1 000 lbs.), allowance must be made for the greater capacity for feed consumption of these animals.

It is wise to aim for extra feed in the programme in case of adverse seasonal conditions when yields are low. By over-estimating, any surplus can be conserved for lean periods.

Using the system

To work out a farm programme, all stock on the farm are regarded as "Mature Cow" equivalents by counting mature cows as "one", and by averaging young stock from weaners to springing heifers as "one-half". Therefore, a 55 milking cow herd with 30 young stock is rated at 70 units or mature equivalents.

To estimate the grazing potential of a paddock in B.M.G.'s the area, the crop, and its yield must be known.

An example of calculating the B.M.G.'s for a paddock is as follows:—

Take a 13·2 ha (33 ac.) paddock (Paddock 10 in Table III) of oats which is strip grazed, for a herd of 70 mature cow equivalents. Using Table I, the yield for strip grazed early oats (80% utilisation) is 3 760 kg/ha of D.M.

To obtain the number of B.M.G.'s per hectare, we divide 3 760 kg/ha D.M. by the standard 400 kg D.M. (1 B.M.G.) per animal:

$$3\,760 \text{ kg D.M./ha} \div 400 \text{ kg D.M.} = 9{\cdot}4 \text{ B.M.G.'s/ha}$$

To find the total number of B.M.G.'s which will be provided by the oats now, multiply the number of B.M.G.'s/ha by the number of ha.

$$9{\cdot}4 \text{ B.M.G.'s} \times 13{\cdot}2 \text{ ha} = 124 \text{ B.M.G.'s}$$

Therefore, this area of oats will provide 124 B.M.G.'s.

To determine the length of grazing time available for each mature cow equivalent, divide the B.M.G.'s by the number of beasts (mature equivalents).

$$125 \text{ B.M.G.'s} \div 70 \text{ units} = 1{\cdot}8 \text{ months grazing/mature unit.}$$

This means that this paddock of oats will give each stock unit 1·8 months of grazing.

Each paddock on the farm with feed available is worked out in a similar manner, and the B.M.G.'s per Unit are added together to give both a monthly and a yearly total.

It can then be estimated when each paddock will provide feed and how much of the available B.M.G.'s will be used in each month. By going through each paddock and calculating the B.M.G.'s used, it can be estimated if there is sufficient feed for each month. This pinpoints the periods of low or inadequate feed supplies and adjustments can be planned to bridge the gaps, or conserve the surplus.

The farmer may wish to break up his herd for different months of the year, depending on calving pattern. He may wish to run his milking cows in one paddock, and the rest of the herd in another. This can be anticipated and allowed for in the final plan.

Other factors to consider

The system described explains the method of planning the year's feed supply for a herd but there are other factors that should be considered, otherwise many advantages of having an adequate feed supply can be lost.

These factors include—

- *Herd management*—This is most important and covers: controlled grazing of the herd for efficient use of crops or pasture; Use of A.I. and controlled mating; Herd Recording and herd improvement programme; disease and parasite control; the efficient rearing of calves and the care of the young and dry stock.
- *Milking management*—It is no use having well fed cows if they are not correctly milked. An efficient milking machine together with recommended milking methods by a person who handles cows quietly would be the ideal.
- *Water supply*—It is most important that cows have access to an adequate supply of good quality water in close proximity to the feed supply otherwise production will suffer.
- *Shade*—Sufficient shade should be available for the herd in the hot summer months to reduce stress.
- *Shelter*—Wind breaks in paddocks and around yards would reduce the drain on energy reserves during cold windy weather.
- *Mineral supplement*.—While it is generally accepted that there are adequate minerals and trace elements in a balanced feed supply for general maintenance, it is felt that as milking cows draw heavily on phosphorus reserves, phosphorus supplement should be fed all the year.

Planning for a region or locality

Gaining information for use in feed year plans is often difficult. Frequently there is insufficient information available on crop production, under a range of commercial situations. It is therefore necessary to obtain data which most closely represents yield in a locality.

This system of feed year programming has being implemented in the basaltic upland country of the Eastern Darling Downs and we now describe how it has been introduced.

The dairy farming system

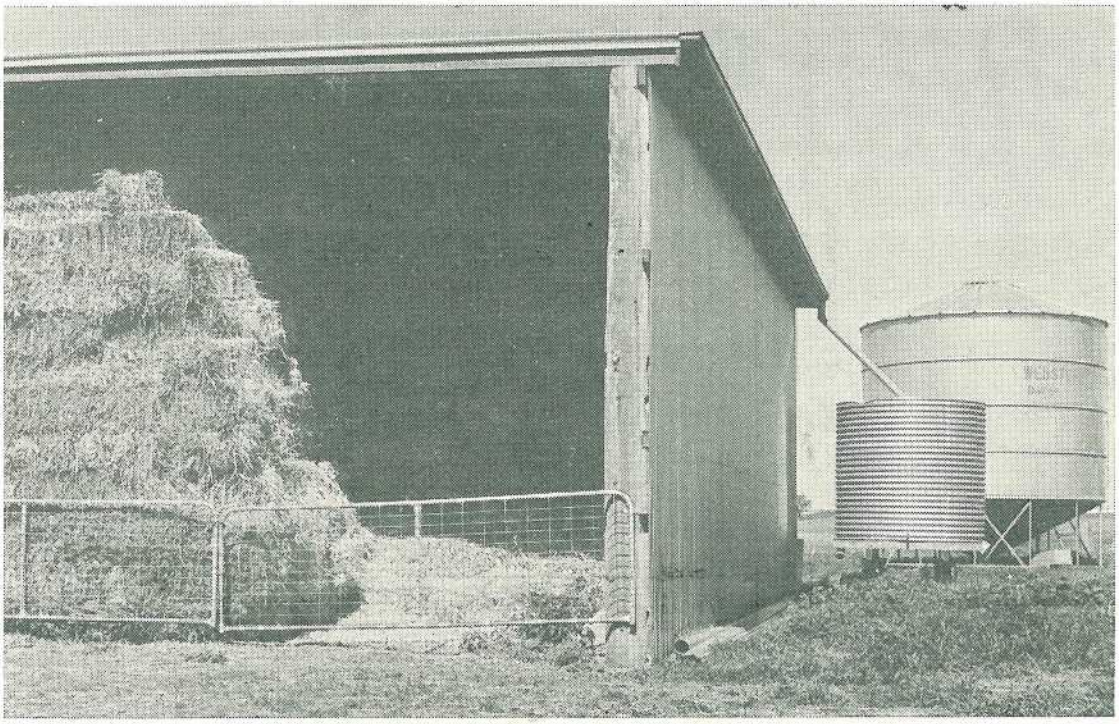
Dairying in this region is mainly carried out by growing cultivated crops for grazing, with the use of native pastures. Because the latter provides limited milk producing feed its place in a feeding programme is often underestimated. Grain crops are also grown, and are mainly dual purpose. This means they can be used for grazing in the poor years or allowed to mature for grain in the good years. Most of the grain produced on the farm is stored for later use, the remainder being sold.

When planning a programme for this locality, provision of adequate amounts of grain and hay (home-grown or purchased) or silage are essential and this must be included in the original programme. These reserves are necessary to supply feed during periods of paddock feed shortage, such as wet or dry weather and to supplement existing crops. As a guide, suggested amounts to store are from 40 to 50 bales of hay, and from half to one tonne of grain for each mature cow or equivalent. Hay can be lucerne, oaten or stubble, but a mixture of these is preferred. Two to three tonnes of silage may be stored in lieu of grain and/or hay.

TABLE I

ESTIMATED YIELDS OF CROPS AND PASTURE GROWN ON THE BASALTIC UPLANDS
with estimated percentage of utilization with different grazing management and the range of nutritive values

Crop or Pasture	GREENLOT (100% Utilization)		STRIP GRAZED			OPEN GRAZED			T.D.N. Percentage Range	Crude Protein Percentage Range
	Estimated D.M. Yield kg per Hectare	B.M.G. /Hectare	Estimated Percentage Eaten	kg D.M. Harvested /Hectare	B.M.G. /Hectare	Estimated Percentage Eaten	kg D.M. Harvested /Hectare	B.M.G. /Hectare		
Pasture natural improved ..	3 360	8·4	..	..	..	60	2 020	5·1	55–30	15–3
Pasture coloratum	5 600	14·0	..	..	..	60	3 360	8·4	55–35	12–5
Pasture irrigated	19 600	49·0	80	15 680	39·2	60	11 760	29·4	65–55	25–10
Natural fertilizer and medics	5 600	14·0	..	..	..	60	3 360	8·4	55–40	20–3
Natural green panic lucerne ..	6 720	16·8	..	..	..	60	4 030	10·1	60–40	20–5
Lucerne irrigated	16 800	42·0	80	13 440	33·6	70	11 760	29·4	60–50	28–12
Lucerne dryland	4 480	11·2	80	3 580	9·0	70	3 140	7·8	60–45	28–10
Zulu and Sudan early	10 080	25·2	70	7 060	17·6	50	5 040	12·6	60–40	20–5
Zulu and Sudan late	5 600	14·0	70	3 920	9·8	50	2 800	7·0	60–35	20–5
Sugar Drip early	8 400	21·0	70	5 880	14·7	50	4 200	10·5	60–40	20–5
Sugar Drip late	5 600	14·0	70	3 920	9·8	50	2 800	7·0	60–35	20–5
Panicums	4 480	11·2	80	4 140	10·4	70	2 690	6·7	60–40	22–5
Cowpeas	3 920	9·8	80	3 140	7·8	60	2 350	5·9	60–50	25–10
Oats early	4 700	11·8	80	3 760	9·4	60	2 820	7·1	65–40	1st grazing
Oats late	3 360	8·4	80	2 690	6·7	60	2 020	5·1	65–40	25–10
Oats irrigated	8 960	22·4	80	7 170	17·9	60	5 380	13·4	65–40	Regrowth 10–6
Stubble barley	1 680	4·2	..	..	..	50	840	2·1	45–40	5–2
Stubble sorghum	3 360	8·4	..	..	..	50	1 680	4·2	45–40	5–2



Fodder conservation (both hay and grain) is essential to maintain production during periods of feed shortages.

Table I gives some feed values obtained for this area. While not a comprehensive list, the table gives most common fodder productions. The criteria under which these productions would be experienced, are described following the table. It is imperative that the table is used in accordance with the criteria provided.

Table II reviews a crop grazing programme which relates to growing patterns in the region.

Yields from the various crops and pastures have been obtained from sampling or grazing records and are given in dry matter weight/ha/year.

Native pasture

The yield would vary with location. Areas near the bails and small night paddocks would produce more in wet summers. Annuals—Urochloa and couch grass appear to yield quite well in these situations. Heavy use of large areas of native pasture is desirable in December and January when quality is reasonable. Dry standing native pasture is also suitable for feeding with lush feed such as young oats.

Improved pasture

The figure of 6 720 or 5 600 kg D.M./hectare would be from a well established dense stand of either Green Panic or *Panicum coloratum* and lucerne. Such a stand would need 35 to 56 kg N./ha and 15 to 35 kg S./ha/year except in good scrub soils. If the grasses are mediocre classify the same as native pasture. A good stand would produce 3 360 kg/ha from the grass and 2 240 kg/ha from the lucerne per year. The crude protein of the grass would average 6% and of the lucerne 20%.

TABLE II

Crop/Grazing Reference Chart for Basaltic Uplands

Crop	Variety	Planting Time	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Oats (E) ..	Algerian	Late February ..				††	*****	*****	*****	*****	*****	†		
Oats (E/M)	Minhafer/Camellia	March/April					††***	*****	*****	*****	*****	*††††		
Oats (L) ..	Algerian/Camellia	July									†††	*****	*****	*
Panicum Millett (E)	White .. .. *Japanese* (Quick Feed)	September	Hybrid Grazing Sorghums just as quick growing									****	*****	*††††
Sudan Cow Pea (E)	Hybrid Variety .. .. .. Caloona/Lab Lab	September to December	*****	*****	*****	*****	†††††						***	*****
Sweet Sorghum Cow Pea (L)	Sugar Drip	December/January ..			†††**	*****	*****	*****	†††††	†††				
Lucerne ..	Hunter River	Late March to June ..	*****	*****	*****	*****	**†††	†††††	†††††	††††*	*****	*****	*****	*****
Irrigated Pasture	Rye, Prairie and Clovers, etc. ..	April/May			****	*****	*****	*****	*****	*****	*****	**†††	†††††	
Pasture			Dry roughage and herbage											
			*****	*****	*****	†††††	†††††	†††††	†††††	†††††	†††††	*****	*****	*****
Pasture	Panics–Rhodes	August/September .. January/February ..	Stand over feed											
			*****	*****	" Closed "		*****	*****	*****		*****	*****	*****	*****

E = Early
M = Mid Season
L = Late

* = Approximate grazing periods under average seasonal conditions—quality and quantity will vary with the season.
† = Limited grazing.

Irrigated pasture

19 600 kg/ha would apply to a constantly irrigated, frequently fertilized pasture. The best growth periods are spring and autumn.

Natural pasture + sulphur

In six out of ten years 5 600 kg/ha should be obtained. In better years the yield could be 7 840 kg while in years when the winter-spring months are dry little medic growth could be expected. The medic growth can be anticipated from August until late October. Dry feed from the medic would be available until early December. This estimate is based on 3 360 kg D.M./ha from the growth of summer grass and 2 240 kg from the medic.

Lucerne irrigated

16 800 kg/ha would be from a good stand constantly watered on a fertile or fertilized soil. Peak growth could be expected from November to February.

Lucerne dryland

4 800 kg/ha is a figure which will vary a lot with topography, soil depth, fertility and the presence or absence of a perched water-table. The range in yields is from less than 2 240 kg/ha to over 8 400 kg/ha/year. Sulphur top dressing is generally needed on shallow hillside soils or flats which have limestone nodules in the soil.

Zulu early

10 080 kg/ha comes from a planting in early October which gives about 5 000 kg/ha in December–January plus two other grazings before winter of about 3 000 kg/ha each. N. at 56 kg/ha with adequate rain after first grazing could boost yields.

Zulu late

5 600 kg/ha comes from a sowing in late December or early January. Grazing should be in March–April with a little regrowth.

Sugar Drip early

8 400 kg/ha. Sown in October to give 3 900 kg/ha in December plus two other grazings around 2 400 kg/ha.

Sugar Drip late

5 600 kg/ha. Sown in mid-January and fed from late April to July.

Panicums

4 800 kg/ha—compares with oats except that it is the other end of the year. Planted October–early January. First grazing 6–8 weeks.

Cowpeas

3 900 kg/ha. These could produce greater yields if sown in October and the summer was hot and wet. They should give one grazing in late December and January and another in March–April. They flower late April, early May. Seed pods are generally frosted before being properly formed.

Oats early

4 700 kg/ha. This is made up of 3 150 kg/ha from the first grazing in May to July plus 1 550 kg/ha on regrowth from August to October. Such oats would receive 30 kg N./ha at sowing in early March. Top dressing the oats after the first grazing with 56 kg N./ha should produce an additional 1 500 kg D.M./hectare, i.e. 6 200 kg/ha.

Oats late

3 360 kg/ha should result from a sowing in July fertilized with 30 kg N./ha. Such land should be fallowed from January to provide sufficient soil moisture. Feeding should occur in late September, October and November.

Oats irrigated

8 960 kg/ha. Sown in March with 30 kg N./ha to give 3 600 kg D.M./ha plus two regrowths, each with 56 kg N./ha to give 2 700 kg/ha each. Crude protein levels of regrowth oats are generally 6 to 10%.

Barley stubble

1 680 kg/ha. This would need to be a reasonable (10 bag) crop.

TABLE III

THE FEED YEAR PROGRAMME FOR A. V. AND C. M. STENZEL'S HERD—70 UNITS (55 COWS AND 30 YOUNG STOCK)

Paddock No.	1	2	3 and 4	5	6	7	8	9	10	11	12	13	14	Total B.M.Gs Grazed	Grain	Hay and Stubble
Crop/Pasture	Sudan	Oats and Grass	Grass	Grass Temperature Pasture	Oats	Irrigated Oats	Sudan and Lab Lab	Oats	Oats	Late Oats	Sugar Drip and Lab Lab	Barley	Grass			
Paddock Area —ha	2·8	1·2 Oats 1·2 Grass	4·0	2·0 Grass 1·2 Pasture	3·2	6·4	12·8	8·0	13·2	6·0	12·0	12·0	16·0	102 ha	50 Tonne	2 000 Bales
B.M.G./ha ..	17·6	7·0	5·1	25·0	9·4	17·9	13·0	9·4	9·4	6·7	7·8		5·1		Planned use of grain with the crops. Average daily use	Planned to use with crops.
Total BMG/ Unit	·7	·2	·3	1·1	·4	1·6	2·3	1·0	1·8	·6	1·3		1·1	12·4		
January ..	*·2		·1				·6						·2	1·1	1 to 2 kg	Hay fed mostly during the winter months. Also used to fill gaps and to extend the grazing of green feed and to balance feed supply.
February ..	·2						·4				·2	For Grain. Will use for Grazing if required.	·2	1·1	1 to 2 kg	
March ..	·1						·3				·4		·2	1·0	1 to 2 kg	
April		Calf Paddock		·1		·1	·2				·5		·1	1·0	2 to 3 kg	
May				·2	·1	·2		·3	·1		·1			1·0	3 to 4 kg	
June				·2	·1	·4			·2		·1			1·0	3 to 4 kg	
July						·3		·3	·4					1·0	3 to 4 kg	
August ..				·1		·2		·1	·6					1·0	3 to 4 kg	
September ..			·1	·2	·1	·2		·2	·2	·1				1·1	2 to 3 kg	
October ..			·1	·2	·1	·2		·1	·3	·1			·1	1·1	2 to 3 kg	
November ..				·1		·1	·2			·5			·1	1·0	1 to 2 kg	
December ..	·2						·6						·2	1·0	1 to 2 kg	
TOTAL ..	·7	·2	·3	1·1	·4	1·6	2·3	1·0	1·8	·7	1·3		1·1	12·4		

* Portion of B.M.G. estimated to be used during that month.

Sorghum stubble

3 600 kg/ha. Feed value of this varies. Sometimes failed crops are available. These would be better quality than harvested crops.

A farm programme

Using this system and the locality data, a feed year programme has been planned and successfully implemented on the property of A. V. and C. M. Stenzel, Greenmount in the Basaltic Uplands region. Details are listed in Table III. The planned programme is to provide one B.M.G./unit each month during the year.

The Farm

The area of the farm is 102·8 ha of which 80·4 ha are cultivation. 22·4 ha are hilly native grass country, included in this area is 1 ha for house, bails and outbuildings. The farm is divided into 15 paddocks.

Average yearly rainfall is 650 mm which, during the past 10 years, fell mainly during the spring and summer months. Temperatures range from below zero during the winter to 35°C during summer.

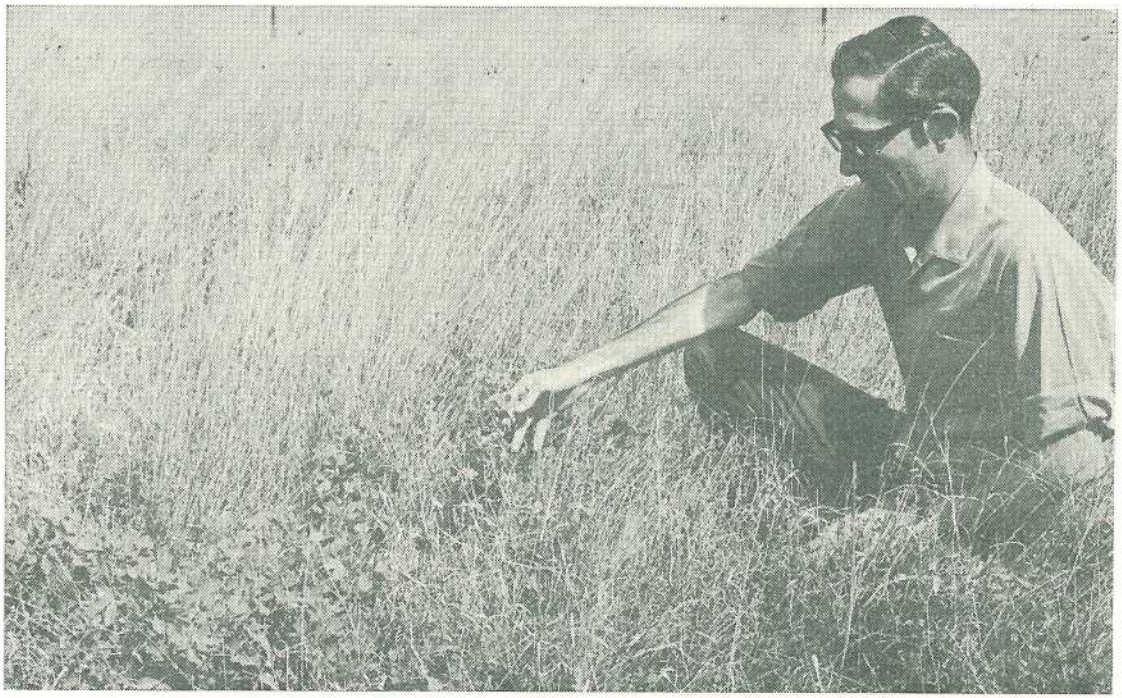
The water supply is provided from four bores, two of which are for stock, one for dairy and house use and the other is equipped for irrigation. Supply is limited to about 11 000 litres/hour.

Most of the farm comprises of deep grey brown cracking clay soils on slopes ranging from 4 to 10%. Some areas of shallow cracking clays overlaying basalt occur in association with the deeper colluvial soils. Small areas of skeletal stony soils occur in the non-arable soils.

Herd

The equivalent of about 70 adult cows are generally run on the farm. These comprise 50 to 55 mature cows and 30 to 50 young stock.

Native pasture typical of that found on the Basaltic Uplands which has responded to the introduction of medics with the application of fertilizer.



The average number of milkers is about 45, ranging from 35 in the January and February period to 50 during the winter period. All herd replacements are reared on the farm, also all young and dry stock are fed on the farm.

Feed supply

The feed supply for the herd is provided by summer and winter grazing crops, grass, and stored hay and grain.

The main winter crops are oats and barley, planting about 0·8 ha per cow. The past three years have seen 90 ha of these crops planted of which 9·6 ha are irrigated. With normal seasonal conditions 12 to 24 ha are planted to barley for grain. This can be used for grazing if necessary.

Planting starts early in March with usually a slow (Algerian) and a quick (Bentland) maturing variety. Planting continues until July. All plantings are fertilized with 125 kg Urea per ha in the heavier soils and a 125 kg of 33/9 per ha is used on the lighter soils. 6·4 ha of early oats is irrigated and usually top dressed after grazing with 125 kg of Nitram per hectare.

Grazing begins late April or early May and continues until late November. Thus oats provides about 6 to 7 months of the year's feed.

Surplus oats is either made into hay or headed for grain. To date Barley has been headed for grain.

Summer feed is provided from Sudan and hybrid forage crops (Zulu), and Dolichos Lab Lab and Sugar Drip. Usually about 28 ha or about 0·4 ha per cow is planted. Planting commences late September or early October with Sudan, about 5 to 6 ha, followed by Sudan and Lab Lab.

Introduced medics plus fertilizer on native pastures can substantially increase their grazing value during spring and early summer months.

Mr. Allan Stenzel, Greenmount, examines a sample of hay. He conserves adequate quantities of good quality hay to maintain production throughout the year.

Lab Lab and Sugar Drip are usually planted during December or early January (about 12 ha).

Feeding normally commences about mid-November with the Sudan and forage sorghum and continues to be fed with the Lab Lab and Sugar Drip through until June or July; thus providing 6 or 7 months of the year's feed supply.

The farm provides all its own feed supply including stored hay and grain, with the exception of supplements and on a few occasions small amounts of hay and grain to fill a couple of gaps.

Normally these areas of summer and winter crops provide good quality feed for the herd during the year given average seasonal conditions.

A general recommendation to farmers of the Basaltic uplands is that each cow requires the following for a year's feed supply—0·8 ha of winter crop, 0·4 ha of summer crop, 0·4 ha of lucerne and 0·4 ha of native grass. It will be noted that by good husbandry, and farm management and limited irrigation that the feed is supplied on Mr. Stenzel's farm from 0·8 ha of winter crop, 0·4 ha of summer crop and 0·4 ha of grass.

While the details (Table III) for the above farm appear quite complex they can be calculated by farmers who have available records and who are willing to consult with advisory officers with additional information on yield values. By using this data and other information, cow requirements for maintenance and production can be estimated.

Feed Year Programming at a Glance for the Basaltic Uplands of Eastern Darling Downs

by R. T. J. GILLILAND and C. W. HINTZ, Dairy Field Services Branch; R. G. WILSON, Agriculture Branch.

The following tabulation summarizes the recommended feeding & cropping programme for the Basaltic Uplands of the Eastern Darling Downs. The areas given and seed and fertilizer rates recommended are for dryland farming practices. If irrigation of crops or pastures is practised, areas would be reduced. If fertilizer is not used areas would have to be increased. Grazing management will determine crop loss; e.g. strip grazing will avoid loss by trampling.

MONTH	LAND PREPARATION AND PLANTING	FEED DIARY	MANAGEMENT IF SEASONAL CONDITIONS GOOD	MANAGEMENT IF SEASONAL CONDITIONS POOR
July ..	Plant late oats. Algerian 50 kg/ha. About 0·2 ha per cow. Sown pastures as for June. For quick feed plant barley.	Milkers—Oats, etc., and crop stubble, hay, grain and silage. Young stock—Stubble and hay with Urea and Molasses.	Normally very little surplus feed in these two months, but if there is—make hay.	*For All Months* *Milkers*—Keep the best feed. Ration according to supply and supplement with hay and grain. Lucerne hay can take the place of green feed. If little or no green feed or lucerne, feed Urea to build up protein intake. *Fresh Cows*—Most profitable producers. Feed hay and up to 6 kg/day grain plus up to 180 grams of Urea. As green feed becomes available reduce grain and Urea accordingly. Always feed at least ·5 kg grain with each 30 grams of Urea. Look after springers and calve in good condition. Maintain condition of late lactation cows.
August ..	Plant sown pastures (Lucerne, Green Panic and P. Coloratum, etc.) where weeds are not a problem. (Summer grasses and Mint). Top-dress established summer pastures with 30 kg N./ha. and 20 kg S./ha.	Early oats, regrowth oats, grain, hay and medic. Young stock—Stubble and hay with Urea and Molasses.		
September ..	Land preparation for early summer crops. For quick summer feed sow millets or hybrid forage sorghums or Sudan 8 to 12 kg/ha. Plant 0·1 ha per cow, late September.	Oats and regrowth oats, clover and medics, irrigated pasture and lucerne, plus grain. Young stock—Stubble and hay with Urea and Molasses. Young grass and medics are good milk producing feed. They cost little. Make good use of them while available.	Make hay of surplus cereal crops or leave to go through for a "Bonus" grain crop. Make lucerne hay.	
October ..	Plant forage sorghum, Sudan and millets 8 to 12 kg/ha with 30 kg N./ha. About 0·2 ha per cow. Lab Lab is recommended at 20 kg/ha in 36 cm rows or 10 kg/ha in 70 cm rows. Light seedings (2 kg/ha) of above crops may be added. Cow peas 15 to 20 kg/ha is an alternative. Sow grain sorghum at 4 to 6 kg/ha for grain.	Late oats and other winter cereals and early millets. Clover and medic and grass. Irrigated Pasture Young stock—Crop stubbles and grass.		

MONTH	LAND PREPARATION AND PLANTING	FEED DIARY	MANAGEMENT IF SEASONAL CONDITIONS GOOD	MANAGEMENT IF SEASONAL CONDITIONS POOR
November ..	Planting as for October. Land preparation for winter and late summer crops and summer pastures.	Late oats or other cereals and early maize. Grass and sown pastures. Lucerne and grain crop stubbles.	Make hay of winter crop stubble and lucerne.	*Young Stock*—Follow milkers and feed crop stubbles and stubble hay with Urea and Molasses and if necessary supplement with 1 to 2 kg of grain daily and try to maintain condition. Urea/Molasses Mix for Roller Drums 45 litres Molasses 135 litres Water 17 kg Urea Sufficient for 50 head for 6 or 7 days. *Home-made Block Lick* Parts by Weight Crushed Grain .. .. 32 Coarse Salt .. .. 32 Molasses .. .. .. 15 Urea .. .. .. 10 Boneflour .. .. .. 7 Meat Meal .. .. 5 Mix and allow to harden. Allow about ½ kg a cow a day.
December ..	Sow sweet sorghum 1 to 3 kg/ha and Lab Lab 10 to 20 kg/ha—approximately 0·1 ha per cow. (Late autumn/early winter feed.) Alternative—Caloona cow pea 15 to 20 kg/ha with or without forage millet. Avoid heavy soils for cow peas.	Early sudan, grass, sown pastures, sweet sorghum and Lab Lab and grain and crop stubbles.		
January ..	Sow sweet sorghum and Lab Lab if not planted in December. Maize can be substituted for sweet sorghum. Prepared land for lucerne and oats. Plant summer pastures—panic and kikuyu.	Sweet sorghum and Lab Lab. Grass and sown pasture and lucerne, and grain. Crop stubbles for young stock.	Make hay of surplus sorghum when growth is between 1 and 1·5 metres high. Best results about 1 metre. Silage can also be considered	
February ..	Sow Algerian Oats 45 kg/ha with 30 kg N./ha about 0·2 ha per cow. Treat uncultivated hillsides with sulphur fertilizer to promote medic growth (February to May), e.g. 250 kg/ha sulphur fortified superphosphate. Plant summer pastures—panic and kikuyu, etc.	Sudan and Lab Lab, grass, sown pastures, lucerne and grain. Lightly graze late Sweet Sorghum and Lab Lab.		
March ..	Sow winter forage crops—Oats, barley, canary and wheat. Oats—Minhafer, Camellia, Cooba, etc., 45 kg/ha with 30 kg N./ha —approximaely 0·2 ha per cow. Can add either Snail Medic (2 kg), Vetch (15 kg), Field Peas (15 kg), Rape (1 kg), to Oats. Early lucerne planting.	Regrowth sorghum and Lab Lab/ Sweet sorghum and lucerne. Irrigated pasture and grain. Young stock—Grass and crop stubbles.	Make hay of lucerne and surplus Lab Lab and Cowpeas.	*Drought Conditions* Grade milking cows on production and feed accordingly. Grade young stock on age, condition and pregnancy and feed each group separately. Sell low producers. Cows advanced in lactation could be dried off. Keep all stock free of external and internal parasites. Keep up the supply of good quality water. Fence off boggy water points.
April ..	Sow lucerne at 6 to 10 kg/ha from this month. Winter forage crops as for March. Sow irrigated pastures (Rye, Prairie and Clover, etc.).	As for March.		

MONTH	LAND PREPARATION AND PLANTING	FEED DIARY	MANAGEMENT IF SEASONAL CONDITIONS GOOD	MANAGEMENT IF SEASONAL CONDITIONS POOR
May . .	Sow lucerne, cereal crops and irrigated pasture if seasonal conditions not suitable in previous month. For quick feed plant barley (Cape and Prior). Sow barley for grain.	Regrowth sorghum, Dolichos, Lab Lab, lucerne and early oats, grain and hay. Irrigated pasture. Young stock—Stubble crops, grass and supplement with Urea and Molasses.	Bale stubble from summer grain crops.	*Drought Conditions* Grade milking cows on production and feed accordingly. Grade young stock on age, condition and pregnancy and feed each group separately.
June . .	Late lucerne plantings. Topdress early grazed oats, etc., 30 kg N./ha. Prepare land for summer crop. Plant sown pasture (lucerne with green panic, etc.). Light cover crop where required. Sow barley for grain not planted in May.	Milkers—Young oats and stubble hay, irrigated pasture and grain. Young stock—Clean up crop stubble and supplement with Urea and Molasses.		Sell low producers. Cows advanced in lactation could be dried off. Keep all stock free of external and internal parasites. Keep up the supply of good quality water. Fence off boggy water points.

Agricultural Census, 1975-76 Season

PRIMARY producers in Queensland are reminded that their annual statistical returns for the year ended 31 March, 1976 are now due for lodgment with the Australian Bureau of Statistics, 345 Ann Street, Brisbane, 4000.

The statistics from this collection provide a reliable picture of production trends in rural industry, and are extensively used by growers' organisations, grovernment authorities, and private enterprise. It is in producers' own interests that comprehensive and factual information should be available to anyone interested in the advancement of rural industry and the analysis of its problems. Producers interested in trends in rural industry generally, or in particular segments, are invited to inquire about the Bureau's statistical service relating to the free issue of annual bulletins covering most items of production in Queensland.

Collection forms together with reply-paid envelopes have been posted to primary producers. If a form has not been received, producers should write to the Deputy Commonwealth Statistician, Brisbane or telephone 33 5011, extension 5403.

The return is compulsory under the provisions of the *Census and Statistics Act* 1905–1973, which also guarantees the confidentiality of information on individual returns. Statistics are published only in the form of aggregates prepared from the figures supplied by individual producers.

Co-operation in forwarding returns without delay will assist in the completion of the 1975–76 Agricultural Census and early publication of results.

The Parrot-peas of South-eastern Queensland

TWO of the wildflowers now known by the common name parrot-pea were first described in 1805 by the British botanist, Sir James Edward Smith. He gave them the name *Dillwynia* in honour of one of his contemporaries, L. W. Dillwyn. The genus is found only in Australia.

Parrot-peas are heath-like shrubs with alternate leaves which are simple, narrow-linear and either terete or somewhat three-angled. The margins are very involute and the upper surface is consequently grooved or channelled. In some species the leaves are conspicuously spirally twisted and this becomes more evident as the leaves dry out.

The flowers are not as prolific as in some of the other genera of pea-flowers. Either they are two or three together in the axils of the leaves, forming long, leafy racemes just below or very near the ends of the branches, or they are grouped in terminal or axillary racemes. They are rarely solitary.

The flowers are typical pea-flowers with five sepals, five petals, ten free stamens and an ovary which contains two ovules. The sepals are joined into a tube at the base, with the free portion of the two upper lobes more or less united into a lip. The bracteoles are very small, and are usually deciduous. They are inserted on the pedicel often at a distance from the base of the calyx tube.

Parrot-pea flowers have a characteristic appearance due to the shape of the standard, which usually enables flowering plants to be readily identified at a glance. The standard is conspicuously broader than long and is usually very emarginate. The pod is swollen, ovate or rounded, and is nearly sessile. It contains two, kidney-shaped seeds.

Although parrot-peas in south-eastern Queensland always have bright yellow flowers, in Western Australia and Victoria there are parrot-peas with apricot, orange-red, yellow and purple or crimson and wine-red flowers.

Five species grow in south-eastern Queensland: *Dillwynia floribunda, D. glaberrima, D. juniperina, D. retorta* and *D. retorta* var. *phylicoides.*

SHOWY PARROT-PEA

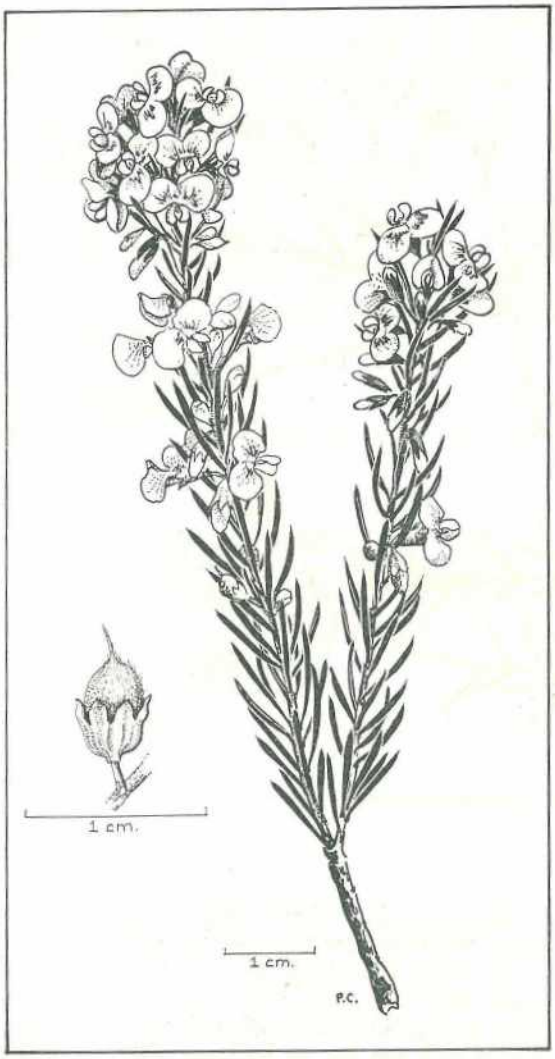
(*Dillynia floribunda*)

The specific epithet is a Latin adjective which means free-flowering, or producing abundant flowers.

DISTINGUISHING CHARACTERS. The crowded long, leafy racemes, with one, two or three flowers in the axils of the leaves is sufficient to distinguish this parrot-pea.

DESCRIPTION. This is an open branching shrub which grows to more than 1 m high, often showing a tendency to a group of lateral stems arising at one point, either at or near the

by BERYL A. LEBLER,
Senior Botanist.



Dillwynia floribunda.

end of the stem. Other plants in the same locality may be unbranched, long and arching. Minute white hairs are scattered on their brown stems.

The dark green linear leaves are crowded along the stems. They are almost sessile, 1 cm long and end in a fine mucro. Usually the leaves are not distinctly spirally twisted. The flowers are in the upper parts of the stem, in pairs in the leaf axils, with a flower held out on either side of the leaf. The peduncles are 0·1 cm long, with a tiny bracteole at the top on either side of the base of the calyx tube which is glabrous, and 0·5 cm long. The corolla is bright yellow and the showy standard is reflexed and widely spreading. It is up to 1 cm wide, less than 0·5 cm deep and is deeply notched at the top, with a broken red arc at the base. The wings project about 0·2 cm beyond the standard, with the upper edges touching and the wings curving away from each other. When the flowers are viewed end on the wings form the same shape arc as the red markings on the standard. The small keel is hidden by the wings.

The pod is inflated, and sparsely covered with appressed, short, white hairs, The ripe pod is broad, with the dead calyx still enclosing its base. It is 0·5 cm long, 0·3 cm deep, and as wide. It contains two black, shiny seeds.

FLOWERING TIME. Although flowers can be found from late autumn through winter, the main flush of flowers is seen in spring.

HABITAT. On the coastal lowlands it is common on wallum flats, on the Darling Downs it grows on sandstone hills, or in sandy granite soil among granite outcrops, near water.

DISTRIBUTION. It is found in South Australia and the eastern States to as far north in Queensland as Fraser Island and the Burrum River on the mainland.

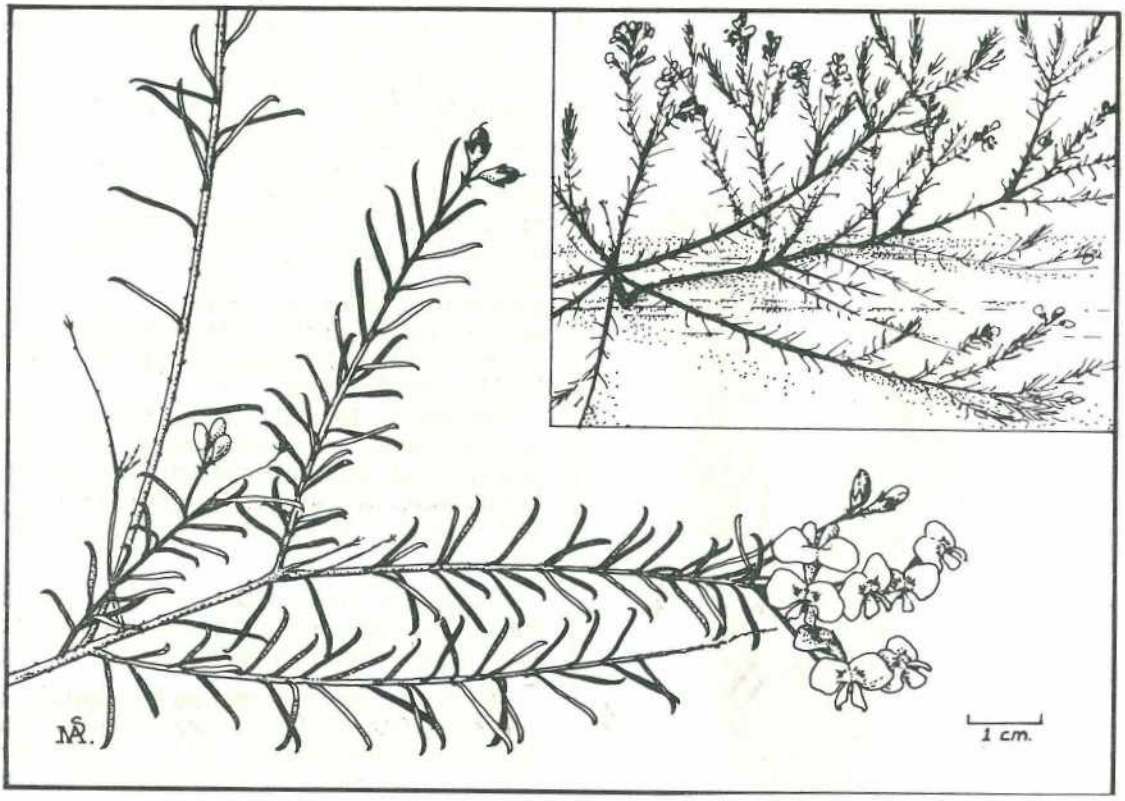
HEATHY PARROT-PEA

(*Dillwynia glaberrima*)

A Latin adjective meaning completely glabrous or very smooth is used as the specific epithet. It describes the leaves of this parrot-pea.

DISTINGUISHING CHARACTERS. The habit of growth and size of this plant, the length of the leaves, and the inflorescences are sufficient to distinguish it from the other parrot-peas in south-eastern Queensland.

DESCRIPTION. This is a slender, branched, woody sub-shrub which seldom grows to a height of more than 30 cm. The branches are often procumbent and spreading from a woody root stock to form a more or less circular mat. In older plants the stems are usually bare of



Dillwynia glaberrima.

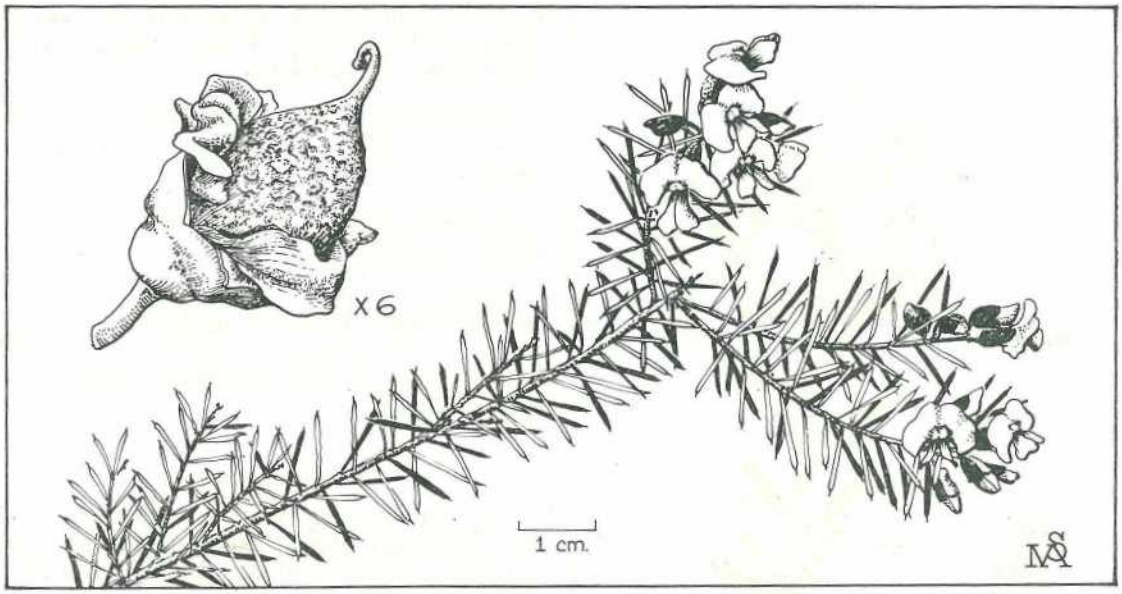
leaves where they lie along the ground. The smooth and shining light green leaves are scattered along the terminal, ascending portions. Magnification shows minute white, spreading hairs scattered on the stems.

The leaves are up to 1·5 cm long, less than 0·1 cm wide, and end in a recurved mucro. In most plants the leaves are straight. The leaves lie close to the stems in young terminal shoots, but spread widely from older stems.

The flowers are golden yellow and are at the tips of the branches, and held above the surrounding vegetation. Usually there are only three or four flowers in the inflorescence but there can be as many as seven. They are crowded into short racemes at the tip of a rhachis up to 1·5 cm long. A small bract is at the base of each pedicel and two tiny braceteoles are attached about halfway up the pedicel.

The calyx is 0·5 cm long and ends in five lobes much shorter than the tube. The corolla is less than 1 cm long, the standard is 1·2 cm wide and less than half that depth. It is very emarginate, and reflexed and spreading. There is a red arc at its base which is wider on the outer surface. The wings project 0·2 cm beyond the standard. Their upper edges touch and the wings curve out away from the tiny keel.

Viewed from the end the wings follow the curve of the red line at the base of the standard. The inner surface of the wings is flushed with red. The pods are swollen, 0·5 cm long, 0·3 cm across and as deep, and are pale brown in colour. The remnants of the calyx surround the pod and examination under magnification shows a sparse covering of appressed short white hairs. The pods split from the end along both sutures to release two smooth black seeds.



Dillwynia juniperina.

FLOWERING TIME. Autumn and spring.

HABITAT. In other parts of Australia it has been found on heathlands and in open forests. In Queensland it grows near the sea, in sandy wallum or in peaty swamps.

DISTRIBUTION. It is found in South Australia, Tasmania and the eastern States to as far north in Queensland as Double Island Point and Tin Can Bay.

GENERAL NOTES. Although this plant was recorded for the first time from Queensland from Cooloola in 1975, and later from Coolum, it had previously been collected at Tin Can Bay, Double Island Point and Stradbroke Island, but had been incorrectly identified.

PRICKLY PARROT-PEA

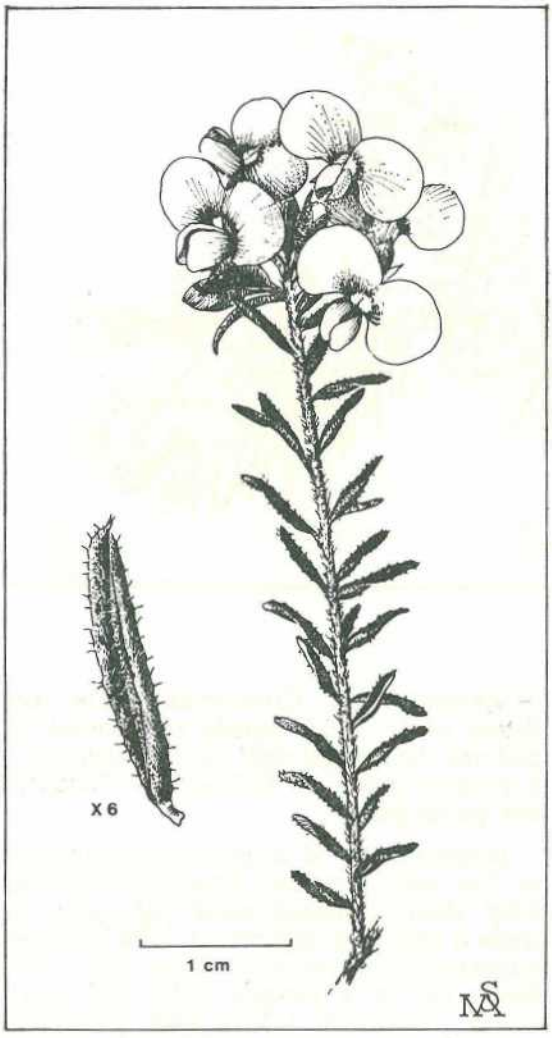
(*Dillwynia juniperina*)

Seeds of this plant were sent in 1818 from Tasmania to Kew Gardens in London. The plants flowered in 1820 and were described with the comment "the general habit of the plant is so much like *Acacia juniperina,* as to render it difficult at first sight to distinguish them".

DISTINGUISHING CHARACTERS. The persistent petals, which remain surrounding the pod and the straight rigid leaves which end in a pungent point are sufficient to distinguish this parrot-pea.

DESCRIPTION. It is an erect prickly shrub to 2 m with divaricate branches and twigs. Very short appressed white hairs give the stems a dirty grey appearance. The leaves are alternate and arranged in a close spiral. The leaves end in a pungent point and spread widely. They are 1·5 cm long, dark green and glabrous, rigid and straight and are somewhat three-angled. The pungent point is 0·1 cm long.

The flowers are nearly sessile and are grouped at the ends of the branches in inflorescences of up to twelve flowers with golden yellow petals. The calyx differs in shape from other parrot-peas in south-eastern Queensland. The lower part of the tube is broad and U-shaped, in vertical section. Minute, white, appressed hairs are scattered over the outer surface. The two upper lobes are broad and united to form a lip and the lower three lobes are much shorter than the calyx tube. The standard is 1 cm wide, 0·5 cm deep, emarginate, with a broad conspicuous dark red band



Dillwynia retorta.

on either side at the base. These are connected at the top by a narrow band shaped like the letter 'M'. The basal portions of the wings are red and the ends are yellow. The keel is shorter than the red portion of the wings and cannot be seen without removing the petals.

This parrot-pea has persistent petals which remain on the spent flower so that the pod is surrounded by the dead petals as well as the calyx. The pod is about 0·5 cm long, swollen and the outer wall is slightly wrinkled. It splits from the tip along both surfaces to release two smooth, black, kidney-shaped seeds about 0·3 cm long.

FLOWERING TIME. Late winter on the coastal lowlands to mid-spring on the Darling Downs.

HABITAT. It grows on stony hillsides in open eucalyptus forests.

DISTRIBUTION. It grows in the eastern mainland States to as far north on the coastal lowlands as the north-western suburbs of Brisbane and in the Stanthorpe area in the Darling Downs.

(*Dillwynia retorta*)

A Latin adjective meaning twisted or turned back provides the specific epithet for this parrot-pea, alluding to the distinct spiral twist along the leaves.

DISTINGUISHING CHARACTERS. The smooth, spirally twisted leaves and the clusters of flowers usually at the ends of long peduncles are sufficient to distinguish this parrot-pea.

DESCRIPTION. This is a shrub with thin woody branches and divaricate twigs. It can be almost prostrate or erect, reaching a height of 2 m or more. Minute, white spreading hairs cover the young twigs, but the old stems are glabrous. The linear leaves are dark green, smooth and shining. They spread widely from the stems, have a distinct spiral twist and are just over 1 cm long.

The flowers are grouped in loose few-flowered clusters at the ends of the stems or in the axils of the terminal leaves. The individual flowers are on pedicels under 0·5 cm long at the ends of peduncles more than 1 cm long, which far exceed the leaves. This, together with the divaricate branches, gives an open, spindly appearance to the plant.

The flowers are often held with the standard "upside-down". They are more than 1 cm wide, 0·5 cm deep, reflexed and widely spreading, and very emarginate. A wide red arc is at the base of the standard. This colour is darker and more pronounced on the outer surface of the standard. The projecting wings conceal the small keel.

FLOWERING TIME. The main flowering period is from late winter to mid-spring.

HABITAT. On the coastal lowlands it is found in mixed open forest, on sandy wallum flats or on sandstone ridges.

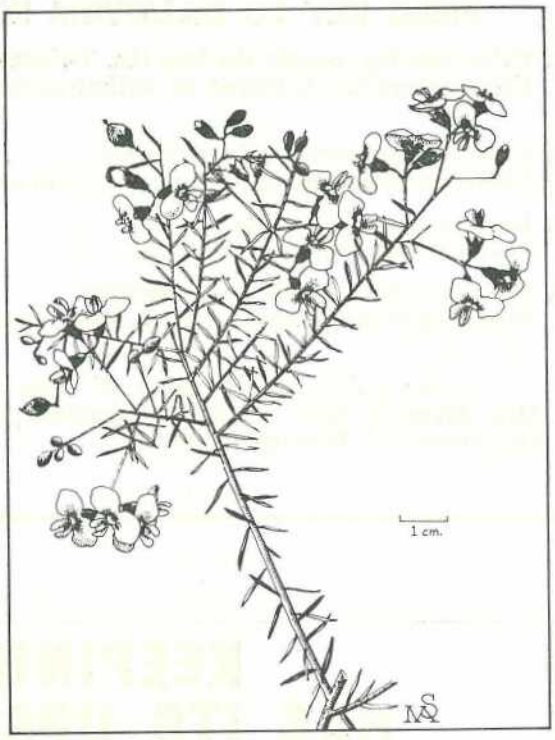
DISTRIBUTION. It grows in the eastern mainland States to as far north in Queensland as Fraser Island on the coast, and the Carnarvon National Park in central Queensland.

HAIRY PARROT-PEA

(*Dillwynia retorta* var. *phylicoides*)

The Greek suffix *oides* indicates resemblance. *Phylica* is an evergreen shrub cultivated in Europe. Its leaves are alternate, crowded and linear. Without flowers this parrot-pea has a superficial resemblance to *Phylica.*

DISTINGUISHING CHARACTERS. The compact, sessile heads of flowers and the stiff tubercle-based hairs on the leaves distinguish this parrot-pea from the other growing in south-eastern Queensland.



Dillwynia retorta var. *phylicoides.*

DESCRIPTION. This shrub is variable in its growth habit. It can reach a height of 2 m but more often is much smaller. It is often the dominant shrub in the plant community. Some plants develop erect, straight branches with the flowers in heads at the ends of very short lateral twigs. In other plants in the same area the flowering twigs are up to 10 cm long and several develop almost from one point on the stem.

The stems and leaves are covered with short, stiff, white hairs. The leaves are dark green, 0·7 cm long, with a spiral twist which can be seen even without magnification.

As many as fifteen almost sessile flowers are crowded into terminal heads. The flowers are 1 cm long, with a standard 1·3 cm wide and 0·5 cm deep. It is very emarginate. Most flowers have a pronounced red arc at the base of the standard, but an occasional plant can be found in which the marking is so faint the whole flower appears to be yellow. The standard is very spreading and reflexed and the wings are curved on either side of the tiny keel.

FLOWERING TIME. On the coastal lowlands the main flush of flowers appears in early spring but it also flowers to a lesser extent in autumn. On the Darling Downs it flowers in summer.

HABITAT. This shrub grows in open eucalyptus forests in gravelly soil on hillsides, or on rocky hills or sandstone ridges.

DISTRIBUTION. It grows in the eastern mainland States to as far north in Queensland as Crow's Nest on the coastal lowland and the Blackdown Tableland in central Queensland, and on the Darling Downs in the Stanthorpe area.

FIELD KEY TO DILLWYNIA IN SOUTH-EAST QUEENSLAND

1. Calyx tapering towards the base (i.e. V-shaped in vertical section) petals deciduous .. 2
   Calyx obtuse (i.e. U-shaped in vertical section) pod surrounded by remnants of petals
   Dillwynia juniperina

2. Flowers in pedunculate short racemes 3
   Flowers axillary, one or two together, or in sessile, terminal heads 4

3. Leaves straight and smooth .. .. *Dillwynia glaberrima*
   Leaves spirally twisted and smooth .. .. *Dillwynia retorta*

4. Flowers axillary, leaves usually straight .. .. *Dillwynia floribunda*
   Flowering in sessile terminal heads, leaves spirally twisted and hairy
   Dillwynia retorta var. *phylicoides*

In this article, and in most of those following, some of the illustrations are by Mrs. Margaret Saul, a botanical illustrator on the staff of the Queensland Herbarium, Department of Primary Industries.

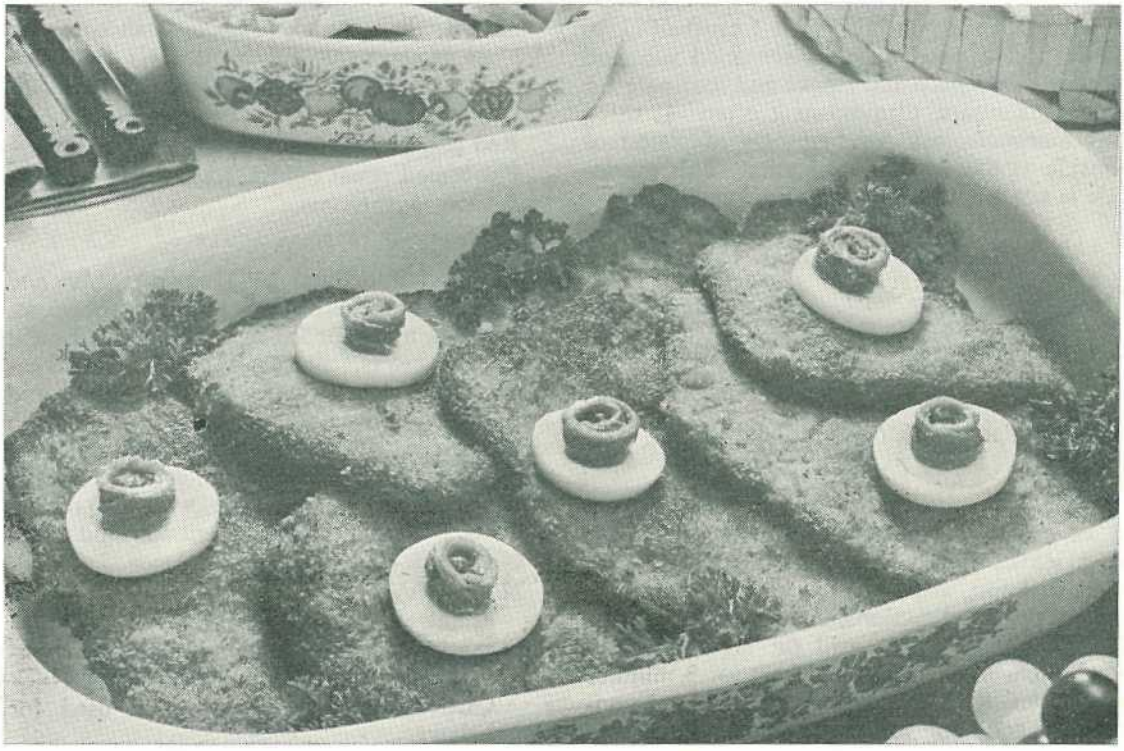
Quick Cooking for budget beef cuts

With the present trend of bulk beef buying—and with bargains often available in the cheaper meat cuts—the thrifty cook often has to resort to time-consuming moist-heat methods of preparing many cuts to make a presentable, tender meat dish.

So here is good news for cooks who don't have a great deal of time to spend in the kitchen! Lawry's, the makers of those popular culinary aids, seasoned salt and pepper, have a new product on the market which will make tough steak tender.

Called "Beef Marinade", it contains a meat tenderiser, plus flavourings and seasonings, for really tasty grilled beef. All it requires is the addition of water. No need to add oil and, or wine, so it is an economical buy. The contents are sufficient for 2 kg (4 lb.) of meat, so use half the packet if necessary, reseal, pack well and store for later use. The marinade can also be used for roasts. Directions are on the pack.

Beef Schnitzels, combined with a special tenderising marinade, make a perfect family meal. Buy budget cuts for this recipe and save the pennies. It's simple and it saves time in the kitchen.



BEEF SCHNITZELS

Ingredients

1 kg (2 lb.) thinly sliced round, topside or bolar blade steak.
½ packet Lawry's Beef Marinade.
1 large egg beaten with 2 tablespoons water.
Dried breadcrumbs.
Oil for frying.
2 hard-boiled eggs, anchovy fillets and parsley for garnish.

Method

Trim steak and cut into serving portions. Flatten between two sheets of plastic. Mix and use marinade according to package directions and marinate steak for 15–20 minutes. Lift out of marinade and drain well, removing excess with paper towels. Dip into beaten egg and coat well with crumbs. Shallow-fry in hot oil until golden brown and cooked through. Drain on crumpled paper towels and arrange on a warm serving platter. Garnish with slices of hard-boiled egg, anchovy fillets and parsley. An alternate garnish can be lemon slices and capers. Serves 6.

Alternate Marinade

Mix ¼ cup lemon juice with 1 crushed clove garlic and a good dash of seasoned salt and pepper. Add prepared steaks and marinate for at least 2 hours, turning meat often. If using this marinade, ask for first cuts of round or topside as these are more tender. This marinade is not as effective as the package mix.

THICK GRILLED STEAK

Ingredients

1 slice round, topside or bolar blade steak cut 4 cm (1½ in.) thick; or 1 piece flank skirt steak (about 500 g or 1 lb.).
½ packet beef marinade.
Oil or melted butter (optional).

Method

Slash fat selvedge at intervals to prevent steak curling; if using flank skirt (i.e. thick skirt steak) lightly criss-cross each side with a sharp knife. Mix and use marinade according to packet directions, marinating meat for 20 minutes. Preheat grill on high and grill steak 8 cm (3 inches) from heat for 3 minutes each side. Reduce heat to medium and continue to cook for further 5 minutes each side for rare; 7–8 minutes each side for medium; 10–11 minutes each side for well-done steak. (Remember, well-done steak is usually drier and a little tougher than medium-done). Brush steak with oil or melted butter during cooking if desired. Place steak on carving board and carve in 1 cm (½ inch) slices with knife held at a 45° angle. Heat marinade and use as a sauce if desired. Serves 4–5.

Alternate marinade

Blend together ½ cup red wine, 3 tablespoons oil, 1 sliced onion, ½ crushed clove garlic, 4 chopped parsley stalks, ½ teaspoon dried thyme or tarragon and a good sprinkling of seasoned pepper. Add meat and leave to marinate in refrigerator for at least 4 hours, turning meat occasionally. Marinade can be strained after use, boiled for 3 minutes and thickened with a cornflour and water paste. First cuts of round or topside should be used with this marinade as they are more tender to begin with. This marinade is not as effective as the packaged product.

BEEF KEBABS

Ingredients

1 kg (2 lb.) round, topside, fresh silverside or blade steak cut 3 cm (1″) thick.
½ packet Lawry's Beef Marinade.
Oil (optional).
Red and green capsicums cut into squares.
Par-boiled small onions.
Button mushrooms.

Method

Cut beef into 3 cm (1″) squares. Mix and use marinade according to package directions, marinating meat for 20 minutes. Thread meat onto 6 skewers, alternating beef with vegetables. Brush vegetables with marinade and grill kebabs under high heat for 2 minutes each side, reduce heat to medium and continue cooking for further 3–4 minutes each side or until done to taste. Brush with oil during cooking if desired. Heat marinade and serve over kebabs. Serves 6.

NOTE.—Vegetables may be placed on separate skewers if desired. Brush with marinade before cooking, oil during cooking. Also alternate marinade from Thick Grilled Steak recipe may be used for kebabs.

PLANT NUTRITION

Strictly speaking the term **plant foods** would have to include the elements carbon, hydrogen, oxygen and their compounds because these make up the great bulk (85%) of the dry matter produced by a plant.

The plant gets these elements from carbon dioxide obtained by diffusion of air through the leaf pores, and from the water obtained from the soil.

Therefore, the mineral components of plant foods may be termed **nutrients.** These are derived from the soil.

THE MAJOR ELEMENTS

These are the elements needed in larger quantity. They include:

Nitrogen	**Sulphur**
Phosphorus	**Calcium**
Potassium	**Magnesium**
Sodium	

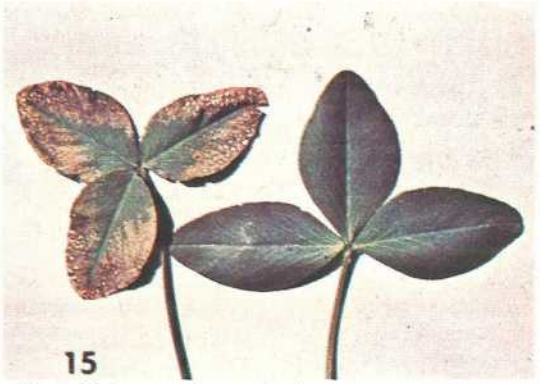
Sodium is most necessary in certain species (such as beets) in which it can substitute partly for potassium.

These are needed in smaller quantities but are definitely as essential as the major elements. They include:

Iron	**Zinc**
Manganese	**Copper**
Boron	**Chloride**
Molybdenum	**Cobalt**

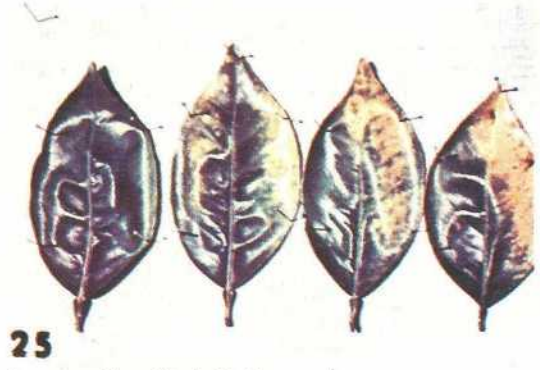
Some of these trace elements are needed in such small quantities, that it is not surprising to find they can be easily applied in amounts that are toxic.

Increasing K deficiency in white clover.



K deficiency in red clover.

K deficiency in bean (Phaseolus sp.).



Increasing K deficiency in orange.

K deficiency in currant.

K deficient coconut palm.

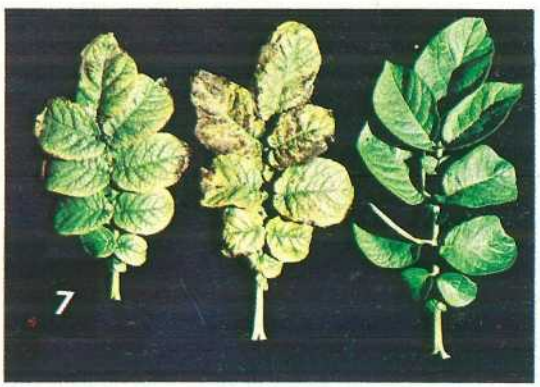
K deficient oil palm leaf.

Healthy and K deficient rubber leaves.

K deficient tobacco plants.

K deficiency in apple tree.

Lucerne showing K-deficiency.



Increasing K deficiency in potato.

POTASSIUM

Our pictures show the effects of potassium deficiency in a wide range of plants.

Potassium is completely water–soluble and mobile in plants, and is to be found particularly where cell–division and growth are most active.

Potassium deficiency is most marked in dry seasons. Some clay minerals can contract and cause potassium to be 'fixed' within the clay lattice during drought conditions.

In cereal crops, 85% of the potassium may be contained in the straw. If the straw as well as the grain is removed from the land, potassium deficiency can set in after a few years of cultivation.

Potassium deficiency and chloride excess often exhibit leaf–symptoms that are very similar.

FURTHER INFORMATION ON PLANT NUTRITION WILL APPEAR IN LATER ISSUES OF THE QUEENSLAND AGRICULTURAL JOURNAL IN THE FORM OF A SERIES OF ARTICLES BY MR. N.G. CASSIDY.

DPI

Brigalow Management

second of a two part series

In this issue

—Beef cattle production

—Cattle management

—Sheep production in brigalow areas

—Brigalow-land management

—Enterprise selection and financial management

—Brigalow Research Station

Articles in this series which appeared in the January issue included:—

—Brigalow clearing and regrowth control

—Brigalow pasture establishment and maintenance

—Growing crops on brigalow lands

Beef Cattle Production

by R. T. STRACHAN, Beef Cattle Husbandry Branch.

DESPITE the potential that Brigalow and associated lands have for high production the unique characteristics of the climatic influences within the region largely determine the level of production achieved. Moisture stress is a normal condition of pastures in the Brigalow Region for much of the time. Consequently, a major feature of the environment is a year by year and within year variability in the capacity of pastures to carry stock.

In the broadest terms production throughout the region is critically dependant on the effectiveness of summer rainfall which falls from October-March inclusive, and roughly makes up two-thirds of the annual rainfall.

While the reliability of summer rains decreases from north to south, total rainfall is variable from year to year throughout the region. The main source of this variation is rainfall from thunderstorms. These tend to be erratic and as the chief source of rain required in early summer to initiate the growth of summer perennials, serious delays are frequent.

Winter rains, on the other hand, are the result of the passage of frontal systems and tend to be more widespread and uniform. They are an important component of the total rainfall north to the tropic, beyond which their influence declines rapidly and the dependence on early summer storms increases.

Another influence which restricts pasture growth and in turn, animal production, is the extremes of temperatures that occur. Frosts are recorded throughout the region with fewer and milder frosts in the north. While frosts which may occur from late April to early October may not be severe or frequent by comparison with colder regions, they have a drastic effect on summer growing perennials. The problem is amplified by the wide diurnal range of temperature that is associated with frosty periods in the Brigalow Region.

At the other extreme, heatwaves are not uncommon from November to February. Extended hot spells with temperatures over 35°C for 30 consecutive days with periods of up to 6 days with temperatures over 40°C have been recorded. The effect of heatwaves in killing young plants and restricting the growth of established plants is well recognised.

The Grazing Lands

The Brigalow Region is not a vast uninterrupted stretch of highly productive land. The region is made up of a mosaic of soils differing sharply in fertility. Much of the land is occupied by eucalypt forests where plant growth is limited by both its physical condition and nutrient deficiencies.

However, while these more infertile lands can provide useful grazing during the growing season, they probably make a more valuable contribution to the total production from the region through their ability to respond to lighter falls of rain, provide a reserve of dry matter for use in drought years and by providing shelter for stock in cold weather.

The complimentary role of the associated lands should not be overlooked in the following discussion which is restricted to lands originally supporting brigalow dominant communities.

Native Pasture

Despite the large increase in the area of sown pastures and crop the area of native pastures has remained relatively constant and still supports a major portion of the region's livestock.

It is only in relatively recent times, since the introduction of heavy machinery in the mid fifties, and the total replacement of the vegetation, that sown pastures have been able to make a significant contribution.

Early development of the Brigalow was restricted to the use of the axe and largely confined to the southern part of the region, south of Taroom and in the vicinity of Miles, Tara and Goondiwindi. It is in these areas that native pastures still supply the major source of fodder for cattle.

Where Brigalow scrubs were destroyed in this fashion, various native pastures grow. Major species include brigalow grass (*Paspalidium* spp.), star grass (*Chloris* spp.), blue grass (*Bothriochloa* spp.) and various love grasses (*Eragiostis* spp.).

The pronounced summer incidence of rainfall imposes a pattern of yield and quality common to both native and improved pastures. There is almost a complete absence of growth in winter even when rain occurs. However, due to a lower rainfall and the high natural fertility of the brigalow soils, under similar management cattle in the brigalow generally out-perform cattle grazing in the spear grass and coastal areas in that they usually maintain or gain weight slightly in winter.

Within the region, cattle performance on native pastures is superior in the south. While this is obviously a result of a more effective winter rainfall and the growth of winter herbage, the lower yield and sparceness of native pastures encourages the regeneration of these annual herbs. Common species include crowsfoot (*Erodium* spp.), lamb's tongue (*Plantago* spp.) and annual medics (*Medicago* spp.).

Data recorded on the liveweight performance of steers grazing native pastures on rung barked brigalow country in the Miles district (Howard 1955-58) indicated that while daily gains may fluctuate from 0·45 kg to 1·35 kg for from 2 to 6 months during the summer and steers may occasionally lose weight for a short period during the winter, overall gains throughout life would average from ·50 kg to 0·55 kg per day. This is supported by the fact that it is not uncommon for 2½ to 3 year old steers fattened on native pastures in the brigalow country to record dress weights ranging from 250 to 275 kg.

At the stocking rates recorded by Howard which varied from 1 beast to 2·4 to 3·2 hectares, annual liveweight production of native pastures ranged from 50 kg to 80 kg per hectare.

This compares more than favourably with the performance of steers grazing native pasture in the spear grass country recorded over 9 years at Gayndah where annual liveweight gain averaged 34 kg per hectare at various stocking rates.

The ability of native pastures to promote a satisfactory liveweight gain in the southern environment was further demonstrated by the CSIRO at 'Tarewinnabar', 50 km north of Goondiwindi. In trials conducted by Coaldrake and Smith, yearling steers grazing native pasture and stocked at 1 beast to 1·8 hectares recorded an annual liveweight production of 114 kg per hectare.

These trials were conducted over 2 years, 1963 and 1964, a period of below average rainfall. The stocking rate was heavier than those recorded by Howard and only 50% of that imposed on three introduced species compared in the same experiment. While the average daily liveweight gain recorded on native pasture was superior (0·57 kg Vs 0·46 kg), the annual liveweight gain per hectare was inferior to sown pastures.

The comparatively high average daily weight gain of steers grazing the native pasture, a mixture of *Chloris, Paspaliduim, Eriochloa, Panicum* and *Eragrostis* species, was partly due to the growth of the volunteer medics. These medics occurred throughout the area, but their density was higher in the native pasture.

It is clear that annual winter herbs, through their ability to promote a superior liveweight gain during the winter and spring are a useful

bonus that can make a very important contribution to annual performance in most years. This, in turn, allows for the better utilisation of the summer grown pastures and stocking rates are generally higher where winter rain is a reliable componant of the total rainfall.

Sown Pastures

The destruction of the brigalow dominant scrubs and the establishment of improved grasses following a burn resulted in a pasture revolution throughout the region. The ability of these pastures to quickly establish on fertile scrub soils provided the first opportunity for the beef industry to intensify.

From an animal production point of view, the main advantage offered by improved pastures lies in their higher carrying capacity. However, in the absence of an effective winter rainfall and the reliance on summer species pasture growth and quality is sharply defined. A compromise must be reached between animal production per hectare and the provision of enough standing fodder of sufficient quality to maintain a satisfactory level of production per animal and of sufficient quantity to provide some insurance against dry periods.

While the reliance on summer growing perennials imposes an obvious restriction on total beef cattle production, particularly in central and northern parts of the region, under sound management production per animal is more than satisfactory. This is largely due to the ability of improved species introduced to the brigalow to provide grazing of a higher quality than native pastures in late summer and autumn and to retain a moderate energy value, thought often deficient in protein, throughout the winter.

The three major pasture species introduced to the brigalow, Rhodes grass (*Chloris gayana*), green panic (*Panicum maximum*) and buffel grass (*Cenchrus ciliaris*) may differ in yield and their ability to provide a higher quality grazing at certain times. However, in the absence of a suitable legume a marginal increase in yield is not important and both yield and quality of the various species and cultivars may vary greatly according to management, soil type, rainfall and temperature.

Graziers have already sorted out the suitable species. Rhodes grass is easy to establish and spreads rapidly, Green panic is suited to the brigalow—softwood scrubs, while buffel grass is the choice for drought hardiness and drier areas.

Production

The ability of well established sown pastures to maintain a satisfactory liveweight gain at a high stocking rate was demonstrated at Banana in Central Queensland. In trials conducted by the CSIRO over 4 years, yearling Hereford steers stocked at 1 beast/0·8 hectares recorded an average annual liveweight gain of 187 kg for a calculated annual production of 233 kg per hectare.

Steers in the Banana trial rotationally grazed a *Sorghum almum* (cv. Crooble) green panic dominant pasture sown into cultivated land after 3 years of pasture.

While the production per animal recorded at Banana is similar to that recorded elsewhere, the relatively high production per hectare is a measure of the ability of the pastures in this instance to maintain a higher stocking rate than is generally practiced commercially.

By contrast, Hereford steers observed by Round at Comet recorded an average annual liveweight gain of 127 kg for an annual production of 42 kg per hectare.

These steers stocked at 1 beast/3 hectares grazed an area in the early stages of development which originally supported whipstick brigalow, yellowwood with some yapunyah and was partly melonhole. Rhodes grass and green panic sown 12 months prior to the observation did not establish well and brigalow suckers were a major problem.

On the other hand, steers on the same property grazing an area with a moderate sucker problem and with a better establishment of pasture recorded an average annual liveweight gain of 205 kg for an annual production of 64 kg per hectare at a similar stocking rate.

As may be expected, the productivity of sown pastures in terms of liveweight gain per hectare varies markedly with the standard of the pasture, which in turn is dependent on

the stage of development. However, performance per animal is often comparable providing a realistic stocking pressure is applied.

Productivity per hectare is likewise influenced by the season which has been shown to be variable. A reliable estimate of productivity can only be made over a number of years.

Mayer *et. al.* recorded an annual production of 58 kg and 87 kg per hectare over 8 years at 'Tartrus' in the northern brigalow belt. Brahman crossbred steers used in this observation grazed a well established green panic pasture and recorded an average annual liveweight gain of 180 kg, similar to that measured elsewhere. Stocking rates varied from 1 beast to 2·2 hectares to 3·2 hectares.

This record of performance is supported by observations at the Brigalow Research Station at Theodore. Over a 4 year period Hereford steers at this centre grazing Rhodes, green panic and buffel grass pastures stocked at 1 beast/2 hectares and at 1 beast/3 hectares recorded an average annual liveweight gain of 168 kg for an annual production of 70 kg per hectare.

These observations conducted over a period of great variation in rainfall are a useful parameter of the productivity of well established sown pasture on brigalow land.

From the data recorded here and elsewhere, despite an extreme variation in the daily gain by month, the annual liveweight performance of yearling steers is relatively reliable. Annual liveweight gains in excess of 170 kg per head could be expected in 2 out of 3 years.

Growth Rate

The majority of properties in the region can be categorised into breeding and fattening, or breeding and stores. Naturally, there is a number of producers who combine these practices i.e. sell a portion as fats and the residue as stores.

Under sound management, which includes a mating policy for early calves, strategic weaning and where necessary effective cattle tick control, the growth rates of steers on improved brigalow country is sufficient to meet the requirements of the major export market for manufacturing beef which requires a low fat carcass with a weight range of 250–300 kg. This is regularly attained at from 2 to 2½ years of age.

The growth of four drafts of Hereford, Brahman and Santa Gertrudis cross steers, in terms of liveweight at weaning and at approximately 2 years and 2½ years of age is shown in Table I. The data implies that the variation between successive groups of steers is not marked.

TABLE I

MEAN LIVEWEIGHT (kg) OF HEREFORD, BRAHMAN AND SANTA GERTRUDIS CROSS STEERS AT 7 MONTHS (WEANING), 23 MONTHS AND AT 29 MONTHS

Year of Birth	Number	Mean Liveweight (kg)		
		7 Months	23 Months	29 Months
1969 ..	115	191	390	471
1970 ..	138	209	404	494
1971 ..	124	223	397	490
1972 ..	156	224	417	498
Mean (4 Years)	..	212	402	488

Source: Breeder Evaluation Trial " Mount Eugene ", Jambin.

The crossbred steers observed at "Mt. Eugene" calved on forest type country from August to mid-December and grazed improved brigalow pasture areas following weaning in May.

It is significant that the productivity per head recorded on these pastures on country developed for over 15 years prior to the commencement of the observations, is similar to that recorded elsewhere. The stocking rate used was 1 beast to 1–2 hectares depending on age and season.

Crop Production

Crops may be grown on most brigalow soils. However, owing to increasing costs and the fact that crops are sensitive to climatic conditions and are a variable source of fodder, cropping for beef production has declined in significance.

Although relatively unimportant in the region as a whole, on individual properties they are an integral part of the annual feed supply.

Fodder crops can be used to counter the decline in pasture quality during the winter and spring. Crops producing liveweight gains of 0·5 kg per day or better from April to October are more valuable than those producing the same rate of gain in the summer. For this reason the emphasis is and should be placed on late summer and winter grazing crops.

Oats is the popular crop for winter grazing in southern brigalow areas. Traditionally, oats is sown to fatten purchased store cattle or to fatten yearling steers for a turn-off off crop at 2 years of age in the spring.

Generally, yearling store steers require oat grazing for from 80–100 days to reach a desirable degree of finish. In practice this is probable in 60% of years. Daily gains range from 0·8 kg to 1 kg for an annual liveweight production varying from 160 kg to 250 kg per hectare.

Winter growing cereal crops, such as oats, are less reliable in northern areas of the region. For this reason safflower and rape have been grown as alternative crops. These crops have the advantage of a large taproot which enables some grazing in the absence of post germination rains. In practice, this advantage can be negated as safflower reaches maturity quickly in the spring and is often unpalatable. Rape is susceptible to aphis attack.

When liveweight gain is the parameter of productivity there is no evidence to suggest that these crops are superior to oats.

Owing to a predominantly summer rainfall summer forage crops are less variable and are widely grown to provide grazing in late autumn/early winter and, particularly in central and northern parts of the region, substitute for winter crops.

Crops grown for autumn and winter grazing should be planted from mid-January to late February.

Grazing sorghums are the most popular. *Dolichos lablab*, the main forage legume, is grown to a limited extent. However, while daily liveweight gains recorded on dolichos are comparable to those recorded on the sorghums, productivity in terms of total grazing and liveweight gain per hectare is usually inferior. The role of *Dolichos lablab* as a companion crop needs further investigation.

The productivity of the forage sorghums varies with the season and the severity of early frosts. Depending on the stocking rate, which usually varies from 1 beast to 0·2 to 0·6 hectares, stand-over sorghum crops may provide grazing from 90 to 150 days.

Daily liveweight gains vary markedly, however the average gain throughout the grazing period usually exceeds 0·5 kg per head per day.

From observations in central Queensland the annual productivity of forage sorghum in terms of liveweight gain is estimated to approximate 165 kg per hectare with a range from 55 kg to 412 kg per hectare.

Grain sorghum is widely grown and sorghum stubble is a useful source of fodder for cattle. Some producers tend to sow grain sorghum instead of forage sorghum. If a success, the grain production will give a better return than from cattle. If a failure for grain the forage value is reasonably comparable to that of forage sorghums in a dry year. The value of grain sorghum stubble varies markedly and animal performance depends on the initial grain yield, the grain residue and the season pre and post harvest. However at a realistic stocking, usually 1 beast per hectare, a daily liveweight gain from 0·3 kg to 0·5 could be anticipated.

There is very little difference between the productivity of oats as the major winter crop, and forage sorghum. However, sorghums are more reliable and can provide grazing for a longer period.

While production per hectare may fall within the range 250 kg to 400 kg liveweight in a good season, these values approach the annual productivity of land used for crop.

Annual productivity from sown pasture on cultivated land has been calculated to exceed 200 kg liveweight gain per hectare under trial conditions. Hence sown pastures could be expected to approach the annual productivity of crop on a long term basis at less cost and without the risk of total failure.

Drought Mitigation

General herd and property management is most important to alleviate the effect of drought. However, the erratic rainfall of the brigalow region makes some form of conservation an essential feature of management.

The strategy adopted e.g. understocking, the conservation of fodder on the property or the accumulation of a cash reserve for drought mitigation purposes is the choice of the individual producer.

Considering the region as a whole, property size and economic factors permit understocking in years of average rainfall or better. Any diminution of property size will inevitably force stocking rates up and conservation will increase in importance.

Using relationships between annual rainfall, stocking rate and beef production per hectare to assess the likely productivity of sown pastures on brigalow land in central Queensland Wegner *et. al.* demonstrated that, based on costs and returns prevailing in 1970, a varying stocking rate according to seasonal conditions as employed by most graziers, was slightly more profitable than constant stocking with hand feeding to meet feed deficiencies.

It was apparent from this study that only slight changes in the direction of higher beef prices and/or lower feed costs would be necessary for constant stocking and intermittent hand feeding to be more profitable.

In the more southern brigalow areas where summer rainfall is less reliable and properties are smaller and more intensively managed, drought conditions tend to be more frequent and of greater severity.

The lack of forage in sufficient quantity and quality to maintain reasonable numbers in production is often the critical factor of drought in the south. As a consequence, the feeding of conserved fodder, which has been shown to be a feasible and economic proposition when harvested and stored on the property as a drought reserve, has increased in importance in recent years.

Cattle management

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

BASIC cattle management practices are designed to ensure relatively high level of productivity with minimum costs for supplementary feeds. The purpose of this chapter is to outline the management practices which give maximum production from native and improved pasture.

Basic facilities

Adequate control of cattle is the most important pre-requisite to implementing satisfactory cattle management practices. The major considerations are:—

Paddock size. This should be designed to restrict the number of cattle in each mob to the limits which can be worked with a minimum amount of labour. On properties which carry up to 2 500 cattle one should base size of mobs on two labour units. Two men can work mobs of 70 to 120 breeders, or 120 to 150 growing or fattening cattle relatively easily. Naturally on larger properties bigger mobs can be accommodated because the basic work force will be larger. Reasons for attention to mob size relative to labour include getting complete musters; time taken for dipping, drafting, branding, implementing drought mitigation practices; etc.

Attention to the design, and maintenance of yards are of major importance. In particular the entrance to yards should be designed to avoid trouble when driving cattle into the yards, drafting facilities should be available, and yards with water and feed troughs for weaning are essential.

Subdivision should be on the basis of class of country so that the nutritional requirements for each different class of cattle can be considered. Broadly, there are three groups to consider. Firstly, breeders are usually carried on the worst pastures on the property. Secondly, cull cows, cull heifers, and herd replacement heifers are carried on the best of the pastures in the breeding country, or the worst of the fattening country. Thirdly, male cattle from weaning to sale should be on the best available pasture.

Breeder Herd Management

The breeding herd is the foundation of a breeding and fattening, or breeding and store selling enterprise. It follows that this section of the herd must be productive. A productive breeding herd must satisfy the following requirements:

- High reproductive rates.
- High weaning weights of calves.
- Low mortality rates of breeders.

In the environment prevailing over the brigalow region, a herd can express these attributes only when correct management practices are implemented. The major factors which must be considered are:—

Time of mating and calving. In the southern and central areas of the brigalow region the preferred time of mating is from October/November to February/March. This coincides with the most reliable period of adequate pasture supply. A cow's nutrient requirements are highest when she is suckling a calf and conceiving for the next year's calf. Obviously, it is desirable to match the period of highest animal requirement with the period of highest pasture productivity. Results from

mating during this period are well documented, and branding rates in the order of 80 to 85 per cent. are achieved regularly with little annual variation.

In the northern areas of the brigalow region, the termination of the dry season is usually four to six weeks later than in the central and southern areas. This means that the most favourable mating period is November/December to March/April. Limited observations suggest that branding rates could be slightly lower than in the southern and central areas. This is probably a reflection of a longer dry season and more variable rainfall.

Table I shows the mean calving dates which have been recorded from the well managed herds in the brigalow region.

TABLE I

MEAN CALVING DATES AND DISTRIBUTION

Site	No. Observations	Period	Mean and Standard Deviation
"Broadmeadow," Moranbah (*a*)	926	1968–1970	Oct. 30th ± 71 days
"Memooloo," Comet (*a*)	3,148	1965–1974	Oct. 4th ± 42 days
"Mount Eugene," Jambin (*a*)	2,805	1969–1974	Sept. 25th ± 43 days
"Yandarlo," Miles (*b*)	1,016	1966–1969	Oct. 7th ± 38 days

Source: (*a*) Beef Cattle Husbandry Branch, Q.D.P.I., Rockhampton. Based on date of birth of claves.
(*b*) Beef Cattle Husbandry Branch, Q.D.P.I., Roma. Based on estimates from stage of progeny, and with maiden heifers deleted.

Time of weaning. The time to wean should be determined by the condition of the breeders and the condition of the pastures. Calves can be weaned down to three to four months of age without markedly affecting subsequent performance and without special treatment.

Calves weaned at three to four months of age should be given the normal weaning treatment. About a month after weaning, any calves showing signs of abnormal stress should be drafted and given special treatment.

The purpose of weaning is to ensure breeders enter the dry season in good condition. In normal seasons it is necessary to wean in April-June to allow the breeder to make some improvement in body condition before pasture quality declines to maintenance or sub-maintenance levels. In the northern areas of the region it is preferable to wean in April/May, but in the southern areas weaning can be delayed until May/June in normal seasons. A February/March weaning is justified following markedly below average summer rainfall. There is no point in letting calves suckle beyond eight months of age irrespective of seasonal conditions.

Strategic weaning is the most economic management practice to reduce mortalities in breeders. Even during drought the number of cows which need feeding for survival is minimal where strategic weaning is implemented.

Analyses of the post weaning performance of calves weaned at 5-9 months of age show that the younger and lighter calves tend to perform slightly better than the older calves in the group. When calves are to be weaned onto improved pasture there is no reason to delay weaning if the condition of the cow indicates that weaning is desirable.

Culling breeders.—The worth of a breeder should be based on her ability to produce a heavy calf each year and not on her appearance. Colour and physical appearance have little to do with productivity. Actually many highly productive cows appear physically inferior because the stress of producing and rearing calves every year prevents accumulation of condition. Culling should be restricted to economically important traits.

These are:—

- Cows which fail to produce a calf should be culled. Firstly, they have no earning capacity. Secondly, in all breeds there is a proportion of sub-fertile cows. The frequency is higher in Tropical breeds than in British breeds. These sub-fertile cows should be culled to make space for fertile cows. In well managed herds in southern and central areas of the brigalow regions all cows which fail to produce a calf can be culled. However, in the northern areas it may be necessary to retain three year old lactating cows which fail to reconceive to maintain herd numbers. Cows which are to be culled for reproductive failure can be located either by pregnancy diagnosis and/or by drafting out dry cows in December/January each year. The choice

of which method to use will depend on the individual situation with regard to the availability of pasture during May to November/December, and cash flow requirements.

• Cows which have physical defects should be culled. Major physical defects include enlarged teats, bad temperament, cancer eye, etc. Culling for ageing falls into this category and should be based on body condition. Cows which are in poor condition relative to their contempories irrespective of age should be culled. In other words, all cows which are in markedly worse condition than the average of their age group. Obviously, comparisons must be made within groups rearing calves. There seems little point in culling for age while a cow is physically sound, maintaining her condition and producing a calf.

The proportion of culls and, conversely, the proportion of herd replacement heifers required will vary markedly between herds, years, and breed of cow. However, the data presented in Table II will serve as an indication of likely culling levels needed under commercial conditions in herds managed along the lines suggested.

TABLE II

CULLING AND RETENTION RATES IN A BRAHMAN CROSS HERD (%)

Fate	Culled				Retained	
Reason for Culling	Reproductive Failure		Physical Defects (*a*)			
Breed Age	First Cross Brahman X Hereford	Back Cross to Brahman	First Cross Brahman X Hereford	Back Cross to Brahman	First Cross Brahman X Hereford	Back Cross to Brahman
1 Year Maiden	5·4	12·1	0·3	0·3	94·6	87·7
2 Year Maiden	8·5	14·9	0·0	0·0	91·5	85·1
2 Year Lactating	17·9	24·9	0·4	0·5	81·7	74·7
3 Year Lactating	8·6	9·6	1·7	0·7	89·7	89·6
4 Year Lactating	11·3	10·4	1·9	2·3	86·9	87·2
5–9 Year Lactating	9·5	6·5	4·5	3·3	86·0	90·3
10–15 Year Lactating ..	6·5	12·3	36·3	24·6	57·2	63·2
Total	9·6	11·3	5·4	2·3	85·1	86·4

(*a*) Includes culling for ageing.

Source: " Mount Eugene," Jambin Beef Cattle Husbandry Trial, RKN–CH395–BF.

The main points emerging from these data are—

• Approximately 15% of breeders ought to be culled annually to maintain herd productivity.

• Culling rates for reproductive failure decrease with age in lactating groups owing to the selection effect and reduced stress in older cattle because they no longer have nutritional requirements for growth.

• There is a breed effect with the higher Brahman component breeders requiring more selection for fertility than the first cross breeders. Other trial work indicates that the Tropical Breeds would react similarly to the Brahman back cross. One would expect Herefords to approximate the first cross group.

• The culling rates for the 10–15 year group imply that the high Brahman component group have better longevity than the first cross. However, this could be because more of them have been culled at an earlier age for fertility reasons.

Cull breeders should be placed in a separate paddock (preferably a fattening paddock). Those culled for reproductive failure should be sold as they reach marketable condition, while those culled for physical defects should be allowed to rear their calves and sold as

soon as they reach marketable condition after weaning. Depending on the time taken to fatten and the control of bulls on the property, it may be advisable to spay cull breeders.

To implement effective strategic weaning and culling practices, controlled mating is essential. Effective strategic weaning is dependent on having time to improve condition of breeders before the dry season. Culling for reproductive failure cannot be implemented effectively without a gap in the calving period.

Replacement heifers. In the southern areas and on better developed properties in the central area of the brigalow region replacement heifers can be mated to calve at two years of age. However, in the northern areas and on poor country it is preferable to delay mating and aim to calve at three years of age. To achieve satisfactory reproductive rates at first mating and at the subsequent mating heifers should be approximately 250–280 kg liveweight at the start of mating, and be in paddocks where the expected weight increase from then to early winter will approximate 100 kg.

If these standards are to be achieved to implement yearling mating, herd replacement heifers should be selected at weaning on the basis of size irrespective of age. At weaning rates of 80%, approximately half the heifers will be needed for herd replacements. The average weaning weight of all heifers at 6–7 months of age would be in the order of 200 kg. Thus the lightest of the replacement heifers would be about 200 kg, and they would need to gain approximately 50 kg liveweight by the commencement of mating. This can be achieved where improved pasture or crop is available.

Where the above standards can be regularly achieved there is little point in giving yearling heifers or two year old lactating cows preferential treatment. However, in marginal situations the use of paddocks with better type pasture can enhance the results from breeders of these age groups.

Additionally, in marginal situations it may be preferable to mate only the oldest and largest heifers as yearlings, the residue of the herd replacement heifers being mated at two years of age.

Difficulties at first calving occur throughout the brigalow region. In the northern and central areas losses of heifers are generally low, probably about 4-8%. In the southern areas these losses commonly range from 10-15% and can rise to 40%. Reasons for these losses are difficult to define, however, the following factors seem to affect the frequency of dystocia:—

- Brahman x British heifers appear to have less calving difficulties than Hereford heifers.

- Heifers which are not well grown appear to have more difficulty calving. Provided that the standards for size outlined previously are met the incidence of dystocia appears independent of age. However, unless heifers are well grown dystocia is frequently encountered in heifers calving at two years of age. In the southern areas commencement of mating heifers is often delayed until December/January to allow for more growth, and to delay calving until September/October. The nutrition for the last three months pre-calving is generally at its lowest, but is usually high enough to maintain adequate body condition.

- Extremes of nutrition appear to affect the incidence of dystocia. Extremely high nutritional levels, especially during the last three months of gestation, are associated with high birth weights of calf and accompanied by difficult calving. Conversely, extremely low nutritional levels increase the frequency of dystocia because the heifers are physically too weak to calve normally.

When there is a history of dystocia, heifers should (if possible) be supervised during calving. However, heifers which have difficult calvings and their progeny should be culled from the breeding herd. There is a probability that retention of heifers with a history of dystocia will increase the frequency of dystocia in the herd in subsequent years.

Bull management. When bulls are removed from the breeders in February/April they should be inspected for physical defects, e.g., eye lesions, sheath or penis damage, testicle abnormalities and temperament. Unsound bulls should be marked for culling. Ideally,

bulls should be replaced at four years of age irrespective of physical soundness to maximise genetic gain, however, it is probably more realistic to cull at six to seven years of age. By determining culling requirements at this time plans can be made to purchase replacement bulls before the selling season starts. Obviously there is a better selection of bulls early in the selling season.

The best place for bulls during the February/April to October/December period is with growing/fattening male cattle. When bulls are in a paddock with steers they are easier to drive to yards, and handle in the yards because they are dispersed amongst the steers. As steer paddocks are the best on the property, bulls will maintain condition without having to resort to supplementary feeding.

There is no critical information on joining rates of bulls. Field experience shows that 2½ to 3 per cent. bulls give satisfactory results on well-developed country. Up to 5 per cent. bulls may be desirable on country with a low carrying capacity depending on the number of water points and breed of bull—there is a comparatively high frequency of sub fertile bulls in the Tropical Breeds. When using bulls at the lower rate it is important to observe the bulls regularly and replace any sick or injured bulls as soon as possible.

Infertility diseases. Brucellosis, Vibriosis, and Leptospirosis are frequently diagnosed in the region. When changing from an uncontrolled mating system to a controlled mating system always check for the presence of the above diseases. Year round mating can mask the effect of infertility disease. These diseases can be controlled by vaccination programmes. Trichomoniasis has been diagnosed in the region, but does not occur frequently. Treatment involves minimising the use of bulls greater than four years of age combined with culling non-pregnant cows.

Performance of progeny

Adoption of the breeder herd management methods outlined often involves discarding traditional methods of selection. This in turn raises doubts concerning the likely effect on the progeny. Data presented in Table III are recorded from a herd managed under this system for the last twelve years.

During the pre-weaning period the steers had access to native pasture only, and during the post weaning period improved pasture only.

TABLE III

MEANS OF WEANING WEIGHT AT 23 MONTHS AND 29 MONTHS BY YEAR, AGE AND PREGNANCY STATUS OF DAM (kg)

Class	Number	Mean Weight of Steers		
		7 Months	23 Months	29 Months
Overall Mean	377	216·9	406·7	490·2
Effect of Mean Date of Birth:				
4–9–69	115	202·6	405·2	481·0
6–10–70	138	220·0	415·0	497·5
26–9–71	124	229·1	399·9	492·1
Effect of Age of Dam:				
2 y	50	212·0	413·2	493·1
3 y	76	216·4	398·5	480·4
4 y	49	211·3	403·1	482·5
5–9 y	179	223·7	402·5	489·5
10–15 y	23	221·2	416·1	505·5
Effect of Pregnancy Status of Dam at Weaning:				
Pregnant	349	217·1	406·0	486·3
Not Pregnant	28	216·8	407·3	494·1

Source: " Mount Eugene," Jambin, Beef Cattle Husbandry Trial RKN–CH395–BF.

Points of interest which emerge from this table include:—

- Although the weaning weights of calves from young cows are lower than those from mature cows, this difference is not reflected in weights at 23 or 29 months. Thus, the age structure of the herd will not influence steer weights because calves which are smaller at weaning due to dam age effects shows compensatory gains during the post weaning period.

- Calves from cows which failed to conceive during the normal mating season were no different in weight at any point to those from cows with a sound reproductive pattern. It follows that culling non-pregnant cows will not affect the growth rate or size of steers.

- Under the management system described the effect of year is negated by 23 to 29 months of age. This means that one can budget turnoff with a reasonable degree of accuracy.

Tick Control and Tick Fever

Cattle tick is endemic in the northern and central areas of the brigalow region. This parasite can cause a reduction of productivity in two ways: loss of weight or reduced weight gains; and deaths caused by tick fever. The problem is accentuated by the widespread incidence of acarcide resistant ticks. An effective control programme involves a combination of the following measures:—

The use of tick resistant cattle is the most important aspect of tick control. Cattle which have approximately 50% *Bos indicus* component have a high degree of tick resistance. More than 80% of these cattle are tick resistant, thus with strategic culling of tick susceptible animals the need to use acarcides can be greatly reduced.

During periods of nutritional stress the resistance of tick resistant cattle can be reduced, therefore some strategic treatment with acarcides may be required. Generally these treatments will be required in late spring or early summer, and mid autumn. Of course, travelling stock must be free of tick before movement.

Pasture spelling can be used to reduce the seed tick population in the pastures. Owing to both pasture management and herd management considerations this method is only ancillary to the use of resistant cattle and acarcide treatment.

The threat of tick fever is an ever-present problem. Although cattle can obtain immunity to tick fever following infestation of tick carrying the causative organism, this is not a very reliable method of controlling tick fever. Age of cattle at the first exposure to the tick fever organism is critical. Owing to the fluctuation of tick numbers, combined with the fact that only a small proportion of ticks carry the tick fever organism, it is likely that many cattle will not obtain immunity before 9 months of age. It is preferable to adopt a preventative vaccination programme by vaccinating at approximately 6 months and 12 months of age.

Suggested Reading List

Breeder Herd Management:—

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Sheep production in brigalow areas

by P. S. BEASLEY, Sheep and Wool Branch.

QUEENSLAND'S brigalow country runs over two million sheep or approximately one sixth of the State's total sheep population. The southern part of the brigalow area carries the largest proportion of sheep. In fact, only 162 000 sheep run north of the Great Dividing Range.

Sheep were grazed over the whole area when it was first settled, but predation by wild dogs and the presence of tall summer growing grasses made the area north of the Great Dividing Range more suitable for cattle.

Because of the relatively small number of sheep north of the Great Dividing Range, this article will deal mainly with the southern area where most sheep are run. The overall management programme and many specific husbandry practices will, however, also apply to the northern areas.

Sheep raising was once the major industry in the southern brigalow country. As the country developed properties became more diversified. Cash cropping, fodder cropping, cattle breeding and fattening, and to a lesser extent, pig raising are now carried out in addition to sheep production.

Table I shows the decline in sheep numbers in three shires over the last ten years.

TABLE I
SHEEP POPULATION

Shire	1963–64	1968–69	1973–74
Tara	1 153 851	1 034 526	569 499
Waggamba ..	1 314 069	979 228	623 790
Murilla	210 322	117 064	32 856
Total 3 Shires ..	2 678 242	2 130 818	1 226 145

Merino breeding, Merino woolgrowing (wethers), prime lamb mother breeding, prime lamb breeding, cattle raising, and cropping are all carried out in the area, either singly or in combination. Cropping is practised on almost all brigalow properties for grain and for fodder production.

Merino breeding is the most important sheep enterprise, followed by Merino woolgrowing. Prime lamb mother production and prime lamb production are minor enterprises. The area is particularly suited to Merino breeding and is noted for its production of 20 to 22 micron topmaking wools. The Merino is well equipped to survive and produce under the wide variety of seasonal conditions experienced in the area. It is surprising that prime lambs play a minor part in sheep production in an area in which cash cropping and fodder cropping are practised. Unreliable rainfall, widely fluctuating lamb prices, competition from interstate producers, and high transport costs make the enterprise a risky one.

Crop fattening of sheep and lambs is quite profitable in some years. The stock are either bought in as stores or bred on the property. Success depends to a large extent on local and interstate seasonal conditions and on markets. Market prices are very dependent on the supply of lambs from New South Wales. If this supply from interstate falls, returns from sheep and lambs can rise dramatically. There are times

when returns from crop fattened sheep can be better than those from cattle. The profitability of breeding fat lamb mothers for sale to lamb producers is also dependent on markets.

TIMING OF OPERATIONS

The timing of operations on mixed enterprise properties is necessarily one of compromise. No matter how well the work programme is arranged, there will be a clash between at least two enterprises at some stage during the year. When this occurs some ordering of priorities is required. To help make a correct decision a logical look at the whole property business is warranted, and could be looked at in the following way:—

- Allocate enterprises into priorities. Naturally, the most profitable enterprise should receive first priority.

- Plan a work programme for the first priority. This should be as accurate as possible yet flexible enough to allow for reasonable seasonal variations.

- Plan for each other enterprise in turn down the list of priorities trying to fit major operations into the quieter periods of the more important enterprises.

It should be remembered that for some minor enterprises, timeliness of some operations is essential. In this area of unreliable rainfall flexibility and allocation of priorities as determined by seasonal conditions could mean the difference between success and failure.

Grain growing is the enterprise most likely to clash with sheep raising. Timeliness in land preparation, planting, and harvesting is of paramount importance in grain growing. It is because of these factors that the sheep enterprise is compromised on most properties. This compromise need not necessarily affect the sheep enterprise adversely.

Grain Enterprises

For the winter grain enterprise, the major operations and times are: ploughing, December–January; planting, May–June; harvesting, mid October–mid November.

Ploughing is done after harvesting and with the increased acceptance of stubble retention is often left later than previously. However, to control weeds and conserve moisture it is usually done in December–January.

The period between ploughing and planting requires some cultivation to control weeds and conserve moisture. Two or more workings or one grazing with sheep and one working are usually required. If soil moisture is to be conserved, the temptation to allow weeds to grow sufficiently for extended grazing by sheep should be resisted.

Timeliness of planting is crucial to the crop enterprise. It is not possible to spend any time on other enterprises during planting.

Harvesting is also demanding on property manpower and sheep work during this period is not possible.

The above operations are essential to the success of the cropping enterprises and so are inflexible. Sheep husbandry practices must be done between these times.

Although cropping is very important to many properties in the area a large proportion of these properties is not cultivated. While livestock and cropping enterprises may compete for labour they do not necessarily compete for land. In fact, sheep can be complementary to the cropping enterprise. There are many areas where weeds such as black oats have been reduced to negligible proportions by grazing with sheep. Uncultivated land along fencelines, swampy areas and other weed propagation patches in paddocks afford useful sheep grazing which at the same time keeps the weeds down.

Sheep Enterprises

Merino Breeding

The Merino sheep is less seasonal in its breeding than other sheep. It does however have a seasonal cycle and better fertility can be expected if ewes are joined in autumn. This means that the lambs are dropped in late winter and spring. Both these times fit in quite well with the cropping programme. Joining, lambing and lamb marking are all done between major cropping operations. The disadvantage is that the lambs are dropped during the driest

time of the year. This could cause losses of ewes from pregnancy toxaemia and losses of lambs through malnutrition and bad mothering. Supplementary feeding could be advantageous in bad years. Fodder crops are grown for this purpose.

An early winter joining would mean that fewer ewes would be cycling and therefore fewer lambs dropped. Better feed for the lambing ewes should be available but high temperatures could cause some lamb mortalities. This breeding programme is likely to clash with cropping operations. In a spring or early summer joining, fewer ewes would be expected to get in lamb, supervision during joining would be minimal, but lambs would be dropped onto good feed and at a time when farming operations are not so demanding.

Shearing and crutching are usually timed to fit in with the breeding programme and are normally done just before periods of expected fly activity. For this reason, an autumn joining is preceeded either by shearing or crutching with the other activity before lambing, is adopted by the majority of producers. A spring joining with similar timing of shearing and crutching is done by most others.

Merino Wethers

The running of Merino wethers is the simplest sheep enterprise to fit in with cropping. Shearing and crutching can easily be fitted into slack periods between farming operations. If these operations are carried out in late summer or early autumn, and late winter/or early spring, areas of the sheep which are susceptible to flystrike will be short wooled during the periods of greatest blowfly activity. Drenching to control internal parasites can also be fitted into these quieter periods.

Prime Lamb Breeding

The aim of the prime lamb producer is to market a quality animal. This is achieved by finishing lambs on grazing crops. For this reason the producer aims for an autumn lambing when feed conditions are good. As native pastures deteriorate, growth rate can be maintained by grazing oats with the lambs being marketed before the oats crops are finished. Unfortunately, the rainfall in this area is unreliable and an oat crop is not possible every year. When oat crops fail most lambs are sold to more favoured areas as stores.

The carry-over lamb is also a problem to producers. When oat crops are successful, other lamb producing areas are also experiencing good conditions which results in large sale yardings and reduced prices. Because lambs must be fattened on winter grazing crops, a spring joining is necessary. British Breed sheep are more seasonal in their breeding than Merinos so that a spring joining is often less successful than an autumn joining. However, British Breed crosses are the only sheep capable of giving the early maturity and quality carcass for the trade.

These problems are largely responsible for the relatively small importance of the prime lamb industry in the area.

Sheep for regrowth control

Because of management problems, sheep are not used to the same extent as previously for brigalow sucker control. These problems derive mainly from the necessity to maintain high density stocking in order to force the sheep to eat suckers. In practice large areas of scrub are pulled and large flocks of dry sheep, extensive fencing and the provision of ample water is required to give adequate sucker control.

Loss of body weight and wool production occurs when sheep are used to control suckers. The nutritional stress is too severe for breeding sheep and even dry sheep will die if they are not spelled on better feed. This increases the number of sheep required.

Mechanical or chemical controls or a combination of these have been found to be more convenient and more effective than sheep for control of brigalow suckers.

Grazing crops

Ploughing is a widely accepted method of sucker control in areas where deep melonholes are not a problem. In order to get a return from this ploughed area crops are grown. Cash crops give the best return per acre but unreliable rainfall precludes these in some years. Crops which fail provide valuable grazing. The growing of grazing crops is a

regular practice on many properties. These have been grown mainly for fattening cattle but in some years can return good profits when used for fattening store sheep. Experience on the Western Downs has shown that a crop of grazing oats can carry up to 24 sheep per hectare (10 sheep per acre) for 90 days. In most cases, store wethers can be fattened in 45 days so that 48 wethers can be turned off a hectare of oats. The financial success of fattening sheep on grazing crops is entirely dependent on ruling market prices. Winter cereals are the crops most commonly grown for grazing by sheep.

The prime lamb industry in the area is almost totally dependent on grazing crops for the growth and fattening of these animals.

Improved pastures for sheep

The very heavy clay soils with deep melon-holes typical of the brigalow country on which sheep run are not conducive to establishment of the normal Queensland improved pasture species such as buffel, green panic and rhodes grass. *Panicum coloratum* has been established on these soils in the easterly areas where rainfall is more favourable. The legumes, Hunter River lucerne and annual medics have been established with some success and these provide valuable sheep grazing particularly during winter.

The lighter belah and box soils often associated with brigalow country are more suited than the heavy clay soils to buffel grass establishment. The shorter varieties, Gayndah and American are more popular for sheep. Apart from being more acceptable to sheep because of their shorter growth, they seem to set more seed and spread more quickly than the taller buffels.

These improved pastures have increased production on individual sheep properties but the area under improved pasture is relatively small. For this reason it is not possible to give reliable figures on the increase in production which is due to improved pastures. Pasture improvement is usually attempted following the several years' cultivation required for brigalow regrowth control. Mint weed (*Salvia reflexa*) is often a problem during the establishment of improved pastures on these heavy soils.

Careful management of native pastures, light stocking and rotational grazing to allow grasses to seed and germinate have resulted in very good natural establishment of Queensland blue-grass (*Dicanthium* sp.) and windmill grasses (*Chloris* spp.) on some properties. Because of the difficulty of establishing introduced pasture species, establishment of superior native species could be the best approach under existing management programmes and knowledge.

EXTERNAL PARASITES

Blowfly

The sheep blowfly is the external parasite causing the greatest economic loss to the sheep industry in brigalow areas. Until recently this parasite was kept under control by shearing, crutching and the use of insecticides.

The blowfly has now developed a resistance to modern insecticides. This resistance has developed to such an extent that these insecticides should be reserved for emergency use in bad fly waves when shearing, crutching and mulesing are not sufficient to prevent flystrike.

The primary blowfly, *Lucilia cuprina,* breeds in moist stained wool on the living sheep. It also prefers warm weather.

Queensland's brigalow country receives the bulk of its rainfall in late summer and early autumn when temperatures are warm. Sheep are wet both by rainfall and by walking through wet vegetation. Similarly, warm weather, heavy dews, and storm activity occur during the spring. These conditions are ideal for the blowfly. Thus, the periods when blowfly waves can be expected are late summer, autumn and spring. The removal of wet and stained wool by shearing or crutching just before these expected periods of fly activity can materially help in keeping fly strike at a minimum. Shearing and crutching at these times also fits in with joining and lambing on most properties.

Even short wool on the breech area of Merino sheep can be wet and stained because of the skin wrinkles which catch urine and faeces. Mulesing which is the surgical removal of these skin wrinkles reduces the incidence of breech strike markedly. In a correctly mulesed sheep not only are unwanted wrinkles and

folds removed, but the bare area around the vulva and tail is increased in size. This eliminates staining of the wool in the breech area and confers a very high degree of resistance to breech strikes for the life of the animal.

Mulesing has traditionally been carried out on sheep at three to six months of age (weaners). In recent years the technique of mulesing three to six week old lambs has been developed. A modified technique gives a degree of fold removal and stretching of bare area as good as that on sheep mulesed at an older age. This operation is combined with lamb marking.

Mulesing at lamb marking has several distinct advantages over mulesing of weaners. The most important advantage is that the sheep has a longer period of protection against fly strike. The extra period of protection is during the critical first few months of life. The sheep are lighter to catch and lift onto the rail or cradle. Mulesing at lamb marking does away with the need for a separate mustering and yard operation; and because it is combined with lamb marking, there is only one healing period when post operative infection can be contracted.

Selection for plain bodied sheep can decrease the incidence of blowfly strike significantly. Research results have shown that plain bodied sheep are less susceptible to fly strike and are more fertile.

Selection of plain bodied sheep, mulesing, and shearing or crutching just before expected periods of blowfly actiivty reduce the risk of strike so that jetting with insecticides can be kept as a tool for use in emergencies.

Keeping jetting as an emergency operation is sound husbandry. The modern organo-phosphorus insecticides when first introduced afforded approximately eight weeks protection from blowfly strike. The blowfly has built up a resistance to these insecticides and the period of protection is now about three to four weeks.

While the period of protection has been halved, jetting is still effective in controlling blowfly during serious outbreaks. It is absolutely essential that the insecticide be applied at the correct strength and pressure, and that the area covered is thoroughly wet to the skin. The blowfly larvae feed at skin level. Insecticide which has only penetrated half way down the wool staple will have no effect.

Lice

Lice infestation has become a significant problem on many brigalow properties in recent years. They can be controlled by dipping short wooled sheep in one of the many insecticides produced for the purpose. If control is to be effective, certain basic rules must be observed. All sheep on the property must be treated; the insecticide must be mixed and replenished strictly in accordance with the manufacturer's instructions as printed on the container; the insecticide used must be suitable for application through the type of machine used to apply it; absolute cleanliness is essential when dipping off shears sheep if post dipping infections are to be avoided; and most importantly, all sheep must be thoroughly wetted to the skin and over the entire skin surface.

Economic circumstances during recent years have meant that properties are operating with reduced labour. This has resulted in poorer musters and less supervision of dipping procedures. These factors have been responsible for most lice burdens in the area.

INTERNAL PARASITES

Modern broad sprectrum drenches have reduced the internal parasite problem. Internal parasites do however cause considerable economic loss to the industry.

The barber's pole worm, *Haemonchus contortus,* is the most prevalent. Other important worms are the black scour worm, *Trichostrongylus* spp., and nodule worm, *Oesophagostonum columbianum.*

The barber's pole worm thrives in warm moist conditions, so it can be seen that Queensland with its high summer incidence of rainfall is particularly suited to this parasite. It has the ability to multiply rapidly under favourable conditions. Quite small populations of the parasite can build up and within a few weeks can cause anaemia, and inhibit body growth, wool and milk production.

The symptoms of black scour worm infestation usually appear in winter in young sheep. This worm does not usually multiply as quickly

as barber's pole worm but can withstand winter temperatures better. Symptoms of infestation are a characteristic dark green to black scour and poor condition in young sheep.

Nodule worm is so called because of the characteristic nodules which form on the wall of the large bowel. This parasite like barber's pole, reproduces during the summer months but symptoms are not usually seen until pastures deteriorate.

Tapeworms have been reported as being troublesome in young lambs in some years but these are generally isolated outbreaks.

The control measures which have been used for many years rely on drenching the sheep with a worm killer (anthelmintic). Modern anthelmintics are highly efficient and have reduced internal parasites to an easily managed problem.

Much has been written on the value of rotational grazing and spelling of pastures as a measure of parasite control. Recent research has shown that infective larvae can survive on the pasture for a much longer period than was previously thought. This period is long enough to make rotational grazing a relatively useless worm control measure. The same research showed that there are times of the year when worm populations both in the sheep and on the pasture are quite low. A single drench at this time can give worm control for quite lengthy periods. Times of low populations are towards the end of dry spells. Dry spells can be expected with reasonable accuracy in southern states and a workable drenching programme has been devised. Rainfall records in the brigalow country reveal that late winter/early spring is usually dry. A drench with a broad spectrum anthelmintic at this time could control internal parasites for a considerable period in most years.

DISEASES

Clostridial Diseases

Infectious diseases are a relatively minor problem in sheep in brigalow country. The most common are caused by organisms belonging to the *Clostridium* genus, tetanus, pulpy kidney, blackleg, malignant oedema, and gas gangrene. These conditions can all be prevented by vaccination. This is usually done at lamb marking time. Where a property has a history of any of these diseases vaccination is recommended. Where sheep are run on grazing crops, vaccination for pulpy kidney with the specific vaccine or preferably a combined vaccine which gives protection against all the above diseases is advised.

Where sheep are run on native pastures, there is no history of any of these diseases, and if good hygiene is observed at lamb marking and mulesing, vaccination is possibly not warranted.

Mycotic Dermatitis

Mycotic dermatitis is another disease which causes problems from time to time. It usually affects sheep in wet years and can affect a significant proportion of a flock. It can be cured by using antibiotics but this is not feasible on a flock basis because of the high cost of antibiotics. Control can be obtained by dipping with a 1 in 500 solution of zinc sulphate in water.

Foot abscess

Foot abscess can be a problem in very wet seasons. Trimming hooves and running sheep on dry country will help the sheep to recover. Valuable animals can be treated with antibiotics.

Pregnancy Toxaemia

Pregnancy toxaemia is common throughout the area and in some years very heavy losses occur. It is not an infectious disease but is caused by lack of feed in the latter stages of pregnancy. There is no cure for pregnancy toxaemia. Adequate feeding and minimal handling of ewes during late pregnancy will prevent it. It occurs most commonly when ewes are lambing in late winter and early spring, but can be expected at any time if lambing ewes run short of feed.

Hypocalcaemia

Hypocalcaemia is another nutritional condition in lambing ewes. It is characterised by low blood calcium and can be cured by an injection of calcium borogluconate in its early stages. It too can be prevented or reduced by minimis-

ing stress (e.g. handling, droving, etc.) and adequately feeding heavily in lamb and lactating ewes.

PLANT POISONING

Poisonous plants do cause trouble from time to time throughout the brigalow country. Plant poisoning is rarely seen in undisturbed sheep in the paddock. Travelling stock which are allowed to get hungry or sheep kept in yards until they become hungry, will eat poisonous species in sufficient quantity to cause poisoning. These losses are often very high. Feeding hay to hungry sheep before they gain access to grazing will prevent these losses. Some poisonous plants which cause poisoning in this area are—pigweeds (*Portulacca* spp.), ellangowan poison bush (*Myoporum* spp.), wild sunflower (*Verbesena enceloides*), darling pea (*Swainsona* spp.).

Humpy back is the name given to a condition where sheep will not travel and develop an arched (humped) back. It causes great difficulty in mustering full wooled sheep during the hotter parts of the year. A widely distributed plant, *Solanium esuriale* or potato bush is suspected of causing this complaint.

MINERAL DEFICIENCES

Copper

Copper deficiency is known to exist in certain well defined areas of the area. This can be alleviated by carefully controlled administration of copper sulphate solution.

Phosphorus

Some of the lighter country adjacent to brigalow is suspected of being deficient in phosphorus. Reports on the results of supplementing sheep on these soils are conflicting.

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Brigalow – Land Management

by Officers of the Soil Conservation Branch.

WISE land use is essential to ensure a stable agricultural system. Bad land use has led to the collapse of agriculture and the crumbling of past civilisations of which examples are to be found to the south and east of the Mediterranean.

Management of the comparatively new lands of the brigalow region in Queensland should be such that they remain productive indefinitely. To achieve this, each unit of land must be used within the limits of its potential and long term productivity. Correct management is based on knowledge, firstly of the basic characteristics of the land and secondly of the effects of use and the precautions adopted by the manager.

Land Classification

In a highly variable climate and changing market opportunities the landholder with a variety of production options available to him is often in the position of making decisions at short notice. However, it is essential that the basic limitations of land types be recognised if land productivity is to be maintained. So a land classification system is used as a broad basis.

The land classification system in use in Queensland is that described by Rosser *et al.* (1974). This classification follows the U.S.D.A. Soil Conservation Service Practice of defining eight capability classes. The classes are so arranged that land having the greatest variety of use, with the minimum risks, is assigned to Class 1, while that with a very limited use and greatest hazard falls into Class VIII.

Of the fourteen limiting factors which contribute to the land classification some operate only in the arable range. Appropriate details are to be found in Table I.

The eventual classification of brigalow lands results from the application of these criteria to the landscape. Interpretation of the criteria requires some experience and judgment but the system does produce a workable classification.

It is often misleading to generalise about land use, but it is quite obvious that climate and soil are the key factors affecting long term productivity. In the brigalow region farmers and graziers have recognised the broad association that exists between particular soil types and the dominant plant communities that occur on these soils. A table is presented (see Appendix Table 1), in which preferred land use is related to the dominant plant communities that are peculiar to the brigalow region.

The four principal categories of land use, based on:—

(a) forestry, wildlife, scenic and recreation.
(b) pasture production.
(c) fodder crop production, or
(d) grain production

are now described in detail.

Forestry, Wildlife, Scenic and Recreation Areas

These activities are usually confined to rugged steep land often dissected by gullies and where there is a thin layer of soil. Frequently there are cliff faces where sandstone or laterite boulders have broken away from the vertical face. Lancewood, bendee, rosewood and narrow leaved ironbark frequently grow in these locations. This vegetation is often associated with sparse grass growth which is not very palatable.

Most landholders tend to regard these areas as unproductive and a liability. While the immediate economic return from these areas is low, this class of country has scenic potential for recreation purposes. Wilderness areas may in time be used for hunting, bushwalking and camping activities provided they are within a reasonable distance of large population centres.

TABLE I

LAND CAPABILITY CLASSIFICATION FOR AGRICULTURE (BASED ON MAINTENANCE OF LONG TERM AGRICULTURAL PRODUCTIVITY (JULY 1974))

Type of Limitation	Limiting Factor	Degree of Limitation	Sub-Class
Factors Limiting Choice of Crops or Crop Productivity	Climatic limitation other than rainfall " C "	Slight restriction to choice of crops or slightly restricted production potential	C2
		Moderate restriction to choice of crops or moderately restricted production potential	C3
		Severley restricted choice of crops and severely reduced production potential	C4
		Climatic limitation too severe to allow cropping	C6
	Moisture availability for crop growth " m "	Occasional limitation to crop production; 7–8 crops possible in 10 years	m2
		Regular limitation to crop production; 5–7 crops possible in 10 years	m3
		Occasional cropping possible. Less than 5 crops possible in 10 years	m4
		Water availability too unreliable to allow cropping	m6
	Effective soil depth " d "	Effective soil depth 60–100 cm	d2
		Effective soil depth 45–60 cm	d3
		Effective soil depth 25–45 cm	d4
		Effective soil depth < 25 cm	d6
	Soil physical factors affecting crop growth " p "	Degree of limitation imposed on crop production from soil physical factors affecting the growth of crop plants, e.g. surface crusting, hard pans, cementation, &c. — Slight restriction	p2
		— Moderate restriction	p3
		— Severe restriction	p4
	Soil nutrient fertility " n "	Moderate deficiencies which may be economically corrected with careful management	n2
		Severe deficiencies, difficult to correct and which require special management practices	n3
		Very low fertility; continuous cultivation precluded by structural decline	n4
	Soil salinity or sodicity " s "	Soil water availability slightly restricted or slight structure decay affecting crop production	s2
		Soil water availability moderately restricted or moderate structural decay with some toxic effect on crops	s3
		Soil water availability severely restricted or severe structural decay with moderate to severe toxicity	s4
		Salinity or alkalinity too severe for crops. Tolerant improved species available	s6
		Salinity or alkalinity too severe for pasture improvement; tolerant herbage available	s7
		Bare salt pan; not practical to vegetate	s8
	Topography " t "	Severe relief or major gullies preclude contour cultivation. Occasional cropping possible	t4
		Slopes 15–20% or severe relief or gullying preventing cultivation	t6
		Slopes 20–45% or extreme gullying but accessible to grazing animals	t7
		Slopes on topography too severe for grazing animals	t8
	Soil workability " k "	Soil properties affecting machinery and thus reducing average production potential, e.g. stiff clay, columnar structure, compaction, narrow moisture range for working — Slight restriction	k2
		— Moderate restriction	k3
		— Severe restriction	k4
Factors Limiting the Use of Agricultural Machinery	Rockiness or stoniness " r "	Tillage restricted with some types of machinery	r2
		Tillage restricted with most types of machinery	r3
		Tillage difficult with all machinery; occasional use possible	r4
		Use of all machinery for cropping impractical	r5
	Surface microrelief gilgai and gullying " g "	Tillage restricted with some types of machinery	g2
		Tillage restricted with most types of machinery	g3
		Tillage difficult with all machinery; occasional use possible	g4
		Use of all machinery for cropping impractical	g5
	Wetness " w "	Use of implements delayed occasionally and slightly reduced production potential	w2
		Use of implements delayed regularly and moderately reduced production potential	w3
		Use of implements very difficult and occasional crops only possible	w4
		Permanently wet; use for cultivation impractical	w5

TABLE I—*continued*

LAND CAPABILITY CLASSIFICATION FOR AGRICULTURE (BASED ON MAINTENANCE OF LONG TERM AGRICULTURAL PRODUCTIVITY (JULY 1974)—*continued*

Type of Limitation	Limiting Factor	Degree of Limitation	Sub-Class
Factors Controlling Land Deterioration	Susceptibility to water erosion "e"	Simple practices required to reduce water erosion under cultivation to the acceptable level	e2
		Intensive practices required to reduce water erosion under cultivation to the acceptable level	e3
		Requires inclusion of a pasture phase to reduce average water erosion losses to the acceptable level	e4
		Continuous pasture required to reduce water erosion losses to the acceptable level	e6
		Special practices or grazing restrictions required to reduce water erosion losses to the acceptable level	e7
		Under grazing water erosion losses are in excess of the acceptable level	e8
	Susceptibility to flooding "f"	Subject to occasional overflow flooding	f2
		Subject to regular overflow flooding	f3
		Subject to severe overflow flooding; permanent cultivation not possible	f4
		Flood frequency and/or severity precludes any cropping	f5
	Susceptibility to wind erosion "a"	Slightly susceptible to wind erosion	a2
		Moderate susceptible to wind erosion	a3
		Severely susceptible to wind erosion	a4
		Potential for wind erosion too severe to allow cropping	a6–8

The timber species associated with this class of land are valuable for station timber supplies and should be protected from fire. If the timber supply is to be maintained, seedlings and young growth need protection from grazing livestock, as does the sparse ground cover of grasses.

Wilderness areas are extremely important on a brigalow block because of their ability to produce runoff water for stock water supplies from small falls of rain. If the ground cover of grass and tree litter is destroyed by grazing, trampling or burning, the unstable soil will quickly erode away and be deposited as silt in the dams.

Wilderness areas are of value and should be carefully managed for the sake of the wildlife itself. As more knowledge is gained about the dependence of one life form on another it is becoming harder to draw the line between beneficial and pest fauna species. Pests in plague proportions often occur in areas where clearing has been rapid and complete. Wilderness areas harbour both predatory birds and reptiles which prey on common pests such as rabbits, rats, mice and grasshoppers.

When rough areas do not exist, representative areas should be set aside in suitably sized blocks, with connecting corridors of timber, to maintain a diverse wildlife population. These refuge areas may be grazed judiciously, but should, as a general rule, be protected from fire.

Pasture Production Areas

This activity is widely carried out on a variety of soils in the brigalow belt. The soils may range in texture from sands to heavy clays, the slopes may vary from flat to steep, and the site may be either wet or dry depending on its location. A range of pasture grasses will be needed for any one property to utilise the soil resources most efficiently. Different grazing management strategies will be needed for each of the principal pasture species.

The aim of pasture management for sustained production is to maintain a vigorous plant with as complete a ground cover as the climate and species will allow. This allows maximum use of sunlight and water. To achieve this aim it is necessary to be able to

segregate livestock according to nutritional requirements and to control the grazing pressure on any area of pasture. These factors, together with the need to segregate stock according to age and sex, make fences and their location a most important management tool on any property.

Fence Location

Fences should be used to separate dissimilar areas and enclose those which are reasonably uniform. This means that few fences will run in a straight line from starting point to finish.

Stock pads and firebreaks always follow fences, as do many roads. Appreciable amounts of runoff water are concentrated on these areas under heavy rainfall, which results in erosion where adequate precautions are neglected. By locating fences along ridges and close to watercourses; roads, stock pads and firebreaks, are in a position of minimum concentration of water. This also simplifies the diversion of runoff water by the use of spur drains.

Aspect has a major bearing on pasture production and should always be considered when locating fences. Eastern and southern slopes are almost invariably fresher and more productive than northern and western slopes which experience higher temperatures and more drying conditions. Prevailing wind direction is also an important consideration, especially where sheep are involved, as they prefer to graze into the wind.

Understocking and Overstocking

Careful pasture management is needed to prevent over-stocking when overstocked pastures in this region lose vigour, ground cover becomes inadequate and they are invaded by annual weeds and a variety of burrs.

Overstocking depletes ground cover, and under heavy rainfall increases the rate of erosion. The easiest way to avoid overstocking is to stock a paddock very heavily for a short time (i.e. one to two months) and then rest the paddock, with the stock moving into one already rested. Where cattle are mustered fairly frequently, for either external or internal parasite control, this system imposes no hardships, and can even reduce labour requirements, because of less paddocks to muster.

Many people believe that overstocking is the cause of all the damage done to pastures by grazing animals. What they really mean is that overgrazing is the problem and not necessarily overstocking. Selective overgrazing is perhaps more common on an understocked paddock than anywhere else. In this situation animals can obtain sufficient feed by nibbling at frequent intervals on small preferred areas or particular pasture species. If a higher stocking rate is applied the animals are forced to graze the whole area in a more uniform manner.

Provision and Location of Water

Sufficient water points are needed so stock can have access to all the pasture without walking long distances. Animals forced to travel long distances to water invariably overgraze the pasture near the watering points. This results in feed being wasted in remote corners of the property.

In the brigalow region, where dams are commonly required, three years may pass without a worthwhile flow in some of the well grassed, low gradient catchments. Big dams of 15 000 m^3 capacity and upwards are required in such situations. If there are small areas of very steep or hard country, small dams may be sited for a quick and frequent catch. On poor catchments harvesting of runoff will be greatly improved if drains are used to divert water from additional areas. If 100 hectares or so immediately above the dam are stick-raked and severely grazed during the summer season this will also increase runoff.

Dams should always be fenced to avoid serious loss of capacity by trampling. Shade clumps should be set aside close to water, but downstream of the bank, as huge amounts of dung get washed in from camps upstream and cause pollution of the water body.

If drainage lines are eroding in the native scrub and the vegetation on their banks is other than blue gum, coolibah, tea-tree or similar deep rooted species, it is wise to pull the timber completely. Brigalow and box, except if scattered, will not allow soil binding grasses to develop in depressions, and as a result erosion will continue.

Ideally, water should be made available at a point as high as possible in each paddock. However, in brigalow country, water is usually

in dams or natural waterholes so there is limited choice about siting the water, unless pumping is employed.

Animal access to deeply incised watercourses should be avoided as this frequently leads to severe gully erosion. In such cases water should be pumped to watering points away from the drainage line.

Shade and Shelter

Shelter clumps, two to five hectares in area, should be provided in paddocks. Round or square clumps are preferable to long shelter strips. Rogue cattle soon learn to use the long shelter strips to avoid mustering.

Many timber clumps left in the initial development within the Brigalow Scheme were far too small and were often destroyed by fires. In these areas replacement may be achieved by maintaining a firebreak around a suitably sized and strategically located area of regrowth timber. Preferred locations are the higher slopes of valleys and on ridge lines where clumps of deep rooted trees should be encouraged.

Need to preserve Trees on Slopes

Most brigalow settlers are aware of salty underground water on brigalow blocks. They are not so aware that there is a real danger of this salty water table reaching the surface following the initial clearing. This can happen if insufficient trees are left on high areas to utilise ground water which in a good season passes beyond the zone of grass roots. It is important that deep-rooted trees be left on broken topography and all steep slopes.

Pasture Burning

Fire is used either to help control regrowth, or to remove dry and unpalatable grass and encourage new pasture growth. Both purposes may be achieved by one burning. Special burning techniques may be required when there is a single objective.

The question then arises when, and how frequently should fire be used. There is little information from research work in Queensland. South African experience suggests that the judicious use of fire can be used to control woody regrowth.

Use of Fire to Control Regrowth

The requirement in this case is a hot and complete fire at a time of the year when maximum damage will be done to the regrowth, and a quick recovery of grass can be expected.

Burning should be carried out as late as possible in the spring-early summer period, when new shoots are appearing on woody regrowth, and before grass has made much new growth. Dry air conditions produce the most effective burn.

Overseas experience suggests the pastures should not be burnt more frequently than once in every four years. Longer intervals between fires are more desirable. However there are cases where more frequent burns are justified. Sandalwood regrowth needs to be burned by 18 months of age or before it is 45 cm high.

To accumulate sufficient dry material it is usually necessary to destock the paddock before burning. This rest-rotation system can be programmed. A decision to use fire in this way is usually taken on economic grounds, and is appropriate to the situation of a developing property which is not fully stocked and has a surplus of feed, while regrowth is not at an advanced stage.

Since a great deal of pasture is wasted, and some setback is caused by so hot a fire, it is important to look at alternative means of controlling regrowth.

Use of Fire to remove Unwanted Top Growth

Periodically most pastures accumulate an excess of top growth which discourages cattle from grazing on new growth at the base of the plants. This top growth also inhibits grass development to some extent.

While slashing or heavy stocking would convert this unwanted top growth into useful surface mulch, the easiest and cheapest way to remove it is by burning. When burning for this reason, the aim should be to remove the unwanted growth only, without destroying surface litter, or injuring new pasture growth.

Burning should be carried out after enough rain has fallen to stimulate pasture growth and while the soil surface and litter are still damp. If carried out under these conditions burning can be an excellent pasture management aid. It should not be carried out annually. If rest-rotation grazing is adopted, heavy stocking

rates can be used to trample the excess top growth into surface mulch which will reduce moisture loss by evaporation.

Fodder Crop Production

The selection of areas for cultivation depends largely on the purpose the landholder has in mind when making the decision to plough. These decisions could be based on fodder crop production, regrowth control, pasture improvement, or grain crop production.

In practice, the first three are often combined, but as grain crop production has more specific requirements, these need to be examined closely before proceeding.

The range of soils suitable for fodder production is much wider than for grain cropping. The best soils for growing fodder crops are the shallower clays down to 45 cm. Many of the duplex soils would be quite suitable; in fact any soil of reasonable depth, structure and fertility could be used.

The moisture requirements of fodder crops differ from those of grain crops in that it is leaf and not grain that is harvested, therefore the greatest demand for moisture occurs somewhat earlier than is the case with grain. While there is a need for some stored moisture in the soil it does not have to be as great, or last as long to provide a worthwhile grazing crop.

It follows that soils with lower moisture holding capacity than is generally required for grain production can produce quite successful fodder crops. This also highlights the flexible nature of the beef/grain enterprise, for in years when follow-up rain is insufficient to produce grain worth the expense of harvest, useful grazing can be had at a time when other feed is likely to be in short supply.

Since the returns from fodder crops are usually less than from grain production, the tendency is to make it a low cost operation, minimising the number of operations carried out, and the range of implements employed in growing the crop. Often a tractor and heavy duty disc plough are the only machinery used, with a seed box attached for planting.

However landholders should beware of "roughing in" the crop with inadequate preparation. As much care and attention is needed to grow a good fodder crop as is required for a good grain crop, the more so if less sophisticated machinery is employed and soils have less potential.

Regrowth Control

Where regrowth control is a major consideration and the decision has been made on practical and economic grounds that ploughing is the best way of achieving it, the soils, and the situation of the area should be examined. A further decision needs to be made as to whether it is desirable to grow a grain or a fodder crop in the interim.

Normally cultivation of three crops is required to gain full control of regrowth, and where cropping will not extend beyond this period, the following recommendations are made:—

- Inspect the area and try to determine if much water will run-on to the block from higher land. If there is a problem of run-on water, this should be diverted by means of a surveyed diversion bank into a natural grassed watercourse.

- Plough the area at least 10 cm deep, but leave unploughed any depressions which appear to carry a significant flow of water. Regrowth in the watercourses may be controlled by chemical means or by fire.

- Plough again in eight to twelve weeks time. Sow if the soil is moist. If the soil is dry, it is usually better to leave sowing and to replough and sow after the next rain. The third ploughing may well be unnecessary if a planter other than a seed box on a plough is available.

- Repeat the cultivation treatment for two to three years and then sow back to a chosen pasture. The pasture seed may be undersown with the last crop, or into a prepared seed bed following the previous crop.

Where fodder cropping is planned to continue on a regular basis beyond the three year period on any area of land, protection against soil erosion is necessary. It is also desirable to have a planter other than a seed box mounted on a plough. This planter should be capable of handling large amounts of rubbish and small sticks. A high clearance, robust scarifier fitted with a seed box is recommended.

Grain Production

Grain production is the most intensive land use to which brigalow lands are subjected, and as such has a potential to cause serious soil erosion and soil deterioration in a very short time if wrongfully managed.

Deep friable clay soils on low-gradient slopes which are not subject to waterlogging are the most suitable for grain production. In order to be able to store the required amount of soil moisture these soils need to be at least 90 cm deep to ensure adequate moisture storage.

The absence of adequate soil moisture is the most common limiting factor for successful crop production throughout the brigalow belt. To grow a successful crop of wheat, sorghum and most other crops suited to the area, require a total of about 250 mm of available soil moisture within the soil profile. Grain crops should only be established on soils which contain sufficient soil moisture to make up deficits that can reasonably be expected in natural rainfall during the growth of the crop.

In practice this restricts successful grain production to soils capable of storing some 100–150 mm of water in the root zone of the plant. This necessitates a fallow period during which moisture from summer rainfall is accumulated in the soil.

While the total rainfall received does not vary greatly throughout the brigalow belt, the proportion of winter rain received is greater in the south. Reliability generally decreases from south to north, while rainfall intensities tend to be greater in northern areas.

Hence in the overall picture, prospects for grain production become less in the northerly region and the likelihood of serious erosion damage becomes considerably greater.

Duplex soils (light surface soil over heavy clay subsoil) are generally unsuitable for cropping because they do not have adequate moisture storage capacity. However, there can be local occurrences of suitable soils, with a greater storage capacity especially in southern areas. It would be wise to seek the advice of an experienced person however, before ploughing large areas of any but the clay soils.

Heavily gilgaied (melon-hole) soils should be avoided. Where the amplitude (height from depression to puff) is less than 45 cm the area can be levelled without undue expense and planting equipment made to function fairly well. After levelling, the depressed areas will tend to remain boggy, when the higher areas are dry enough for sowing. The similar problem can occur at harvesting time. Patchy crops are likely to occur because of nutrient differences between the puff and depression soils. The greater the amplitude of the gilgais the worse the problem.

Soil Conservation for Arable Areas

Importance of Soil Cover

The brigalow belt is subject to high intensity summer storms which may occur in the period September to March. In order to accumulate soil moisture for summer or winter crop it is necessary for a fallow to occur at some stage in that period, if not for all of it.

It is essential to protect the soil surface during the fallow period with a mulch of crop residues, otherwise high intensity rainfall will seal the surface and cause loss of valuable moisture as runoff, and serious soil erosion. Stubble therefore should not be removed except if needed for grazing purposes during drought. Stubble generally should not be burnt.

Machinery is available to handle stubble from primary tillage through to planting. This includes sweep ploughs with sweeps from 90–150 cm in width; chisel ploughs using twisted shovels or low profile duck-feet; and specially designed high clearance planters and scarifiers fitted with seed boxes. Problems exist with tyne implements where stumps are present, but ploughs using 90 cm sweeps have proved satisfactory. For areas of permanent cultivation, the cost of completely clearing stumps should be investigated. The relatively high cost should not act as a deterrent.

Sunflower, safflower and soybean crops provide poor ground cover during the growing period, and only small amounts of crop residue are available for use as a fallow mulch. Wheat and sorghum provide better cover and more residues, and are preferred to the above summer crops.

Highworth Lablab is a leguminous plant which has grown well on brigalow lands in Central Queensland. This legume produces

great bulk and a high yield of seed. It is a selection from the leguminous plant, *Dolichos lablab*. This plant should be kept in mind for use in all brigalow farming areas, since it can build up nitrogen in the soil as well as giving excellent cover and residues.

Summer or winter crops may be grown annually in southern areas and the stubbles are not generally in much demand for fodder. Cropping schedules are usually planned to ensure that reasonable amounts of crop cover are present during the period of high intensity summer rains.

Most summer crop plantings in the nothern section of the brigalow belt take place in January–February when runoff conditions are worst, and soil cover is least. Sorghum should be grown on a once in two year basis provided adequate land is available.

The technique implies that a plant crop is harvested between May and July, with the stubble being immediately available for grazing. The stubble does not die over winter but begins to produce green fodder in the spring when rain falls. The area is grazed right through to the following March–April, whilst the new grain crop for that summer is grown on an alternative cropping area. The grazing area is then reploughed in April–May in preparation for cropping in the following summer. This management system gives the best possible chance of obtaining a grain yield with maximum protection of the soil.

Fallowing is required to store soil moisture and should not continue longer than necessary. When adequate soil moisture is available, a winter or summer crop may be sown. Machinery capable of planting to a depth at which moist soil occurs can help increase frequency of successful winter crops.

Tillage Practices

The preferred tillage implements are those which retain the maximum stubble on the soil surface. These are almost exclusively tyned implements.

A disc plough should only be used whenever high density viney weed growth is present. Moderately deep ploughing to a depth of at least 10–12 cm, is required to produce a rough surface to trap local rainfall.

When soils are widely cracked at harvest the initial ploughing should be delayed until after the first weed producing rains. This delay allows runoff to be reduced as it enters the deep cracks.

Tillage operations should be restricted to the minimum number of workings needed for weed control purposes. The right implement should be selected to ensure effective weed control.

The use of weed-killers as an alternative to cultivation for weed control is being evaluated in many places but in Queensland at the present time, cultivation is preferred.

Conservation Measures

These should be planned and implemented under the guidance of Soil Conservation Branch Officers. A whole range of measures and combinations is available and may be tailored to suit the needs of each situation. These measures include contour cultivation, contour strip cropping, modified tillage practices and the installation of graded banks.

Contour cultivation

Contour cultivation can be used on low gradient country to minimise soil erosion. Its use should be restricted to slopes of 0·5 to 2·0%; above this slope graded banks become essential. With low slopes on uniform terrain, parallel or slightly curved parallel lines may be defined within tolerable limits from the true contour.

Contour lines should be surveyed at intervals across the slope of the land. The distance between lines will depend on the steepness of slope. It is recommended that only alternate bays should be ploughed initially, with the others remaining in grass. After several years the cultivated areas should be sown to pasture and the bays with timber regrowth ploughed. The cultivation cycle can then be repeated at a time interval to suit the individual property.

In this way, runoff and erosion will be substantially reduced and regrowth is controlled. Adequate pasture is then available in the same paddock as the sown crop (particularly valuable with winter fodder crops). Cultivation strips can be made parallel to simplify tillage operations. Contour banks are not essential under this system.

Contour Strip Cropping

Contour strip cropping is based on the concept that vegetation strips may be needed to supplement contour cultivation. Vegetation may take the form of alternate bays of cultivation and grass, grass strips generally 20 metres wide between bays of cultivation, or strip cropping by growing alternate bays of summer and winter crop.

- ALTERNATE BAYS OF CULTIVATION AND GRASS. This undoubtedly gives the greatest protection and has a place in the more northern areas where cropping is not reliable, and dependence on livestock is greatest. This conservation practice has not been used to any extent in the main grain growing areas.

- NARROW GRASS STRIPS. This practice can be used in gully free areas where grass growth is dense and vigorous. However, their limitations must be recognised. In contrast to graded banks surplus water is not removed from a number of collection points down the slope. An occasional high intensity storm can cause a considerable amount of damage because of the large amount of runoff that accumulates at the bottom of the paddock.

- ALTERNATIVE STRIPS OF SUMMER AND WINTER CROPS. In contrast to narrow grass strips, conventional strip cropping lay-outs have most application in areas around and to the south of Taroom. The key element is rainfall which is required to grow both summer and winter crops. It is only in the more southern areas that there is a reasonable chance of doing this. Strip cropping is preferable to grass strips since the barrier to water flow is greater and the area in bare fallow is smaller.

This combination makes good use of available moisture and affords protection through having half the area either protected by a growing crop, or in a rough ploughed condition for the greater part of the year.

The main disadvantage of the practice is the likelihood of being unable to establish a crop, in which case the strip pattern may well be lost, and prove hard to re-establish. Grazing of sub-standard crops may also be difficult.

Widely spaced contour banks would be desirable as a supporting measure with this system.

Graded Banks

Where slopes exceed 2% contour banks are generally required. Broad based banks are required on cracking clay soils. These may be fully cultivated to control weeds, which are a common problem with narrow-based banks.

Whatever banks are used, there must be provision for safe disposal of water. Contour layouts can be more readily made parallel for ease of working if a maximum number of disposal areas in grassed depressions is available. Modern machinery with hydraulic remote control permits long runs, lifting the machine to cross the grassed depressions.

Commonsense Approaches to Conservation

Aside from specific soil conservation measures outlined above, there are several do's and don'ts that landholders should observe as general principles. These are:—

- When stick raking include any natural watercourses where a tractor can work, so that grass cover in the area can be improved.
- Do not push material into drainage lines. Timber debris restricts the flow of water and can cause harmful eddies, siltation, or even change of direction of the watercourse.
- Never extend cultivation areas across natural depressions which drain large areas higher up in the catchment.
- Keep cultivation well back from major watercourses, leaving a protective strip of trees wherever possible.

PROPERTY PLANS

The orderly and co-ordinated implementation of land use management decisions is made much easier by the availability of an accurate plan or aerial photograph of the property. Most brigalow blocks require a plan with a scale of 1:10 000 or 1:20,000 depending on the size of the block and the extent of land with potential for cultivation.

The plan needs to show natural features such as soils, ridges and watercourses, together with watering points, access roads, farm buildings, fences, pulled and grassed areas and cultivated areas. With this information, the basic stages for increasing the intensity of development of the property for pastoral or agricultural purposes can be planned.

Soil conservation officers are available to assist settlers to obtain aerial photographs of their properties or to supply them with an accurately scaled map with much of the data listed above already plotted. An up-to-date property plan can be prepared provided the farmer or grazier can supplement the officer's technical skill with on-the-spot advice on current land use.

APPENDIX TABLE 1

RELATIONSHIPS OF VEGETATION AND SOIL TYPES

SCRUB COMMUNITY	SOIL TYPE	SUSCEPTIBILITY TO EROSION	RECOMMENDED LAND USE	REMARKS
Brigalow-wilga ..	(a) Deep gilgaied clays > 3 metres deep.	Not susceptible unless completely smoothed.	Improved pastures generally. Cultivate only gilgais < 20 cm deep.	Use deep gilgais for para grass, swamp couch, &c.
	(b) Sedentary clays usually 1–1½ m deep.	Low slopes but high erosion risk when cultivated.	Improved pasture and cultivation.	Incorporate a legume in the rotation.
Brigalow-yellowwood	Sedentary and alluvial clays dominant. Some duplex soils.	As for (b) above.	Clays suited to cultivation except where frequently flooded. Duplex soils, improved pasture.	Use heavy ploughs or sharp discs for first cultivation.
Brigalow-softwood ..	Friable, free draining. Light clay surface, sometimes red earth.	Slopes of 5–10% and highly erodible soil produce severe erosion risk.	Improved pastures.	Highly suited to green panic.
Brigalow-belah ..	Deep gilgaied clays, sedentary clays, miscellaneous deep clays.	Erodible if cultivated except for gilgaied areas.	South of Taroom, non-gilgaied land prized for cultivation. Northern areas best suited to pasture—waterlogging.	Some cultivated belah soils may suffer serious wind erosion.
Brigalow-sandalwood	Shallow duplex soils.	High risk if cultivated.	Improved pastures.	..
Pure brigalow ..	Deep gilgaied clays. Deep alluvial clays.	No risk on gilgaied areas. Flooding risk on alluvials.	Improved pastures, except where flooding is infrequent —cultivation.	..
Brigalow-poplar box	Deep duplex > 30 cm surface, over yellow clay.	High risk if cultivated.	Improved pastures, some fodder crops with very careful management.	Small areas excellent cattle camps.
Brigalow-Dawson gum (blackbutt)	Shallow duplex, < 30 cm surface, over dark clay.	As above.	As above.	..
Brigalow-yapunyah ..	Frequently shallow and rocky on ridge crests.	As above.	Timber, shade and shelter.	..
Brigalow-coolibah ..	Alluvial clays.	Subject to regular flooding.	Pasture, but improved species difficult to establish.	..
Brigalow-gidgee ..	Usually well structured, clays.	High risk if cultivated.	Improved pasture, maintain areas for station timber.	Usually too dry for cropping.
Brigalow-blackwood	Deep gilgaied clays or alluvial clays.	No risk on gilgais. Flooding risk on alluvials.	Improved pasture.	Treat as pure brigalow.
Brigalow-boree ..	Saline clays.	High risk if cultivated.	Leave strictly alone.	Grows only specialised plants due to high soil salinity and sodicity.
Brigalow-patchy plain	Sedentary clays.	Need careful management.	Use in natural state or when cleared, cultivation.	..

Enterprise Selection and Financial Management

by T. D. WILSON, Agricultural Economist, Rockhampton.

THIS section is concerned with the application of business principles and techniques to the management of brigalow properties. Financial factors play an important part in almost all decisions made on the property. It is reasonable to assume that the more fully acquainted the manager is with his business operations, the better decisions he is able to make. The primary aim of good financial management is to supply accurate information on which to base decisions.

The manager's role can be defined as that of a resource manager. In financial terms, these resources can be shown diagramatically:

START OF FINANCIAL YEAR		END OF FINANCIAL YEAR
Opening Cash Balance +	*Add* (cash receipts—cash payments)	Closing Cash Balance +
Assets— Land Improvements Plant Livestock Farm Supplies —	+ (asset purchases + asset appreciation) — (asset disposal + asset depreciation)	Assets— Land Improvements Plant Livestock Farm Supplies —
Liabilities— Trading Bank Agricultural Bank Stock Agent, &c.	+ (new loans—principal repayments)	Liabilities— Trading Bank Agricultural Bank Stock Agent, &c.
Opening Equity		Closing Equity

If a manager's goal is to increase the value of assets he owns, his success is measured by the increase in equity over time. There are other goals generally considered important such as income stability and maintaining an adequate standard of living. Whatever the goals may be, the well organized manager is able to place monetary values on all items in the diagram. Management decisions can be evaluated by their effect on the relevant sections of the diagram.

A simple system of recording for financial management is to take records of the year's transactions to an accountant at the end of the financial year for him to prepare the annual taxation return. No financial analysis is done by the manager. This is a poor system, since at any point in time, there is little data on which to base decisions. Mort difficult is the use of complex planning techniques which demand a high input of the operators' time. This is neither practicable nor worthwhile.

Brigalow managers need to give attention to the following areas if an adequate standard of financial management is to be achieved.

The Property Office

A basic requirement is an efficiently run property office. Office work is an essential part of the property business. It is not a time consuming activity if well organized.

The main items of equipment required are:

- Diary to detail important day to day events.
- Trays to handle inward and outward correspondence.
- Filing cabinet and a well organized filing system for quick retrieval of information.
- Clip folder to keep all monthly accounts and account sales together.
- Cash analysis book. A 32 column book provides ample room for break up of receipts and payments.
- Stock and crop record books to provide a record of wool cuts, branding percentages, crop yields and other physical data.
- Electronic calculator.
- Incidental items such as: staplers, paper punch, writing paper and pencils.

Expenses should be paid for by cheque whenever possible. A cash docket should be kept for items purchased by cash.

Money received is normally deposited directly into the bank or stock firm account. A bank deposit book should be used to bank items thus avoiding loose sheets of paper.

The cash analysis book should be written up monthly as follows:—

Cash Receipts Section. This should be divided into 2 broad sections:

(i) details of the transactions—date, what was sold, how much and to whom.

(ii) enterprise breakdowns—beef, sheep, grain, personal.

Cash Payments Section. Again, this can be divided into 2 broad sections:

(i) details of the transactions—date, what was bought, and from whom, cheque number and physical quantities.

(ii) dissection columns to dissect payments into main cost categories.

The following broad breakdown is useful:

Operating

VARIABLE COSTS. These change with the level and form of production and include fertilizer for grain cropping and animal health expenses.

FIXED COSTS. Don't vary with the level of production. They are fixed for a particular level of investment on a property such as rates and insurance on buildings.

Financial or Loan Capital Repayments.

Capital Items for property improvements.

Personal—living expenses.

Monthly crop and livestock records should also be kept.

A sound office procedure ensures a permanent record is kept of business transactions for future reference.

Enterprise Selection

Enterprises on Brigalow country are limited to extensive or semi intensive crop and livestock activities. Budgets of the expected profitability of alternative enterprises assist in the selection of those likely to be most profitable. A good set of property records provide a basis essential for future estimates.

Two budgeting techniques are recommended to assist in enterprise selection. These are *gross margins* and *partial budgets.*

Gross Margins

A distinction between fixed and variable costs has already been dealt with. The gross margin (G.M.) of an enterprise is the difference between the output and the variable costs allocated to that enterprise. In the short term, fixed costs are independent of the enterprises carried on.

G.M. = Enterprise output—variable costs.

The G.M. is expressed per unit of the most limiting factor of production.

With cropping enterprises, the cultivated area is normally the factor limiting production. Crops are compared on the basis of their G.M.'s per hectare. The enterprise with the highest G.M. is the most profitable.

Example: The G.M. per hectare for grain sorghum is calculated as follows:

Enterprise	
	$
Output per Hectare	
1·25 tonnes at $50 tonne at railhead	62.50
Variable Costs per Hectare	
Fuel and Oils 3·5 hours at $1 per hour ..	3.50
Repairs and maintenance 3·5 hours at 55c per hour	1.92
Seed 4·5 kg at 44c kg	1.98
Midge Control 1 spray at $4.20	4.20
Contract Harvesting at $12.50 ha	12.50
Cartage to railhead 30 kilometres at 10c per tonne kilometre	3.75
	27.85
G.M. per ha	$34.65

Note that labour is not costed. If it is necessary to hire casual labour, this should be included. If a harvester is owned, normal header running expenses should be included rather than contract charges.

The profitability of other crops could be calculated in a similar manner. Examples of the use of G.M.'s in a cropping programme are:

- To compare sorghum and sunflowers to work out a summer cropping programme.
- To compare wheat and safflower in a winter programme.
- Fodder crops can be compared with cash crops by estimating the animal production in terms of dollars of additional output per hectare.

Because of the erratic rainfall pattern, the yield variability of crops in Brigalow areas is generally high. Although the G.M. per ha gives an indication of which crops to grow, decision making should include the risk factor. For example, the yield variability of sorghum in Central Queensland over a number of seasons is approximately:

Probability	Yield (tonnes/ha)	
0·2	Fail crop	
0·2	0·6	
0·2	1·0	
0·2	1·6	
0·2	2·6	
1·0	1·16	Average

Winter crops are generally less reliable than summer crops in the northern Brigalow areas. Reliability increases in the southern areas.

Livestock enterprises may also be compared using gross margins. The criterion for profitability depends on the factor most limiting. If finance is available to fully stock the property, the G.M. per ha should be used. If finance is limited, the G.M. per dollar livestock investment is used. The G.M. per beast equivalent or per dry sheep equivalent can also be used.

Example: Beef Gross Margin
Assumptions: Branding: 80% Mortality 3%
Age of Turn off: 2 years
Price: 44 cents/kg dressed weight.

Herd composition per 100 breeders:

Breeders	100
Weaners	80
Yearlings	78
Bulls	3
Herd value	$16,840
Beast equivalents*	214

Annual turnoff per 100 breeders:

Aged cows	17
2 years steers	39
2 years heifers	19
Annual turnoff	$7,296

Variable Costs per 100 breeders:

	$
Animal health	250
Bull depreciation	150
Stock Assessments	37
Selling—Commission	365
Cartage—50 kms	112
Yard dues and levies	45
	$959

G.M. per ha (1 beast equivalent to 4 ha)	$7.40
G.M. per dollar investment	37·6 cents
G.M. per breeder	$63.37
G.M. per beast equivalent	$29.61

* Expressed in terms of adult cattle.

Examples of the use of G.M.'s to compare livestock enterprises are:

- To calculate the optimum age of turnoff for a beef herd.
- To compare breeding with store fattening.
- To compare sheep and beef enterprises. One beast equivalent equals 8 dry sheep equivalents.
- To compare ewes with wethers.

Calculated livestock G.M.'s are generally more reliable than crop G.M.'s. Livestock performance will however, be lower than expected when a major drought occurs. These can be expected every 6–8 years.

Livestock and crop activities cannot be compared on the basis of the G.M. per ha because of the different levels of asset investment and therefore different levels of fixed crops. Livestock enterprises need investment in watering points, yards, subdivision fencing, and livestock. Crop enterprises require investment in plant and grain handling facilities. Labour requirements per hectare will also be different.

Partial budgets

Fixed costs depend on the investment in land, improvements, plant and livestock. If a change is being considered which changes the level of investment and fixed costs, the profitability is calculated by a partial budget. This considers all operating costs—both fixed and variable.

The annual increase in profitability is calculated using the following formula:—

Increase in annual profits = (Extra output + costs saved) — (decreased output + extra costs).

Example: Consider the annual increase in profitability by clearing and developing a block of 200 ha of Brigalow–Yellowwood scrub to grow sunflowers. The country is presently stocked at one beast equivalent to 12 ha.

Asset investment

	$
Scrub pulling at $10 ha	2,000
Stick raking at $20 ha	4,000
2 contract ploughings at $6.25 ha	2,500
Fencing	500
Extra machinery	6,000
	$15,000

- This assumes a good initial burn after pulling. The investment figures for fencing and machinery are the estimated average value of these assets during their productive life.

Present livestock investment:

17 breeders plus progeny $2,860
Net increase in investment $12,140

Extra returns:	$	Decreased output:	$
Sunflower sales 0·6 tonne/ha at $150/ tonne at railhead	18,000	Cattle sales at $73 per breeder	1,241
Costs saved:		Extra costs:	
Animal health	42	Fuel and oils	700
Bull depreciation	26	Machinery repairs and maintenance ..	384
Stock assessment	6	Seed	300
Selling—		Contract harvesting	3,000
Commission	62	Cartage to railhead	600
Cartage	19	Casual labour	400
Yard dues and levies	8	Repairs—Fencing	25
		Depreciation—	
		Machinery	1,250
		Fencing	25
	$18,163		$7,925

Annual increase in net return $10,238

$$\text{Return of net increase in investment} = \frac{\$10{,}238 \times 100\%}{12{,}140} = 84\%$$

At this rate of return, it would pay to borrow money to finance the development. To borrow for development projects, the expected rate of return should be higher than the cost of borrowing i.e. the interest rate.

Note that these figures are based on buoyant sunflower prices ($150 tonne at railhead) and depressed beef prices (44 cents kg D. Wt.). If beef prices stayed at 44 cents, the break-even sunflower price is $75 tonne at railhead. That is, the project would then give no increase or decrease to the profitability of the property.

- The profitability of all aspects of property development. A land capability plan of the property prepared by soil conversion branch officers is useful in determining development priorities.
- The profitability of machinery purchase and replacement.
- Alternative drought strategies. Drought planning is an integral part of property management in Brigalow areas. Properties nearing full development should consider fodder conservation.
- The profitability of some improved herd management practices e.g. buying performance recorded bulls.

Budgeting in General

When calculating gross margins and partial budgets, care should be taken to include all relevant costs. A check list of operating expenses is useful here. Prices, costs and physical performance data should be the best estimates available at the time the budget is prepared. The budget should be revised as new information becomes available.

Gross margins and partial budgets help in selecting profitable enterprises for both the short and long term. However, it is not suggested that decisions should be made on the basis of a single profitability figure. Nevertheless, well prepared budgets give better information on which to base a decision. Experience has shown that Brigalow properties which can diversify are better able to cope with changing economic conditions than the property which specializes. Soil, climatic limitations and distance from a railhead preclude cash cropping in some areas.

Budgeting

Once a plan of operations for the future has been arrived at, a whole farm budget should be worked out. This should give a complete picture of expected receipts and payments over a particular period, usually a financial year.

An annual cash flow budget is most important. This should be calculated at the start of the financial year and should be standard practice on all properties. The purpose is to give advance warning of the need to reduce or delay expenditure, to alter selling policies, or to arrange finance to make ends meet.

The budget shows how operations are to be financed by estimating the flow inwards and outwards of money. Note that only cash items are included. Basically, these are items which are likely to appear in the bank or stock agent accounts. The budget should be done on a monthly or quarterly basis. The dissection of receipts and payments should be the same as in the cash book. The cash book figures should be compared with budgeted figures at least every quarter. If actual figures differ greatly from budgeted figures, there may be a need to change the plan of operations and to rebudget.

Usually, the object of a cash flow budget is to indicate the size of the peak overdraft during the year; thus giving an indication of the borrowings necessary. When seasons and prices are favourable, the object may simply be to predict surpluses.

Other types of whole farm budgets which are often useful are:

- Profit and loss budget. This forecasts the likely net profit or loss which will be earned during the period.
- Finance budget. This shows how cash deficits are to be financed by borrowings from different sources such as banks, stock agent or hire purchase company.

Calculating Profits

Most properties employ an accountant to prepare annual financial statements; the main components being the profit and loss account and the balance sheet. In most cases, they are the only source of information available on the financial performance of the property.

It should be remembered that taxation accounts can give a misleading impression of the yearly profit and the owner's equity in total assets.

By adjusting these accounts, figures can be calculated which are more useful for management.

Adjustments to the profit and loss account

- Bring livestock values into line with market values.
- Exclude all capital expenditure items.
- Show a realistic figure for depreciation.
- Allow for changes during the year in inventories of farm supplies. Use market prices.
- Exclude transactions in drought bonds.
- Exclude all non farm income and expenditure.
- Use realistic figures for produce used internally.
- Exclude revenue or expense items not related to that particular year's production.
- Include an item of revenue for produce sold before the end of the year but not paid for.

The adjusted profit is the return that the owner has received for his labour, management and property investment. Note that this investment is measured by that portion of total assets which he owns namely his equity.

Adjustments to the balance sheet

- Revalue all assets at realistic market values as at 30th June. Adjustments are normally required to revalue land, improvements, plant, livestock and farm supplies. Cash balances are normally accurately recorded.
- Record all liabilities as at 30th June. These are usually recorded accurately.

By deducting total liabilities from total assets at market values, a realistic figure for the owner's equity is obtained.

It is also a useful exercise to review the composition of liabilities. How much is short term, medium term and long term debt? A high proportion of short term debt can result in an unnecessarily high annual debt repayment.

Remember that it costs money to have an accountant prepare these returns. To get maximum benefits from them, they should be interpreted in a logical manner.

Tax planning

The objective is not to minimize the income tax payable. It is the "after tax income" that should be maximized. This implies a dual objective. On the one hand, we wish to maximize income and, on the other hand, to minimize taxation.

Taxable Income

Basic statement—

Gross Income
Less allowable Deductions

Taxable Income .. X

Gross Income—

1. Business proceeds
2. Livestock profits
3. Depreciation recovered on sale of depreciated assets
4. Trading stock profits
5. Other income.

Items 1, 2 and 4 are normally the main income sources. Examples of short term strategies to minimize gross income and therefore taxation.

- Carry over end of year saleable stock.
- Value natural increases at low values.

Allowable deductions—

1. Operating expenses
2. Allowable capital expenditure
3. Depreciation
4. Investment allowance
5. Drought bonds
6. Concessional deductions.

Many capital expenditure items could be claimed as a full deduction in the first year prior to 1973. These must now be claimed in equal instalments over an extended period. For example, scrub development is now claimed over 10 years. The 20% special depreciation rate which applied prior to 1973 no longer applies. "Normal" depreciation rates now apply. However, a double depreciation rate on a range of new equipment will apply at least until 30th June, 1976. In addition, a 40% investment allowance was introduced in January, 1976, and applies to certain new items costing over $1,000. There is a sliding scale of rates for items between $500 and $1,000. Examples of short term strategies to increase deductions and therefore to minimize taxation:

- Fodder conservation; all costs are fully deductible.
- Increase the level of maintenance expenditure in relation to depreciable capital expenditure.

Rates of Tax

Primary producers can average their incomes over 5 years to determine the rate of tax. The incomes averaged are the previous 4 years and the current year. Averaging is used to determine the rate of tax and not the taxable income itself.

Example:

	Taxable Income $
1970–71	5,000
1971–72	7,000
1972–73	3,000
1973–74	15,000
1974–75	10,000

Average income = $8,000

Tax payable on $8,000 = $1,820

Tax rate for 1974–75 = $\frac{1{,}820 \times 100}{8{,}000}$ = 22·75 cents in $

Tax on 1974–75 income = $10,000 at 22·75 cents in $
= $2,275.

One result of averaging is to keep tax rates fairly stable. A high taxable income in any one year does not necessarily imply a high rate of tax.

Provisional Tax

Income tax is paid on the 31st March. The tax payable in any one year consists of two components:

- Provisional tax for that year.
- Plus tax on the previous year's income, less provisional already paid.

The Tax Department calculates provisional tax on the assumption that taxable income will be the same as the previous year. If he wishes, the taxpayer can elect to "self assess" his income for the current year to calculate provisional tax. This can be done anytime before the 31st March.

The self assessment option should be used when it is expected that current income will be less than in the previous year. Otherwise, provisional tax will be based on the good year's income.

It is always a wise move to submit details of the year's transactions to the accountant promptly at the end of the financial year. This allows him time to assess the situation, to give advice on taxation matters and to give an early estimate of the tax payable on the 31st March. This estimate should be included in the annual cash flow budget.

Planning the Estate

Estate planning is the process of transferring via wills and other legal means, the accumulated wealth of generations between generations so that the benefits to both are maximized.

Specifically, the successful estate plan has two requirements:

- To ensure the property owned derives the maximum use of his assets during his lifetime, while paying a minimum of taxation.
- To ensure that his assets are passed on to his family at his death with a minimum of death duties.

The major monetary benefits which result from estate planning may be either short or long term in nature.

Short term benefits. Estate planning can lead to significant income tax savings. For example, a sole trader would pay $3,820 taxation on a taxable income of $12,000. If this income was split two ways through a husband and wife partnership, the total tax paid would be $2,000.

Long term benefits. Estate planning can lead to savings in death duties. For example, if a man was to die leaving an estate of $200,000, Queensland Succession Duties and Federal Estate Duties would be $63,125. If he had made provision to leave an estate of only half of this through a husband and wife partnership, the duties payable on his share of $100,000 would be $17,620.

The legal aspects of estate planning are complex and require a detailed knowledge of the law with respect to business and taxation. Methods of re-arranging an estate include family partnerships, trusts, companies, assignments and gifts. A will is of vital importance.

Anyone contemplating action in the field of estate planning should contact their solicitor and accountant for expert guidance. Laws change periodically, as do the circumstances surrounding your estate. Therefore, the planning of your estate should be reviewed periodically.

Financing operations

Borrowed funds play an important role in financing operations in Brigalow areas. In particular, the $23 M administered by the Lands Administration Commission has financed much of the development in the Fitzroy Basin.

Main types and sources of lending

Short Term (0–2 years)	Medium Term (2–8 years)	Long Term (8–30 years)
Carry on finance Purchase of turnover livestock	Purchase of machinery and breeding stock	Major expenditure in property purchase and development, farm amalgamation and debt reconstruction
Trading Banks Stock Agents	Trading Banks (term loans) Commonwealth Development Bank Queensland Agricultural Bank Hire Purchase	Trading Banks (development loans) Commonwealth Development Bank Queensland Agricultural Bank Rural Reconstruction Board. L.A.C.

When preparing a case for a loan, a written application with supporting financial statements from your accountant is desirable. A 12 month cash flow budget is required when applying for seasonal carry on finance.

Generally, it pays to borrow money if the project returns significantly more than the cost of borrowing i.e. the interest rate. As a rule of thumb, it is desirable to maintain at least 50% equity in the property. While the total

debt is important, the debt structure is also important. For example, a debt structure is poor if it contains a high proportion of short term loans necessitating high repayments.

The overdraft system of simple interest calculated on a reducing balance is the cheapest source of credit, followed by annuity repayments on a regular basis in fixed term loans. A flat interest rate charged on the total loan until fully repaid is costly e.g. some hire purchase finance.

At the present time the main interest in beef areas is in obtaining carry on finance. The question of the earning rate of the project does not arise. It is simply a matter of borrowing enough money to cover immediate cash commitments, and the less required the better. Funds for beef producers are available through the Commonwealth Development Bank and the Rural Reconstruction Board. Skilful cash flow budgeting is the order of the day.

A Management Framework

With efficient organization, the business aspects of management should not be a time consuming activity. However, a logical and systematic approach is recommended. As already stated, a well organized office and recording system are basic requirements.

The main planning period should be at the start of a financial year i.e. in the July–September period. The steps involved are:

1. Submit records to the accountant promptly.
2. Review last year's performance. Main factors to consider are the yearly profit, percentage return on assets and various other efficiency criteria e.g. cattle income per breeder.
3. Assess the present financial position. Main factors are the equity in total assets and the debt composition.
4. Review estate plans. See accountant and solicitor if necessary.
5. See accountant for advice. In particular, find out if self assessment will be required in the current year, how much tax will be due on the 31st March and what the likely tax rate will be in the current year. Possible tax strategies should be discussed.
6. Look at alternatives for the future, both for the next 12 months and in the long term. Use gross margins and partial budgets.
7. Work out a physical plan of operations for the next 12 months.
8. Test the financial feasibility of the physical plan by a cash flow budget. The plan may have to be modified.
9. Arrange finance if necessary e.g. from bank or stock agent.

Monthly records of cash receipts, cash payments and physical data should be kept over the whole of the financial year. Compare actual cash balances with budgeted cash balances at least every quarter, but preferably every month.

The management of Brigalow properties should be as flexible as possible. A plan budgeted at the start of the year will often need changing. This will be caused mainly by unexpected seasonal conditions and changes in commodity prices. Steps 5–9 above may have to be reworked in some circumstances.

In the January–March period, it may be appropriate to consider self assessment of provisional tax again. Towards the end of the year, it may be feasible to adopt strategies to minimize tax. These should be carefully budgeted out.

Illustrative Property Figures

Several beef properties in Brigalow Area III are making use of the D.P.I. Farm Management Accounting Service. The following table shows the averages for these properties in 1972–73 and 1973–74. They are presented to show the level of returns and expenses which can be expected from beef production.

In considering these figures, two factors should be remembered:

- The properties were still in the developing stage.
- The downturn in beef prices in 1974 is reflected in the 1973–74 figures.

	Units	1972–73	1973–74
Number of Properties	No.	9	7
Physical Data—			
Effective Area	ha	8 140	7 044
Cultivated Area	ha	265	0
Improved Pasture	ha	2 154	1 951
Beef Cattle (> 1 year)	No.	534	891
Labour Units	No.	1·52	1·40
Rainfall	mm	n.a.	1 118
Capital Investment—			
Land	$	146 263	161 807
Improvements	$	26 064	25 859
Plant and Equipment	$	17 646	15 657
Livestock	$	98 233	127 540
Total	$	288 206	330 863
Property Output—			
Livestock Sales	$	19 483	22 003
Less Purchases	$	19 571	12 513
		−88	9 490
Livestock Inventory Change	$	50 427	19 563
Produce Inventory Change	$	706	83
Other Income	$	871	71
Total	$	51 916	29 207
Operating Expenses—			
Production Expenses	$	4 796	3 547
Selling Expenses	$	2 335	1 465
General Service Expenses	$	71	209
Administrative Expenses	$	10 822	8 509
Total	$	18 024	13 730
Economic Performance—			
Operating Profit	$	33 892	15 477
Less Unpaid Labour	$	2 819	4 171
Return of Assets	$	31 073	11 306
Less 7·5% Interest	$	21 616	24 815
Return to Management	$	9 457	−13 509
% Return on Assets	%	10·35	3·20
Efficiency Ratios—			
Output per—			
Labour Unit	$	43 793	23 979
$100 Expenses	$	295	247
$1 000 Assets	$	179	87
Effective Hectare	$	3·13	4·60
Profit per Hectare	$	5·01	2·40
Expenses per Hectare	$	2·72	2·30
Total Assets per Hectare	$	41·76	51·70
Land Value per Hectare	$	20·48	25·00
Breeders per Labour Unit	No.	326	408
Cattle Income per Breeder	$	149	54
Stocking Rate (Ha per Beast)	No.	17·71	8·05
Herd Reproduction Rate	%	63·61	61·35
Herd Mortality Rate	%	6·22	4·82

Further reading:

1. *Accounting and Planning for Farm Management,* Qld. D.P.I.
2. *Farm Management Handbook,* 4th Edition, Qld. D.P.I.
3. *Guidelines for Efficient Farm Office Administration,* A.B.R.I., University of New England.
4. *Income Tax for Primary Producers,* Aust. Dept. of Agriculture.
5. *Estate Planning,* Econ. Services Branch Publication, 1975.
6. *Farm Business Management & Taxation,* Econ. Services Branch Publication, 1975.
7. *Financial and Physical Record Keeping,* Econ. Services Branch Publication, 1975.
8. *Make your Farm Office Work For you,* Econ. Services Branch Publication, 1975.

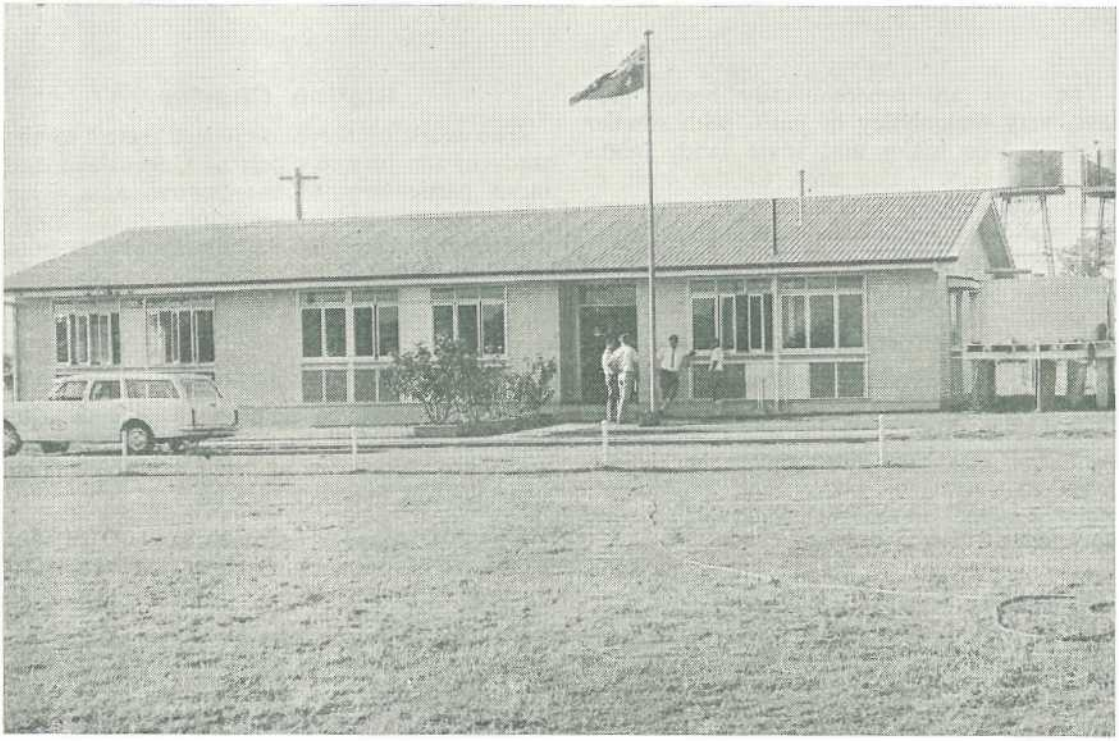
The Brigalow Research Station

by G. H. ALLEN, Executive Officer, Research Stations Branch.

THE Brigalow Research Station was established in 1963 and officially opened on 8th May, 1965. It is located 51 kilometres from the townships of Theodore and Moura which are both adjacent to the Dawson River.

The Station has an annual rainfall of 640 mm, and an altitude of 152 metres, situated in Latitude 20° 45′S; Longitude 149° 50′E. It has an area of 3 600 hectares containing soil types and vegetation which are reasonably representative of the lands being developed in the 2 million hectare Fitzroy basin project. Most of the land is between Fish Creek and Roundstone Creek and provides some open forest and large areas covered prior to clearing with virgin brigalow, belah and softwood scrubs.

The Brigalow Research Station.



Staff and members of the Industry Consultative Committee inspect areas of the new Highworth lablab crop.

The soils are predominantly heavy grey clays, very melonholey in parts, with smaller areas of deep loams and some sandy loams overlaying clay. The area to the west of Roundstone Creek is typical of burnt out brigalow, belah and Dawson gum (blackbutt) scrub. Areas of dense scrub regrowth were common.

Administration

The Brigalow Research Station is one of the twelve regional centres administered through the Research Stations Board which has a representative from each Division of the Departments to formulate policy and co-ordinate multi-discipline research concerning rural problems.

At the local level the programme is developed by members of the Station Committee. Full recognition is given to requests and information furnished by an Industry Consultative Committee which has six members from the rural community.

Station Charter

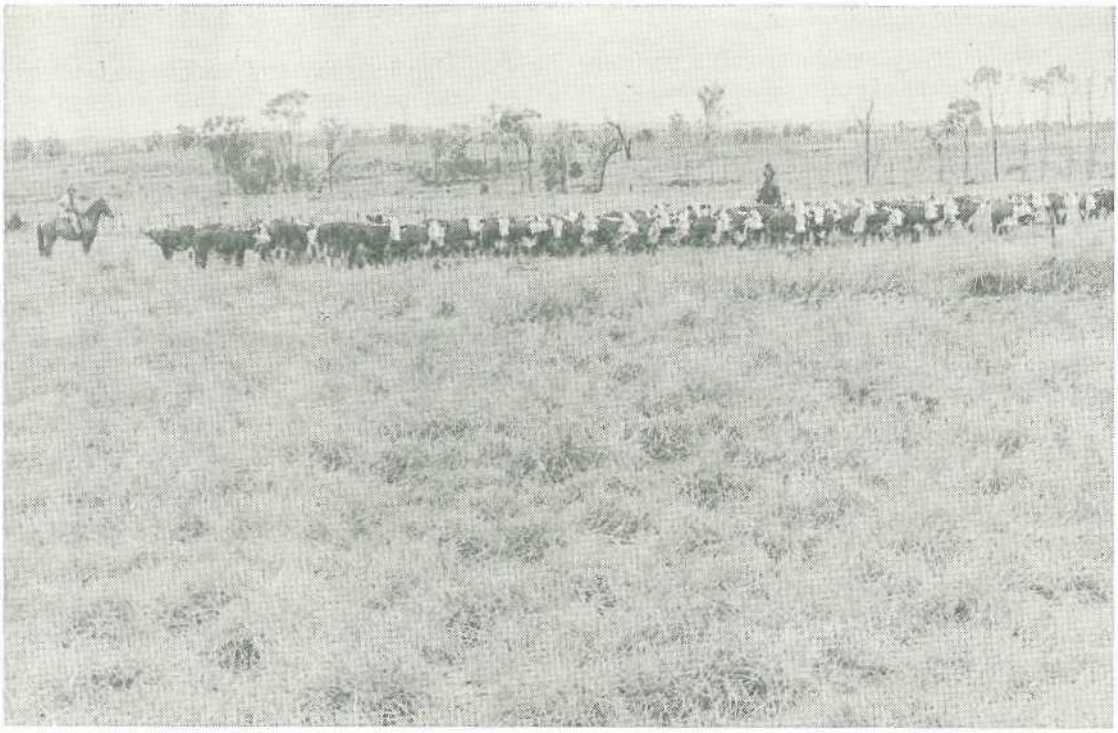
The work of the Station is directed to the study of the brigalow belt of Queensland and more particularly to the central area lying within the 600 to 800 mm rainfall zone. Some aspects of research have application throughout the State.

Main Functions

(a) To serve as a research and demonstration centre for the rational and economic utilisation of Brigalow lands with special emphasis on livestock production.

(b) To conduct research on *current problems* of livestock, pasture and crop production.

(c) To pursue research directed to the better understanding of the local environment by studying the relationship between climate, soils, vegetation and other natural resources.



Portion of the 1,500 beef herd at the Brigalow Research Station. The property forms part of the 2·3 million hectares of brigalow lands now under use and development.

(d) To gather and disseminate information regarding the establishment of livestock, pasture and crop industries and to study current and potential systems of management.

(e) To introduce, test and develop equipment as a means of improving livestock and agricultural production in the area.

(f) To assist as required in the investigation of particular or emergent problems.

(g) In pursuance of the above functions full recognition is given to:—

- The economic and marketing situations in relation to the development of rural industries.
- The conservation of natural resources.

Main Research Programme

(a) Methods of timber destruction and subsequent regrowth control in relation to pasture and crop production.

(b) Evaluation of types of beef cattle and the techniques of management, feeding and breeding of livestock.

(c) Production, conservation and utilisation of pastures and agricultural crops under raingrown conditions.

(d) Productivity of the region in relation to stable land use systems.

(e) Special projects—e.g. water supply, soil conservation.

(f) Associated activities—demonstrations, field days and extension services.

Current Projects

Continuing data collection

- Recording and survey of climatological data.
- Survey of soils and vegetation relating the work of the Station to the broader types defined by C.S.I.R.O.
- Rainfall run-off studies.

Specific Current Investigations

- Beef Productivity—study of cattle performance on pastures of buffel, Rhodes and green panic grasses.
- Simmental—Hereford and Brahman Crossbreeding—assessment of the principal factors of production and reproduction of Hereford and crossbred cattle.
- Hereford heifer mating evaluation—Comparison of breeding performance of groups of thirty heifers mated at 15 and 27 months of age and an evaluation of pasture or forage crop grazing in the post weaning period.
- Simmental-Hereford Productivity trial—comparative study of weight gain, temperament and eye pigmentation of Hereford and crossbred weaner steers.
- Weaner supplementation—evaluation of different rates of molasses and urea-molasses for winter growth of weaners on buffel grass pasture.
- Performance recording—basic study of the Station herd.
- Grain supplementation—evaluation of weaner growth on pasture with different levels of added grain.
- Summer—Winter pasture grazing—evaluation of two paddock rotational grazing with selected pasture species.
- Green panic grass—Leucaena productivity —comparison of green panic alone and with the browse shrub Leucaena.
- Pasture plant introduction nursery.
- Medic strain trial.
- Stylosanthes evaluation, including study of new cultivars.
- Brigalow-Dawson gum pilot development land use systems and techniques for use of areas affected by Dawson gum regrowth.
- Lucerne persistence under grazing.
- Molopo buffel grass—Lablab purpureus, grazing trial.
- Nitrogen responses on grass pastures for winter production.
- Soil nitrogen studies in the brigalow region.
- Cropping intensity and variety performance of soybeans, sunflowers, sorghum, wheat, barley and other grains.
- Early-harvested grain sorghum studies—harvesting, storage and feed assessments of high-moisture grain.
- Winter forage crop grazing trials.

The current programme emphasises that many changes have been made in the past three years. Problems relative to the initial clearing, timber treatment, pasture establishment and property development within the region have been largely resolved. The present studies deal with more specific problems of land use, productivity, nutrition, husbandry and economic factors relevant to the brigalow lands.

Land use

Improved pasture 1 556 ha (3 845 ac.) Native pasture 140 ha (346 ac.) Standing scrub 1 117 ha (2 760 ac.) Being developed 370 ha (114 ac.) Cultivation 333 ha (823 ac.) Creeks, roads, etc. 83 ha (205 ac.)

Livestock

The beef herd varies between 1,400 and 1,600 cattle based on the Hereford breed but including some Brahman and Simmental crosses used in the experimental programme.

Staff

The Station has a resident staff of 10 in research and administration and 9 other employees. Visiting specialists from several Branches of the Department participate in the experimental programme.

Visitors

In addition to the major field days, an Open Day is provided on the first Wednesday of each month. Special inspections or discussion groups at other times may be arranged with the Station Manager.

Gardening notes

Tomato Growing in the Home Garden

by Officers of Horticulture Branch.

THE tomato is one of the most popular vegetables grown in home gardens. It not only has many uses, but the fruit also has a high vitamin content.

Climate

The tomato is very sensitive to frost and should not be grown during the cooler months in areas where more than very light frosts are likely to occur. The crop is best suited to spring and autumn growing. Summer production of tomatoes is possible, especially in tableland areas, but pests and diseases may be troublesome.

Soils and fertilizer

Almost any reasonably good soil will grow tomatoes, but the land must be well-drained. In marginally drained soil, it is desirable to grow the plants on beds built up well above the surrounding garden.

The method of preparing the soil for planting depends on the type of soil and the location of your garden. However, the first digging should be deep and made several weeks before planting.

Tomatoes are fairly tolerant of acid soils. However, if the garden bed has not been limed during the past 12 months, an application of lime or dolomite at 200 g per square metre is beneficial. The material should be incorporated in the soil several weeks before planting.

Proper fertilizing is essential for good yields of high quality fruit. The actual amount depends on the soil type, previous cropping history and the amount of residual fertilizer that may be left in the soil from a previous crop.

Usually, a basal dressing of about 200 g per metre of row of a complete mixture containing 5% nitrogen, 6% phosphorus and 4% potash, that is, a 5:6:4 mixture, is desirable as a foundation for the tomato crop.

The fertilizer is best applied in the bottom of a furrow or drill dug 100 to 150 mm deep about 7 to 10 days before planting. After spreading the fertilizer, the furrow or drill should then be filled with soil and the ground levelled.

Later, after the first hand of fruit has set, a light side dressing of 200 g of urea per 10 metres of row is usually necessary. The fertilizer is applied in a band about 150 mm from the plants and watered in immediately.

Excessive amounts of nitrogenous fertilizer should not be applied as this can produce large bushy plants with few fruit.

Varieties

Many varieties of tomatoes are grown in Queensland. Some varieties are adapted to only certain areas of the State, while others are more widely adapted.

Some varieties that are popular in home gardens are the globe types: Grosse Lisse, Red Cloud, Tropic, Floradel and Indian River. Another type is the egg-shaped variety Roma.

Sowing the Seed

The production of sturdy, vigorous seedlings is essential. The seed can be sown in seed-boxes or seedbeds containing a mixture of equal parts of sand, or light soil and well rotted animal manure, or peat moss. A small

quantity of a mixed fertilizer high in superphosphate is added to the soil.

Ready prepared seed-raising mixtures are obtainable from home garden stores.

The seed is sown thinly in shallow drills about 100 to 150 mm apart and about 6 mm deep. After covering the seed with soil, the bed should be gently firmed with a flat board, lightly watered and mulched. Regular watering will be needed until the seeds have germinated. Well-rotted manure and clean sawdust are good mulching materials, but old bags can be used for his purpose provided they are removed as soon as the plants appear above the ground. When the seedlings are about 25 mm high, they are thinned out to about 30 mm apart.

Tomato seedlings are sometimes raised individually in small cardboard or plastic containers. The plants can then be set in the garden bed without disturbing the roots. Because of this, there is no transplanting shock and the first pick is usually advanced by about two weeks. A similar result may be obtained by planting the seed directly in the garden bed and thinning the seedlings to the required spacing.

Transplanting

In 4 to 8 weeks after sowing, according to the time of year and the locality, the seedlings should be large enough for transplanting. About a day or two before transplanting, they are hardened off by withholding water but, immediately before transplanting, the seedbed is given a good soaking to make it easy to remove the seedlings without injuring their roots.

When transplanted into the garden bed, the seedlings are placed a little deeper than they were in the seedbed. This encourages deep rooting and helps to keep them upright.

The distance between plants depends on the variety used and on whether the tomato plants are to be grown on the ground or on stakes or trellises.

There are many advantages in supporting the plants off the ground. Pest and disease control and harvesting are all made easier, fruit wastage from ground rots is at a minimum, and a smaller area of ground is needed to accommodate equal numbers of plants.

When grown on the ground, the plants are spaced about 1 m apart in rows 1·5 to 2 m apart.

Where staking is used, plants are supported individually on hardwood stakes 25 mm x 25 mm x 2 metres long, driven into the ground at 45 cm spacings in rows 1·2 metres apart. A plant is spaced at each stake and trained to one or two stems.

The stem is tied to the stake every 30 to 40 cm with binder twine. The tie is made loosely so that it does not cut the stem and is placed just under a leaf where possible. The twine is passed around the stem, crossed, and again wrapped around the stake twice before knotting.

The other method of training is to use a parallel wire trellis. In this system firm strainer posts 100 mm x 100 mm thick and 2 metres long are driven into the ground, and anchoraged at each end of the row. If the row is long, smaller posts about 80 mm x 50 mm are spaced at 10 m intervals along the row.

As the plants grow, thin wire is tightly strung along each side of the posts and the plants encouraged to grow between the wires. The first pair of wires is run about 30 cm above the ground and subsequent wires are placed at intervals of 200 to 300 mm up the post.

The trellised rows are spaced 1·5 m apart and the plants spaced 45 to 60 cm apart in the row.

All side shoots appearing below the first hand of fruit should be removed. No subsequent pruning is usually necessary.

Watering

Tomatoes need to be watered regularly to ensure even and rapid plant growth. Aim at wetting the ground thoroughly in the root zone at each watering, but avoid overwatering. Do not wet the foliage any more than is necessary while watering as this can increase the spread of leaf diseases.

Harvesting

Harvesting from a planting normally begins in 10 to 12 weeks after planting and extends over a period of about 6 to 10 weeks depending on locality and the season.

The earliest stage the fruit can be picked is when the dark-green colour of the skin has changed to a bright, glossy green and the flesh surrounding the seed has changed from a light colour to a deep amber or to a deep amber tinged with pink. When picked before this, the fruit does not mature properly and consequently fails to develop full colour and flavour.

Care should be taken not to bruise the fruit when picking or it will decay rapidly. The stalk should be removed from the fruit at harvesting.

Pests and diseases

Insect Control

Several insect species damage tomatoes. Some of the more important pests encountered in the home garden are, heliothis, and green looper caterpillars, tomato mite, aphids and several species of bugs.

Most caterpillars and bugs may be cantrolled with endosulfan, aphids with dimethoate, and tomato mite with sulphur.

Disease Control

There are many fungus diseases affecting tomatoes, some of which attack the leaves and fruit, while others cause wilting and death of the plant.

Most leaf and fruit diseases can be kept under control with sprays of mancozeb, maneb or zineb at 7 to 10-day intervals depending on the weather. Sprays are ineffective in controlling the wilt diseases as these are caused by fungi that live in the soil. To avoid plant losses from wilts, use resistant varieties or plant the tomatoes in a different plot each year or in ground where the diseases have not previously occurred.

Nematodes (causing root-knot) are common in home gardens and readily infest tomato roots. The method of treatment is relatively more difficult, and the gardener is advised to ask for a leaflet with detailed instructions.

Rather than adopt separate control measures for each tomato pest and disease, home gardeners may find it more economical to apply a general-purpose spray that contains both insecticides and fungicides.

The sprays should be applied according to manufacturer's directions.

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Diseases of Grapevine

DOWNY MILDEW OF GRAPE VINE

DOWNY mildew, caused by the fungus *Plasmopara viticola* is the most important fungal disease of grape vine in Queensland. An expensive and regular programme of fungicide spraying is necessary to control this disease, particularly when cool, moist conditions favourable for its development occur.

In the Granite Belt where most of Queensland's grapes are grown, the medium, though erratic, rainfall and the effects of altitude often combine to produce these conditions. On the coast, periods favourable to the disease are more frequent because of the increased humidity, and commercial plantings will be defoliated unless a regular spray programme is adopted.

All grape vine cultivars are susceptible to downy mildew.

Symptoms

Downy mildew attacks mainly the leaves of the vine but shoots, tendrils and fruit are also affected. Leaves, particularly the older ones, first show a light, oily spotting which affects more and more of the leaf area and eventually appears on the younger leaves. In moist weather, a white, downy growth develops on the spots on the undersides of the leaves as well as on shoots and tendrils. If dry weather follows, the spots turn brown and affected leaves shrivel, die and fall to the ground resulting in partial or complete defoliation.

Affected bunches show large, purplish blotches on fruit stalks and berries and the latter eventually wither and fall from the vine.

Spread

The white mildew underneath the leaves and on shoots and tendrils produces spores in moist conditions. These are spread readily by wind or water to new leaves and germinate to produce new infections provided water is present. They are not tolerant of harsh conditions. In autumn, the fungus produces a different spore which is resistant to environmental changes. This survives the winter inside fallen leaves and is the source of new infections in the spring.

Control

Downy mildew control depends on regular applications of protectant fungicides throughout the season commencing when the shoots are 15 to 20 centimetres long. It is important that spraying with copper fungicides be suspended firstly during flowering otherwise berry set is reduced, and secondly when the berries are maturing to avoid residue problems. Coastal vineyards require more frequent spraying than those in the Granite Belt.

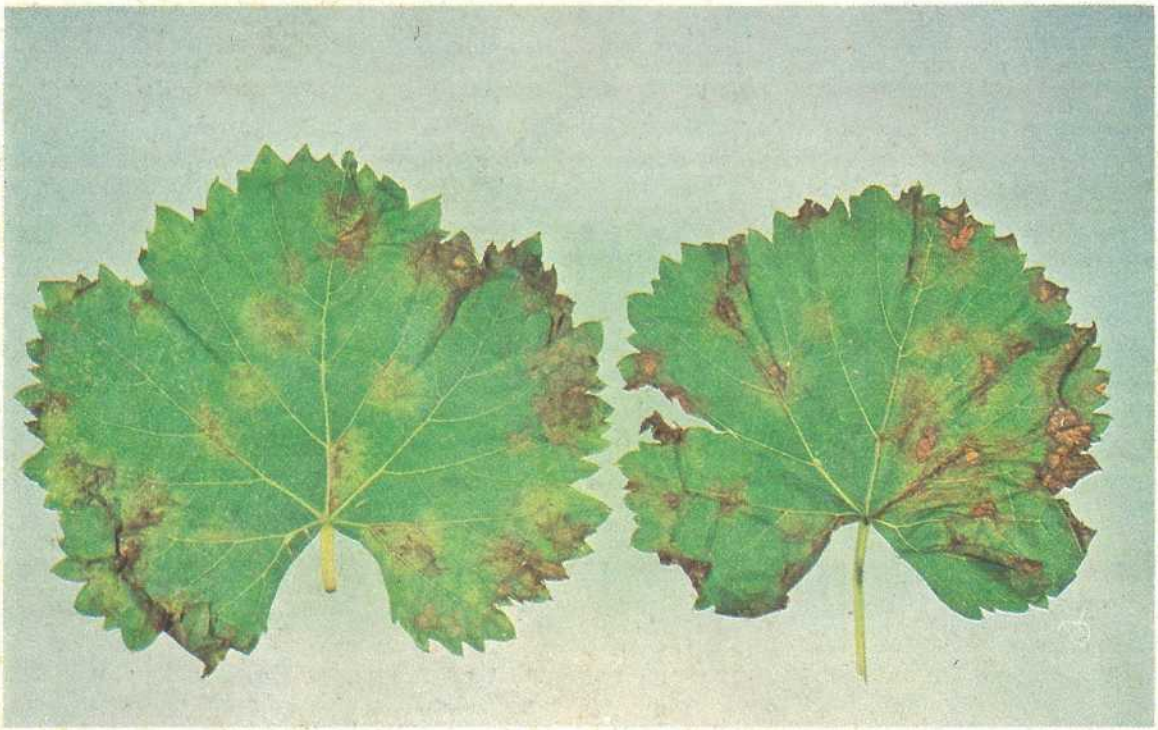
Some fungicides should not be used within two weeks of harvesting wine grapes because of their effects on fermentation.

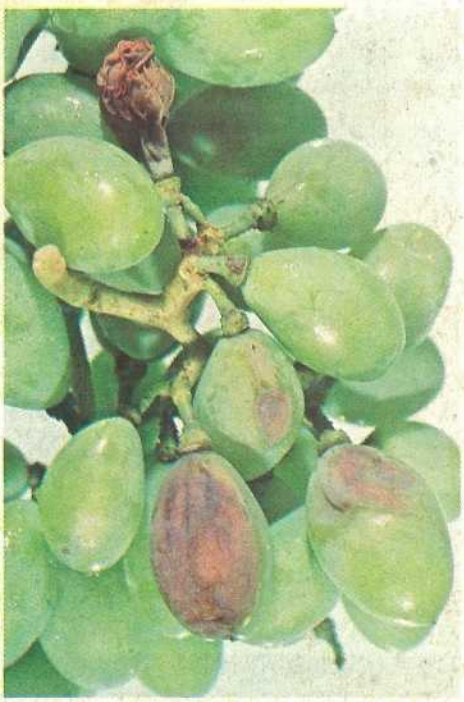
Removal of all prunings, fallen leaves and fruit during winter reduces the sources of infection for the coming season.

Compiled by N.T. Vock, Plant Pathology Branch.

(Further information including recommended fungicides may be obtained from either the Plant Pathology Branch office at the Granite Belt Horticultural Research Station, Applethorpe, Q. 4378, or the Director, Plant Pathology Branch, Department of Primary Industries, Meiers Road, Indooroopilly. Q. 4068.)

Diseases of Grapevine - 1





DOWNY MILDEW. Upper: spots on upper leaf surfaces. Lower left: mildew on the lower leaf surfaces. Lower right: affected berries.