Queensland
AGRICULTURAL JOURNAL

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Meat Inspection

Safeguard for both producer and consumer.

Meat inspection is not new. The ancient Egyptians carried out a form of meat inspection, and in the pre-Christian era the Jewish nation adopted certain principles of meat inspection as part of their religion.

No doubt these pioneering attempts at meat hygiene were the practical outcome after diseases from certain classes of meat animals had caused widespread outbreaks of human sickness and death.

In Queensland, the policy and regulatory requirements of meat inspection are carried out by the Slaughtering and Meat Inspection Branch of the Department of Primary Industries.

The responsibilities of the Branch include:

* ante-mortem and post-mortem inspection of stock killed in the State for domestic consumption. Full-time inspection is provided at abattoirs (in co-operation with Commonwealth officers at export meatworks); part-time inspection is provided at slaughter-houses.

* the licensing standards for abattoirs and slaughter-houses, and the inspection of these premises for hygiene.

* registration and inspection of butchers' shops and meat delivery vehicles -
* at wholesale, retail and manufacturing levels.

* keeping a watch for disease. This includes recording information, collecting specimens, tracing and identifying livestock, and providing information on disease.

* implementing the Queensland Meat Industry Authority policy to control orderly slaughtering and marketing of meat.

* poultry slaughtering. This includes licensing and hygiene controls, and part-time inspection of poultry abattoirs.

* controlling edible by-products, such as tallow and casings.

* controlling the manufacture and distribution of pet foods.

* the grading and classification of meat.

* providing the industry and the consumer with the latest information on meat quality.

The overall meat inspection programme in Queensland is one that is unique to this State in that it is a total concept programme that follows right through from the live animal to the consumers' hands.

In our cover picture for this issue we see the results of some of this work - a bright modern butcher's shop, providing the consumer with quality meat, and helping the producer promote his product to the best advantage.

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Taking a Closer Look

Special Feature

In this issue on page 39 we start the first of a two part series on farm management in brigalow areas.

Livestock

Two new breeds of cattle are highlighted in this issue.

On page 11, a tick-resistant dairy breed is discussed; on page 17, we look at Belmont Red, a promising new beef breed.

Modified shears can help with Mulesing.

Read how it's done on page 25.

A useful technical article is Eperythrozoon infection in sheep.

On page 88.

From Sheep and Wool adviser, L. B. Dunlop, comes a story of a sheepman who has managed to save himself a lot of time and labour.

The story is on page 111.

Agriculture and Horticulture

On page 3, an interesting report of an irrigated pasture system based on annual ryegrass sowings.

Interested in growing strawberries in the home garden?

You'll find our feature on page 115 particularly helpful.

Entomology

Of concern to fruit growers is the discovery of new exotic fruit fly in northern Queensland.

Story on page 93. Light traps, and how they work, are discussed by P. H. Twine in an article beginning on page 99.

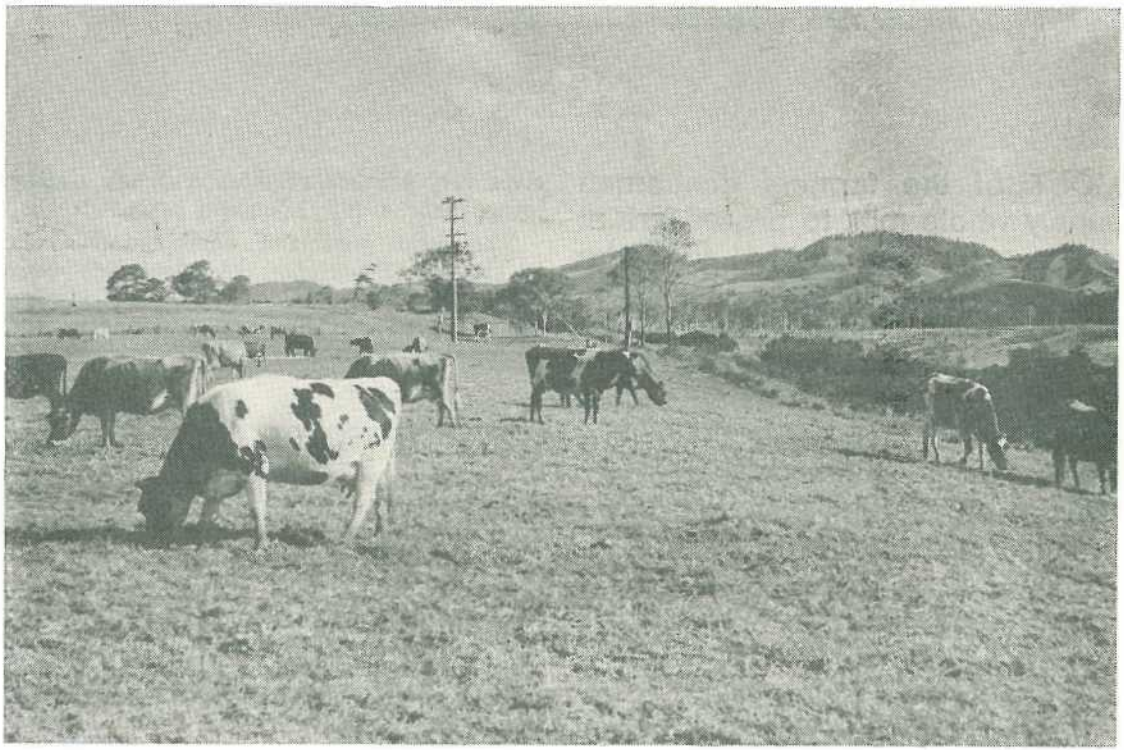
An irrigated pasture system

based on annual ryegrass sowings

IN the Mary Valley over the last three years, an expanding group of dairy farmers, in conjunction with field staff of Consolidated Fertilizers Limited, has developed an intensive and profitable system for the production and utilization of high quality irrigated forage.

by R. O'GRADY and G. J. CASSIDY†*

Cattle grazing ryegrass pasture.



*Consolidated Fertilizers Limited. †Formerly Agriculture Branch, now Extension Services Section.

Close up of an irrigated Tama ryegrass pasture ready for grazing under a rotational system. Mary Valley, June 1975.

MOST of the farmers concerned supply whole milk to processors at a current basic price of $1.45 per kg butterfat, which income is supplemented by a share in the modest factory quota of city market milk. In the case of one processing organization, a winter incentive of 22 cents per kg butterfat paid from May to August inclusive (1974–75 opening prices) is provided.

The system consists essentially of an annual autumn oversowing of winter forage grasses into perennial summer growing grass pasture. By establishing high plant populations and using high levels of nitrogen fertilizer, as well as adequate irrigation, this grass combination gives very efficient production of top quality-forage over a full 12-month cycle.

The most productive combination so far is kikuyu (*Pennisetum clandestinum*) oversown in the autumn with ryegrass (*Lolium* spp.) but a paspalum (*Paspalum dilatatum*) pasture can be oversown in the same way.

FEED SEQUENCE

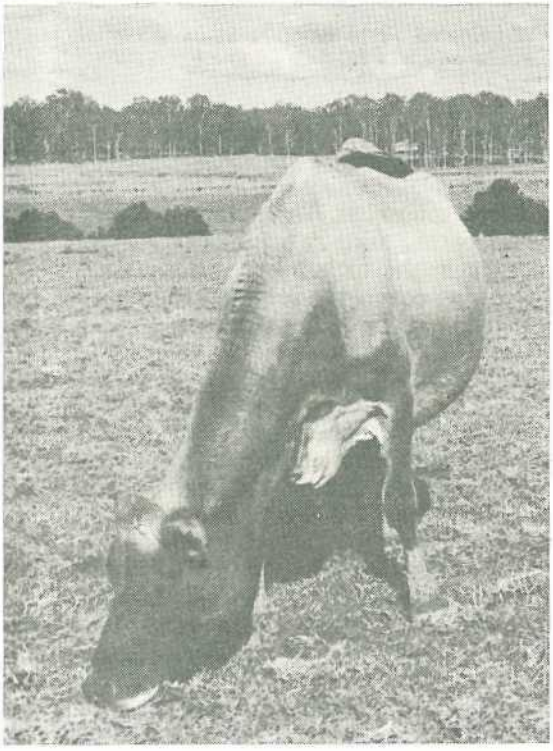
For vigorous establishment and high productivity before mid-winter, oversowing of the ryegrass component is carried out in March–April. If plantings are made too early, germination and seedling survival are reduced by too high a soil surface temperature. Mary Valley and coastal sowings are generally best made no earlier than April, while in some elevated areas such as the Maleny plateau sowings can be made in March.

Grazing begins 5 to 6 weeks after sowing, the forage then being ryegrass with or without perennial grass regrowth, depending on the severity of pre-sowing cultivation. Ryegrass then dominates through June, July, August and September, phasing progressively into quality spring production from the summer component (kikuyu or paspalum) during October and November.

CULTIVARS

Successful experience in the Mary Valley has been based on the use of mixtures of two or three cultivars to extend the productive season as long as possible. Generally speaking the familiar cultivars Wimmera and Grasslands Paroa (formerly Italian), which provide early feed, are mixed with a long season cultivar such as Grasslands Tama, Grasslands Manawa (H.1), Kangaroo Valley or Grasslands Ariki to extend the season into November.

A ryegrass/kikuyu pasture under grazing in the Mary Valley, June 1975. At this stage 100 cows get all their grazing from 24 hectares of the mixture. The pasture is set stocked.



Although comparative seed prices have greatly influenced the selection of component cultivars, the main considerations are vigorous establishment and a long growing season. The cultivars Grasslands Tama and Grasslands Paroa combine these virtues and can be planted singly. The growth rates resulting from regular use of fertilizer nitrogen and intensive utilization of the young forage prevent the development of rust problems.

Botanical names of the cultivars are as follows:—

Cultivar	Botanical Name
Wimmera	*Lolium rigidum*
Grasslands Paroa	*L. multiflorum*
Grasslands Tama	*L. multiflorum*
Kangaroo Valley ..	*L. perenne*
Grasslands Manawa	*L. perenne* x *L. multiflorum*
Grasslands Ariki ..	*L. perenne* x (*L. perenne* x *L. multiflorum*)

SEEDBED PREPARATION

This is essentially a renovation treatment, carried out with a tandem disc implement or a rotary cultivator, involving, at its best, severe but temporary destruction of the existing grass sward. Prior removal of accumulated grass cover by slashing and/or heavy stocking is necessary. The two essentials are that ground preparation be done quickly and that it be *shallow*. These two requirements are dictated by other factors besides economics. The district norm at this time of the year is for wet season conditions to prevent conventional seedbed preparation for any crop; as a result most previous attempts to cultivate for winter forage crops ended up in late plantings and low yields. This seasonal limitation on cultivation operations has led a few farmers to experiment successfully with minimal disturbance of the existing grass cover, compensating with high seeding rates.

Early sowings require the most vigorous seedbed preparation because of the end-of-season competition offered by the summer growing grasses. Sowing with minimal renovation cannot be carried out before mid-April. By this time declining temperatures reduce the competition offered by kikuyu and/or paspalum regrowth. Even then, this technique requires stocking after sowing to further check competitive regrowth, and the application of nitrogen fertilizer should be delayed until the four-leaf stage of ryegrass growth (about mid-May).

Mr. T. Dolan, of Kandanga, examines a 10-ha patch of irrigated Tama ryegrass in its 9th week since planting. At this time it had been under grazing for 3 weeks and was feeding 90 head of young animals (12 to 18 months of age). June 1975.

SOWING

Local research by D.P.I. pasture specialists has indicated that under *conventional seedbed conditions,* (i.e. grass-free, clean and fully prepared) there is no advantage to be gained in yield or ground cover by using more than 23 kg/ha of broadcast ryegrass seed. However, the degree of ground preparation involved in this system results in something a good deal short of an ideal seedbed for ryegrass establishment. Because of this a heavier seeding rate is necessary to establish the high population of ryegrass plants needed for frequent and heavy grazing.

Under local conditions a broadcast rate of from 35 to 45 kg/ha is used, depending on the farmer's assessment of the final seedbed achieved. If a sod-seeding type implement is used to drill the seed then the rate can be reduced somewhat. The authors suggest a rate of 35 kg/ha, using two runs of 17 kg/ha each at right angles to improve distribution. Light harrowing covers the seed and rolling is always an advantage on such seedbeds.

FERTILIZER SCHEDULE

Fertilizer, especially nitrogen fertilizer, is an essential major input to the system. Most operators use a total of 460 kg/ha of elemental nitrogen (i.e. 1 000 kg/ha of urea) during the growing season (March to November). The latest results (1973 and 1974) from local D.P.I. research indicate that this level of nitrogen usage on ryegrass can grow 10 000 to 14 000 kg/ha of high quality (25% crude protein) dry matter during that period. Such yield data confirm the carrying capacities and milk production levels being achieved on farms.

The initial fertilizer application, made at planting time, must include basal dressings of phosphorus (22 to 45 kg/ha) and potassium (62 kg/ha) where required, as well as nitrogen up to 125 kg/ha. Sources of these are superphosphate, muriate of potash and urea respectively. Mixed or compounded fertilizers may be more convenient to apply but do not compare favourably with the "straights" on the basis of on-the-ground cost.

Individual nitrogen dressings during the season are usually made at rates of from 63 to 125 kg/ha of urea, and these are applied following grazing of each sector or subdivision in the rotational system. The usual time between grazings is 16 to 18 days. During the colder part of the season (June to August) the rate of urea applied at each application is doubled (for example, increased from 63 to 125 kg/ha) in order to maintain grass growth rate at a level which will support the herd under this fixed rotation.

APPLYING NITROGEN WITH IRRIGATION

For convenience and economy it is a standard recommendation that top-dressings of urea be applied dissolved in the irrigation water. The technique of introducing urea solution into suction lines of standard medium pressure spray systems is now widely used and needs no description in this article.

Several farmers have demonstrated that urea solution may also be metered through travelling, "water-winch" operated, high pressure irrigators, at a rate appropriate to the speed of travel. This technique involves a tank of urea solution connected to the suction line close to the pump. The connecting pipe is attached to the tank and to the suction line by standard "ring and tail" assemblies.

In the assembly near the tank is incorporated a simple straining device comprising two rubber washers and a small disc of fine gauze (Rega C.N. 2 strainer). In the other assembly, close to the suction line, again held in place by two rubber washers, is incorporated a stainless steel disc with a single small hole in the centre, so that the urea solution is fed into the suction line at a slow and steady rate. The discs used are standard fittings on Rega chemical spray systems and can be purchased as such (e.g. Rega C.N.5 B has a 1·2 mm hole). Thus, there are two factors which can be adjusted to achieve a desired metering rate:—the size of the hole in the disc and the volume of urea solution per run.

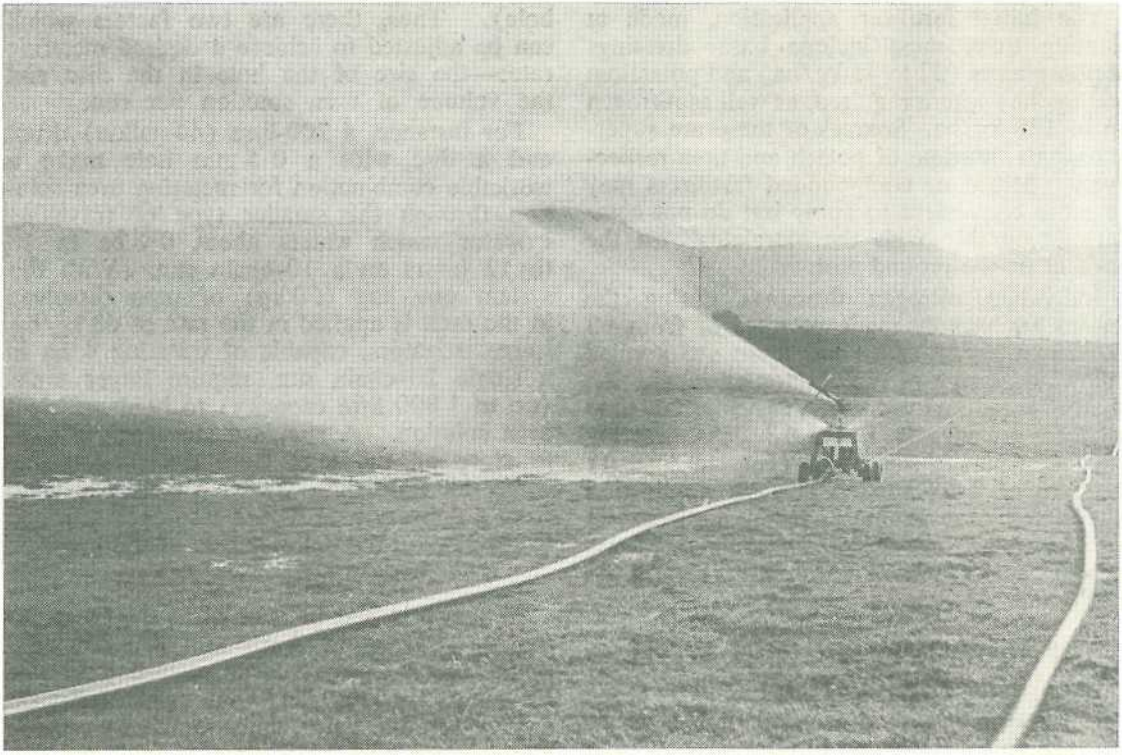
For instance, a 200-litre (44-gallon) drum and a disc with a 0·5 mm hole make a workable combination for metering urea solution through the smaller type of travelling irrigator which waters about 0·8 ha in 10 to 12 hours on a 10–chain run. With this system one bag (50 kg) of urea dissolved in the tank is applied at the rate of 63 kg/ha. Large irrigators, capable of watering 4 ha in a single 20–chain run, require larger tanks (up to 1 800 litre capacity) to hold sufficient urea solution. A standard stop-cock is used to close off the tank from the suction line when not fertilizing. Tanks are usually filled from a delivery pipe with a stop-cock attached to the line on the delivery side of the pump.

GRAZING SYSTEMS

Ryegrass is best utilized when the cows are mated to calve in April and are fed continuously on the oversown pasture until late November. The feed maintains sufficient quality for one cow's daily intake to provide maintenance plus 17·5 litres of milk per day for the 210 to 240-day period.

Provided the pastures receive nitrogen top-dressings of the order and frequency already described, as well as adequate irrigation, their overall carrying capacity rises from about five milkers per ha in May–June to better than six per ha during the spring months (September to November). This is based on the assumption that the animals are on the ryegrass all day, and that, between the morning and afternoon milkings. The rotational system usually employed in the Mary Valley provides the herd with a fresh strip daily on a 16 to 18-day rotation, with watering and fertilizing being caried out immediately following grazing.

The basic carrying capacity and method of grazing outlined above are meant to define, approximately and conservatively, the level of productivity which can be expected from the system. The figures may be used as a basis for calculating grazing systems on limited areas of irrigable land. For example, 4 ha would carry 20 to 25 milkers, with access to the pasture all day, from June to November, or it would provide 2 hours grazing a day for 80 to 100 milkers over the same period.



A large "water winch" type irrigator working on Mary River terraces. It waters about 4 hectares in a single 12-hour run. June 1975.

At the same time there is district evidence that, with an increase in the scale of operation, the financial input required for sub-division and rotational grazing is unnecessary. In the district's largest irrigated pasture operation, the farmer concerned irrigates 50 ha of oversown ryegrass in one large paddock, under set stocking. No internal sub-division is used. Irrigating and top-dressing are carried out while the herd is grazing the paddock. During the period July to December this 50-ha area has carried 325 milkers continuously, that is day and night. These animals also have access to a 22-ha area of mixed kikuyu and paspalum which is not irrigated.

IRRIGATION

Wide Bay soils generally need 35 to 50 mm of water per application, watering every 10 to 12 days. Watering at this frequency is vitally important during ryegrass establishment up to the four leaf stage, especially with earlier plantings. The delicate ryegrass seedlings literally vanish if they encounter moisture stress at this time.

The number of designs and capacities for irrigation layouts is legion but usually the ultimate deciding factor is the water resource available. Assuming that there is enough water available for an adequate irrigated forage

enterprise, the next common limiting factor on the one-family dairying unit is the labour input necessary for the actual watering process. Moving medium pressure spraylines by hand every few hours consumes two of the dairyman's scarcest resources—time and effort. Therefore, in practice, such hand carried sprayline systems are limited to an 8–12 hectare operation (per man) and are rapidly giving way to systems which need less labour.

Such systems within the medium pressure range (i.e. for the same pumping costs) are those with "permanently" assembled spraylines which are moved bodily by the "side-roll" or "end-tow" methods. In both these systems the sprayline is mounted on wheels and the motivation is provided by man-power, a small built-in motor or a tractor used for towing. The fairly rigid nature of the sprayline assemblies, however, demands an even ground surface and a symmetrically shaped area. Generally speaking, neither the irrigable land along the Mary River and its tributaries, nor that surrounding farm dams in the region, meets these requirements.

Travelling, single nozzle irrigators which operate at high pressure, are gaining favour because of their ability to handle large, odd-shaped areas of uneven country for a minimum labour input. Models are available which are designed to water from 12 to 50 ha for half to one hour's attention per day. The purchase price range is about twice that of conventional hand moved sprayline systems. The higher nozzle pressure is maintained by extra horsepower, which adds to the pumping costs. These extra operating costs are the price of saved labour.

ECONOMICS

The cost of growing this highly productive feed (approximately $300 per hectare in 1975) is 25 to 40% of the cost of a similar amount of bought feed.

Milk production in excess of 17 500 litres (or 722 kg butterfat) per hectare, valued at over $1,000, has been achieved.

This pasture system provides the maximum efficiency in the use of limited and costly irrigation resources.

A break-down of the costs per hectare (April 1975) of irrigated ryegrass is as follows:—

	$	$
Discing and planting		25.00
Seed (35–45 kg/ha of mixed varieties)		25.00
Basal fertilizer		
92 kg N, 43 kg P, 62 kg K		
200 kg urea @ $134.00/tonne ..	26.80	
450 kg super @ $72.70/tonne ..	32.72	
125 kg muriate of potash @ $133.40/tonne	16.67	
Total cost of basal fertilizer ..	76.19	
Top-dressing nitrogen		
368 kg N		
800 kg urea @ $134.00/tonne ..	107.20	
Total fertilizer cost		183.39
Water charges		
6 megalitres @ $2.50/megalitre ..		15.00
Irrigation pumping costs (including plant depreciation)		
6 megalitres @ $8.00/megalitre ..		48.00
Weed control		
1 litre 50% amine 2,4–D		1.32
Total cost per hectare		$297.71

With an expected dry matter production per hectare of 10 000 to 14 000 kg, cost per kg dry matter is 2 to 3 cents. Analyses of grazed pasture indicate that short leafy growth has up to 28·5% crude protein, 75% T.D.N. and 0·4% phosphorus. The equivalent value of this feed, in terms of a lower protein commercial dairy meal at 8 cents per kg is $800 to $1,120.

FRINGE BENEFITS

There is evidence on some farms of a build-up in soil fertility, due to the re-cycling through the cows, of plant nutrients originally purchased as fertilizer. The $183 worth of fertilizer applied per hectare provides 460 kg nitrogen, 43 kg phosphorus and 63 kg potassium. The same amount of money, if spent on dairy meal in 1975, would buy only 52 kg nitrogen, 7 kg phosphorus and 8 kg potassium. This is a six to nine-fold difference in the input of major plant foods into the farm system which, through paddock rotation, leads to an improvement in soil fertility and the spread of more productive grasses such as kikuyu.

Of particular interest

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

Gatton College centre for Australia-wide Bee-breeding course

A bee-breeding course, with the emphasis on artificial insemination of Queenbees, is to be held at the Queensland Agricultural College, Lawes, from December 5 to 11 this year.

The course is being organised by this Department, College staff and a Queensland-based bee-keeping equipment manufacturer, John L. Guilfoyle (Sales) Pty. Ltd., or Darra, Brisbane.

It will cover Queenbee breeding and genetics, honeybee genetics, A.I., races of honeybees and selection and evaluation.

Enrolment nation-wide will be limited to 24 in an effort to provide individual tuition to ensure that the skills and information gained can be applied without delay towards the improvement of bee-keeping in Australia.

The course will cost students $300, which includes the supply of selected material for study beforehand and accommodation.

The principal lecturer and demonstrator will be Professor J. Woyke, Honeybee Division, Agricultural University of Warsaw, Poland—an acknowledged world leader in the bee-breeding field.

He will be supported in expertise by well-known professional Queenbee breeder, Mr. N. V. Rice, of Beaudesert.

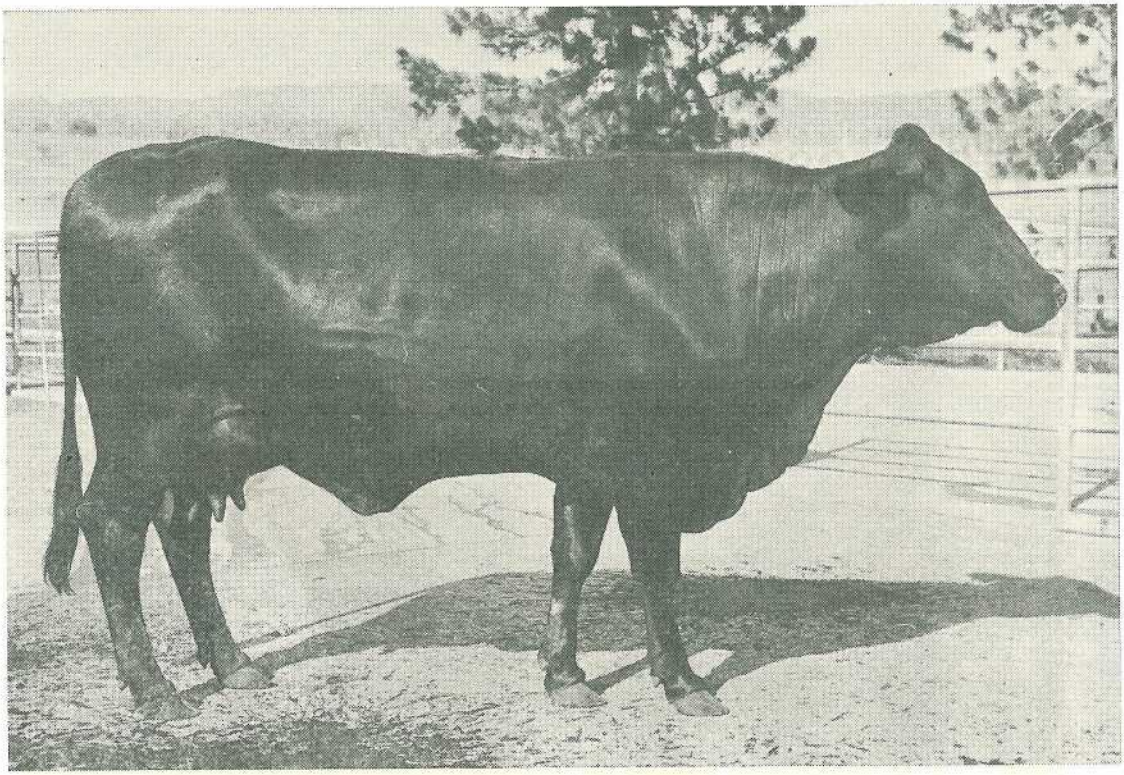
Other members of the lecture team will include Messrs. V. Sisson, a leading light in the Dadant Company's hybrid bee-breeding programme in the United States, and Queenslanders P. Grogan, Senior Lecturer in Genetics and G. Kleinschmidt, Bee-keeping lecturer (both of Gatton College) and C. Roff, Chief Bee-keeping Adviser in the D.P.I.

Application for the course will close on July 31. Forms are available from the Registrar at the Queensland Agricultural College at Lawes.

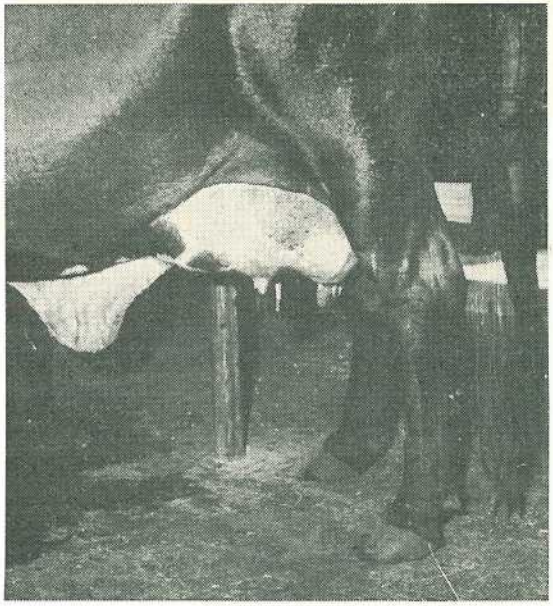
A Tick-resistant dairy breed

by I. BYFORD, P. COLDITZ, Research Stations Section and R. SIBBICK, Dairy Cattle Husbandry Branch.

A look at a new dairy breed developed by the Dairy Cattle Husbandry Branch of the D.P.I.



A young A.F.S. heifer.



Silky udder with even teats—a feature of the breed.

THE increased incidence of resistance in ticks to the insecticides used for the control of cattle tick in Queensland, has led to a great deal of interest in alternative methods of tick control. In the beef cattle industry there has been considerable use of pasture spelling and development of tick resistant strains of cattle.

Pasture management techniques are not practicable for dairy cattle, and because of the difficulties associated with introducing tick resistance into highly productive milk producing animals, there has been less impetus towards developing strains of dairy cattle with adequate levels of tick resistance.

In recent years, C.S.I.R.O. has developed the Australian Milking Zebu. This possesses tick resistant characteristics from the Sahiwal and butterfat production from the Jersey.

The Dairy Cattle Husbandry Branch of the D.P.I. has been working on a cross between the Sahiwal and the Friesian—The Australian Friesian Sahiwal (A.F.S.) This breed will provide adequate levels of milk production as well as conferring tick resistance to subsequent generations of selected cattle. Animals from this programme, conducted in North Queensland, will be suitable for most dairy areas of the state.

Progress

From the original importation of Sahiwal cattle from Pakistan in 1952 two crossbreeding programs have been developed. C.S.I.R.O. produced the Australian Milking Zebu (A.M.Z.) by crossing Sahiwals with Jersey cows in Northern New South Wales. Semen from A.M.Z. bulls selected on tick resistance and heat tolerance is gaining widespread use in the developing countries of South East Asia.

The Queensland Department of Primary Industries program began by crossing A.I.S., Jersey and Friesian cows with Sahiwal bulls and milking the heifer progeny at Ayr Research Station in 1963. Heifers were selected on milk production and suitable dairy temperament. Subsequent generations have maintained about 50% Sahiwal breeding. The Friesian crossbred has been found the most reliable in terms of milk production.

The breed

The new breed which we are naming the Australian Friesian Sahiwal (A.F.S.) is already mainly half Friesian–half Sahiwal. However, some animals, including some of the bulls, have Jersey or A.I.S. cross in their pedigrees. The Jersey and A.I.S. component will of course be increasingly diluted in subsequent generations.

There is a range of colour in the later generation animals as might be expected to result from these different parent breeds, but the most common colours are black, tan and red. In body conformation, cows generally tend towards the accepted dairy type, but have large ears, slight humps and sloping rumps with smooth sleek coats. They have particularly good feet and legs and appear to have a lower incidence of foot troubles than the Friesians in the Kairi Research Station herd.

Mature cows average 580 kg in weight with bulls averaging 650 kg.

The relative freedom from calving difficulties which has been a feature of the new breed is consistent with the comparatively low average birth weight (28 kg) of calves from cows of this size.

Performance

(a) *Milk Production*

Once a dairy breed is established it gains and maintains favour with the industry only when it satisfies certain requirements. They must have the ability to:—

- Produce milk of a required quantity and quality.
- Thrive and calve regularly in the particular environment.
- Produce milk efficiently under the particular management system.

The A.F.S. breed satisfies these criteria even at its present stage of development as demonstrated by average milk production of A.F.S. cows at Ayr and Kairi Research Stations in Table 1.

TABLE 1

MILK YIELD AND COMPOSITION FROM A.F.S. COWS 1972–73

Place	No. of Cows	Lactation Length	Milk	Butterfat		Total Solids	
		days	kg	%	kg	%	kg
Ayr	16	260	2 376	4·2	96·4	12·8	318·6
Kairi	18	266	2 648	4·2	106·8	12·7	329·5

Individual cows have recorded lactations of 5 500 kg milk, with one heifer calving at two years and solely grass fed giving 4 000 kg milk at 4·5% butterfat test.

An experiment is being conducted at Kairi Research Station to compare the productive capacity of A.F.S. and some selected Friesian cows on a relatively high grain ration and quality pasture.

Twelve cows of each breed were each fed 1·5 tonnes of maize meal over a 300 day lactation. Feeding rates commenced at 8 kg/day for the first month of lactation and decreased by 1 kg/day in each succeeding month. The cows were grazed on glycine—green panic pasture which was irrigated during the dry season.

Comparative performance of the two groups was as follows:—

—	Milk	Fat	S.N.F.	Fat
	kg	kg	%	%
Friesian ..	4 634	163	8·54	3·60
A.F.S.	3 250	143	8·95	4·50

The A.F.S. cows gave 70% of the milk production and 88% of the butterfat production of the Friesians.

It can be seen from these figures that a group of selected animals of the new breed are capable of high levels of milk production, especially when it is considered that the Friesian cows they were being compared with were some of the best at Kairi Research Station and came from a greater pool of animals than that from which the A.F.S. were drawn.

(b) *Growth and Beef Production*

The A.F.S., selected for its ability to thrive and resist tropical parasites, could be expected to be useful for beef production. At Kairi Research Station, A.F.S. calves have been reared and compared with Friesian calves for a number of years. Slaughter data on steers at 10 months and two years set out in Table 2 give a good indication of the potential of the A.F.S. as a beef producer.

A.F.S. calves are smaller at birth than Friesians but grow well to weaning at eight weeks. If suckled on the cow to 10 months, A.F.S. steers finish at the same weight as Friesians, have a higher dressing percentage and produce carcasses with a greater thickness of fat.

As steers grown on to two years old, the A.F.S. perform as well as Friesians. Compared to traditional beef breeds they should therefore perform very favourably and finish well. The fat cover at 400 kg liveweight was adequate.

TABLE 2

GROWTH RATES AND MEAT PRODUCTION OF A.F.S. AND FRIESIANS

—		A.F.S.	Friesian
Birthweight	(kg)	30	39
Growth rate to 8 weeks—			
Bucket reared	(kg/day)	0·40	0·50
Multiple suckled	(kg/day)	0·45	0·58
Growth rate when multiple suckled to 10 months	(kg/day)	0·85	0·77
Growth rate following weaning at 8 weeks to—			
8 months	(kg/day)	0·39	0·36
2 years	(kg/day)	0·56	0·54
Meat Production—			
At 10 months—			
Liveweight	(kg)	270	270
Dressing %	(%)	51	49
At 2 years—			
Liveweight	(kg)	400	400
Dressing %	(%) ..	50	50

From these observations it is clear that bull calves from an A.F.S. dairy herd should provide acceptable dairy beef. Heifer replacements of the new breed can also be easily reared to calve at two years.

(c) *Tick Resistance*

Considerable emphasis is placed in the new breed on selection for resistance to cattle tick (*Boophilus microplus*). Heifers of the same age are run as a group and tick counts made on them once every month. This quickly shows those susceptible to ticks which are subsequently culled from the program. Bulls will go through a more intensive tick resistance evaluation.

In the comparisons of A.F.S. and Friesian heifers it has been found that about one third of the A.F.S. were as susceptible as Friesians to cattle ticks and were culled as a result. This gave two thirds of the original number which had enhanced tick resistance to be evaluated for milk production.

Mean tick counts over six days on unselected A.F.S. and Friesian heifers were:—

Day	1	2	3	4	5	6
A.F.S. ..	2	7	15	16	13	10
Friesian ..	34	75	85	84	35	28

Temperament

Regular and intensive handling for tick counting has allowed the temperament of the A.F.S. heifers to be readily observed. It was found that in a group of 45 heifers only one animal did not become very quiet and easy to work and handle. Similarly, A.F.S. cows that are being milked adapt to the milking routine readily and become leaders in the milking herd because of their intelligent and alert nature.

Farmer co-operation

This project has reached the stage where industry interest and participation will demonstrate the practicable application of the new breed. Co-operation by dairy farmers in having some of the animals in their herds will also provide a greater number of A.F.S. cows for use in progeny testing young bulls. To this end the Dairying Division of the Department of Primary Industries has arranged for cows to be loaned out to interested farmers. These farmers will participate in the evaluation of the breed and the progeny testing of successive generations of young bulls.

The development of this new breed, both in numbers and performance, will be successful with the full co-operation of farmers who realise the value of high producing, tropically adapted, tick resistant dairy cattle.

Wool grower with ideas

WHEN most Australian farmers were feeling the pinch of the current economic situation Mr. Glen Heath, a grazier of Stratford-on-Avon near Sale in Southern Gippsland decided to take the advice of the old saying "God helps those who help themselves".

Mr. Glen Heath poses beside one of the first hand-patterned sheep-skin rugs.

Mr. Heath, who was running more than 6,000 sheep and Hereford cattle, decided that although wool and beef prices might be down high quality decorative carpets were bringing unparalleled prices. He decided to combine art with wool and prepared a series of designs which he felt could be recreated into hand made sheepskin carpet squares.

Mr. Heath felt that the natural fleece, hand selected, dyed and polished could be reproduced in rugs of an individuality and quality never before produced for the Australian market.

Each of the rugs consumes 20 or more selected skins and on an average are approximately 2 metres by 3 metres although larger ones are available on special order.

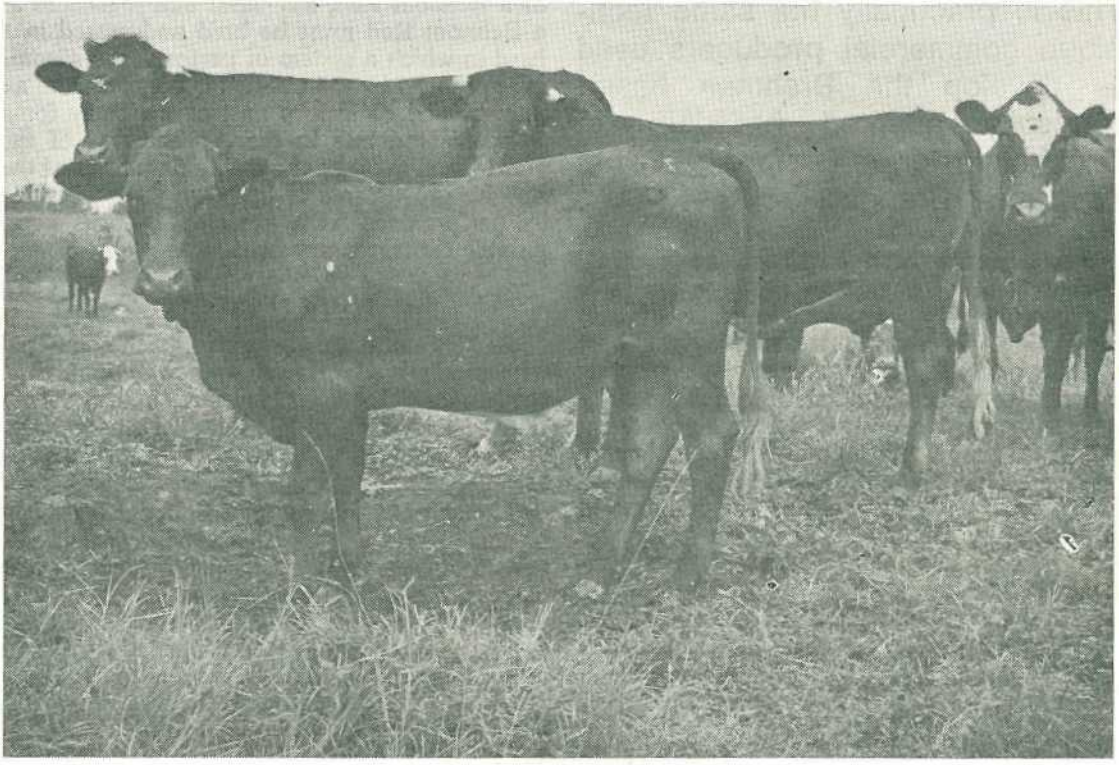
Whilst Mr. Heath has been the brains behind the project he has been assisted in the making up of the rugs by three women of the neighbourhood: Mrs. Teresa Hollan, Mrs. Judith Walsh and Mrs. Gayle Paliew.

Belmont Red

a promising breed for the tropics

by T. H. RUDDER, Beef Cattle Husbandry Branch, G. W. SEIFERT and J. E. VERCOE, C.S.I.R.O., Rockhampton.

A group of Belmont Red Cattle near Rockhampton.



The Belmont Red is a tropically adapted breed of cattle which has been developed at the National Cattle Breeding Station, "Belmont". At this station, the research programme is designed to identify the characteristics that influence productivity in a tropical environment. In comparative trials, the Belmont Red has shown many attributes required by cattle for high productivity in the tropics.

This article summarizes the comparative performance of the Belmont Red, and discusses the roles this breed may have in commercial beef production.

BELMONT Red Cattle were developed by first crossing Africander bulls with Hereford and Shorthorn cows.

The crossbred progeny of this mating were then mated to produce a breed which is nominally ½ Africander, ¼ Hereford, ¼ Shorthorn. This is practically the same technique commercial producers used to develop the Brahman based tropically adapted breeds, e.g. Droughtmaster, Braford, Santa Gertrudis, Brangus.

Selection has been based on an accurate measurement of characters that are heritable and economically important in terms of beef production. These are: weaning weight, post weaning gain and tick resistance. By restricting selection to these characters selection intensity is high enough to ensure real and permanent gains. Although the colour is predominantly red, no selection for this trait has been made. The breed has been accepted for registration in the C Appendix of the Australian Africander Association. The main methods of establishment are:—

(a) by grading up from any base cow herd through three generations of mating to registered Belmont Red bulls, the fourth calf drop being registrable Belmont Reds;

(b) using purebred Africander bulls over any base cows to produce halfbred progeny, these offspring are graded up to Belmont Red through two generations of mating to Belmont bulls.

Details are available in the Australian Africander Association's Constitution and Rules.

The rules also state that, in addition to the foregoing breeding specifications for definition of a Belmont Red, any adult bull registered as a Belmont Red must be bred and reared in a herd in which a system of performance recording approved by the Council is adopted; and an integral and obligatory part of the entry for a Belmont Red bull in the Appendix C of the Herd Book must be the rating or ratings of the bull for growth rate or body weight, expressing its performance as a percentage of its comparable contemporary herd mates.

EVALUATION

At "Belmont" this breed has been compared with similarly developed lines of Brahman x British, and British (Hereford x Shorthorn) lines. It is also being evaluated under commercial conditions by comparison with commercially bred cattle.

The comparative value of Belmont Reds can be assessed on the basis of environmental adaptation, survival, reproduction, growth and carcase characteristics.

Environmental Adaptation

Environment factors that affect productivity in the tropics are cattle tick, worms, disease, high temperatures, and fluctuating nutritional

conditions. Both the Brahman x British and Belmont Red cattle have a higher resistance to cattle ticks than British cattle. The difference between Brahman x British and Belmont Red is not large, but favours Brahman x British. This resistance markedly reduces the need for dipping, especially when nutrition is above maintenance requirements.

Brahman x British have a higher tolerance of worms than the Belmont Red which are more tolerant than British cattle. Belmont Red cattle have a much higher resistance to blight than British cattle but their level of resistance is slightly lower than that found in Brahman x British cattle. This disease is associated with reduced weight and weight gains.

Belmont Red and Brahman x British cattle have approximately the same heat tolerance, which is superior to that of the British cattle.

In tropical areas there are extended periods when pasture quality is below that required for maintenance. It follows that cattle that have lowest maintenance requirements are likely to have higher survival rates during extended dry seasons. Brahman x British have lower maintenance requirements than British cattle and the Belmont Red tends to be intermediate, but on poor nutrition, are closer to the Brahman x British.

This information shows that the Belmont Red is well adapted to a tropical environment, although in some respects the level of adaptation is not quite as high as that found in Brahman x British cattle. The lower tolerance to worms suggests that the breed may be better adapted to the drier zones of the tropics.

Survival

At "Belmont", deaths among the Belmont Reds have been markedly fewer among the British and marginally fewer than in Brahman x British cattle up to the age of two years. Among adult cattle the Brahman x British have slightly higher survival rates than Belmont Red cattle, which have much higher survival rates than British cattle.

Reproduction Rates

The first cross Brahman x British and Africander x British cattle were more fertile than Hereford x Shorthorn cattle. However in the second and subsequent generations, fertility in the Brahman x British cattle decreased dramatically. This was due to decreased fertility in both males and females. By contrast, the Africander x British cattle showed no drop in fertility when hybrid vigour was depleted. Table I shows this effect.

TABLE I

CALVING PERCENTAGE BY BREED AND GENERATION—BELMONT

Breed	First Generation	Second and Subsequent Generations
Belmont Red ..	76	77
Braham x British ..	81	61
British	70	67

This lowered fertility has also occurred under commercial conditions. Pregnancy rates of breeding females sired by Brahman, Santa Gertrudis, Droughtmaster and Belmont Red from Brahman x Hereford cows, and by Hereford bulls from high grade Brahman cows were compared. Data from this trial are shown in Table II and were from yearling maiden heifers and two year lactating cows.

TABLE II

PREGNANCY RATES BY BREEDING—MOUNT EUGENE

Genotype of Females	Pregnancy Percentage
$\frac{5}{8}$–$\frac{3}{4}$ Brahman	63
Hereford x Brahman First Generation	86
Santa Gertrudis x Brahman Hereford	71
Droughtmaster x Brahman Hereford	75
Belmont Red x Brahman Hereford ..	86

This information indicates that the pregnancy rates from Belmont Red x Brahman Hereford will be high and comparable with F1 Hereford Brahman. The Santa Gertrudis x Brahman Hereford and Droughtmaster x Brahman Hereford are genetically similar to the Brahman x British line at the National Cattle Breeding Station, and show a similar reduction in fertility.

Under commercial conditions this weakness can be partially overcome by a programme of culling subfertile cows. The result is a highly fertile group of mature cows, but owing to low heritabilities for reproduction, fertility in the first and second calvers is not improved.

Growth

Belmont Red and Brahman x British cattle have better growth rates than British cattle in a tropical environment. These differences are the result of the better environmental adaptation of the Africander and Brahman based breeds. The slightly better environmental adaptation of the Brahman x British cattle is reflected in slightly better growth rates than those of the Belmont Red.

Unlike fertility, growth rates were not seriously depresed in the second and subsequent generations. Relative growth rates of the different breeds and generations are shown as weight at two different ages in Table III.

TABLE III

WEIGHT OF THE DIFFERENT BREEDS AT 250 DAYS (WEANING) AND 820 DAYS OF AGE—BELMONT

Breed	First Generation		Second and Subsequent Generations	
	250 days	820 days	250 days	820 days
	kg	kg	kg	kg
Belmont Red ..	186	354	183	341
Brahman x British	217	368	208	387

The initial data show that the weaning weights of the F1 Africander x British were 86% of the Brahman x British, but recent data show that the weaning weights of the Belmont Red are now 97% of the Brahman x British. This is probably due to higher selection intensity for weight for age and tick resistance in the Belmont Red, which has been possible because of their higher fertility.

TABLE IV

WEIGHTS OF STEERS OF DIFFERENT BREEDING—MOUNT EUGENE

Genotype	Weight at 180 days	Weight at 500 days
	kg	kg
$\frac{5}{8}$–$\frac{3}{4}$ Brahman	207	331
Hereford Brahman First Generation	196	326
Santa Gertrudis x Brahman Hereford	202	321
Droughtmaster x Brahman Hereford	203	322
Belmont Red x Brahman Hereford	203	322

In a commercial herd, the growth rate of steers sired by Belmont Red bulls has been shown comparable to that of progeny of commercially bred bulls. This is shown in Table IV.

Although Belmont Red cattle may have slightly lower weight at a given age than Brahman x British cattle, this difference would be more than offset by the better reproduction rates. Additionally, the higher reproduction rates allow for a greater selection pressure for weight, and given sensible selection criteria, the difference could be reversed in two or three generations.

Carcase Characteristics

It has been established that weight is the major factor affecting carcase composition in terms of lean meat, fat and bone. While there are differences between breeds, these differences are usually small at any given weight.

Within the lines of cattle examined at Belmont, the Brahman x British have the highest dressing percentage, and the British and Belmont Red have similar dressing percentages. In terms of total yield of trimmed meat in retail cuts, Belmont Red carcases had the highest (72%), while the Brahman x British and British carcases were the same (70%). The yield of choice hindquarter cuts tended to favour the Belmont Red and British carcases (30%) over the Brahman x British carcases (29%). The eye muscle area is generally largest in the Belmont Red. Within each breed the faster growing animals had higher proportion of muscle in the choice hindquarter cuts.

Miscellaneous

The nervous temperament of Brahman based breeds is well known. In this trait the Belmont Red appears to be markedly superior. Temperament has important implications regarding normal cattle handling, bruising, and fat colour in carcases.

Colour has no real economic value, but some breeders like evenly coloured animals. Belmont Red cattle are predominantly red even when no selection for colour is practised.

By contrast, Brahman x British cattle have a wide variation in colour, and breeders who select for colour have to discard animals which are productive in terms of beef production.

CONCLUSIONS

No breed of cattle has all the attributes desired by beef producers. The choice of breed is a value judgement which can be made more accurate if the factors affecting environmental adaptation, and the comparative production traits, are known and understood. Both the Brahman based breeds and the Africander based Belmont Red are well adapted to a tropical environment.

While Brahman based breeds have excellent environmental adaptation and growth rate on pasture, lowered reproductive efficiency is a serious disadvantage. Belmont Red cattle are slightly less well adapted to the tropical environment and this is reflected in slightly lower growth rates. But these disadvantages are offset largely by excellent reproductive efficiency and temperament. It is probable that in the drier areas of the tropics, where worms and ticks are less active, the growth rate of the Belmont Red will approximate that of the Brahman based cattle.

Acknowledgements. These results were largely drawn from the published work from the Tropical Cattle Research Centre. Rockhampton.

Oats varieties for 1976

by Officers of Agriculture Branch

IN Queensland oats are sown mainly for grazing. Less than 12% of the area is given over to seed, hay and silage production.

The main oat plantings are south of the Tropic of Capricorn.

Oats are usually classified according to their rate of growth as either quick growing or slow. The accompanying table provides details of the characteristics of a number of oat varieties.

The varieties Bentland and Minhafer are examples of quick growing types which have an erect plant habit, and high early growth rate. These often present grazing management problems under normal seasonal conditions.

Algerian and Camellia, on the other hand, have a slower growth rate and are semi-prostrate in habit. They are usually easier to manage in a forage sequence than the quick growing types.

Seven varieties have been recommended this year, together with varieties that may be sown if seed of the recommended varieties is not available.

Where this problem arises, farmers should contact their local Department of Primary Industries office or consult the table of oat varietal characteristics to determine a useful alternative.

Where Saia is sown the planting rates should be at the lower end of the range shown.

Fertilizer recommendations and further information should be obtained from the local D.P.I. officer.

District Recommendations

District (Shires)	Planting Months	Varieties	Planting Rates kg/ha
North Queensland			
Townsville, Ayr, Millaroo, Bowen	IRRIGATED April–May	Camellia, Saia	50–60 (Saia Lower rate)
Capricornia			
CENTRAL COAST			
A. Broadsound, Calliope, Fitzroy, Livingstone, Mirani, Nebo, Pioneer, Proserpine, Sarina	March–April	Camellia	40–50
	April–May	Bentland, Minhafer	
B. Banana Shire and Duaringa Shire South of the Capricorn Highway	GRAZING Late Feb.–June	Camellia, Algerian, Minhafer, Bentland	25–50
	HAY April–June	Minhafer, Bentland	25–50
C. Bauhinia, Belyando, Emerald, Peak Downs	February	Algerian	20–40
	March–June	Algerian, Camellia	20–40
Burnett			
CENTRAL AND UPPER BURNETT			
A. Biggenden, Gayndah, Mundubbera, Perry, Eidsvold, Monto	Feb.–April	Camellia, Algerian	30–50
	March–June	Minhafer, Saia, Bentland	
COASTAL BURNETT			
B. Gooburrum, Isis, Kolan, Miriam Vale, Woongarra, Burrum, Woocoo (limited application)	March–June	Minhafer, Saia, Bentland	30–50

District (Shires)	Planting Months	Varieties	Planting Rates kg/ha
South Burnett			
Kilkivan (part), Kingaroy, Murgon, Nanango, Wondai, Rosalie (Cooyar only)	Feb.–June	Camellia, Algerian	40–50
	March–June	Minhafer, Bentland	
Near North Coast			
Landsborough, Noosa, Maroochy, Widgee, Tiaro, Kilkivan (part)	March–June	Saia, Bentland, Minhafer, Camellia, Algerian	40–60 (raingrown)
	March–June	Saia, Bentland, Minhafer	50–90 (irrigated and sod seeded)
East Moreton			
Caboolture, Pine Rivers, Albert, Beaudesert	April–May	Saia, Bentland, Minhafer, Camellia, Algerian	40–60 (raingrown)
	June	Saia, Bentland, Minhafer	50–90 (irrigated and sod seeded)
West Moreton			
Kilcoy, Esk, Gatton, Laidley, Moreton, Boonah	March–April	Saia, Minhafer, Bentland, Algerian, Camellia	40–60 (raingrown)
	May	Saia, Minhafer, Bentland	50–90 (irrigated and sod seeded)
Darling Downs			
NORTHERN DOWNS:			
Chinchilla	Feb.–March	Algerian, Camellia	25–35
	March–June	Minhafer, Bentland, Camellia	25–40
Wambo	March–June	Algerian, Minhafer, Camellia	25–40
	July	Algerian	35–45
CENTRAL DOWNS:			
Crow's Nest, Jondaryan, Pittsworth, Rosalie, Millmerran (east of Condamine River)	Feb.–March	Algerian, Camellia	35–45
	March–June	Minhafer, Garry, Bentland, Camellia	35–45
	July	Algerian	35–45
Millmerran (west of Condamine River)	Feb.–March	Algerian, Camellia	25–35
	March–June	Minhafer, Bentland, Camellia	25–40
SOUTHERN DOWNS:			
Clifton, Allora, Glengallan, Rosenthal (River alluvial soils)	Feb.–March	Algerian, Camellia (Rodney in selected areas)	35–45
	March–June	Minhafer, Camellia, Garry, Bentland	35–45
	July	Algerian	35–45
GRANITE SOILS:			
Stanthorpe, Rosenthal (Trap-rock and Granite Soils)	Feb.–March	Algerian, Saia, Rodney	25–35
	March–June	Saia, Minhafer	25–35
	July	Algerian	25–35
Inglewood	Feb.–March	Algerian, Camellia	30–40
	March–June	Minhafer, Bentland, Camellia	30–40
	Darling Downs Irrigation–Sowing rate increased to		**50–60**
Near South West			
Tara, Murilla, Taroom	March–June	Minhafer, Bentland	25–30 (35–late planting)
	March–July	Camellia, Algerian	20–25 (30–late planting)
Bendemere, Bungil, Warroo, Booringa	GRAZING		
	March–July	Minhafer, Garry, Camellia, Algerian	25 20–25
	HAY		
	April–June	Minhafer, Bentland	20–25
cnne, Waggamba	GRAZING		
	March–July	Minhafer, Bentland, Camellia	20–25 (30–35 late planting)
	HAY		
	April–June	Minhafer, Bentland	20–25 (30–35 late planting)

CHARACTERISTICS OF OAT VARIETIES

Variety	Growth to Flowering	Early Plant Habit	Growth to First Grazing	Frost Tolerance	Rust Resistance		Seed Colour	Awns	Tillering Ability	Grain Yield
					Crown	Stem				
Recommended Varieties										
Algerian ..	Sl	Prostrate	Sl	Good	S	S	Brown	Fine X	Good	Fair
Bentland ..	Med–Sl	Erect	Q	Fair	S	S	Yellow	Few fine	Fair	Fair
Camellia ..	Med–Sl	Semi-prost.	Med–Sl	V. good	S	V.S.	Yellow	Few fine	Good	Fair
Garry ..	Sl	Semi-erect	Q	Fair	Mod. R.	Mod. R.	Yellow	Few strong*	Fair	Fair
Minhafer ..	Med–Sl	Erect	Q	Fair	Mod. R.	Mod. R.	Cream	Few strong	Fair	Fair
Rodney ..	V. Sl	Erect	Q	Fair	S	S	Cream	Few strong*	Fair	Fair
Saia	Med–Sl	Semi-erect	Med	Poor	S	V.S.	Black	Med	Fair	Poor
Others may be sown when seed of above not available										
Avon ..	Med	Erect	Med	Poor	S	V.S.	Cream	Nil	Poor	Poor
Belar ..	Med	Semi-erect	Med	Fair	S	S	Lt. Brown	Strong*	Good	Good
Benton ..	Med–Sl	Erect	Q	Fair	S	S	Yellow	Fine	Fair	Fair
Cooba ..	Sl	Prostrate	Sl	V. Good	V.S.	S	Lt. Brown	Nil	V. good	V. good
Coolabah ..	Med	Semi-erect	Med	Good	V.S.	S	Cream	Strong*	Good	Fair
Fulghum ..	Q–med	Semi-erect	Med	Good	V.S.	S	Lt. Brown	Nil	Fair	Good
Klein ..	Sl	Prostrate	Sl	V. good	S	S	Lt. Brown	Fine X	V. good	Fair
Lampton ..	Sl	Semi-erect	Med	Poor	S	S	Lt. Brown	Strong	Fair	Fair
Landhafer ..	V. Sl	Semi-prost.	Med	Good	S	S	Brown	Fine X	Good	Fair

Sl = Slow; Med = Medium; Q = Quick; V.Sl. = Very slow; S = Susceptible; V.S. = Very susceptible; R. = Resistant; Mod R = Moderately resistant; X = Awns on both grains; * Strong awns indicated by twisted black base.

Modified shears help Mules operation

by P. S. BEASLEY and R. J. ANSON, Sheep and Wool Branch.

TO be efficient at Mulesing it is essential that mulesing shears be in first class order. Well set, sharpened shears with weakened bow springs allow the operation to be done easily and quickly.

Shears are usually the dagging type with a 127 mm blade, available as left or right hand design. The design is important because a left-handed operator using shears of right hand design is liable to injure his hands. Most operators usually carry at least four pairs of shears and a medium aluminium oxide silicon carbide sharpening stone.

Modification

Modification consists of four features:—

- Shortened and rounded-off shear points.
- "Off set" handles which permit the points of the blade to remain open in the form of a V when shears are held in the closed position.
- Weakened bow springs.
- Ground-back shoulders on the blades.

Reasons

Shortened and rounded-off shear points minimise the risk of injury to the catchers if sheep are held over the rail for mulesing. The rounded-off points of the shears do not foul in long wool nor dig into flesh or muscle of the sheep's leg.

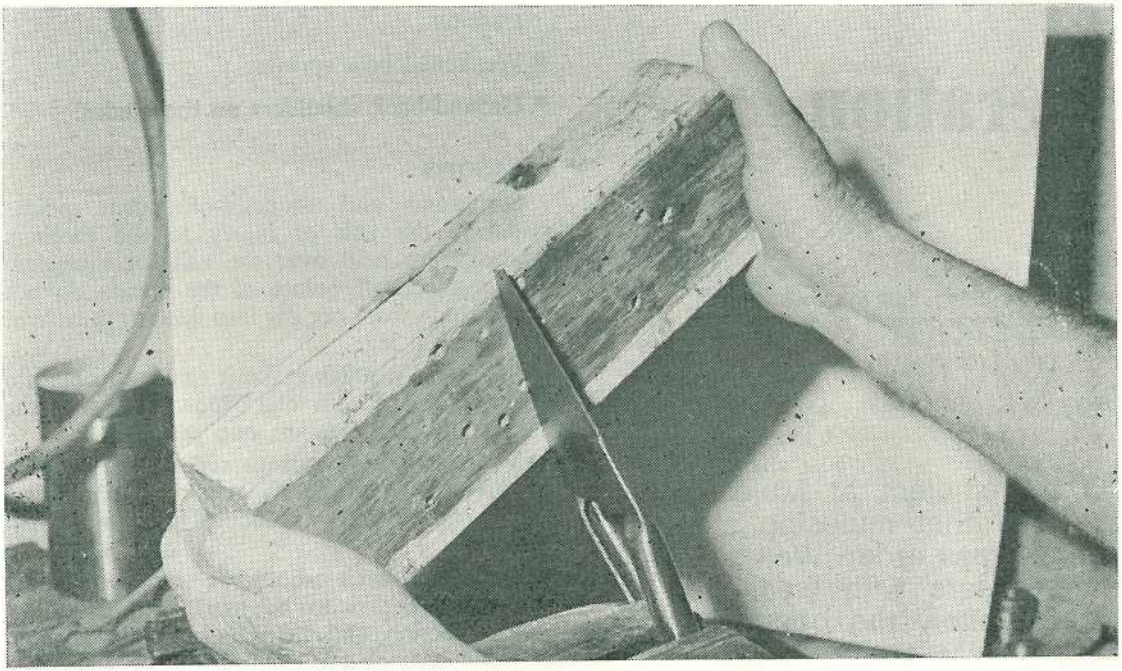
"Off set" handles make it easier to obtain a wider skin cut with one "blow" allowing the skin to be removed in one piece.

Weakened bow springs reduce the amount of pressure required to grip and manipulate the shears, thereby reducing hand and wrist fatigue.

Ground-back shoulders on the blades allow the shears to be used with a sliding, cutting action and help to maintain a finer, sharper edge on the shears.

Breaking points off and reducing length of blade by 6 mm. Ends should be bevelled to a rounded blunt point.

"Off Set" Handles. Showing method used to pull blades off normal set. Each blade pulled 6 mm. off usual set.



Methods

Shortened shear points.—The points can be cut back by grinding them on an emery wheel or breaking them off in a vice. The reduction in length of blade should not be more than 6 mm. The ends should be bevelled to a rounded, blunt point.

"Off set" handles.—Each handle is placed in a vice so that it is gripped at a point 38 mm from the curve of the bow spring. The blade is pulled 6 mm off normal set. To do this a 305 mm length of 75 mm x 50 mm hardwood is placed across the cutting edge below the points of the blade, gripped at each end and pulled so that the blade is moved back from its normal position. The V formed at the points by this "off setting" should measure 32 mm across and 50 mm long.

Weakened bow springs.—The bow springs are weakened by drawing the handles across each other as shown in. (Gloves are needed to do this as it is easy to injure the hands).

Ground-back shoulders on the blades.—The blades of new shears are from 1 mm to 2 mm thick on the cutting edge. The first job is to remove much of the steel over a 15 mm face from the edge. To do this it is best to grind the shears on a water sandstone wheel. This initial grinding may take an hour. If an emery wheel is used great care must be taken to prevent loss of temper of the steel through overheating. A shearing comb or cutter emery disc running at half speed is also suitable for cutting back. The angle from the cutting edge to the shoulder should be approximately 15°. If this angle is more acute the cutting edge is liable to "gap" during subsequent use.

Setting

In the process of modifying the shears the setting of the blades may alter. To bring the blades and cutting edges into correct alignment place each blade separately in a vice and pull, push or twist the handle gently until the gap between the blades when shears are examined in the closed position should measure from zero at the V to 2 mm at the heel approximately the thickness of a 20 cent coin.

Sharpening

The most efficient method of sharpening the shears without disturbing the bow spring or the setting of the cutting edge is to cross the blades.

A strap buckled round the handles will ease the pressure of holding the blade in position for sharpening and allow the oil stone access to the whole blade. Sharpen along the whole length of the blade at an angle of 15° until a light "burr" is turned over. This "burr" or "feather edge" can be felt by rubbing the thumb across the sharpened edge (not along it). A light rub along the back of the blade, keeping the stone absolutely flat, will remove this "burr". It is important to maintain the same sharpening angle at all times and to use a circular motion. The finishing strokes should be direct movements straight along the blade from heel to point.

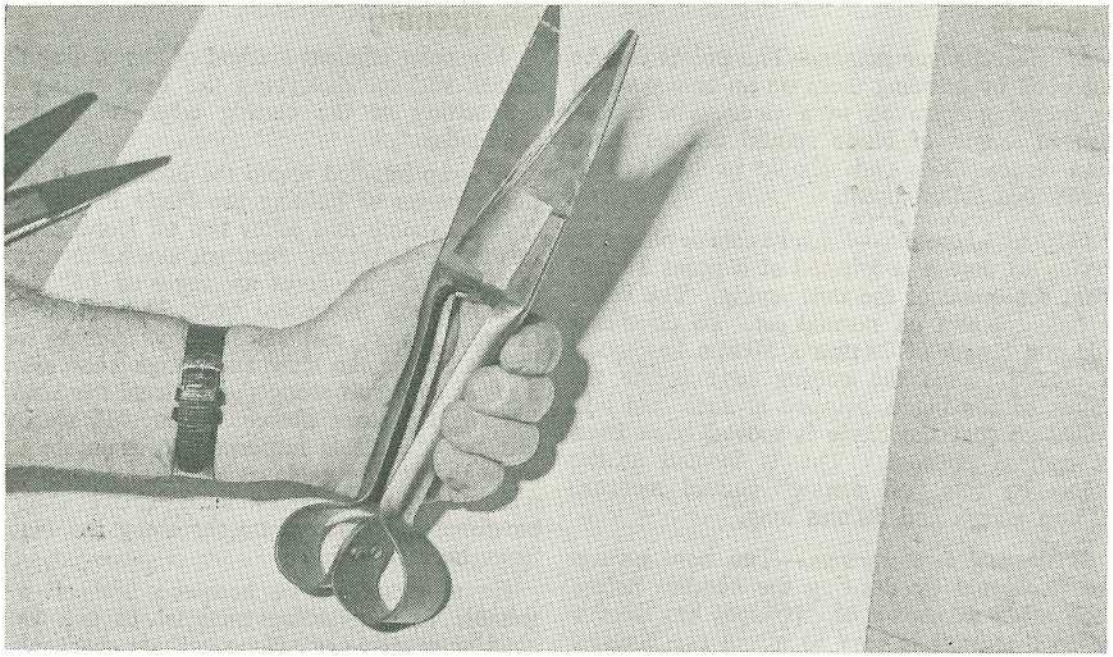
Equal quantities of kerosene and oil are suitable as a grinding material to use with aluminium oxide or silicon carbide sharpening stones. These lubricants will not "clog" the stone.

Advantages

- The modified shears are suitable for either grown sheep or lambs.
- The open points and ground-back shoulders make it easier to remove sufficient skin and to "run" the cut.
- Ragged edges are practically eliminated.
- Off-set blades with their small range of movement and weakened bow springs make the work less tiring.

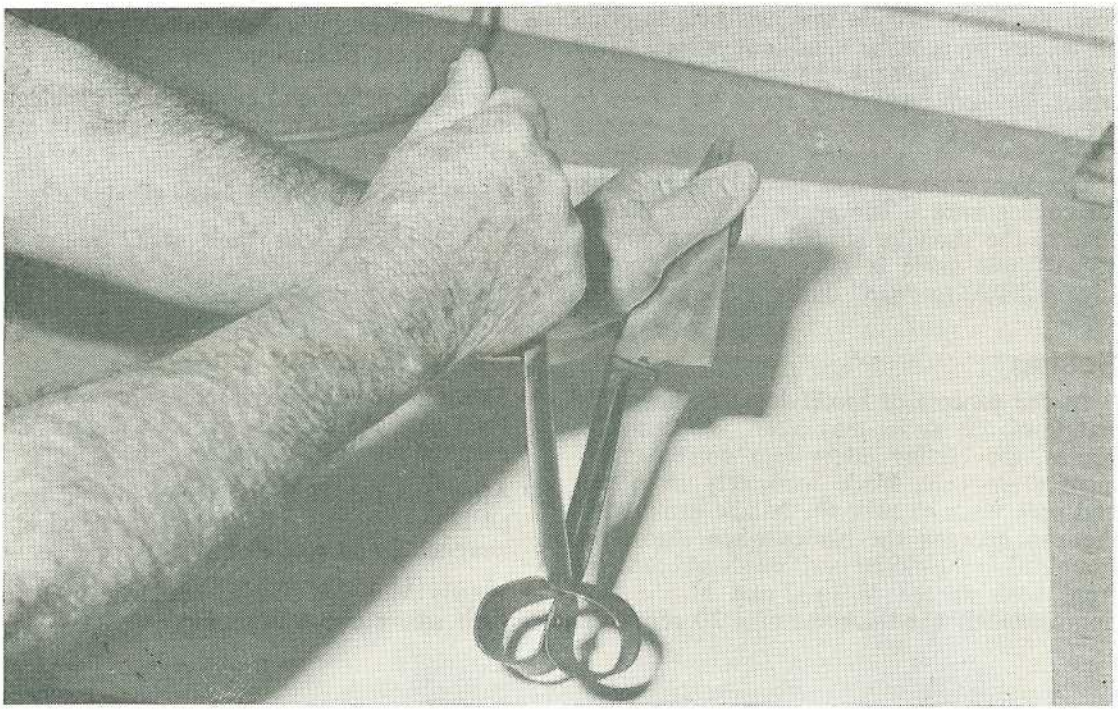
Care of Mulesing Shears

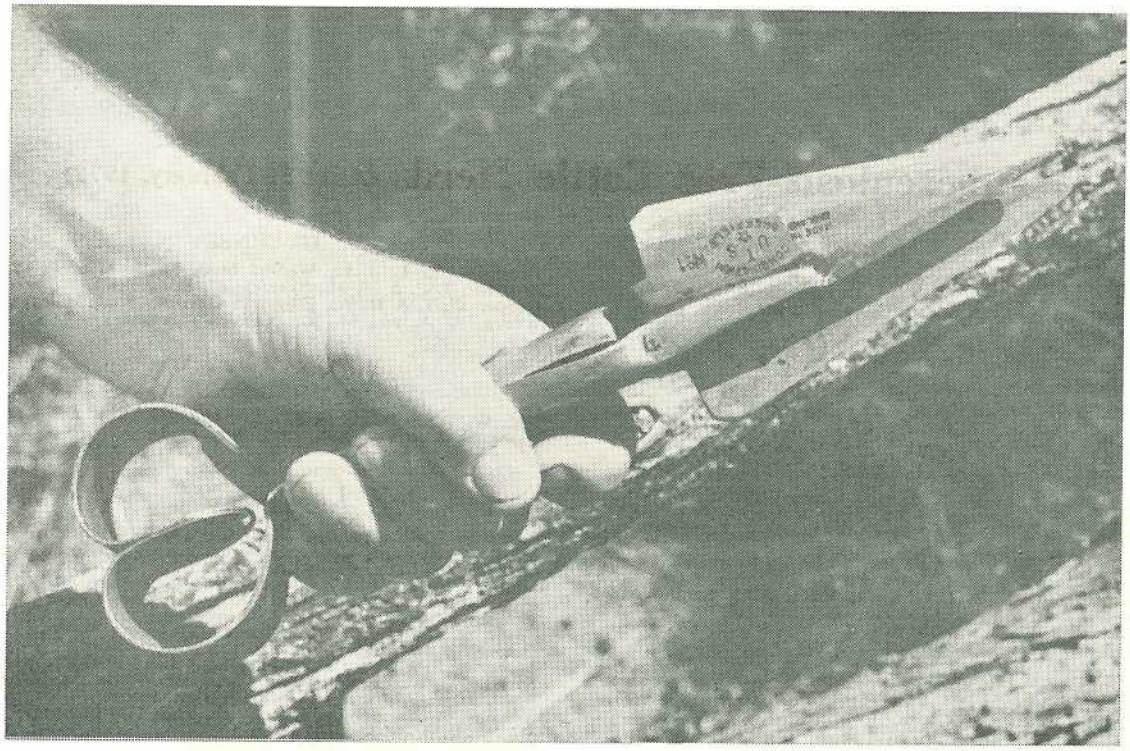
- The blades are most susceptible to rust. Rust near the cutting edge causes gaps and eventual ruin of the blades.
- After use, the Mulesing shears should have all blood washed off, thoroughly dried and wrapped in an oily cloth.
- Finally Mulesing shears should be used for their sole purpose Mulesing.



Showing V 32 mm. x 50 mm. formed on Shears after "Off Setting".

Weakening the Bowsprings by drawing handles across each other. (Gloves should be used on hands.)





Crossing blades as shown allows for efficient sharpening of the whole blade and does not disturb setting, or initial tension of bow springs.

FOURTH EDITION—FARM MANAGEMENT BOOK

The fourth edition of this handbook is aimed at providing a ready reference to technical and financial data which can be used by educational institutions, extension officers, farmers, graziers and others concerned with property planning and development.

The handbook has been completely revised and converted to the metric system. It brings together reference data from numerous sources and presents it, for convenience, in a single publication.

To obtain your copy of the Farm Management Handbook, send $2.50 to: Director of Economic Services, Department of Primary Industries, William St., Brisbane, 4000.

Tuberculosis-Free Cattle Herds (As at 21 February, 1975)

ANGUS

Corden, E. B., Netherby, Warwick
Crothers, H. J. "Mooreenbah", Dirranbandi
Mayne, W. H. C. & Sons, "Gibraltar", Texas

A.I.S.

Cox, T. L. & L. M. J., Seafield Farm, Wallumbilla
Evans, E. G., Lauraven A.I.S. Stud, Maleny
Henry, Mrs. K. & Sons, "Tara", P.O. Box 4, Cambooya
H. M. State Prison Farm, Numinbah
Klein Bros., Kapleton A.I.S. Stud, Ma Ma Creek, via Grantham
Lawley, E. D. & Sons, Arley A.I.S. Stud, Maleny
Marquardt, C. R. & J. L., Cedar Valley A.I.S. Stud, Wondai
Martin, J. P. & R. J., Kentville, via Forest Hill
Middleton, C. W., Airton Vale, Cambooya
Mitchell and Mulcahy, Rosenthal
O'Sullivan, P. W., "Navleigh", M.S. 371, Greenmount
Pagel, E. E., and Hayes, E. M., Trafalgar Stud, Tarampa, via Lowood
Queensland Agricultural College, Lawes
Ross, W. & Co., M.S. 23, Rosewood
Schelbach, N. N. & Co., Allanview Stud, Warwick
Siebenhausen, J. & S. C., "Meniton", M.S. 195, Pittsworth
Thompson, W. H., "Alfa Vale", Nanango
Vohland, A. R., Bevallan, Stoneleigh, M.S. 150, Pittsworth
Weier, L. G., Prairie Plain A.I.S. Stud, M.S. 765, Allora

AYRSHIRE

Goddard, B., Inverell, Mt. Tyson, via Oakey
Scott, J. N. & Son, "Auchen Eden", Camp Mountain

BRAFORD

Bowden, W. H., "Brendale", South Pine Road, Strathpine
Thompson, M. A. K., "Glen Kyle", Buderim

FRIESIAN

Behrendorff, E. C. & N. G., Inavale Friesian Stud, M.S. 786, Boonah
Evans, P. J., M.S. 28, Dragon St., Warwick
Guppy, N. J. & H. M., Bli Bli Road, Nambour
Hickey, K. A. & M. R., Bunya
Lobley, N. E., "Neloby", Mt. Pleasant, via Dayboro
McWilliam, A. A., Oatlands Stud, M.S. 918, Toowoomba
Martin, R. J. and E. L., Kentville, via Forest Hill
Panzram, J. & K., Bienheim, via Laidley
Queensland Agricultural College, Lawes
Stumer, A. O., Brigalow, Boonah
Vonhoff, A. R. & D. G., M.S. 918, Toowoomba

GUERNSEY

Dionysius, R. L. & L., Warana Stud, M. S. 1796, Proston
Erbacher, J. P. & M. M., "Leafmore", Hodgsonvale
Hopper, G. T. & H. W., Ellendean Guernsey Stud, Maleny
Wilson, R. A. and M. R., "Okeden", Proston

HEREFORD

Hill, W. W. & P. C., "Mathalla", Dirranbandi
Panorama Stud Pty. Ltd., M.S. 765, Allora

JERSEY

Conochie, I. S., Brookland Jersey Stud, M.S. 461, Kalbar
H. M. Prison Farm, Capricornia Stud, P.M.B. 11, Rockhampton
H. M. State Farm, Palen Creek
Lau, J. F., "Rossallen", Goombungee, Toowoomba
McDonald, R. G., "Buffelvale", M.S. 807, Mundubbera
Paulger, S. & S. M., "Advale", Kenilworth
Postle, R. S. & G. C., "Yarallaside", Pittsworth
Queensland Agricultural College, Lawes
Snare, A. E. & Son, Laidley Park Stud, Laidley, 4341
Spressor, O. W., Carnation Jersey Stud, Mt. Walker Rd., Rosewood
Todd, J. R., Aberfoyle, Laravale, via Beaudesert
Vohland, A. R., Bevallan, Stoneleigh, M.S. 150, Pittsworth
Waite, H. M., M.S. 182, Laidley
Westbrook Training Centre, Westbrook

POLL HEREFORD

Anderson, J. H. & Sons, "Inverary", Yandilla
Christensen, B. L. & M. O., "Elavesor", Rosevale
Morris, H. J. & D. I., Gaiview Stud, Clifton
Nee Nee Pastoral Co., Dirranbandi, 4392
Stiller, N. L., "Vine Veil", Guluguba

POLL SHORTHORN

Leonard, W. & Sons, "Welltown", Goondiwindi
Pointon, R. B. & S. C., "Wywurri", M.S. 780, Kingaroy

BRAHMAN

Queensland Agricultural College, Lawes
The Cherokee Group Brahman Cattle Co., Tanby

SANTA GERTRUDIS

Barbara Plains Grazing Co., Barbara Plains, Wyandra
Central Estates, Comet Downs, Comet

SHORTHORN

Pointon, R. B. & S. C., "Wywurri", M.S. 780, Kingaroy

DROUGHTMASTER

University of Queensland, Veterinary School, St. Lucia

Part 3

Guide to soils and plant nutrition

by N. G. CASSIDY

In this section:

Salt and alkalinity;

Cation exchange;

Anion exchange;

Phosphate fixation.

Salt and Alkalinity

SALT is a very frequent cause of injury to plants; and alkalinity (see later section on pH) is an important cause of damage to soils.

The term salt generally refers to sodium chloride (common salt) although other chlorides such as calcium chloride, and other salts such as calcium sulphate and sodium bicarbonate may also be involved.

A salt represents the union of two ions, a cation with an anion.

It is only the first part of the salt (sodium, calcium or magnesium ion) to which we refer when ALKALINITY is in question.

When *excess of salt* is a matter of concern, sodium chloride is most often the salt predominating, and the chloride ion is the most toxic one under nearly all natural conditions.

We will discuss the reason for this special toxicity of chloride ion to plant life in a later chapter. It can result in the death of leaves and finally in the death of the plant. A plant analysis for chloride that is based on the dry weight of the plant (or oven-dry matter) may be completely misleading, and in such a case a request for chloride expressed on the basis of "sap" should be made to the laboratory to assess the true level of toxicity.

Most plants of commercial importance are tolerant to chloride only up to 0·25% in sap (70 milliequivalents per litre) but halophytes (plants tolerant to salt) such as asparagus, barley, beets, cotton, kikuyu grass, lucerne, will stand much more. Coconut palms have double the normal level of tolerance and date palm would probably have the highest level for cultivated plants. See Table 1.

The accumulation of chloride in plant leaves eventually kills plant cells, and this is seen visually in the brown, dead patches near the leaf tips and the adjacent leaf margins.

When a very high level of salinity is present in the soil (as on a salt pan), chloride accumulates in the lower section of the stem faster than it can be transported to the leaves. Under less severe conditions, the leaves contain the highest amount of chloride salt and are the best indicators of salinity.

Alkalinity

Alkalinity of the soil affects plants indirectly: the direct effect is on the soil itself.

The chemically active part of a soil is the clay present in it. Clay is in its most desirable state when it has mostly calcium ions combined with it, and only few sodium ions. In such a state the soil holds both water and air well, and it is not unduly sticky.

When the proportions of calcium and sodium begin to be reversed, the clay deteriorates badly, and so does the soil. As shown in Section 2 the structure of the soil falls down. The soil becomes a slurry when wet, and powders easily when dry. The supply of air in the soil is diminished and plants will not grow. Seedlings may not be able to penetrate the hard crust that forms on the soil when the surface gets dry. In every way plant production suffers.

In technical terms, the soil deteriorates when the replaceable sodium ion amounts to 3-5 milliequivalents per 100 g soil or more generally when the sodium amounts to about 10% of the total replaceable cations. At 15% the damage is usually quite visible to the eye, and the soil is likely to be impervious to water, and to set very hard when dry. In a domestic water-supply calcium and magnesium are the cause of "hardness". In this situation sodium is to be preferred, because it makes softer water. This has given rise to the saying, "Soft water makes hard soil". It is the soft character of some bore waters that makes them useless for the irrigation of plants. (Other bore waters are too saline for irrigation.)

The *quality of irrigation water* becomes critical:—

- when a high total salt content raises the osmotic pressure of the soil solution.
- if the sodium present is many times greater than calcium.
- if sodium bicarbonate, or the trace element boron, exceed values that are safe (5m.e./1 and 0·5 p.p.m. respectively).

An excess of salt in the soil-moisture causes plants to show decreased *transpiration.* This is because the water is subject to restricted movement when it has much salt dissolved in it.

Pure water has greater free energy than water that has salt dissolved in it. For this reason, if pure water contained in one compartment is separated from salt water in another compartment, by a partition that will let only water pass through, a change in water level takes place.

Water passes from the "free" compartment faster than it can pass from the salt compartment. This results in an increasing level in the salt one, until such time as the extra pressure **(OSMOTIC PRESSURE of salt solution)** brings further flow to a stop.

This kind of action goes on as long as contiguous solutions have different salt concentrations.

Normally the soil solution contains less dissolved matter than does the plant sap, so water (and in this case salt as well) can pass into the plant, and be carried up by transpiration.

When there is too much salt in the soil solution the process could come to a stop were it not for the energy which the plant obtains from sunlight in its life processes (metabolism).

Osmotic pressures are often measured as multiples of atmospheric pressure. Wide variations in O.P. may occur in plant-tissue fluids, depending on the environment. For

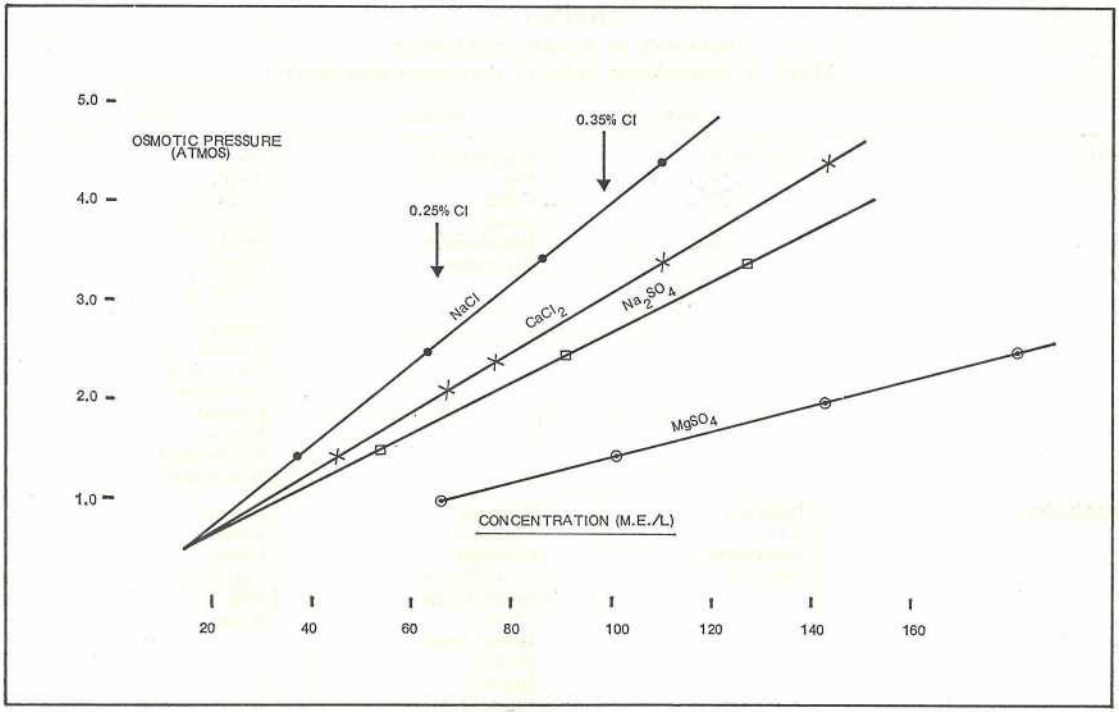
TABLE 1

TOLERANCE OF PLANTS TO SALINITY

(Listed in approximate order of decreasing tolerance)

	High	Medium	Low
Fruit	Date Palm	Pomegranate Fig Olive Grape Rockmelon Mulberry	Pear Apple Orange Grapefruit Prune Plum Almond Apricot Peach Lemon Pecan Nut Avocado Loquat Papaw Persimmon Strawberry
Vegetables	Beetroot Kale Asparagus Spinach	Tomato Broccoli Cabbage Cauliflower Sweet Corn Carrot Broad Bean Onion Squash Pumpkins Cucumber	Potato Radish Celery Lettuce Peas Beans
Fodders	Rhodes grass Couch grass Barley (hay) Birdsfoot–Trefoil Barley grass Kikuyu grass Sea barley grass Wimmera rye grass Lucerne	White sweet clover Yellow sweet clover Perennial rye grass Strawberry clover Paspalum Sudan grass Rye (hay variety) Wheat (hay) Oats (hay) Cocksfoot Toowoomba canary grass Reed canary grass	White Dutch clover Meadow foxtail Red clover Alsike clover Ladino clover Subterranean clover
Field Crops	Barley (grain type) Rape Cotton	Rye (grain) Wheat (grain) Oats (grain) Rice Maize Sorghum (grain) Linseed	Sunflower Castor beans Field beans Tobacco*
Ornamentals	Carnation Clematis	Bougainvillea Chrysanthemum Hibiscus Oleander Stock Gerbera Sanseviera	Aster Gladiolus Bauhinia Poinsettia Rose African Violet Azalea Camellia Gardenia Hydrangea Magnolia Primula Violet

* Due to adverse effect in leaf quality



example salt bush (*Atriplex* sp.) may have values from 22 to 63 atmospheres. Cultivated plants generally have values less than 2, and most cultivated plants begin to show ill effects at 3·5 atmospheres. This corresponds to 70 milliequivalents per litre of plant sap if the salts are NaCl or $NaHCO_3$ (sodium chloride & sodium bicarbonate). For $CaCl_2$, $MgCl_2$ or Na_2SO_4 (calcium & magnesium chloride and sodium sulphate) the concentration would be 120 m.e. per litre: and for $MgSO_4$ (magnesium sulphate) it would be 275 m.e. per litre. This demonstrates that chemically equivalent amounts of different salts can have quite different osmotic pressure.

There are two reasons for this: first O.P. is proportional to the *number of ions* which one chemical equivalent can supply: and second, simple salts such as NaCl (mono-mono valent) are more completely ionised than say $MgSO_4$ (di-di valent).

The effect of an increasing O.P. in the soil solution was investigated for lucerne.

Lucerne	Osmotic pressures (atmospheres)			
In soil solution	0·9	4·2	6·6	8·2
In plant sap	12·3	14·5	17·9	19·9
Relative plant yields ..	100	62	32	22

Tolerance

It is clear that as the osmotic pressure of the soil solution was increased the O.P. of the plant sap increased correspondingly. This is one requirement for *tolerance to salinity*: the other is that the plant tissues must be able to tolerate the increased tension. In actual fact, lucerne is known to have a good tolerance to salt: but the effect of very high salinity is still evident in the reduced yield.

The plant has in fact so increased in the O.P. of its sap that the difference between sap and soil solution has not altered. If the soil becomes salty enough, the plant must eventually lose water from the roots to the soil.

This is a case where abundant water is present, but its availability is limited by high osmotic pressure. It is sometimes known as physiological drought.

Distribution

The *distribution of salt* in the soil profile can be a matter of life or death for young plants. If much of the total salt is concentrated as a crust on top of the soil, seedlings may die as soon as they have germinated. This can be avoided by ridging the soil before planting, and then sowing the seed near the foot of each ridge.

The ability *to detect the presence of salinity,* and to measure the extent of it, are of everyday importance in soil science.

A water-extract of the soil is made and this is analysed for chloride salts, and (when necessary) for sulphates or carbonates.

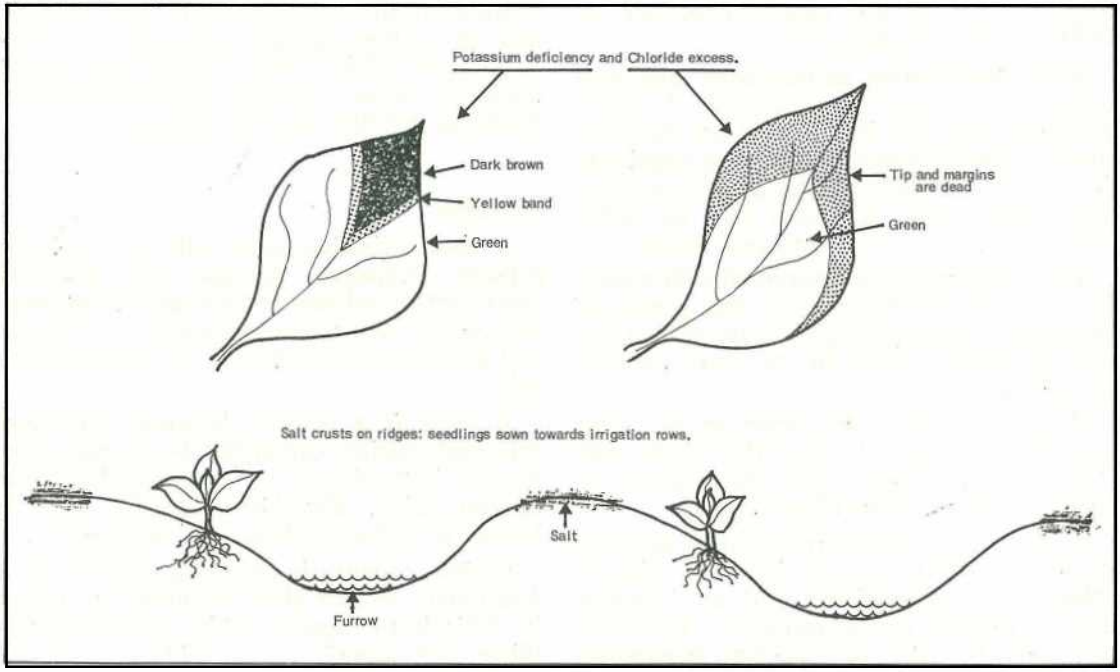
The determination of osmotic pressure is not so easy and is seldom made. O.P. values are usually calculated from the amount of soluble salts present. However, electrical CONDUCTIVITY provides a useful and *quick way* of measuring soluble salts in a soil. The soil is made into a slurry with distilled water and a suitable electrode is dipped into the mixture. The reading obtained is a measure of all the soluble salts present. An investigation of a salt problem in a bowling green showed the following:

		Conductance @ 25°C
Good patch ..	(Cl—0·014%)	124 × 10^{-6} mhos.
Bad patch ..	(Cl—0·06%)	574
Very bad patch	(Cl—0·39%)	2,380

The increasing salinity (mainly chlorides) is confirmed by increasing values of the conductance.

The measurements of conductivity were made at a soil: water ratio of 1:5. The value obtained depends on how much water is added to the soil. In interpreting the results it must be realized that the plant is eventually subjected to soluble salts that are present in only a very little water, e.g. the water present when the soil is near wilting point. Here the soil:

By watering in the furrow the status quo is maintained, with most of the salt at the top of each ridge, due to capillary rise of water followed by deposition of salt.



solution ratio may be 1:0·04, so the true conductivity of the soil solution could be over 100 times greater than the value measured.

A normal, fertile, irrigation soil at the wilting point may have a true conductance in the soil solution, of 2,000 to 3,500 mhos x 10^{-6}.

Under the quick, practical system the value recorded would be one hundredth of this, in agreement with the "good patch" in the preceding table.

Detection

Under field conditions, salt can often be detected by a thin white crust on the soil surface or by the glittering of tiny crystals.

A strong white crust usually means sulphates are predominant. Chlorides are more likely to show their presence by dark, oily-looking patches. The latter are generally the most toxic.

Cation Exchange

THIS is a property which is especially characteristic of soil. It refers to both the mineral and the organic parts of the clay. (Silt shows little evidence of this property and the sands even less so.)

In practice it has proved much easier to investigate the mineral part of the soil, because here the use of X-ray analysis has enabled definite clay minerals to be identified, whereas not so much success has been obtained in trying to identify specific compounds in the organic part of the soil. (See GLOSSARY for Cation, Cation Exchange.)

Naturally-occurring zeolites have long been known to possess the property of cation exchange, and this is the basis of the well-known "water-softener". It may be noted that the modern "de-ionizer" goes further and simultaneously effects a cation and an anion exchange, thereby producing pure water.

The water softener is concerned with removing calcium and magnesium, the causes of "hardness", and replacing them by sodium that was previously present in the small particles of zeolite.

When the process has gone on for some time it is necessary to treat the zeolite with sodium (from common salt) in order to recharge it and renew its effectiveness.

This cycle operates in the opposite direction when we consider a soil (normally rich in calcium and magnesium) and an irrigation water (normally rich in sodium). The water will tend to take out calcium/magnesium, which then are largely lost in the drainage, and to leave sodium attached to the clay and organic matter, thus causing a "dispersed" condition. A preventative measure in such a situation is to add calcium in the form of gypsum (calcium sulphate). This may be added as a top-dressing to the land (perhaps 2-5 tons per acre, depending on circumstances) or even as a small amount dissolved in the irrigation water. When an irrigation water also contains sodium bicarbonate as well as sodium chloride, another danger is present. Free exposure of the water to the air, with resulting loss of carbon dioxide, may cause greater removal of calcium from the soil than would otherwise occur. Even 5 milliequivalents of $NaHCO_3$ per litre may be suspect.

Irrigation

A good irrigation water will not need this gypsum treatment, because one chemical equivalent of calcium can off-set the opposing tendency of about four equivalents of sodium, and no change will therefore take place in the soil.

If there *is* a reaction between water and soil, each calcium cation that is removed from the soil is "replaced" or "exchanged" by one sodium cation. For this reason the action is known as cation exchange or replacement.

Cation exchange is not to be regarded as a bad thing. In fact plant nutrition depends on it. This is the way in which potassium fertilizer, for example, reacts with the soil and

is held by the clay so that it is not washed out of the soil. Instead, it is gradually taken up by the plant roots; and the plant also obtains its calcium and magnesium from the same convenient store. Much of the cation content of a soil remains in a form of safe deposit, and only goes into the exchangeable form as the plant draws on its immediate resources.

The plant roots possess a cation exchange system of their own that allows free cations in the soil solution to be taken up by the roots.

Hydrogen ion formed from carbon dioxide and water is probably instrumental in releasing cations from the soil. Cation exchange is sometimes known as base exchange though this is not the preferred title.

Cation exchange is chemically of interest because it concerns the reactions of ions, not with other ions or molecules, but with COLLOIDAL particles. The latter are large aggregations that are not in true solution. They can be removed from the solution by strong centrifugal force or by certain filters. Substances in true solution are not affected in this way.

In spite of this, cation exchange reactions are practically instantaneous, and we have seen that they are reversible. Cation exchange is also involved in the correction of soil acidity.

Anion Exchange and Phosphate Fixation

IT has been known for a long time that soils can combine strongly with (or "fix") phosphate fertilizers, when these are applied to the moist soil. Indeed very little phosphate ion may be detected even in a soil that has had superphosphate broadcast over it. Most cultivated soils contain only 0·2–0·4 parts per million P in their SOIL SOLUTION.

The reaction that takes place between phosphate and soil may be partly an anion exchange (which is analagous to cation exchange) and it may be partly a combination with iron and aluminium oxides in the soil.

This latter reaction tends to be irreversible, whereas the exchange reaction can be reversed by addition of another anion, such as sulphate, silicate, bicarbonate, nitrate or chloride. In practice nitrate and chloride do not unite very tenaciously with the soil clay; so they will not readily replace phosphate from the clay. Silicate, sulphate, bicarbonate and hydroxide are important in releasing phosphate that is held on aluminosilicates.

Fixation by iron or aluminium is a special feature of red soils such as krasnozems and latosols, but it is not restricted to these soils.

A latosol may fix as much as 200 p.p.m. phosphate ion. Organic matter is very effective in moderating this.

The fact that phosphate can be fixed in a soil does not necessarily mean that it is a bad thing, nor does it mean that the phosphate is now unavailable to plants.

Fixation in this way assures that phosphate is never subject to the large losses that are suffered by nitrate when it is leached out by heavy rainfall or irrigation.

The phosphate may only be fixed as regards removal by pure water. If it remains soluble in dilute acid or alkaline solution, the plant may still slowly obtain its supply of phosphate.

The practical outcome is that soluble phosphate fertilizer will penetrate no further than about 5 cm. in most soils.

When the soil has high fixing capacity, a broadcast application of the fertilizer will cause the soil to have its maximum effect. This can be alleviated by applying the fertilizer in bands close to the plant roots. The crop farmer does this by drilling the fertilizer under or close beside the seed. Horticulturalists and gardeners can achieve the same thing in their own way. The result is to allow the plant roots

easy access to all of the fertilizer, but to deny this to the bulk of the soil. This has been called "placement availability".

There should be no unnecessary delay between fertilizer placement and planting, because time may increase the amount of fixation. However, on a krasnozem at Maleny the residual effect of superphosphate broadcast on pasture 10 months previously was even better than the immediate response had been. Yet this soil showed considerable fixation as measured by laboratory methods of extraction. It is unwise to rely on laboratory assessments, unless they are known to be in agreement with plant trials. In the past, "fixation" even against simple water-extraction has (erroneously) been regarded as unavailability to plants. The deciding factor may be the rate at which the plants need to get their phosphate. A short-term, leafy crop like lettuce will have a different kind of requirement from sugar cane that may be in the ground for more than a year.

Natural Deposits

Some natural phosphate deposits consist largely of iron and aluminium phosphate. Lau Islands phosphate unlike normal rock phosphate (calcium phosphate) is almost insoluble in dilute citric acid. As a fertilizer it is inert. It failed to show any measurable improvement except under flooded rice culture, and then it was much inferior to superphosphate.

Calcinin (heating) has been suggested as a means of improving low-grade phosphates Christmas Island phosphate of low grade was calcined, and compared in pot trials with other phosphates, on a tropical legume, Siratro.

RELATIVE YIELDS FROM USE OF PHOSPHATES

Superphosphate	100
Low grade rock phosphate—calcined ..	87
High grade rock phosphate—untreated ..	64
Low grade rock phosphate—untreated ..	47

A study of the economics of manufacture would be necessary to decide if the process is worthwhile.

Glossary

ALKALINITY—The presence of alkali: in soils this involves presence of sodium ions.

CATION—An ion carrying positive charge; e.g. hydrogen, sodium, potassium, calcium, magnesium, zinc, copper. Combined with hydroxyl ion they form hydroxides ("alkalis" or "bases".)

CATION EXCHANGE—Cations carry positive electric charges and are thus attracted to the soil clay which carries negative charges. A large amount of introduced cation can replace or "exchange for" other cations that are already present.

COLLOID—In solution, such a substance is dispersed as particles which are larger than molecules, but too small to settle out. They carry electric charges.

OSMOTIC PRESSURE—(of a salt solution). The pressure, or "head" of water that will just stop pure water passing through a membrane into a given salt solution. (The membrane must be pervious to water but not to salt.) It is usually measured in terms of normal atmospheric pressure, or bars.

SOIL SOLUTION—The water (and whatever may be contained in it) that is in equilibrium with the soil. The quantity of water for a given soil mass will vary. If the water is separated when the soil is saturated, this is known as the saturation extract. When soil is treated with a much larger quantity of water, the separated liquid is simply a soil extract.

Brigalow Management

first of a two part series

In this issue

—Brigalow clearing and regrowth control

—Brigalow pasture establishment and maintenance

—Growing crops on brigalow lands

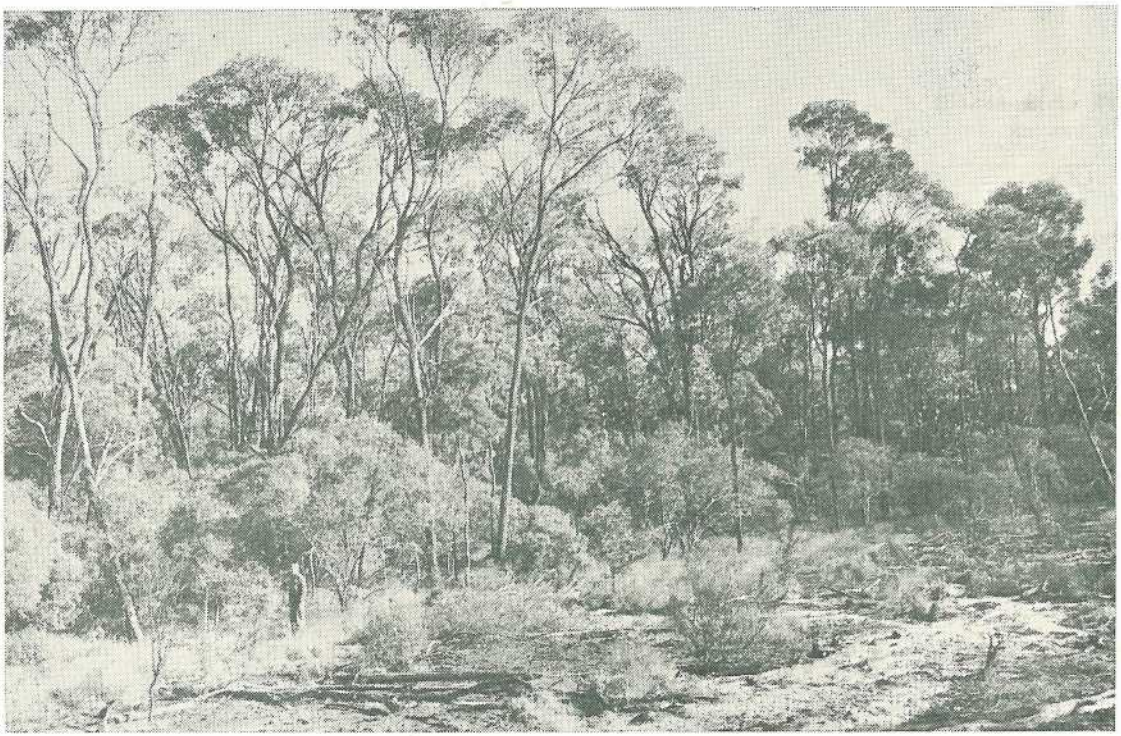
Brigalow Clearing and Regrowth Control

by R. W. JOHNSON, M.Sc., Ph.D.,
Assistant Director, Botany Branch.

BRIGALOW is a leguminous tree which in Queensland grows from the N.S.W. border north to about Charters Towers. It forms forests, known locally as scrub, up to 20 m tall in the 550-750 mm rainfall belt.

These scrubs cover an area of approximately 6 million hectares and prefer heavy cracking clay soils. In their natural state the scrubs are relatively unproductive though some of the open grassy brigalow forests can carry a beast to 8 ha.

Because the brigalow soils are much more fertile than those of the adjoining eucalypt forests large scale clearing of the brigalow scrubs has taken place. The clearing of these scrubs for pasture or crop is not a recent venture; it has been in progress for more than 80 years.



Virgin brigalow—wilga scrub.

Today the clearing of brigalow scrubs in most areas has been completed and emphasis has shifted towards the maintenance and utilization of pastures and the control of regrowth. The initial development phase will now only be of historical interest to many land holders, though some areas, cleared unsuccessfully more than twenty years ago will have to be treated by techniques similar to those used on virgin scrubs.

Planned Development

Indiscriminate clearing of scrub or regrowth simply for the sake of clearing has no place in a sound programme of planned development. A clear idea of the reason for developing any particular area of scrub or regrowth is needed and this should form the basis of any brigalow development programme.

As well each property is unique with its own particular resources and needs, and any programme of planned development must take account of this. Before embarking on a brigalow clearing or regrowth control programme the effect of any such programme on the property as a whole should be considered. It should be planned in conjunction with other property management decisions.

Brigalow clearing and regrowth control are usually undertaken with the intention of maintaining or increasing production. Other practices such as dam construction, fencing and herd improvement also serve the same end and must be considered as alternatives. For example, the purchase of 200 head of stock or the subdivision of large paddocks may be a better investment at a particular stage than controlling regrowth by ploughing.

Having decided to undertake brigalow clearing or regrowth control the next stage is to prepare a sound programme of attack leading eventually to the control of brigalow and its replacement by a productive long term pasture or a crop. Brigalow, because of its ability to sucker from roots and stems when damaged, is well adapted to survive the onslaught of man and areas of regrowth have persisted after years of hard work.

No single operation can be expected to solve all brigalow problems. Productive pastures and crops can only be achieved following a series of well planned and executed steps involving the removal or killing of the existing woody vegetation, the prevention or control of regrowth and the establishment of a pasture or crop. Besides considering the most suitable techniques for controlling brigalow in a particular situation thought must also be given to the additional management and capital requirements to make most effective use of the increase in area of pasture or crop.

Pulling virgin scrub using a cable and chain.

Inputs needed to prepare a sound development programme include—

(a) *Growth Form of Brigalow*—Programmes for the clearing of areas of tall whipstick or virgin brigalow will be different from programmes for the control of brigalow suckers.

(b) *Seasonal Conditions*—The timing of various phases in any development programme should depend on prevailing seasonal conditions and expectations. For this reason any programme should be flexible enough to accommodate and take advantage of varying seasonal conditions.

(c) *Proposed Land Use*—If land is to be prepared for annual cropping the development programme will be different from that devised for a grazing situation.

(d) *Financial Resources*—Available finance will determine both the type of programme to be undertaken and the area that can be handled at any one time. Such finance should be sufficient to cover not only the brigalow control operations but also consequential requirements such as fencing, watering, pasture seed and stock.

Ultimately the effectiveness of any programme will depend on the skill of the manager.

Available programmes are of two types—

(a) *Initial Development Programme*—These involve the steps to convert virgin, whipstick or tall sucker brigalow into pasture or crop.

(b) *Maintenance and Reclamation Programmes*—These involve the steps required to prevent brigalow suckers from destroying productive pastures or to convert dense stands of brigalow regrowth into pasture or crop.

Initial Development Programmes

The aim of any initial development programme is usually threefold:—

(a) Establishment of productive pasture or crop.

(b) Prevention or control of woody weed regrowth.

(c) Provision of means to effectively utilize the crop or pasture.

To achieve this a well prepared development plan which will incorporate a number of separate but related operations is needed. This must be prepared before beginning the first operation. Careless decisions to pull large areas of scrub before considering the consequences of the action have spelled doom for quite a few settlers.

Over the past 20 years it has been usual to clear brigalow scrubs by pulling them to the ground with a heavy chain or a chain and a cable dragged by two high powered bulldozers. This method replaced ringbarking which was the favoured method prior to that time and which was used to clear about 1·5 million hectares of brigalow scrubs mainly in southern Queensland. Since 1954 aerial spraying with 2,4,5–T has been used on a few properties to initiate development programmes.

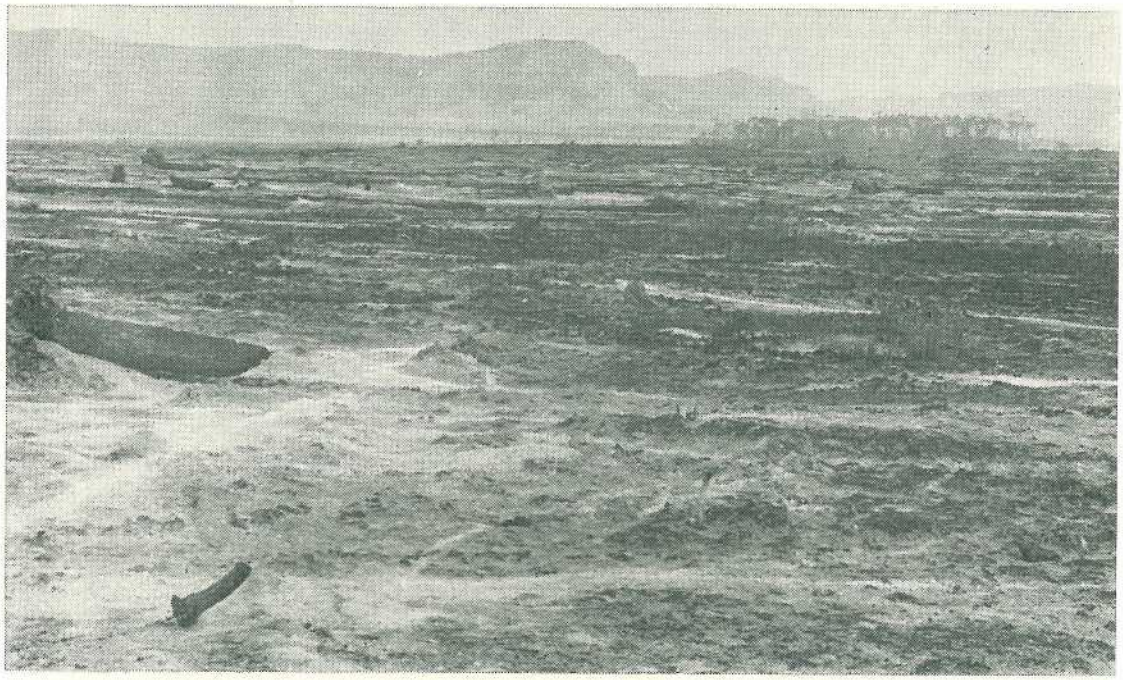
Pulling

The selection of the particular area or areas to be pulled should be decided only after careful consideration of the long term plan for developing the property as a whole.

Areas to be pulled at any one time should be as uniform as possible, that is, country requiring similar treatment and management. It is rarely advisable to pull more than 800 ha at any one time. So, to have relatively uniform blocks it may be necessary to subdivide the pulled area and treat each subdivision in a specific way. The ultimate size of the area to be pulled should depend on the money and resources available to convert standing scrub to relatively sucker free pastures and crops and to utilize the increased production.

The finance needed to ensure the regrowth is controlled in the initial stages of development will depend partly on the type of scrub being cleared as this has an important influence on the extent of the likely regrowth problem. Where burnt out and whipstick brigalow scrubs are being cleared a serious regrowth problem is almost inevitable and the early implementation of a regrowth control programme is essential for sound development. On the other hand, it is rarely necessary to undertake regrowth control during the initial development phase of brigalow-softwood scrubs.

While it is always wise to make provision for regrowth control measures as part of the initial development programme, with tall brigalow-belah and brigalow-wilga scrubs, seasonal conditions at the time of pulling may ultimately determine whether regrowth control is needed.



Ash seedbed following a satisfactory initial burn.

Less regrowth will occur if pulling is carried out in the summer and autumn under moist soil conditions. Pulling in the winter and spring, particularly when dry, usually results in a sucker problem which should be faced during the initial development phase.

In planning the pulling operation, provision should be made for shade and shelter. Isolated trees or small groups of trees should not be left standing. They are usually killed in the fire and the presence of scattered trees either dead or alive hinders the effective use of aerial spraying to control regrowth. Isolated trees of some species such as Dawson Gum can also act as focal points for seedling epidemics.

Trees should be left in belts or blocks to provide shelter from cold winds in winter and shade in summer. Belts also make effective wind breaks and firebreaks. Because of the severity of the initial burn blocks should be at least 2·5 ha in area while belts should be at least 100 m wide.

Burning

Burning is a very important operation in every development plan. The aim of any initial burn is to remove the trash lying on the ground, kill the native grasses, control or kill native woody plants and, where pastures are being sown, to provide a suitable seed bed for the germination and establishment of introduced grasses. Provided the native grasses have been killed, the presence of some logs on the burnt area is an advantage, as these aid germination and establishment and help to stabilize the soil and ash until pasture has developed.

The effectiveness of the initial burn is partly dependent on the amount of trash lying on the ground and this is influenced by type of scrub being pulled. Within these limitations it is important to get as hot a fire as possible because a poor burn leads to poor establishment of introduced pastures and the young grass plants face severe competition from native grass and woody weeds.

Successful initial development. Buffel grass pasture established on an ash seed bed.

In selecting the particular time to burn the pulled scrub a number of factors should be considered—

(a) *Delay between pulling and burning*—Less brigalow regrowth will occur if burning is delayed for at least 9 months after pulling. Where scrubs have been pulled in the late autumn, winter and spring less regrowth will occur if burning is delayed for at least a year.

(b) *Type of scrub pulled*—With brigalow-softwood scrub, many of the softwood trees and shrubs are not killed in the pulling operation and they regrow when conditions are warm and the soil moist. After they have regrown burning becomes a difficult operation. Because brigalow regrowth is not a problem here, it is often advantageous to burn these pulled scrubs before the dried leaves fall. Similarly, burning of pulled whipstick brigalow is often more intense before leaf fall. However, because this early burning will aggravate the brigalow regrowth problem, its use will depend on the control measures envisaged.

(c) *Month*—Best burning conditions usually occur between October and December and burning at this time, particularly after the end of October and before the advent of the expected summer rains, is ideal for pasture establishment. If ploughing or sheep are being used to control regrowth, advantage can be taken of suitable burning conditions at other times during the summer and autumn.

(d) *Day*—The exact day on which to burn the pulled scrub cannot be determined in advance and the decision when to burn is a critical one. The day should be hot, dry and cloudless and the burning procedure should be well organized to enable the area to be lit quickly—preferably on all sides.

During the course of the burn and for some days after, the area should be inspected frequently and efforts made to burn patches which have escaped the first wave of fire.

After treatment

After burning several alternative approaches are possible for any particular area. It cannot be stressed too strongly that the after treatment must be planned thoroughly before the scrub is pulled.

Sowing introduced pastures with or without spraying

Good pasture establishment will not eliminate the sucker problem. If suckers are common following burning pasture grasses will usually only slow down their growth and hide a problem which will eventually have to be faced.

Seeding is best carried out as soon as possible after the fire to take advantage of the favourable ash seed bed, of possible germinating rains and to give the introduced pasture every chance to compete successfully with regrowth from native grasses and weeds. If the original scrub is tall and dense and the initial burn very intense, sowing can be delayed; but unless the area was burnt in the early to mid-spring it is better to sow soon after burning.

Selection of introduced pasture species must be related to establishment, coverage, persistence and productivity characteristics in particular situations. While a thick grass cover slows the growth of brigalow suckers none of the introduced species used will prevent regrowth from becoming established.

Buffel grass, green panic, Rhodes grass and to a lesser extent *Sorghum almum* are commonly sown. However, where spraying is planned, the use of *Sorghum almum* is discouraged. If cropping is to be used to control regrowth after a pasture phase, buffel grass should not be used in the pasture mixture.

Even if pasture establishment is good the long term productivity of the sown pasture will be largely dependent on the density of brigalow regrowth on the burnt area. Suckers compete strongly with sown species and hasten their replacement by less productive native pastures. Sucker densities of 1,000–2,000 sucker per ha can cause serious reductions in productivity within 5 years. If they are not controlled during the initial development phase they will need costly control measures in the future. Densities as low as 500 suckers per ha will eventually form a mature scrub.

Some brigalow regrowth usually appears after burning. In years of average to below average rainfall approximately 50% of the suckers will have emerged 10 weeks after burning and 80% will have emerged 15 weeks after burning. Virtually all of the suckers will be visible by about the fifth month, but under very wet conditions maximum emergence may occur at an earlier date.

During the 10 to 15 week period an estimate should be made of the likely final density and a decision made on what areas need treatment. This allows enough time to prepare for the spraying operations which should be delayed until at least 5 months after the first burn to allow all the suckers to emerge.

It will be necessary to spray within a year of burning if the sucker density is estimated to be greater than 1,000 per ha. There will be long term benefits if control is undertaken even where suckers are half as dense. The exception is where the area is to be cultivated within 5 years.

The chemical 2,4,5–T is used for spraying brigalow and it should be applied at the rate of 0·75 kg per ha in diesel distillate. Aerial application is the most economical and effective method for controlling regrowth on large areas and kill of 80–90% can be expected if spraying is carried out 5–6 months after the burn. A tractor mounted misting machine can also be used where regrowth is in small patches or where tall standing timber is very common.

With aircraft the spray solution should be applied at about 28 litres per ha while with tractor-mounted misting the rate of application should be 45 litres per ha.

In years of average to above average rainfall, shielding of the suckers from the spray by a dense pasture cover can reduce the effectiveness of the spraying. Under these conditions:

(a) The area should be grazed after the grass has seeded and before spraying; or

(b) The area should be grazed during the winter and early spring and spraying should be undertaken after the first good fall of rain in the spring.

Flogging with Sheep with or without spraying

In the southern wool-producing areas of the State, sheep have been used extensively to control regrowth following pulling and burning. Sheep will eat brigalow suckers that are young and soft, but if the suckers are allowed to harden off they become unpalatable and sheep will die rather than eat them. By stocking the areas as soon as the suckers push through the ground after the burn, heavy concentrations of sheep will keep them eaten down to ground level.

Though young suckers are known to be equal in food value to first grade lucerne, the sheep will lose condition because they must be kept starved so that the suckers never have a chance to grow.

Sheep can survive in this starved state for only a short period and must be rested and built up in condition by spelling them on good pasture. As soon as the suckers make growth again, the sheep must be moved back on them. The more sheep that are available, the smaller is the period of time needed to crop the suckers down to ground level and the better the condition in which the sheep can be maintained.

By continuing this grazing programme, the reserve food in the roots becomes depleted and brigalow can be killed out. If enough sheep are available, the time of pulling and burning is not critical.

To be successful, this method needs large reserves of sheep and of country and a high level of managerial skill.

FAILURE TO CONTROL REGROWTH USUALLY RESULTS FROM:

(a) *Failure to fence off and provide adequate water on the treated block*—Sheep will graze the young suckers effectively only if they have no access to other herbage in reasonable condition. It is necessary that the sheep be fenced on to the suckers and that water facilities are good enough to allow them to feed over the whole paddock.

Unsuccessful initial development. Failure to implement sound brigalow control measures.

The sowing of improved pastures into the ash following burning is only a hindrance to effective control by sheep. Besides providing an alternative source of food for the sheep, improved pastures will not persist under such heavy grazing and the cost of seeding is soon lost.

(b) *Pulling areas of scrub too large to be handled by the number of sheep available*—The stocking rate needed to control suckers is determined largely by the type of scrub pulled. With virgin brigalow–belah scrubs, sucker regrowth can be controlled by stocking at the rate of 2·5 to 5 sheep per ha, but where the scrub contains dense understorey brigalow or is dense whipstick or sucker brigalow, a maximum rate of about 12 sheep per hectare is needed during part of the flogging programme. The number of sheep available for brigalow control should determine the size of the area on which control can be attempted. As well as the area being flogged, there must be enough pasture on the property to carry sheep when they are being spelled or after all vegetation has been removed from the treated area.

(c) *Failure to put sheep into the treated area early enough*—It is necessary to flog any herbage off the area before the suckers appear so the sheep are forced to concentrate on the suckers. Sheep should be introduced into the burnt areas as soon as the first green shoots appear, whether they are brigalow suckers or herbage.

Complete eradication is rarely achieved. Good Rhodes grass with suckers hidden underneath.

Generally, it takes up to two seasons of flogging to clear an area of suckers by this method. Where conditions are favourable, areas have been cleared after only one season's grazing.

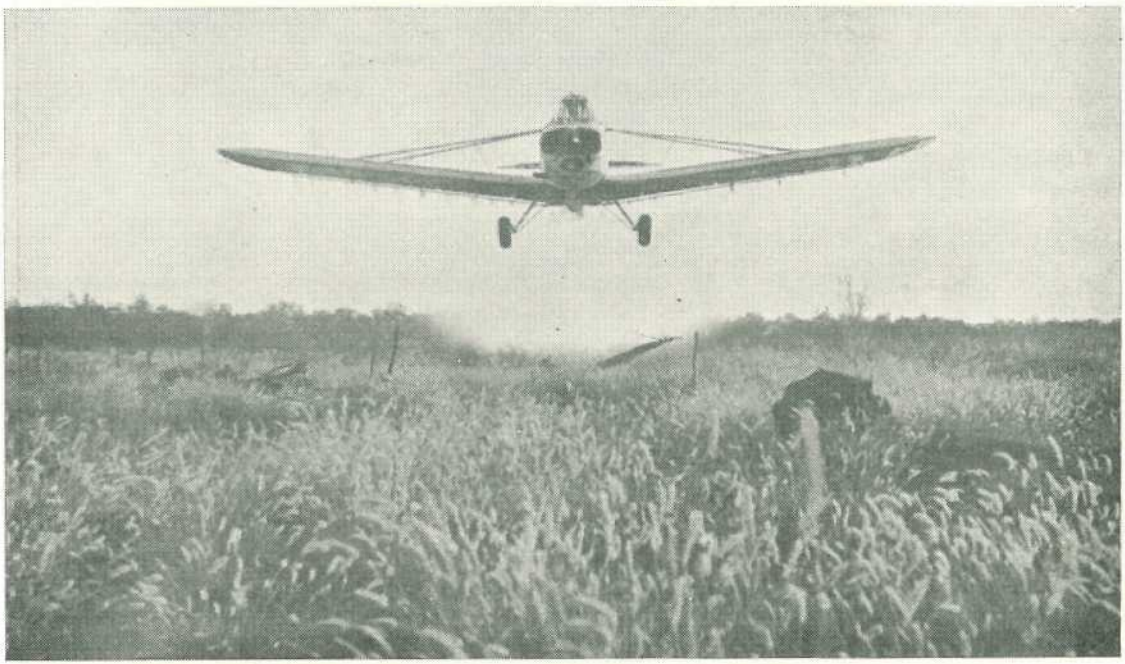
On the surface, this method appears cheap. It may require no additional outlay of money. But by holding starving sheep on suckers, the wool clip per sheep is reduced. Although the carrying capacity of the treated land is increased, reserve pastures must be held to carry the sheep while they are spelling, and their lower wool clip usually results in a lowered income over the whole property.

Income can also be lowered further by added handling and drenching costs, discoloured wool and even stock losses. The extent of the reduction is almost directly related to the quality of management, to the availability of reserves of sheep and of pasture and to the price being received for wool.

If it is obvious that the available sheep are not controlling the sucker regrowth, spraying can be introduced to bring the regrowth under control. When flogging with sheep is used in conjunction with spraying, lower rates of application of 2,4,5–T are sufficient. Good kills can be expected following aerial spraying using 0·55 kg a.e. 2,4,5–T in 28 litres of diesel distillate per ha.

After the regrowth has been controlled the treated area usually supports only scattered plants of unpalatable species such as dog burr (*Bassia tetracuspis*). By this time the ash seed bed is destroyed and the soil surface has become compacted. Under these conditions introduced grasses will not establish without cultivation but with spelling or light grazing and average or better seasonal conditions a fair cover of native grass can be expected after two years. If clearing has been undertaken to grow improved pastures it is more economical to establish them on an ash seed bed and use spraying to control regrowth.

Aerial spraying to control brigalow regrowth in an establishing buffel grass pasture.



Ploughing and planting a crop

Brigalow regrowth poses no great problem if brigalow scrub is converted directly into cultivation. This is a costly method of development but if sufficient finance is available it provides a means of obtaining a quick return on capital and allows the high initial fertility to be exploited. Only limited areas can be handled in this way, and if large areas are being cleared, spraying may also be needed to control regrowth on any areas that will not be cultivated within 4–5 years of burning.

The decision to embark on a cropping programme should not be taken lightly. On properties being developed primarily for beef or wool production, regrowth control should be regarded as a by-product of rather than the main reason for undertaking cropping.

The use of a cropping phase must be considered in the light of environmental suitability, the stage of development of the property, the capital resource and the availability of a profitable market for the produce whether it be grain or livestock. Distance from railhead and the availability of stock will have an important bearing on any decision to convert scrub directly to cultivation.

A major item in the cost of this approach is clearing trash from the ground before ploughing and this cost can be reduced considerably by well-organized burning.

Many graziers prefer to sow the area to pasture following pulling and burning before converting the land into cultivation. Pastures in the first few years are highly productive and subsequent burning can reduce the amount of trash which must be removed before ploughing can be undertaken. In these circumstances buffel grass should not be used in the pasture mixture.

Aerial spraying

This is very effective for killing virgin and tall whipstick brigalow but should be limited to situations where—

(a) the scrub is pure brigalow and there are few associated woody species.

(b) the canopy is reasonably uniform and there is little understorey brigalow.

In these circumstances excellent results can be obtained if the spraying is carried out under still air condiitons when soil moisture is high. This method results in a rapid development of native herbage. If the herbage is sparse in the untreated scrub, grasses such as green panic, buffel, Rhodes and *Sorghum almum* can be established by sowing them into the freshly sprayed area. Under these circumstances it is advisable to spray between December and February.

The 2,4,5–T should be applied at 0·75 kg per ha in 28 litres of diesel distillate.

Ringbarking

This method is slow and rather costly and is no longer used for clearing large areas but is still a very effective means of killing brigalow. It is a convenient method for clearing small patches and isolated trees.

A single series of overlapping cuts through the bark into the surface of the sapwood is sufficient to kill brigalow trees to ground level. No collar of bark need be taken out. If ringbarking is carried out during the summer and autumn under moist soil conditions a regrowth problem can be avoided.

Maintenance and Reclamation Programmes

While sound guidelines are available for the successful clearing of brigalow scrubs, many attempts at clearing have been unsuccessful. This has been largely due to—

(a) insufficient initial planning

(b) underestimating the ability of brigalow and associated woody weeds to survive

(c) external pressures to pull large areas without sufficient back-up finance to control regrowth and utilize the increased pasture production.

Even where the initial development programme has been successful some follow-up treatment in the future may be necessary to maintain a good pasture. Where it has been a complete or partial failure further treatment will be required to reclaim the rapidly deteriorating area.

Some landholders have created their own regrowth problems, others have inherited theirs. Large areas of productive pastures are reverting to brigalow suckers with some now as unproductive as the original scrubs. The need to maintain animal productivity in the face of increasing regrowth problems is of much greater concern today than initial development.

Established pastures are highly productive in the first few years and maximum use should be made of them at this stage. While there will inevitably be a decline in productivity after the initial flush, animal production can still be maintained at very satisfactory levels. The greatest threat to established sown pastures is brigalow regrowth usually associated with overgrazing.

Not only does it reduce pasture productivity through competition for moisture and nutrients but it also favours a shift from sown pasture to less productive native species. Once native species have become reestablished it is expensive to replace them; it is important, therefore, to tackle the regrowth problem while the introduced species are still dominant.

Three weapons are used in the fight against brigalow regrowth.

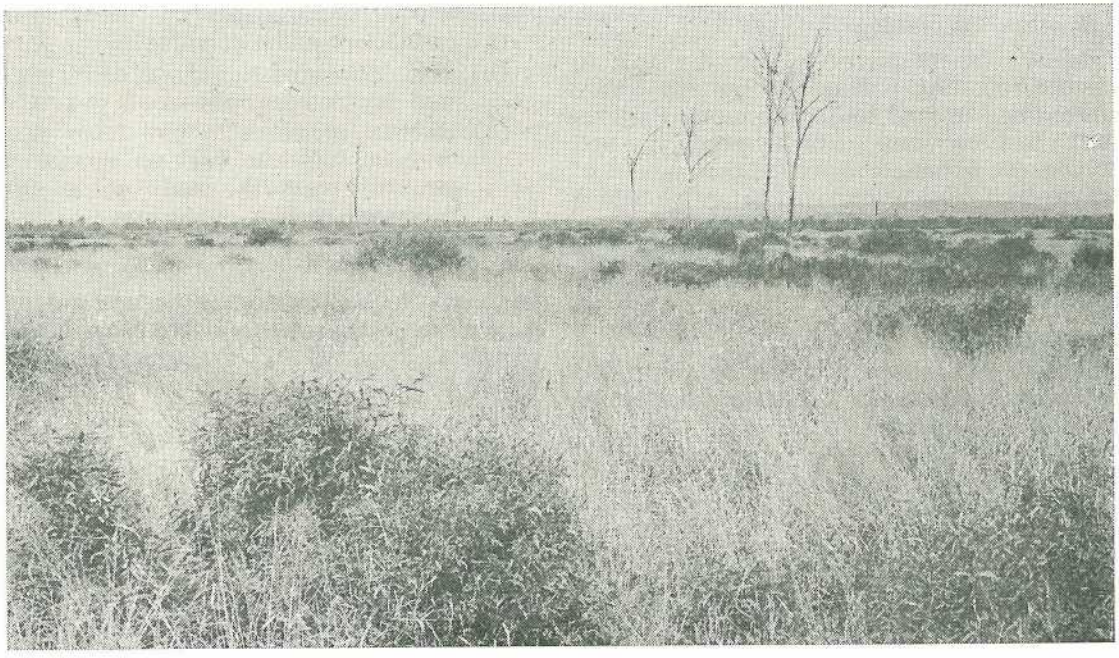
1. Burning
2. Spraying
3. Ploughing

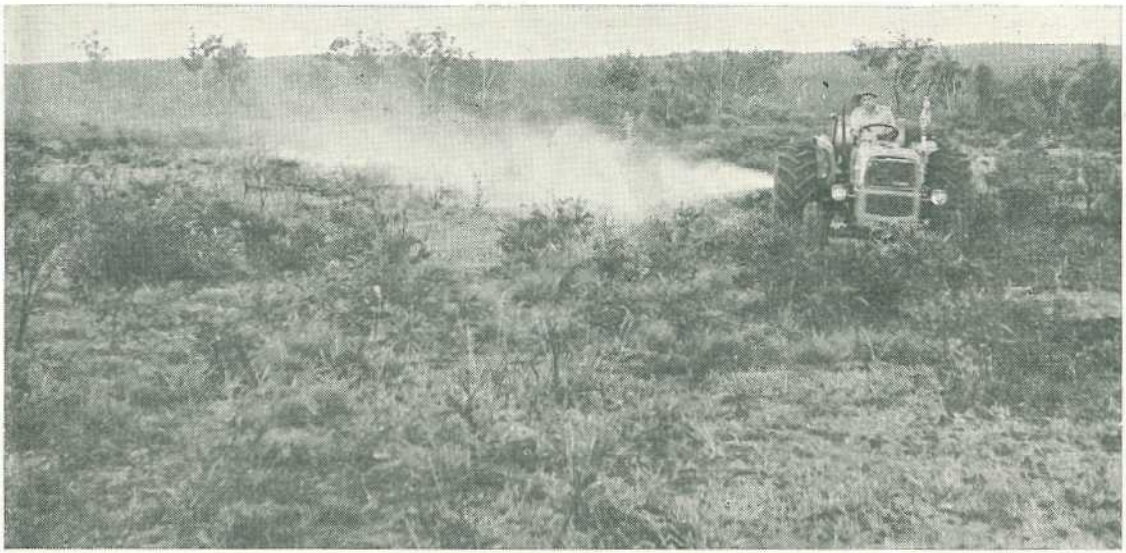
These are not necessarily alternatives. They can be used very successfully in combination and in addition sheep can be used to improve results. The ultimate choice will depend on a number of factors including:—

(1) *State of pasture*—If the introduced pasture has not deteriorated greatly, spraying can be used to control regrowth and maintain productivity. Where regrowth is sparse and grass plentiful, burning can also be used. If the area has reverted to brigalow and native grasses the re-establishment of introduced pastures can only be obtained by some form of cultivation.

(2) *Associated woody species*—If the regrowth is predominately brigalow with few other woody species either ploughing or spraying can be used. Where other species such as sandalwood, limebush, Dawson gum or yellowwood are common, overall spraying will control the brigalow regrowth only and release the regrowth of the other species from competition with brigalow.

Brigalow suckers overtopping dense Rhodes grass pasture. Burn for sucker control at this stage.





Tractor mounted misting of 3-year old suckers.

(3) *Financial Resources*—If finance is not limiting cultivation can be used to bring regrowth under control. Successful regrowth control is assured but successful establishment of crop or pasture cannot be guaranteed. At the other end of the scale, where financial resources are meagre, burning can be used to delay the need for an expensive spraying or ploughing programme; alternatively, burning and successful flogging with sheep may be possible, with a minimum outlay of additional capital.

(4) *Proposed Land Use*—Whether the particular paddock is best suited for cultivation or pastures may determine the most suitable reclamation programme.

Burning

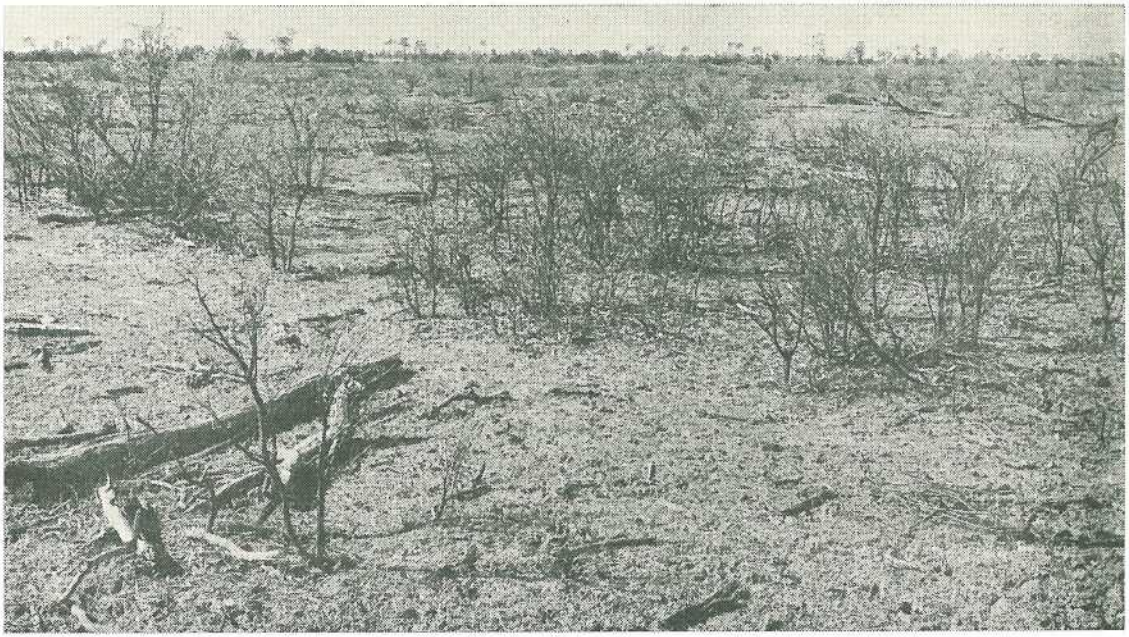
If there is enough herbage to carry a hot fire, brigalow suckers can be knocked down to ground level. However, the horizontal root system is rarely damaged by a grass fire and fresh regrowth usually occurs from the butt of the burnt suckers or from the horizontal roots.

On rare occasions substantial reductions in sucker density have been reported following burning; however, these appear to be associated with unusual conditions such as waterlogging after burning or with habitats which are marginal for brigalow.

If the soil is moist at the time of burning or if rain falls soon after, the pasture grasses will outgrow the suckers and a temporary improvement in carrying capacity is achieved.

Where suckers are not common and there is a surplus of grass, occasional burning can help to maintain a good pasture. Where suckers are common, spelling or reduced stocking is needed through the autumn, winter and spring. This means an overall reduction in carrying capacity though it is balanced to some extent by improved grazing for some time after burning. Repeated burning every 3 to 4 years may be necessary to prevent domination of the pasture by the brigalow regrowth.

The economic soundness of a regular burning programme to keep a serious brigalow regrowth problem under control is very doubtful. Besides this, once the cycle of burning, grazing and spelling is broken through the inability to burn at the critical time because of drought and overgrazing or a series of wet years, a major reclamation programme must be undertaken.



Successful control of dense 5-year old suckers following spraying and flogging.

Within the above limitations, burning can play a very important role in regrowth control by:—

(a) Delaying the need for a major reclamation programme. In times of financial stress burning can be used as a holding operation.

(b) Preparing the way for other more effective control measures such as spraying, flogging or ploughing.

Where grass is sufficient to carry a reasonably hot fire, burning should be carried out in the late spring or early summer preferably when the soil is moist. Ideal conditions are found on hot, dry cloudless days a few days after a late spring storm. Where grass is sparse and suckers are common extremely hot and dry conditions are needed for effective burning.

Spraying

If brigalow regrowth is not treated within the first year after the scrub burn it becomes progressively more difficult to control by spraying with 2,4,5–T ester. Kills of at least 80–90% can be antcipated following the spraying of regrowth 5–6 months after the initial burn; however, when suckers are 5–10 years old, kills even under ideal conditions are rarely likely to exceed 50–60%. It is not uncommon for kills to be less than 10–20% if spraying is undertaken under dry soil conditions.

The effectiveness of 2,4,5–T is directly related to soil moisture status and best kills are obtained if spraying is carried out when the soil is moist. Because of the rainfall distribution pattern of the brigalow lands this situation is most likely to occur between November and April and in particular in January and February. However, excellent kills can be anticipated even in the winter if abnormally wet conditions prevail.

The benefits to be gained by spraying are related not only to the percentage kill obtained but also the composition of the existing pasture. Most brigalow pastures which result from an initial development programme are mixtures of introduced and native grasses.

Where brigalow regrowth is common, the native grass component becomes relatively more important with time and after 4 to 5 years only remnants of the original improved pasture may remain. Returns from spraying will be much greater if spraying is carried out before the pasture has reverted to native species.

Without cultivation introduced species will not establish and compete successfully with already established native grass species, except perhaps on some of the lighter soil types, and spraying brigalow regrowth in a native pasture can only lead to better native pastures.

Compared with ploughing, spraying needs little capital outlay and no loss in income is incurred during treatment. The return is lower than for ploughing but if the pastures are still in good order and if spraying is undertaken under favourable conditions productive pastures can be maintained.

The method application used will depend on the area involved and equipment available.

(a) *Knapsack misting*—This is relatively slow (0·5 to 1 ha an hour) but very effective. The whole plant should be covered with a fine mist as unsprayed branches will continue to grow. The standard mixture is 0·55–0·75 kg a.e. 2,4,5–T per ha in 45 to 70 litres of diesel distillate. With a single application kills can be expected to decrease from 80–90% to 60% as suckers increase in size up to 1·5 m.

(b) *Tractor-mounted misting*—This is much faster than knapsack misting (4 ha an hour) but is less effective than either knapsack misting or aerial spraying. It has advantages over aerial spraying where tall standing timber is common and where suckers are growing in patches. Spraying should be carried out under relatively still air conditions preferably with a slight breeze provided it is relatively constant in direction and strength. The standard mixture is 0·75–1·00 kg a.e. 2,4,5–T in 45 to 70 litres of diesel distillate per ha.

The direction of travel of the tractor should be at right angles to the prevailing breeze and the spray should be directed with the wind. For efficient spraying successive runs of the tractor should be parallel and between 10 and 20 m apart. The broadest swathes will be used with powerful misting machines when wind speed is higher and suckers are of lower stature. With a single application kills can be expected to decrease from 70–80 per cent. to 15–30 per cent. as suckers increase in size up to 1·5 m.

(c) *Aerial spraying*—This enables large areas to be treated in a short time and advantage can be taken of ideal conditions. Tall trees should be cleared before spraying as they prevent the aircraft from flying close to the sucker canopy and result in greatly reduced kills. The standard mixture is 0·75 kg a.e. 2,4,5–T in 28 litres of diesel distillate per ha. With single applications, kills can be expected to decrease from 80–90% for suckers less than one year old to less than 50% for 5–10 year old suckers.

Ultra low volume spraying using 3–6 litres of spray solution per ha has been undertaken on an experimental basis but results have generally been inferior to those following conventional spraying.

One of the factors contributing to poorer kills on large suckers is the difficulty in obtaining adequate coverage of the foliage. A number of strategies can be used to make spraying a more efficient operation:

Where this is sufficient grass to carry a hot fire, burning can be used to knock suckers down to ground level. By spraying the young regrowth rather than the older suckers, the effectiveness of spraying can approach that obtained following the initial burn. It is important that spraying be delayed sufficiently to allow the suckers to emerge. With spring and early summer burning, spraying should be delayed for 5 to 6 months and then preferably undertaken when the soil is moist. With burning in the late summer and autumn, spraying should be delayed until after the spring rains. Advantage can also be taken of the destructive effects of wild fires to control regrowth.

A practical problem to be faced when using burning as a pre-spraying treatment is the prevention of shielding of the young suckers by vigorous pasture regrowth. Grazing will usually

be necessary before spraying but as young suckers are eaten, particularly where sheep are used, grazing should stop a few weeks before spraying to allow damaged suckers to regrow. Burning will usually be undertaken in the October–December period and spraying should be planned for the autumn and timed to coincide with a period of high soil moisture.

Subsequent grazing with sheep can greatly enhance the effectiveness of spraying. Sheep will eat the young coppice shoots and root suckers arising from suckers defoliated by spraying. Kills in excess of 80% have been achieved using aerial spraying with 2,4,5–T at 0·55 kg per ha on 5 year old suckers where sheep were allowed to graze the treated area at stocking rates in excess of 2·5 sheep per ha.

Where management precludes the use of fire or sheep then two sprayings 10 to 12 months apart can be used to reduce sucker densities by at least 70–80%. An interval of at least 10 months is necessary to allow unkilled suckers to regrow and new suckers to appear. Both sprayings should be carried out when the soil is moist. Preventing shielding by pasture species of regrowth from the first spraying may necessitate grazing prior to the second spraying. This problem can be minimized by undertaking the first spraying in December or January and planning the second spraying for the late spring after the expected spring rains but before the summer flush of pasture growth.

Equally successful and perhaps better results can be expected if the pasture regrowth following the first spraying is utilized for a few years, then burnt and the young brigalow regrowth resulting from the burn sprayed. If this approach is to be adopted it is important that the burning be undertaken while the pasture is still productive and before the brigalow suckers regain dominance.

Accidental burning is a hazard in cleared brigalow country. Sprayed areas should, if possible, be protected from fire for at least 9 months after spraying but after this time burning does not appear to have any detrimental effect. Burning from 9 months to 2 years after spraying has on occasions actually enhanced the effectiveness of spraying, particularly when the burn occurred during the summer under moist soil conditions. If the spraying has been carried out under unfavourable conditions and dense regrowth is appearing burning should be considered even if only to prepare the suckers for a second spraying.

Ploughing

Annual cropping for 3 years is the most effective method of controlling regrowth and on farming properties brigalow regrowth poses no great problem. For effective control, ploughing should be at least 10 cm deep and a heavy duty disc plough should be used at least in the initial stages of cultivation. There appears no need to plough deeper than 10–15 cm. With light implements and shallow ploughing, suckers can persist for many years under annual cropping. If logs are present the area should first be stickraked.

On grazing properties where cropping can be economically incorporated into property management, ploughing can play an integral part in any brigalow control programme. Annual cropping requires heavy capital outlay but the cost of land preparation can be recouped by a few successful crops. A 3 year cropping phase followed by the introduction of improved pastures enables large areas to be controlled on a rotational basis.

Winter cropping and summer ploughing appears more effective in controlling regrowth than summer cropping and winter ploughing but both systems can be used and the ultimate selection will depend on management requirements.

Brigalow suckers grow mainly between September and March and ploughing is more effective when timed to coincide with the latter part of the growing season.

On many properties being used primarily for wool and beef production the area of cultivation which can be economically and physically maintained for cash and forage cropping is limited. Also many properties particularly in the western and northern parts of the brigalow belt are marginal for economic cropping and the risks associated with annual cropping are high. Under these conditions if cultivation is contemplated the aim is to achieve maximum control with a minimum number of ploughings.

A single deep ploughing is generally insufficient to control brigalow regrowth. Even under highly favourable conditions of good soil moisture and actively growing suckers kills in excess of 50% are rare. However by combining a single ploughing in the summer with other

methods of control such as spraying or flogging with sheep excellent control can be achieved. If spraying is to be used the ploughed ground should be sown with improved pastures and spraying undertaken, preferably under good soil moisture conditions, at least 4 to 5 months after the ploughing to allow regrowth to emerge. Kills of at least 85% could be expected following ploughing and spraying.

Sheep could be used to flog the young regrowth after ploughing but results would depend on the managerial ability of the grazier and the effectivensss of the initial ploughing in removing all of the old top growth. The use of sheep inhibits the development of good improved pastures and, on ploughed ground, sowing and spraying is preferred.

A second ploughing approximately 16 weeks after the first preferably combined with the sowing of improved pastures can result in kills in excess of 80% if both ploughings are undertaken during the warmer months.

On grazing properties where replacement of brigalow by high quality pastures is a prime objective the use of a single cash or forage crop, either summer or winter, in combination with spraying can reduce brigalow densities by more than 90%. In trials at the Brigalow Research Station sowing pasture seed at planting and spraying the brigalow regrowth after harvesting the crop converted brigalow dominant native pastures to highly productive sown pastures.

Regrowth from Associated Woody Species

Regrowth from a number of species which occur in the canopy and understorey of brigalow communities can prove troublesome after clearing. These species include Dawson gum (*Eucalyptus cambageana*), coolibah (*E. microtheca*), sandalwood (*Eremophila mitchellii*), yellowwood (*Terminalia oblongata*), limebush (*Eremocitrus glauca*), tea trees (*Melaleuca pubescens* and *M. bracteata*) and currant bush (*Carissa ovata*). All of these species have the capacity to regrow, following damage, from either butts or butts and roots, while epidemics of seedling eucalypts can erupt under special conditions.

Regrowth problems with these species can be minimized by ensuring that the initial burn after pulling is a very hot one. Pasture burns will knock the regrowth to ground level but usually with no marked reduction in density. Ploughing for brigalow control will also control all these species except limebush. Overall spraying with 2,4,5–T at the rates used on brigalow regrowth has little effect on any of them.

Fortunately, regrowth from most of these species occurs only in isolated areas and in many cases it does not appear to reduce pasture productivity greatly. Root raking under moist soil conditions has proved successful in controlling sandalwood regrowth but other woody species growing with the sandalwood will persist.

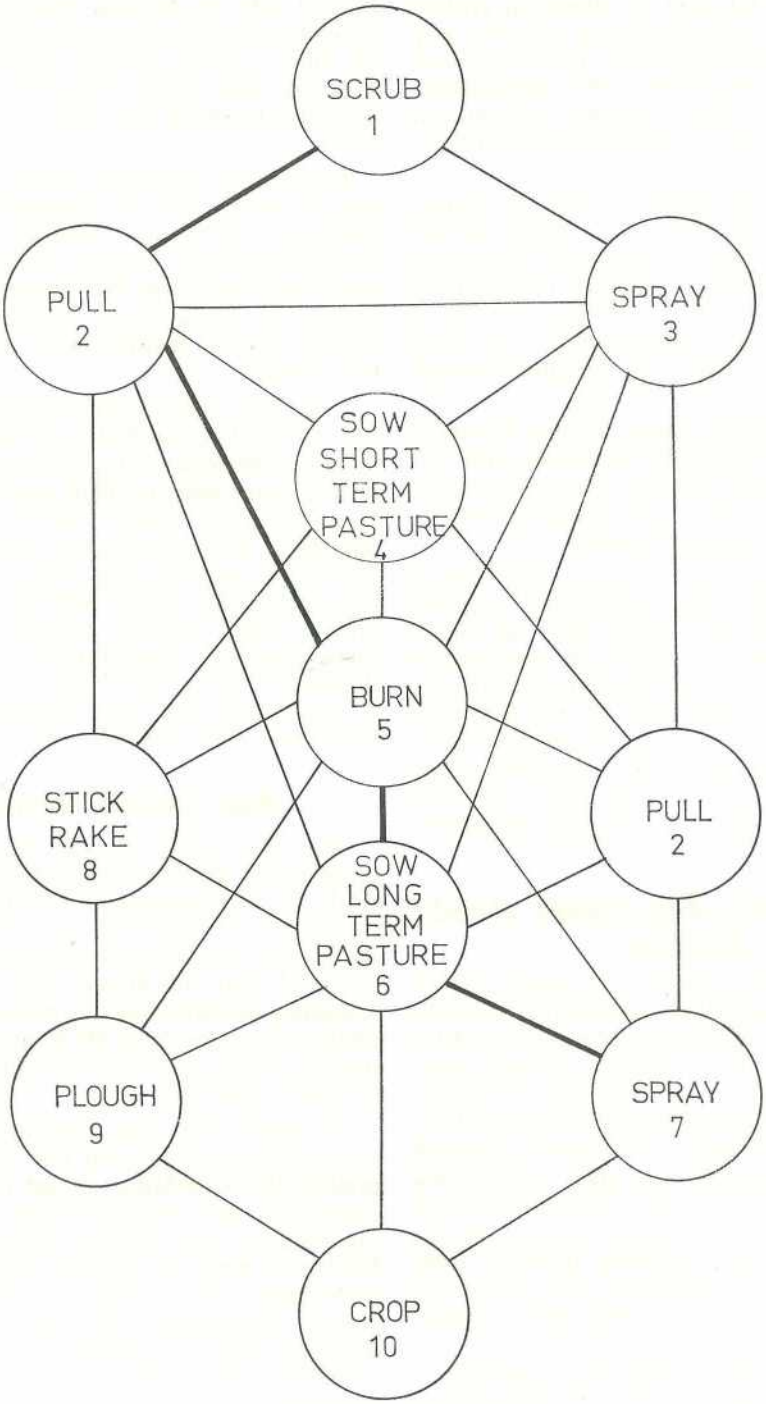
Chemicals, using individual plant treatments, can be used to control some of the species. However, because of the time consuming nature of this work and the high cost of labour and chemicals only limited use is made of this tecnique. *Eucalyptus* spp. can be killed by basal bark spraying, cut stump or stem injection treatments using picloram based weedkillers. High volume overall spraying with these chemicals can also be used to control limebush and currant bush. Sandalwood can be controlled with basal bark and cut stump treatments using 2,4,5–T ester.

Plan before beginning

Any large scale attempt to control woody plants must be considered within the framework of the management objectives of the property as a whole. The reason for beginning, alternative management proposals, a carefully prepared plan of attack, the availability of resources to carry out the plan and the probability of success must all be considered at the outset. Sound planning is equally as important as good implementation.

A sound plan must consider all available information and this can best be gathered by pooling the knowledge gained from your own experience and the experience of successful landholders and D.P.I. extension officers. Decisions made in advance on the basis of experience can provide the backbone of a sound programme of land development; decisions taken in haste to retrieve an ill planned venture may only lead to further disaster.

FIGURE 1: BRIGALOW DEVELOPMENT PATHWAYS.



Brigalow pasture establishment and maintenance

by D. G. CAMERON and J. H. WILDIN

PASTURE development on brigalow scrub lands can take a number of pathways (see previous page) depending on the scrub type, the density of understorey grass, the resources available and the planned future use of each section of the property. Since the late 1950s the main pathway has been pull, burn, aerial sow and then, if necessary, aerial spray for control for brigalow suckers.

There are considerable variations in soil texture, depth and chemical and physical properties over the brigalow region. To complicate things further, the growth form of brigalow and the types of associated tree and understorey species vary considerably and are related to soil and climate. Basically, however, the brigalow region can be separated into three major divisions; southern, central and northern. (See Fig. 2 following page.)

Climate varies from the south to the north and from east to west; the most humid and least variable climate is experienced in the south-eastern parts of the brigalow region while the most variable and least humid climate occurs in the north-west. Appreciation of the long term climatic patterns within a district is important in successfully developing scrub lands to achieve long term economic production as quickly as possible after pulling the scrub.

Most areas of brigalow have now passed the initial pasture stage and many of the cropped lands are being converted to pasture. However, there are still tracts of brigalow scrub which await development, especially in the central and northern areas.

This discussion on growing, using and maintaining brigalow pastures will include all phases of initial scrub development and the development of pastures following a cropping phase.

ESTABLISHMENT

Variables which can influence the success of pasture establishment and can be easily controlled include quality and quantity of seed planted, state of seedbed, species, time of planting and initial grazing management. Each is important and neglect of any one can increase the already high risk of failure due to the erratic nature of rainfall.

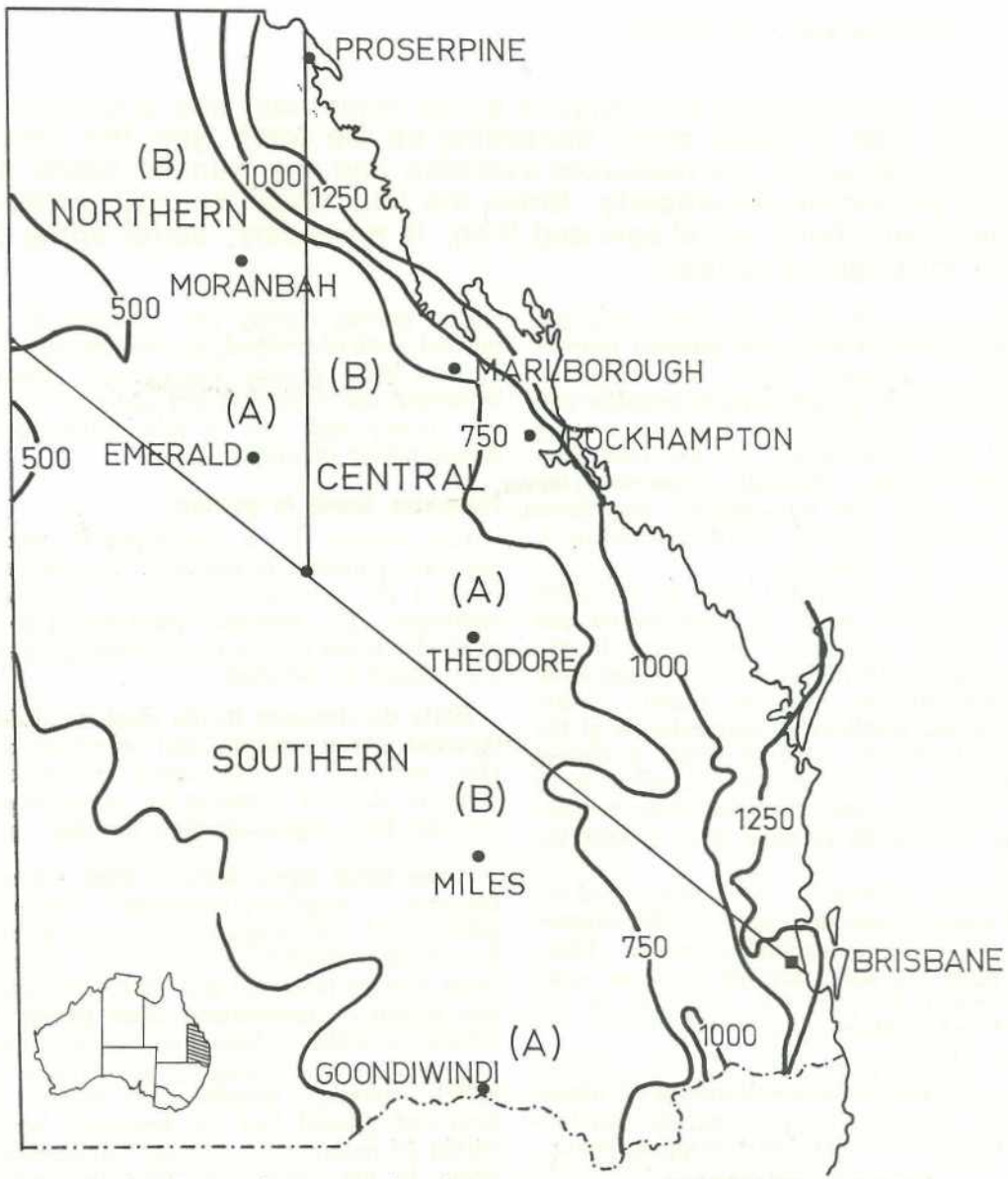
Planning: Scrub to pasture

For success in a development venture adequate planning is essential. As shown in Figue 1 the development can take numerous pathways. The approach most suited to the particular scrub type in the particular brigalow area should be adopted.

Early development in the southern division involved sheep grazing and cropping soon after burning. In the central and northern divisions 2,4,5–T spraying for regrowth control has been important after burning.

Some scrub types, such as thick whipstick brigalow, brigalow/bonewood, brigalow/yellowwood, and brigalow/gidyea are virtually free of grass ground cover at pulling. On such areas seeding perennial and short term grasses just before or immediately after pulling has advantages which include early establishment of perennial species, especially green panic and buffel, reduced invasion of weeds, and improved ground fuel for successful burning within 15 months after pulling. In many situations in the central and northern divisions this practice has been very successful and is worthy of consideration for scrubs without ground cover.

FIGURE 2



A map showing the southern, central and northern brigalow divisions. The reliability of winter rains and the expectancy of early summer storms decreases from south to north. Within each division the rainfall reliability decreases and variability increases from Zone (A) to Zone (B). Mean annual rainfall isohyets are also shown.

In planning, the size of each development unit should be governed by the resources available to bring that unit into production as quickly and as economically as possible and at the same time considering the optimum paddock size and burning unit.

Burning and Seeding

A good burn is vital to the successful development and management of brigalow lands. A poor burn, often the result of inadequate planning, results in a number of defects in the pasture obtained. These defects include poor sown grass establishment, greater density of woody weeds and native grass, and as a result reduced carrying capacity. As well, stock grazing and handling are generally less efficient.

Planning, preparation and the lighting technique are important. To achieve a hot, clean burn, the actual timing must consider the density and dryness of timber and ground fuel, relative humidity, air temperature, wind speed and the resources available on the site such as firebreaks and equipment.

Reliance solely on personal judgement of optimum weather conditions can lead to a high proportion of unsatisfactory burns. Thermometers to accurately record air temperatures and relative humidity have been most valuable for selecting the right day to burn. Because the best burning conditions may occur only once during the period October to January, it is advisable to burn on the first occasion when conditions are ideal for the particular felled scrub, as indicated on the BRIGALOW BURNING GUIDE. After the end of November, the chance of storm rains wetting the fuel and causing the herbage to green rises rapidly.

A good burn provides a good ash seedbed. It need not include the burning of all large logs. There are definite advantages in sowing as soon as the ash has cooled (2–3 days after burning) and before any rain has fallen to set the ash. Rain falling after sowing on loose dry ash will plant the seed, thus protecting it from whirlwinds, wash and ants. Also, if the burn has not been as good as desired the grass seedlings have an even chance of competing with seedlings of native grass and weeds.

On the other hand, where there is a good depth of loose ash resulting from an abundance of timber fuel plus excellent burning weather, satisfactory grass establishment has resulted from delayed sowings. Also, in such a situation there is no native grass or weed seed present. Thus, where an early burn (October–November) has been a very clean one, sowing can be delayed until mid-December to mid-January. The expectancy of rain at this time of year is higher, and extended rain periods with 4–5 wet days are more likely to occur. In the central and northern areas and especially the north-west seed loss from false germination can be avoided by delayed sowing. However, with scrub burns carried out after mid-December it would be wise to sow soon afterwards. Stock hoof prints on the ash beds collect sown seed and trap water and are an advantage on very clean burns.

Seed quality and quantity

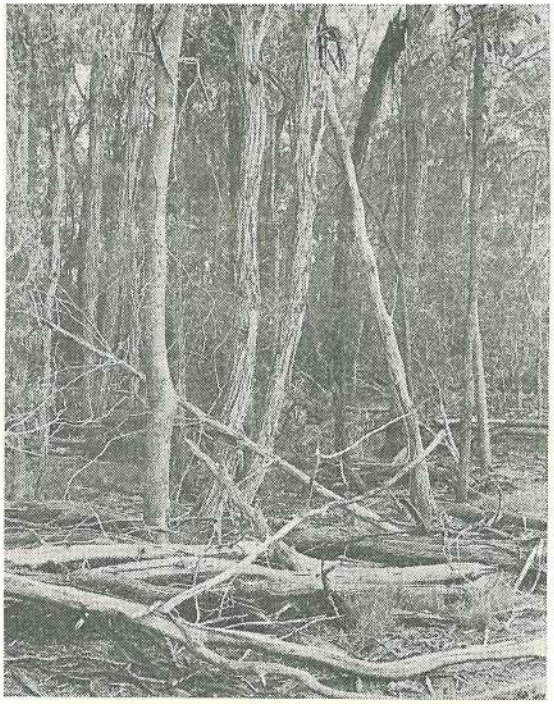
Ideally at least 2 kg per hectare of good quality seed should be planted. All pasture seeds offered for sale in Queensland must pass a minimum standard for *purity* and *germination*. Most grasses have a minimum germination standard of 20% but good samples should approximate 40%. It is an advantage to compare the price of seed and to adjust seeding rates on the basis of *pure live seed* (PLS) percentage, i.e. $\frac{\textit{Purity} \times \textit{germination \%}}{100}$.

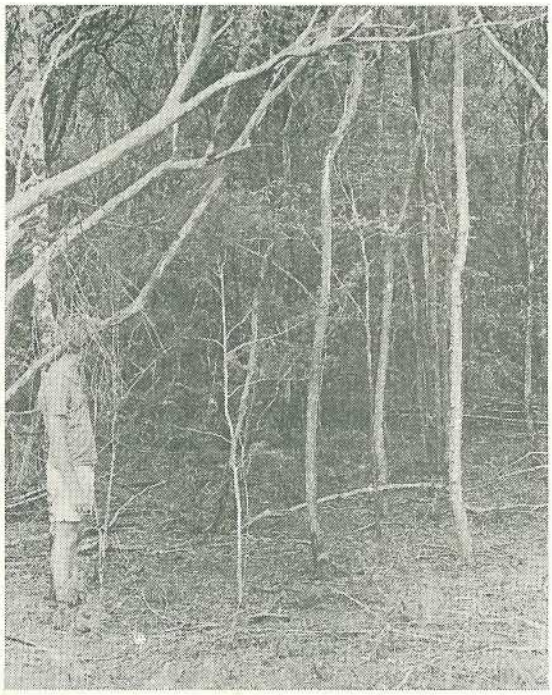
The higher the PLS of a sample the better value it is relative to other samples of similar price but lower PLS percentage.

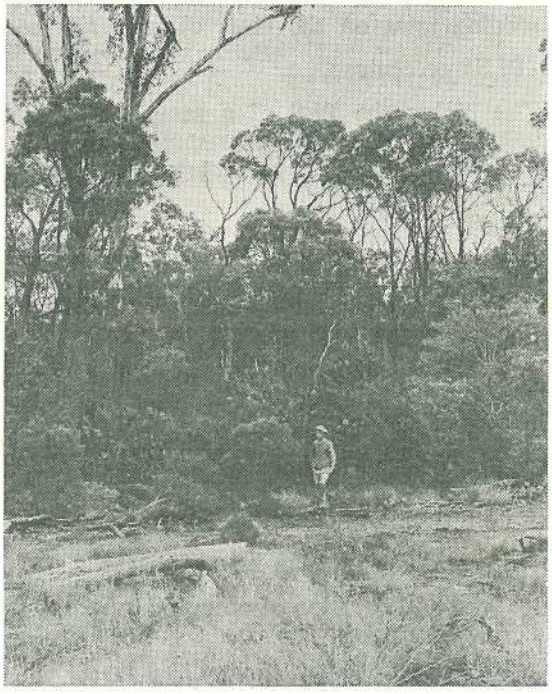
Species and Mixtures

For any given area the following factors will determine the best mixture to plant:

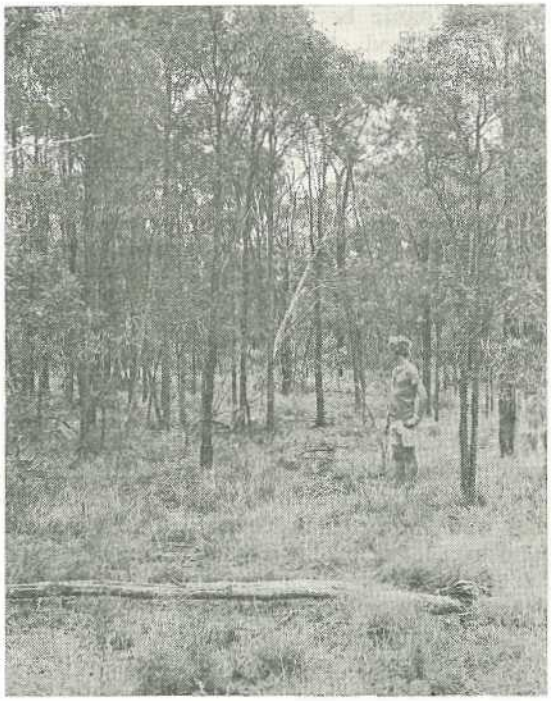
- Regrowth potential and control measures proposed.
- Availability and relative seed price of adapted species and varieties.
- Soil type and evenness of the area.
- Location within the brigalow area.
- Type and duration of cropping proposed for the future.
- Availability of stock.

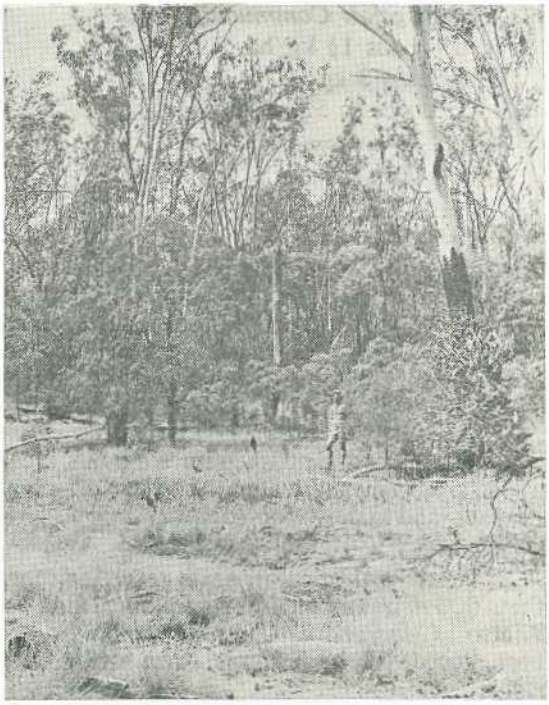






Tree density, brigalow growth form, associated tree and shrub species and amount of native grass, determine the efficiency of pulling and the quantity and type of fuel available for burning. These six pictures show the range of variability occurring in brigalow scrubs.





Where the whole area is even or can be easily divided into uniform types of country, one selected grass species or simple mixtures can be planted. Very complex mixtures are not favoured. Selection of perennial grasses is limited to the adapted species which include green panic (*Panicum maximum* var. *trichoglume*), Gatton panic (*Panicum maximum*) Rhodes grass (*Chloris gayana*), the various cultivars of buffel grass (*Cenchrus ciliaris*) and on heavy clay soils subject to flooding, the makarikari grasses (*Panicum coloratum* var. *makarikariense*).

Suggested mixtures for various types of scrub are:—

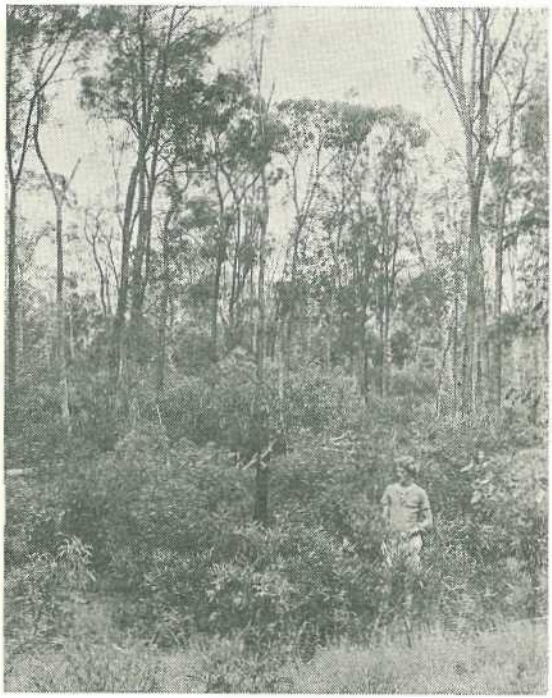
Brigalow/Softwood Communities

(a) Green panic 1½ kg/ha
Rhodes grass ½ kg/ha.

or

(b) Buffel grass 1½ kg/ha
Rhodes grass ½ kg/ha.

(c) Green panic 1½ kg/ha.
Buffel grass ½ kg/ha.



Flooded Brigalow Communities

Rhodes grass 1½ kg/ha.
Buffel grass 3 kg/ha.
Bambatsi panic 50 g/ha.

Other Brigalow Communities

(a) Rhodes grass 1 kg/ha
Buffel grass 1½ kg/ha.

(b) Buffel grass 1 kg/ha.
Green panic 1 kg/ha.

Supplementation or substitution of these species by varying proportions of *Sorghum almum* or other shortlived species such as sudan grass, sugardrip sorghum or the annual millets is warranted depending on the local situation and recommendations. *Sorghum almum* can be a pest in grain sorghum areas as a weed in cultivation, carrier of plant diseases and a host for sorghum midge. Its use should be carefully considered.

In the eastern brigalow areas receiving more than 500 mm rainfall in the *summer* months, Siratro (*Macroptilium atropurpureum*) has been successful in pastures sown with buffel or green panic both on light and relatively heavy textured soils. Such areas generally receive 750 mm rainfall or more annually.

Grasses and their sowing rates

RHODES GRASS was used extensively in early developments, often exclusively, but its use is decreasing. It has little value in drier areas and in other districts its long term persistence is often in doubt. Its stoloniferous habit makes it valuable as a pioneer species, providing early protection against soil erosion.

BUFFEL GRASS is the major species used throughout the brigalow areas and is the only perennial grass planted in the drier districts. The tall cultivars such as Biloela and Nunbank are normally preferred but in drier districts where grazing intensity is lower, the free seeding and more palatable cultivars, American and to a lesser extent Gayndah, are also used, especially where sheep are being run. American is especially valuable in areas receiving less than 600 mm rainfall. In grain cropping lands buffels can be a pest of cultivation.

In scrub types without ground cover seeding perennial and short term grasses at time of pulling results in some early establishment of perennial species and an improved fuel supply for the burn. This picture shows Sorghum almum *plants resulting from such a seeding.*

GREEN PANIC is particularly well adapted to most softwood scrub soils and alluvial soils within the brigalow region. It will establish well under some pulled unburnt scrub. It is usually included in most plantings in the higher rainfall areas (greater than 700 mm). It should not be planted on flooded country.

GATTON PANIC can be used as a substitute for green panic in the more favoured areas.

BAMBATSI PANIC is suited to the heavy textured soils and flooded country. It has the best tolerance to flooding of any species climatically adapted to the region. Seed availability and price generally restrict the proportion used in a sowing mixture. Establishment is sometimes slow in northern areas. Other *Panicum coloratum* cultivars (Pollock, Burnett and Palmgrove) can be used equally successfully.

Sorghum almum can be a valuable component of the sowing mixture in some situations because of its ready germination and quick growth. It can thus provide some early soil cover and distract the attention of marsupials from the slower growing perennial grass seedlings. In the northern areas where establishment of buffel and green panic is difficult on the heavy clay soils the inclusion of *Sorghum almum* ensures that some grazing will be available in the season of sowing.

In using *Sorghum almum* care is necessary to guard against achieving too thick a stand which will retard the growth of the perennial sown grasses. For this reason the sowing rate in the mixture should be limited to ¼ to ½ kg per hectare and stock should be available for early grazing.

Sorghum almum should not be used in those brigalow scrubs where spraying for controlling a possible sucker problem is envisaged in the first season. This will restrict its use to scrubs with a dominant softwood component or those brigalow scrubs where cropping is envisaged as the means of handling a potential sucker problem.

Some poor quality Crooble *Sorghum almum* (in some cases contaminated with Johnson grass (*Sorghum halepense*)) has been used. If the quality of the *Sorghum almum* seed is in doubt, other forage type sorghums or annual millets may be substituted.

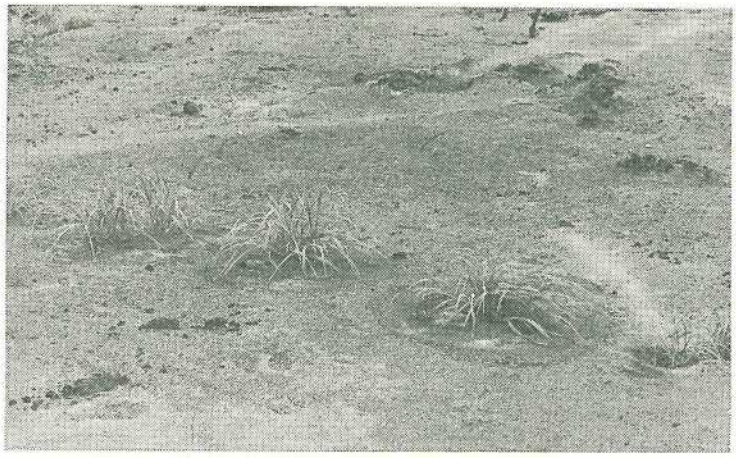
Pastures on Cultivation

Cultivated seedbeds for pastures can be widely different in their degree of preparation. Pasture sowing can follow a period of cropping, a single cultivation soon after the initial scrub burn and stickraking, a single or double ploughing in a reclamation programme, or the soil disturbance caused by log clearing by a front-mounted stickrake. The aim in a cultivated seedbed is to remove competing plants and to create a micro-habitat which will aid germination and early growth of the sown species.

The *timing of the cultivation and sowing* is important for success. Sowing should take place at the final cultivation or immediately after. For pure grass stands planting should be in the period December to mid-February, although spring plantings can be successful in far southern areas where expectancies of adequate winter-spring rainfall are higher.

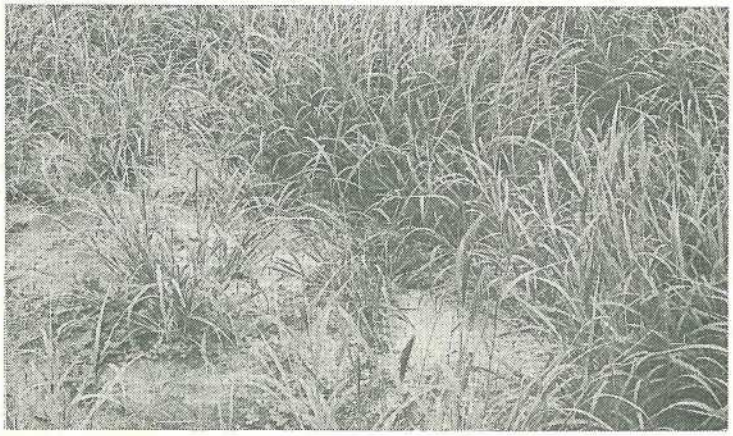
Companion crops will retard establishment and early growth of the undersown pasture species. To minimise competition seeding rates of the crop should be reduced and/or row spacing increased. A legume companion crop for undersown grass is likely to offer less competition for nitrogen than gramineous crops. When only grass is undersown, summer sowing gives better establishment than winter sowing.

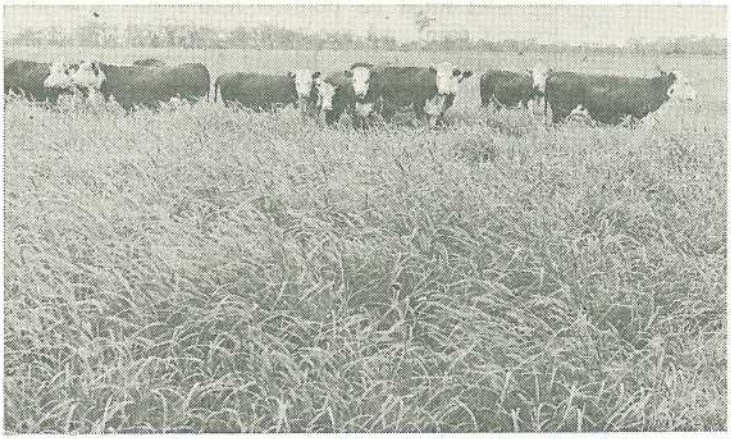
Where lucerne (*Medicago sativa*) or annual medics (*Medicago* spp.) are included in the pasture, they nodulate better when planted in autumn-winter than in mid-summer. These legumes must be planted into moist soil following rain and are usually planted with the last winter crop. Ideally the crop planting rate should be reduced by from 30–40%. On winter crop land the grass can be planted with the last crop or if resources allow it, a more uniform stand is ensured if planted after light cultivation in the following December/February period. Buffel establishment in the cool months is less erratic than that of green panic, but both grasses establish best in mid-summer. In the eastern parts of the central division, Siratro has been successfully grown on both light and heavy textured soils which receive 500 mm or more in the *summer* months.



The young seedlings and the beneficial effect of hoofprints for trapping seed and moisture.

The subsequent colonization of the bare spaces by plants arising from self sown seed.





The dense pasture stand that was finally achieved.

Brigalow in Queensland

'Brigalow' is the common name given to a tree of the acacia or wattle family. The botanical name is *Acacia harpophylla*. Although different forms of brigalow may be observed, and considerable variation exists in the size, shape, colour and texture of the phyllodes ('leaves'). the shape of the trunk, colour of the bark and thickness of sapwood the different growth forms are not varieties in the botanical sense. (Johnson, 1964).

Several hundred species of *Acacia* have been recorded in Australia. Two very common species are mulga *(Acacia aneura)* which inhabits large tracts of south-western Queensland and gidgee *(Acacia cambagei)* which grows under drier conditions than brigalow but typically appears in higher moisture situations than mulga.

Three forms of brigalow are common. Sucker brigalow has a low branching habit and is usually less than four metres in height. Suckers are produced from the lateral roots, their appearance often being initiated by damage to either the roots or the above ground part of the tree. Suckers frequently appear in clusters, which later tend to thin out.

Whipstick brigalow is so called because of the non-branched and thin stems. Typically, this form is dense with a high population of stems, ranging from 4 500 to 20 000 per hectare. Most whipstick brigalow is between four and ten metres in height. This form is usually very slow in growing and while it could be expected that whipstick would eventually change to the tall or virgin form the length of time involved is not known. Some stands of over 60 years of age still retain the whipstick form

The third form is named tall or virgin brigalow and represents the mature stage. Trees range in height from 10 to 25 metres while most are within the range of 13 to 20 metres. Seldom do branches appear on the lower part of the trunk but the top section branches out to form a canopy. Where brigalow trees grow in the open a lower-branched form is common.

Most of the brigalow in Queensland is found within the 500 to 750 mm rainfall zone. While the distribution of rainfall is predominantly during summer, in all but the far northern areas there is a small but useful winter component, which is more marked in the southern regions.

Soils supporting brigalow are mainly clays although in the central and northern regions substantial areas of texture-contrast soils occur. Isbell (1962) identified two major groups – the deep gilgaied clays and the sedentary clay soils – which together account for a large percentage of the total area of brigalow lands in Eastern Australia. Though available phosphate levels are often low, the clay soils are generally regarded as being fairly fertile with good moisture holding capacity. Where the topography is undulating, or exhibiting long slopes the brigalow soils are subject to erosion when cropped on an intensive system. Soil erosion occurs in some areas where the brigalow vegetation is in its natural state. Clearing and grassing reduces erosion under these conditions.

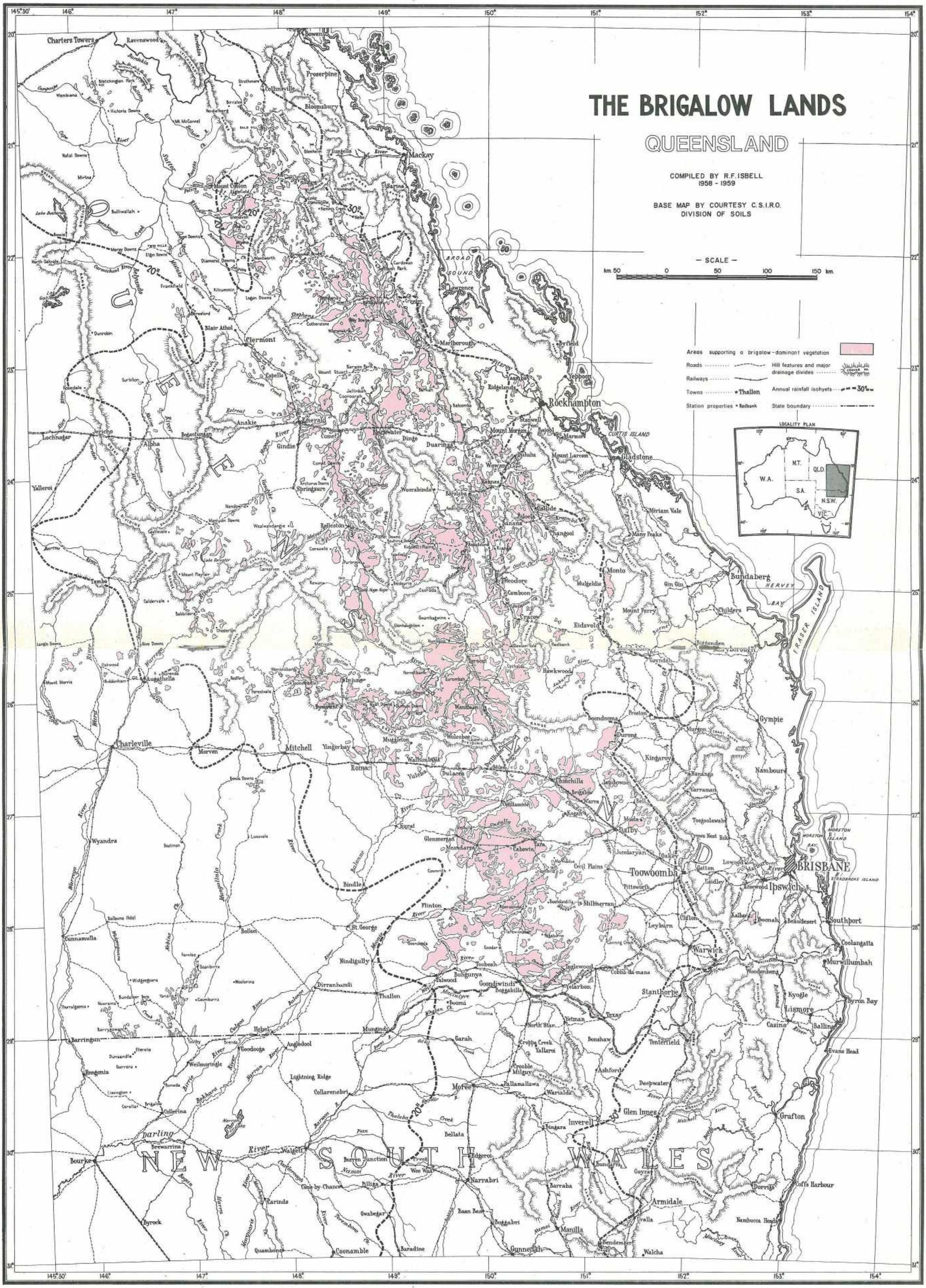
From the map it will be observed that the brigalow areas are by no means continuous as other forest communities and areas of native grassland are interspersed.

Moreover, the brigalow communities themselves show a deal of variety. Some areas of virtually pure brigalow occur but more commonly, brigalow grows in association with other species. Some major communities are:

(a) Brigalow in association with the shrub wilga *(Geijera parviflora)* which seldom exceeds five metres in height.

(b) Brigalow with belah *(Casuarina cristata)* which is a tall growing oak commonly found in the more southern areas.

(c) Brigalow – yellowwood *(Terminalia oblongata)* communities are found in central Queensland and north of the tropic of Capricorn. Yellowwood typically occurs on dark cracking clay soils on gently sloping or flat plains and tends to be confined to fringes of the community.



THE BRIGALOW LANDS
QUEENSLAND
COMPILED BY R.F. ISBELL
1958 - 1959
BASE MAP BY COURTESY C.S.I.R.O.
DIVISION OF SOILS
— SCALE —
km 50 0 50 100 150 km
Areas supporting a brigalow-dominant vegetation
Roads
Railways
Towns Thallon
Station properties Redbank
Hill features and major drainage divides
Annual rainfall isohyets 30"
State boundary
LOCALITY PLAN
W.A.
N.T.
QLD.
S.A.
N.S.W.
VIC.
QUEENSLAND
NEW SOUTH WALES
Charters Towers
Mackay
Rockhampton
Gladstone
Bundaberg
Maryborough
Gympie
Brisbane
Ipswich
Toowoomba
Dalby
Warwick
Charleville
Mitchell
Roma
St. George
Goondiwindi
Emerald
Clermont
Moree
Bourke
Narrabri
Armidale
Grafton
Coonamble
145°30'
146°
147°
148°
149°
150°
151°
152°
153°
154°
20°
21°
22°
23°
24°
25°
26°
27°
28°
29°
30°
31°

(d) Brigalow also occurs as a component of so-called 'softwood scrub' communities. These are commonly dense with a heavy canopy which severely limits the growth of grass species at the base.

(e) Brigalow also occurs in communities with various species of eucalypts. The major ones are poplar box *(E. populnea)* commonly found in a zone between the open poplar box forest of frontage areas and drainage lines and other brigalow communities. Dawson Gum *(E. cambageana)* occurs in associations in the central and northern areas while yapunyah *(E. thozetiana)* associations occur throughout the region. Sandalwood *(Eremophila mitchellii)* is often common in these eucalypt-brigalow communities. Coolibah *(E. microtheca)* forests are found along river terraces which are subject to occasional flooding.

The foregoing descriptions are neither exhaustive nor comprehensive but do indicate the fact that the broad term 'brigalow country' covers not only a large number of brigalow associations but also includes other forest communities.

Brigalow itself is not a valuable commercial timber but is sometimes used for rails in stockyards. Early settlers used various means such as ringbarking and burning to convert the forests to pastures and cultivation lands. In many areas there has been a continual struggle to prevent sucker regrowth dominating the pasture.

The Fitzroy Basin (Brigalow) Land Development Scheme involved the conversion of some brigalow lands of Central Queensland to pastures. Some settlers have also introduced a cropping phase. In addition to areas of brigalow scrub which may be retained at the discretion of landholders the following reservations amounting to almost 100 000 hectares have been made.

(i) National Parks – 22 420 hectares.
(ii) Timber Reserve – 31 363 hectares.
(iii) An outstation of Emerald Rural Training School 9 340 hectares.
(iv) Reserve for scientific purposes (Flora and Fauna conservation) south of Bauhinia Downs 25 900 hectares.
(v) Department of Primary Industries' Brigalow Research Station, Theodore where a reference area is maintained 3 597 hectares.
(vi) Department of Aboriginal and Island Affairs property at Zamia Creek near Bauhinia Downs 2 795 hectares.

Further Reading:

Isbell, R.F. (1962) 'Soils and Vegetation of the Brigalow Lands, Eastern Australia'. C.S.I.R.O. Division of Soils. Townsville, Qld.

Johnson, R.W. (1964) 'Ecology and Control of Brigalow in Queensland'. Qld. Dep. Pri. Ind. Brisbane.

Skerman, P.J. (1953) 'The Brigalow country and its importance to Queensland'. J. Aust. Inst. agric. Sci. 19:167–76.

Skerman, P.J. (1959) 'The Brigalow country as an Asset to the State' in 'Report on Progressive Land Settlement in Queensland' by The Land Settlement Advisory Commission. Govt. Printer, Brisbane.

Because of the wide range of planting alternatives throughout the region, the local agricultural extension officer should be consulted for more specific recommendations.

Grasses for Gilgais

Gilgaied soils are found throughout the brigalow region and in some areas the proportion of land under gilgais is considerable.

Gilgais or melonholes vary considerably in size and depth. Inundation restricts the choice of grass species to those which survive flooding in the wet season and drought in the dry season.

The very shallow gilgais will support the makarikari grasses, pangola (*Digitaria decumbens*), water couch (*Paspalum distichum*) and para grass (*Brachiaria mutica*). In depressions 0·5 to 1 metre deep, any of these grasses may be used. In gilgais greater than 1 metre deep the selection is restricted to para grass.

The Makarikari grasses may be planted from seed but all other species require vegetative or clonal planting. This however, will give rapid colonization of the gilgai.

Phasey bean (*Macroptilium lathyroides*) can also be planted in gilgais in higher rainfall areas.

Gilgai grasses offer green succulent feed to stock long after the surrounding pasture has dried off. They are all well accepted by stock and make a definite contribution in badly gilgaied land.

MANAGEMENT

Management involves a sound stocking policy commensurate with pasture quality and availability. It also involves the maintenance of a high level of pasture production by the control of regrowth of brigalow and other weed species and the conservation of soil fertility.

Pasture maintenance and management for ash-sown pastures differ in many respects from that for cultivated pastures. These are discussed separately.

Ash-sown pastures

As grass seedlings emerge, so in many instances do brigalow suckers. While further emergence of sown grass seedlings is dependent on germinating rains, brigalow suckers continue to emerge irrespective of rainfall. Around March the ash-sown area should be inspected and decisions made as to initial stocking, and the need for aerial spraying of brigalow suckers.

Initial grazing

For the amount of pure live seed sown, only a small percentage (2–10) establishes in the season of sowing. Because there is often a range of plant sizes depending on time of emergence, the timing and intensity of the initial grazing can greatly influence the thickening up of the stand.

All grasses except the short-lived forage species such as the sorghums should be permitted to flower before grazing. So long as the stocking rate is not excessive most grasses will then set adequate seed under grazing.

Where it is intended to aerial spray for sucker control and a good early pasture growth has been achieved it may be desirable to graze rather more heavily than would otherwise be considered desirable in April/early May (immediately before spraying) to ensure maximum coverage of suckers by the spray.

Once the first seeding is complete the pasture should be grazed heavily over the first winter to clear as much obstruction as possible from seedling germinations that will follow the first summer storms. This seedling crop can be as important as the first stand in thickening the pasture. Again the area should be spelled following germination to permit maximum further establishment. Beyond this point normal use can start.

Pastures dominated by *Sorghum almum* and other forage species should be grazed as a forage crop. Grazing should begin at a height of about 1 metre, before flowering and at a high stocking rate (a beast to ½ ha or at the most 1 ha) to capitalize on the initial flush of fertility which they will express.

Weed control

Since competition by weeds reduces the productivity of sown species, weed control is important in the management for maintenance of the sown pasture.

The original scrub type, the soil moisture conditions at pulling and the intensity of the scrub burn all influence brigalow suckering, other woody weed regrowth and annual weeds.

Woody weeds such as currant bush, false sandalwood, yellowwood, gidyea and Ellangowan poison bush are susceptible to very hot fires.

Spraying

If the density of brigalow suckers in March warrants an intense control programme, serious consideration should be given to aerial spraying with the recommended rate of 2,4,5–T ester that autumn when the suckers are most susceptible. A kill of 80–90% can be achieved then. The kill is much poorer in subsequent years.

Ploughing

The emerging brigalow suckers, other woody weeds and annual weeds are most susceptible to ploughing in the season following the scrub burn. The soil at that time is relatively loose and ploughing 10–15 cm deep is readily achieved, with maximum weed control.

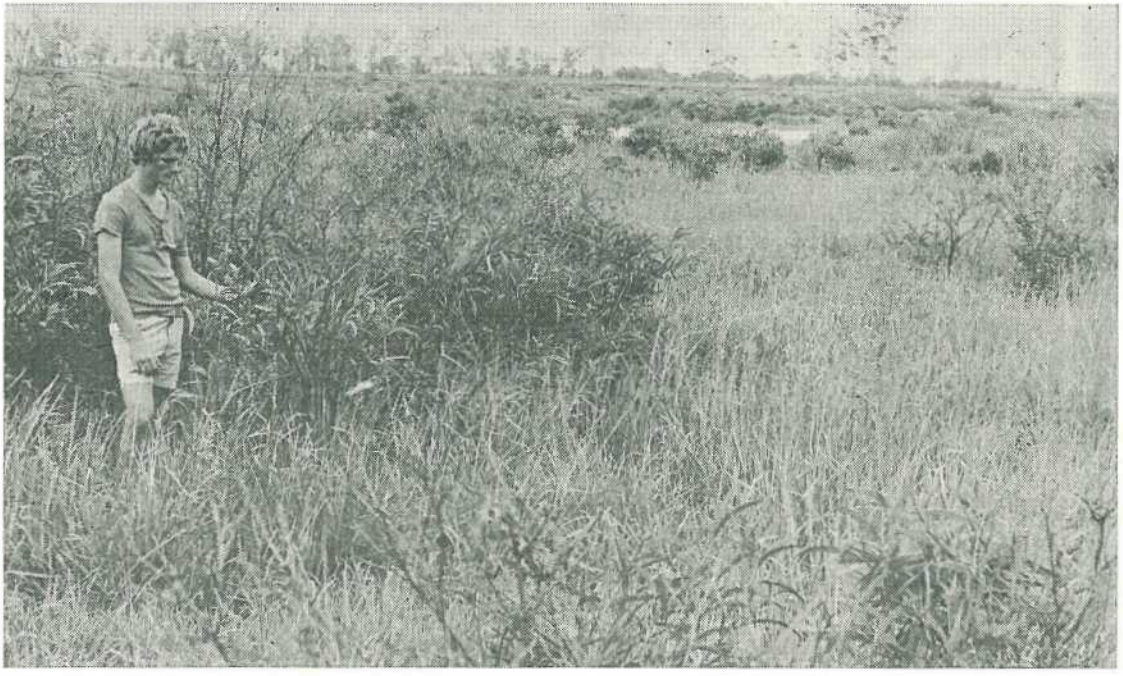
Woody weeds more than one year old require greater effort for their control. A programme designed to control brigalow suckers will also control other woody weeds. Techniques have been developed to control these older suckers by a combination of burning, ploughing and spraying, double ploughing early and late in the summer, and by continuous cropping for three years. Details are available from district extension officers.

Burning

Repeated pasture burning can lead to degradation. Effective burning only brings suckers back to ground level and the competitive process starts again. Burning can be wasteful of resources available but under very tight economic conditions many graziers have to resort to burning.

Burning can, however, be combined with other more effective control measures involving spraying or ploughing. Effective burning needs a good bulk of fuel so that very light grazing or pasture spelling during the summer prior to burning is necessary.

Failure to spray brigalow suckers in the first year has resulted in this situation. Older suckers become resistant to spraying and suppress grass growth.



Timing is also important and the burn should be carried out when suckers are just overtopping the grass. To avoid loss of the organic mulch on the soil surface and to allow the grass to regrow soon afterwards, burning should be done when a high proportion of the grass fuel is dry but the soil and organic mulch are still wet after spring or early summer rains.

Regular burning can accelerate soil fertility decline by continually removing the surface organic mulch, resulting in excessive run-off during high intensity storms, overgrazing in droughts and other forms of deterioration due to these.

Reclamation of Run-down Pastures

Pastures which were originally sown to Rhodes grass and/or *Sorghum almum* are often invaded by less productive native grasses and weeds as they age. This is due to a combination of declining available nutrients, the effects of drought, fire and overgrazing and the competitive effects of the encroaching species. Such areas can be reclaimed by the introduction of green panic or buffel grass following some degree of cultivation to prepare a seedbed.

Three alternatives are available. A full cropping programme followed by pasture re-establishment can be undertaken or quicker and cheaper means of reclamation used. These involve either one ploughing or stick raking. For reliable establishment with minimal cultivation techniques the cultivation/seeding operation is best carried out in the period December to February.

Other management factors are common to both ash-sown and cultivated pastures and are discussed accordingly.

Grazing system

In most instances continuous grazing is used. This is adequate for pure grass, and grass-annual medic pastures but when lucerne is included rotational grazing is essential. Lucerne cannot stand continuous grazing and a system of 2 weeks grazing with 6–8 weeks rest is preferred.

Suckers were not a problem in this pasture but the Rhodes grass (left) was in a run down state. One ploughing and seeding to buffel grass has produced the excellent pasture on the right.

Gilgais, or melonholes, are inundated during the wet season. Several grasses will thrive in gilgais and the one shown here is water couch (Paspalum distichum).

Stocking rate

Stocking rate is a function of the quality of the pasture and beef production objectives. The Brigalow Scheme was established on the basis of 1 beast to 3 ha but Coaldrake and Smith have reported gains of 115 kg estimated dressed weight per head for the first year of a *Sorghum almum*—green panic pasture at Banana stocked at 1 ha a beast in a year of below average rainfall. This was a fully cultivated and sown pasture with no logs, sticks or regrowth to reduce the effective pasture area. Elsewhere ash-sown pastures grazed at a beast to 2 to 3 hectares have sustained liveweight gain per head at from 130 to 160 kg annually. On the other hand, difficulty can be experienced in reaching even the 1 beast to 3 hectares level when initial establishment is poor and/or extensive regrowth occurs.

Once a pasture is fully established, it should be stocked at maximum carrying capacity taking care to ensure that adequate drought reserves are ahead of the stock on hand. Lenient grazing of a pasture will do little to slow sucker regrowth but may ensure better drought persistence of Rhodes grass. On the other hand stocking rate will have less effect on the persistence of buffel grasses. This factor can be utilized when deciding where temporary stress periods can be weathered best.

There is little to be gained by ultra conservative stocking, especially in the early development stages. This only wastes the advantages of high production from the initially high soil fertility.

FERTILITY MAINTENANCE

Fertility maintenance is the biggest unknown quantity associated with pastures on brigalow lands. There is little available information both in relation to the rate of fertility decline, uncomplicated by encroaching regrowth, and methods of averting this decline. That pure grass pastures must eventually run out is widely appreciated. This process will be speeded up by cropping.

On less fertile soils low nitrogen fertility has long been known to be the major limitation to continued high yields from pure grass pastures beyond the establishment period.

The incorporation of a leguminous component is the classical method of maintaining or at least substantially slowing the rate of fertility decline. There is, however, little information from which to assess the position with these soils.

The highest figures available for nitrogen fixation by legumes in the field are only in the order of 200 kg N per hectare per annum under ideal soil moisture conditions. Under the more severe conditions of the brigalow region much less can be expected from any legume. Therefore, the immediate prospects for adequate economical methods of maintaining the nitrogen fertility are not bright and considerable research work in this direction is required.

The inclusion of those legumes available can make some contribution and an input of 30–40 kg/ha of nitrogen per annum may be enough to maintain long term pasture stability.

The legumes include lucerne and annual medics which are best adapted to the more southerly areas where winter rainfalls are more reliable. In the wetter eastern margin of the brigalow, Siratro is successful but in the inland areas no pasture legumes are available.

The forage crop Highworth lablab bean (*Lablab purpureus*) can make a major contribution in this direction where cultivation is practised. When harvested for grain, however, a large proportion of the nitrogen it contributes will be removed with the seed.

At Biloela, on alluvial soils, lucerne has increased grass yields up to 75% in the third and fourth years after planting when grown in intimate mixtures with six grasses compared with pure grass stands; however, it is not well adapted to the heavier brigalow soils in Central Queensland.

Brigalow soils are also known on occasions to be low in available phosphorus. Although molybdenum and sulphur also bear watching, little information is presently available.

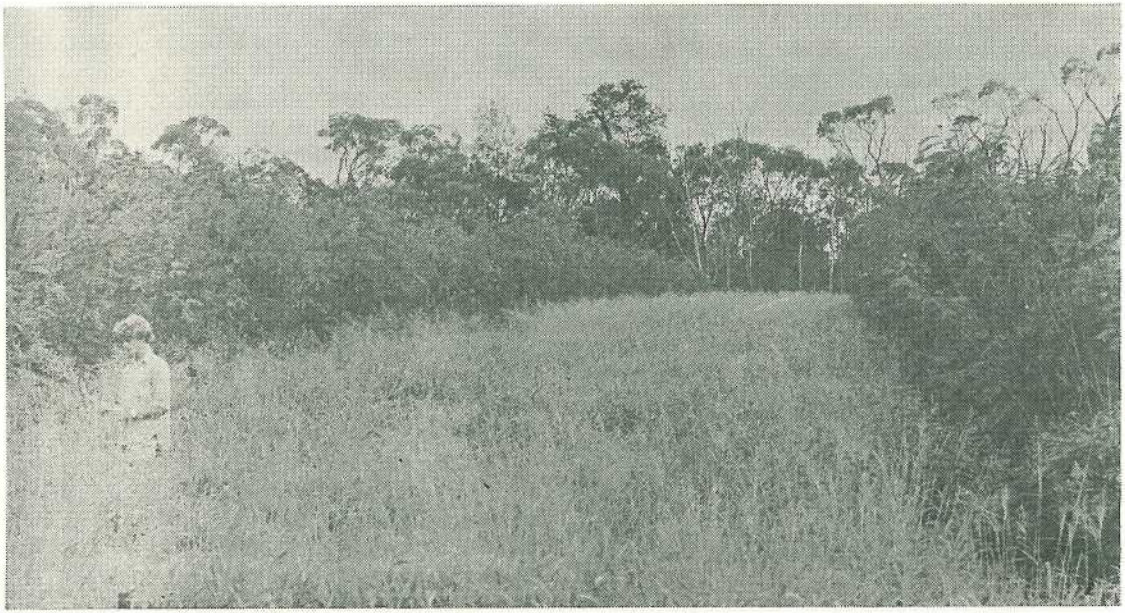
Maintaining high animal production

On brigalow properties with extensive areas of high yielding grass pastures stock management can achieve reliable beef turn-off with judicial stocking pressures. Further improvement, however, can only be achieved with alternative feeds of higher quality at strategic periods.

Special purpose pastures involving forage crops, legume-based pastures and fertilized grass pastures can play a role. In the south, oats and sown pastures based on lucerne or annual medics greatly improve autumn- to-spring production. In the central and northern areas oats is unreliable and forage sorghums offer little over good grass pastures.

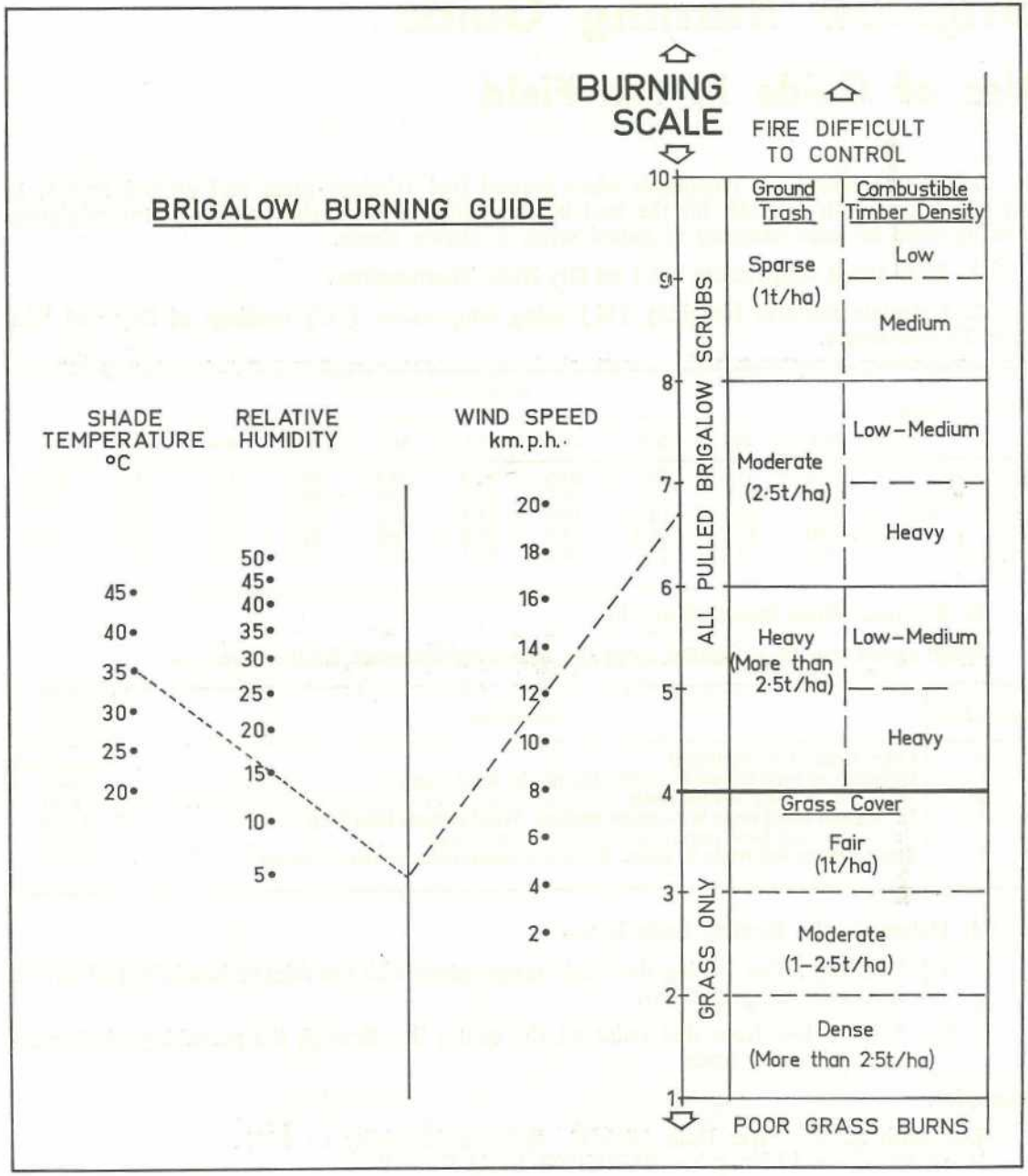
From the evidence available in the central and northern areas, increased turnoff in the autumn-early winter would ease the stress of the winter-spring period by reduced stocking pressure. Leucaena, the only persistent legume on the subcoastal clay soils, and the quick growing, high yielding forage legume Highworth lablab are high protein feeds which show promise of raising animal productivity in the February to July period and effectively increasing beef turnoff.

Acknowledgement: The assistance received in preparation of this article from various Agriculture Branch extension officers located throughout the brigalow regions is gratefully acknowledged.



Above: The shrub legume leucaena growing in widely spaced rows with green panic grass established between the rows.

Below: Highworth lablab bean is a forage crop which can provide high protein feed in autumn-winter-spring and can return nitrogen to the soil.


BRIGALOW BURNING GUIDE
SHADE TEMPERATURE °C
RELATIVE HUMIDITY
WIND SPEED km.p.h.
45
40
35
30
25
20
50
45
40
35
30
25
20
15
10
5
20
18
16
14
12
10
8
6
4
2
BURNING SCALE
FIRE DIFFICULT TO CONTROL
ALL PULLED BRIGALOW SCRUBS
GRASS ONLY
10
9
8
7
6
5
4
3
2
1
Ground Trash
Combustible Timber Density
Sparse (1t/ha)
Low
Medium
Moderate (2·5t/ha)
Low–Medium
Heavy
Heavy (More than 2·5t/ha)
Low–Medium
Heavy
Grass Cover
Fair (1t/ha)
Moderate (1–2·5t/ha)
Dense (More than 2·5t/ha)
POOR GRASS BURNS

Brigalow Burning Guide

Use of Guide in the Field

During prevailing dry conditions when ground fuel (timber, grass and ground trash), is dry check daily this GUIDE for the best burning time. For satisfactory burns, the minimum burning scale for each category of pulled scrub is shown above.

1. Read shade temperature (°C) on Dry Bulb Thermometer.

2. Calculate Relative Humidity (%) using temperature (°C) readings of Dry and Wet Bulb Thermometers.

Relative Humidity		Dry Bulb Temperature °C									
		21·1	23·9	26·7	29·4	32·2	35·0	37·8	40·6	43·3	46·1
40%	Wet Bulb °C	13·9	16·1	18·3	20·5	22·2	24·4	26·7	28·9	31·1	33·3
30%		12·2	14·4	16·7	18·3	20·5	22·2	24·4	26·1	28·3	30·0
20%		11·1	12·7	14·4	16·7	18·3	20·0	21·7	23·3	25·0	27·2
15%		10·0	11·7	13·9	15·5	17·2	18·9	20·5	22·2	23·9	25·5
10%		9·4	11·1	12·7	14·4	16·1	17·8	18·9	20·5	22·2	23·3

3. Estimate Wind Speed (Km.p.h.).

Wind speed can be estimated from the following Beaufort Scale values:—

Beaufort Scale	Specification	Wind Speed Km.p.h.
0	Calm, smoke rises vertically	Less than 2
1	Direction of wind shown by smoke but not by wind vanes	2–5
2	Wind felt on face; Leaves rustle	6–11
3	Leaves and small twigs in constant motion. Wind extends light Flag	12–20
4	Raises dust and loose paper, small branches are moved	20–30
5	Small trees in leaf begin to sway. Crested wavelets form on inland waters	30–40

4. Determine the Burning Scale by:—

(i) Drawing a line joining the shade temperature with the relative humidity and extend it to meet the centre line.

(ii) Draw a line from that point on the centre line through the prevailing wind speed to the burning scale.

Examples:

Dry Bulb 35°C Wet Bulb 18·9°C Relative Humidity = 15%.
Wind Speed = 12 Km.p.h. BURNING SCALE = 7—

Growing crops on brigalow lands

by J. HARBISON and C. C. GILLIES.

IN the main, matters of general principle are discussed in this article. Wheat and sorghum are discussed in some detail. Much of what applies to wheat applies to other winter crops and much of what applies to sorghum applies to other summer crops.

A reading list appears at the end of the article which growers may wish to use to gain a more detailed description of matters relating to crop production in the brigalow lands. In addition, Departmental extension officers can provide information relevant to the particular region and farm situation.

Brigalow is restricted to eastern Queensland from Collinsville in the north to the New South Wales border in the south; and from the eastern coastline to St. George, Morven and Jericho in the west. The discontinuous belt covers some 1 200 km (N–S) by 500 km (E–W). However the main cropping areas occur along most of the length of the belt and between 100 km and 400 km from the coast.

CLIMATE

The climate varies considerably over the area. Information on rainfall, rainfall variability temperature and frost for selected centres appears in Tables 1, 2 and 3.

TABLE 1

CLIMATIC DATA FOR REPRESENTATIVE CENTRES

Climatic Factor	Centre and Latitude			
	Goondiwindi 28° 33′	Miles 26° 40′	Biloela 24° 24′	Clermont 22° 50′
Annual rainfall mm	520	610	700	640
April–September rain as % of annual	37	32	29	26
Average maximum temperature April–September °C ..	21·9	22·9	24·8	25·7
Average minimum temperature April–September °C ..	8·0	6·8	7·5	9·7
Average maximum temperature October–March °C ..	32·1	31·8	31·8	33·4
Average minimum temperature October–March °C ..	17·5	17·1	17·1	19·1

(Source " Climatic Averages Australia " Bureau of Meteorology, 1956)

Rainfall for the main cropping area varies from about 500 to 750 mm annually. Rainfall decreases from north to south and from east to west. Distribution of rainfall throughout the year varies with latitude. For example at Goondiwindi in the south, 37% of annual rain falls in the cooler six months of the year (April–September), while at Clermont in the north the figure is only 26%. Also the chance of receiving effective winter rain decreases generally from south to north.

Frosts occur throughout the area but are less frequent and generally less severe in Central Queensland. Figures for Biloela belie this. The reason is that the recording station is situated on a creek flat. Such flats are renowned for lower minimum temperatures as are depressions in the rolling brigalow country.

TABLE 2

FROST DATA FOR REPRESENTATIVE CENTRES

Centre	Number of frost free days in year (2°C in screen)	Average date of first frost (0°C in screen)	Average date of last frost (0°C in screen)	Number of severe frosts/year (0°C in screen)
Goondiwindi	274	June 30	August 3	4·6
Miles	238	June 10	August 31	20·3
Biloela	252	June 21	August 27	18·4
Clermont	319	July 14	July 27	2·1

(Source: Frost in tne Australian Region; Foley, C. J., Commonwealth Meteorological Bureau, 1945)

High summer temperatures are recorded throughout the brigalow lands but conditions on the Central Queensland Highlands are far more severe than for the other regions. The average maximum temperature over the summer months for Clermont is shown as only 1·6°C above that of Biloela. However, the occurrence of heat waves (defined here as occurring when the temperature on two successive days exceeds 37·8°C) at Clermont is five times that at Biloela.

With regard to cropping, the higher winter component of rain would be expected to favour winter cropping in the south and the higher summer component to favour summer cropping in the north. This is the general situation but other factors operate which make growing summer crops in the south and winter crops in the north attractive propositions.

While rainfall is higher in the north, evaporation is also higher and this lessens the effectiveness of rainfall, particularly summer rainfall. Evaporation in the south (particularly in the eastern parts) is lower and this means that although summer rainfall is lower it tends to be more effective than an equivalent amount in the north. In addition areas cropped throughout the brigalow lands are generally heavy clays. Providing they are deep (75 cm +), enough water can be stored in them before planting to provide much of the moisture needed by the subsequent crop.

The overall picture is that a range of grain and fodder crops can be grown over the whole area. The main crops are grain and forage sorghums cultivated throughout the whole area; wheat and sunflower grown from about Clermont south; safflower produced mainly in Central Queensland and oats (mainly for grazing) and barley grown mainly in the southern brigalow belt.

THE SOIL

Moisture Conservation

Moisture stress is the factor which most commonly limits crop production in the brigalow lands of Queensland. Fortunately, as mentioned before, many brigalow soils have a high clay content and provided they are deep enough can store large quantities of water for subsequent use by plants.

TABLE 3

RAINFALL EXPECTATION (mm) WITH SPECIFIED PROBABILITIES FOR THE SIX MONTH PERIOD FROM THE START OF MONTH SHOWN, FOR SELECTED CENTRES

Centre	April 20%	October 20%	April 50%	October 50%	April 80%	October 80%
Clermont	263	627	149	463	88	301
Banana (similar to Biloela) ..	273	624	183	475	117	349
Goondiwindi	295	511	204	359	146	282

(Source: Extract of table from " Rainfall Probabilities " (1975). Robinson, I. B., Mawson, W. F. Y. *Qld. Agric. Jour.* 101 (2): 163–182.)

Research has shown that yield of rain-grown wheat, sorghum and cotton in Queensland is heavily dependent on the amount of moisture stored in the soil at planting. This no doubt applies to other rain-grown grain crops such as barley, sunflower, safflower and to fodder crops such as forage sorghums, oats, cowpeas and lablab. Grower experience certainly supports the proposition for all crops. The importance of understanding and applying measures which will trap and store the maximum amount of moisture in the soil therefore cannot be over-emphasized.

Recommendations

Recognise that moisture in most cases rather than soil fertility is currently the factor most often limiting crop yield.

Understand the dimensions of this deficiency and that it can be made good by antecedent fallowing.

The following seven guide-lines for efficient fallowing to ensure maximum build-up of soil moisture are most important:

- Don't plough winter crop stubbles on cracking clay soils until weed producing rains have been received. The cracks help get deep storage of moisture from storm rains.
- Keep fallows clean of living plant growth. All plants are soil moisture robbers. One-way disc ploughs or disc tillers are the most efficient weeders in general use. Other types of weeders, for example modified tyne implements and rod weeders, now being tested, are giving good weed kills with less moisture loss than occurs with conventional discing.
- All sloping ground must be cultivated on the contour to retard destructive concentration of water run-off.
- Preservation of crop residues on the soil surface is essential to reduce raindrop impact damage and early surface sealing. Farming with stubble has its problems—so has farming with inadequate moisture. Choose your problem. Farm machinery is being evolved to cope with stubble mulch situations. The Soil Conservation Branch has such machinery available for trial. Farmers are invited to use this machinery and evaluate it for themselves.
- Plough moderately deeply—at least 10–12 cm—to produce an initial cloddy fallow. This will resist the destructive force of raindrops to some extent and retard the occurrence of surface sealing. Subsequent cultivations will fine down the fallow all too quickly, especially on some of the sandy-surface texture-contrast soils. Repeated shallow working at the same depth each time is to be deplored. Avoid, at all cost, the use of harrows for fining down the seed bed at least until March-April and then only if the tilth is too open. Avoid the use of worn discs and avoid cultivation when the soil is too wet.
- Work the ground as little as possible to avoid producing a dusty surface mulch. Cultivate to control weeds, not for the sake of cultivation. Make sure the cultivation implement is doing the job. Don't use a combine when a scarifier is required—don't use a scarifier if a disc plough is required.
- Work disc implements at a speed which doesn't unduly pulverize soil particles. Six kilometres per hour is the most satisfactory speed.

Judge the effectiveness of a fallow not in terms of so many months since it grew a crop but in terms of depth of wet soil. As a general rule do not sow crops on less than 60 cm of fully wet soil. Winter grain crops (wheat, safflower, barley) will perform better if at least 90 cm of wet soil is available at planting.

Learn to use intelligently an auger-probe of about 1 cm diameter. A light-weight man can push such a probe through adequately wet soil with about the same resistance that firm butter offers to a knife. If the tool has to be used as an auger, the soil is not sufficiently wet.

In general, select the cracking clays for grain production, rather than the duplex soils —especially those with a shallow, sandy surface. Soil depth is an important consideration. Highest yields will normally be expected on deepest soils, while ideally only forage crops should be established on any soil less than 75 cm deep. Heavy gilgaid country can never be considered as anything but second class cropping country. There are strong differences in soil between puffs and depressions. These continue to show up even after levelling and patchy crops result.

SOIL FERTILITY

Two elements deserve special consideration.

Phosphorus. Research has identified widespread deficiencies of this element. A soil test is already available but current research should help to refine this.

Nitrogen. Since brigalow is a legume, soils cleared of it tend to have adequate supplies of nitrogen in the initial years. Mineralization occurs rapidly under favourable conditions in the initial years providing lush crops (and weeds). Current research aims at identifying any deficiencies in nitrogen in the southern brigalow belt and to provide a suitable soil test.

Rotations

Although the physical condition of the surface soils of much of the brigalow lands in their natural state is good, they are liable to deteriorate under intensive cultivation. A pasture ley of several years will aid in improving soil structure at least temporarily. At present, however, pasture rotation in brigalow lands is rarely practised for the good of the soil but rather as a matter of convenience or financial necessity to aid a grazing programme. In times of depressed livestock prices there is likely to be a swing to cropping for the same reason.

Rotation of summer and winter crops, however, is a widespread practice in those parts of the brigalow lands suited to both enterprises. Here again the reason for the change is often one made for immediate monetary gain. On the other hand a change from summer to winter cropping for a period is recognized as an efficient way of controlling summer weeds through cultivation over summer. Likewise winter weeds can be controlled by a swing from winter to summer cropping.

WEEDS

Many brigalow soils because of their initial fertility, and often later through poor husbandry, grow heavy populations of vigorous weeds. Unlike the treeless plains of the Darling Downs and the open plains of the Central Queensland Highlands many brigalow soils dry out very quickly on the surface. This permits the operation of cultivating and planting machinery before the weeds have germinated. Thus the weeds will not be killed. For this reason most grain growers allow the weeds to germinate before they use their planting machinery.

Troublesome weeds (apart from brigalow suckers which are dealt with in another article) include—

For winter crops

Wild oats (*Avena ludoviciana* and *A. fatua*), New Zealand spinach (*Tetragonia tetragonioides*), Climbing buckwheat (*Polygonum convolvulus*), Turnip weed (*Rapistrum rugosum*), Mexican poppy (*Argemone mexicana*), Wild turnip (*Brassica tournefortii*).

For summer crops

Datura spp., Black pigweed (*Trianthema portulacastrum*), Pigweed (*Portulaca oleracea*), Urochloa grass (*Urochloa panicoides*), Love grasses (*Eragrostis spp.*), Barnyard grass (*Echinochloa crus-galli*), *Sesbania pea* (*Sesbania benthamiana*), Bellvine (*Ipomoea plebea*), Noogoora burr (*Xanthium pungens*), Johnson grass (*Sorghum halepense*), Mint weed (*Salvia reflexa*).

Broadcast plantings (15–25 cm row spacing) rely on quick ground cover to smother weeds but crops sown at wider row spacings (e.g. 40 cm or more) rely on inter-row cultivation to keep weed populations down. Wider use of intermediate spacings (e.g. 30 cm) associated with press wheel drills are expected to increase weed populations in weed prone areas. This is because current planters of this type are not as efficient weeders as the conventional combines.

While agronomic measures for weed control are preferred, recourse to chemical weed control is often necessary. Herbicide recommendations are available for the major weeds.

ESTABLISHMENT

Stored soil moisture is of little use if a good stand is not achieved after planting. Gappy stands cause straight-out yield reductions. They also lead to differences in crop height, head size and maturity which can cause harvesting problems—severe in sunflower particularly and to a lesser extent in sorghum.

Conventional equipment, such as combines, need a conventional seed bed for successful establishment—moist, fine-textured soil mulch overlying a firm moist bed at 5–10 cm. Establishment of winter crops under these conditions is not generally a problem. However, establishment of summer crops can be difficult even under good conditions especially if soil mulch is coarse textured and hot weather following planting causes quick drying of this mulch.

Continuing Departmental research is identifying the factors which can improve germination of sorghum and sunflower seed (a combination of planting depth, seed placement mechanism and roller types and roller pressures). Commercially, a light rolling following planting is often used to improve germination in situations where the problem is likely to occur.

Exciting developments have been taking place in the development of planting machinery which can be used to establish crops successfully in stubble mulch situations and where surface soil moisture reserves are depleted. The moisture seeking drill fitted with press wheels is of particular significance.

The Department's Soil Conservation Branch has repeatedly used drills of this type to sow deeply in stubble mulch situations, and successfully establish crops in soil so dry in the surface layers that establishment with a conventional combine would be impossible. Better root development often followed establishment with the moisture seeking drills. This is important particularly for the winter cereals. Farmers too are successfully using similar equipment, either commercial, adapted or constructed entirely by themselves.

A great deal of research at farmer, manufacturer and institutional level is being undertaken to adapt the equipment so that versions will be available to plant successfully in a range of soil types and soil moisture conditions. There is little doubt that the equipment will be of great benefit in the brigalow belt by allowing consistent establishment over a far wider range of conditions and planting dates than is possible at present.

The trend to wider row spacings particularly in such crops as sorghum, sunflower and safflower to produce more consistent yield could be considered a detrimental practice in terms of erosion control. The erosion hazard can be reduced to some extent by restricting the wide row planting of sorghum to country of low gradient and to use contour planting techniques.

CROPPING STRATEGIES

Accepting soil moisture conservation in the fallow and good, even establishment as essential for successful cropping in the brigalow lands, what other ingredients are necessary to ensure maximum montary return from cropping while minimizing soil erosion and soil fertility losses?

Taking them in logical sequence they are:

- choice of crop to suit the planting season—summer or winter, grain or forage.
- choice of the desired variety of that crop to suit the particular planting time within the season and considered to be the best adapted to the region and, where known, the particular area sown on a particular property.
- choice of suitable planting rate for the particular variety, for the specific time of planting and taking into consideration the soil type and depth of wet soil at planting.
- choice of suitable fertilizer regime (where required), commensurate with level of return expected.
- implementation of measures designed to minimize soil erosion.
- protection of crops from excessive damage caused by weeds, insect pests and diseases, and of harvested grain from insect pests of storage.
- efficient harvesting of grain crops and/or grazing in the case of fodder crops.

Good farmers have been using these or similar guide lines for years, consciously or unconsciously, in helping them to decide the best strategy for a particular crop. In recent years Departmental regional varietal recommendations for wheat, sorghum and oats have paid particular attention to the need for adjustments to be made to varietal choice and planting rates for different times of planting.

Mr. D. R. Woodruff of the Queensland Wheat Research Institute has recently completed a report dealing with decision making in wheat growing which should prove of value to farmers. The report summarizes the existing information on wheat yield expectancy in a given year on a given farm property. Factors known at planting; for example, depth of wet soil, time of sowing, cultivation history, are used to provide a yield expectancy table. This can be used as a decision tool by the farmer with respect to his optimum decision as regards cropping practices, e.g. choice of variety, sowing rate and fertilizer practices. A wide research base (results from 300 Departmental trials conducted over 25 years) was used in this study. Similar reports on other major crops will be provided when the research base for them is wide enough to review the work with confidence.

WINTER GRAIN CROPS

Wheat

Time of planting

Apart from occurrence of planting rains, the most important factor which controls the time of planting of wheat in the brigalow lands is frost. Grain yields are reduced progressively as planting is delayed in the later part of the season. So the aim is to plant wheat as early as possible and still have the crop flower later than the date of the expected last frost of the season (Table 2).

Obviously the date of last frost varies from region to region and even from one part of a farm to another especially on rolling country. Hence optimum planting dates vary from early-April to mid-June in regional recommendations. However, some farmers in Central Queensland familiar with the frost risk on their properties plant in March or even February and have recorded reasonable yields. Other farmers in colder areas would be loath to plant quick maturing wheat varieties before late June. The importance of becoming familiar with the frost regime in your particular environment can therefore not be stressed too strongly.

Varieties

The combined effects of reasonable soil nitrogen supply and the quick finish to the season in most brigalow lands is to produce wheat of high protein content. Provided grain is not weathered or pinched, growers expect premium payments associated with Prime Hard or Hard 1 classifications, both at a fairly high level of protein. Varieties recommended for all or some of the brigalow regions—Timgalen, Gatcher, and Oxley—are all acceptable Prime Hard varieties while the new variety Kite is acceptable as a Hard 1 variety.

Kite and Gatcher can be expected to perform well over the whole region and under a range of environmental conditions. Timgalen performs better when growing conditions are favourable. Oxley, as the only mid-season variety, should be planted early to give it any chance of success and preferably in more favoured areas of the brigalow lands experiencing milder climate.

Awn length is an important characteristic in wheat in brigalow lands. Some grain growers require awnless varieties which can be fed post-flowering to stock should the crop fail as a grain proposition. Other grain growers require awned varieties. These are less attractive to the wild pigs which cause serious damage on occasion in awnless varieties. Of the recommended varieties only Kite is virtually awnless. All the others are strongly awned.

Information on recommended varieties, planting dates and planting rates is given each year in the March issue of the Queensland Agricultural Journal.

Planting rates

Wheat can produce good yields at quite low planting rates (20 kg/ha) under a range of growing conditions. On the other hand, under harsh growing conditions high populations tend to use more water and haying off can result. It makes good sense, therefore, to err on the low side particularly if soil moisture is limiting. In Departmental recommendations allowance is made, depending on the region, for planting on light soils or heavy soils (heavier rate), planting with restricted or adequate soil moisture (heavier rate) and planting early or late (heavier rate). Wheat generally tillers less when planted late (higher temperatures), hence the heavier planting rate recommended for late sowing. Higher populations recommended for Central Queensland probably are made on the basis that wheat plants tend to

tiller less there. Certain varieties, e.g., Timgalen and Oxley, tiller profusely and can have their planting rate adjusted downwards in potentially harsh situations.

Row spacing used is still mainly 18 cm although there is a trend towards spacings of up to 25 cm or even 30 cm where press wheel drills are being used.

Fertilizer application

Phosphorus is the element most likely to be lacking in the region and can be applied in accordance with recommendations made as a result of a soil test. Test strips of fertilizer at a light and a heavy rate will give a guide as to whether a response is likely.

Diseases

Leaf and stem rust are the most serious diseases of wheat. No varieties are completely resistant to leaf rust but Oxley has a useful level of field resistance at present. At the time of writing the resistance in Timgalen, Gatcher, Kite and Oxley has proven effective against common field races of stem rust.

Other diseases which cause problems in the region from time to time are common root rot, black point, yellow spot, glume blotch, loose smut and crown rot.

Insects

Grain storage pests present the greatest recurring problem and farm hygiene is of great importance.

Locusts and mice cause acute problems in certain seasons. Cut-worm, army worm, wireworm, ant, thrip, aphid, Petrobia mite and blue oat mite infestations cause severe problems in localised areas spasmodically.

Barley

Barley is used mainly as a grain crop in Queensland but is well suited to grazing as well. It will grow well in brigalow lands but the extent to which it is grown depends largely on the monetary return from it as compared with alternative crops. Barley will normally outyield wheat in areas where it is well adapted but present varieties do not appear to have any real yield advantage over wheat in most of the brigalow lands.

Quality-wise most growers in the brigalow-belt would be extremely lucky to gain malting grade for barley because of the inherently high nitrogen levels in the soil at least in the early years of cultivation and because of the hard finish generally experienced. With the advent of high-yielding varieties grown specifically to provide grain for animal feed and human food markets barley might become a more attractive proposition in the brigalow lands.

Recommendations for sowing barley appear each year in the January issue of the Queensland Agricultural Journal.

Safflower

Up to this stage safflower, one of the most sought-after oil seeds, may be claimed as a Central Queensland or even a Central Queensland Highlands crop. In each of the past two seasons it has been worth more to the Highlands than grain sorghum, traditionally the mainstay crop for the area. It has been tried in other parts of the Queensland grain belt but it has not, in general, been able to compete monetarily with other crops.

Even in the Central Queensland Highlands it has had a checkered career, partly because of very bad seasons and partly because it was treated as a poor relation. Wheat was sown early on the best land (deepest soil and better soil moisture). Safflower was usually sown on the next planting rain, often as late as September, and on shallow soils with less stored moisture. The results were usually disastrous.

Safflower has a higher moisture requirement but it also has a highly developed tap root system which allows it to extract moisture very efficiently from depth. It makes good sense then to restrict its use to deep soils well supplied with moisture (90 cm preferably) and to plant early to let the plant develop under cooler conditions.

Many growers have realised the value of these practices and recent high yields bear this out. Research conducted at Biloela Research Station has shown strikingly the value of May-June plantings as against later plantings. Growers are also appreciative of the fact that as a tap rooted plant safflower does not require follow-up rain which the winter cereals do for secondary root development.

Current recommendation for planting rate is 5–7 kg/ha in 36 cm rows. Recent research has shown that the crop can compensate for lower populations by producing more heads. It is logical therefore to use low planting rates. The plant can then compensate by producing more heads under good conditions, and during poor conditions there is less chance of crop failure.

Great potential is seen for safflower on the deeper, heavy clay soils of the northern brigalow belt. However, any soils subject to waterlogging should not be used as safflower is susceptible to root rotting diseases.

As the crop produces a high value grain it can be profitable to grow safflower at greater distances from the rail head than lower value crops such as sorghum or wheat. There is an advantage in freight costs in favour of safflower. This tends to make safflower an attractive proposition in remote areas such as Area 3 of the Brigalow Development Scheme.

SUMMER GRAIN CROPS

Grain Sorghum

Time of planting

In Central Queensland rain-grown grain sorghum is recommended for planting from mid-December to mid-February. Earlier sowings are not encouraged as crops developing from them tend to flower during the hottest time of the year and yield loss can result. Later sowings run the risk of frost damage to the developing grain.

In South Queensland brigalow lands sorghum plantings are recommended over an extended period from September to February depending on the region. For best results sorghum is sown into warm soil after the risk of frost killing seedling growth has passed.

Varieties

A range of commercial hybrid varieties and the open-pollinated Alpha are available for planting. Details of those recommended are published annually in the *Queensland Agricultural Journal* for July. In addition to varieties recommended there are several which have given encouraging performances in trials and are listed "for trial" for that season. The idea is that a farmer can test these new varieties over a small area without committing himself to great expense and form an opinion on them. Varieties are categorized as fast-maturing, mid-season and late maturing. With a range of maturities available it is possible to juggle varieties to make use of planting rains received over the recommended planting period.

As most of the State's brigalow lands could be classified as having a fairly harsh environment we would expect quick maturing varieties to perform well as they would tend to rely more on stored soil moisture and less on growing season rainfall than slower maturing hybrids. In point of fact, up to the present, it is the mid-season and late maturing hybrids which have generally found most favour. The main reason for this is that several of them tend to withstand lodging more.

Lodging, which is associated with drought conditions post-flowering, is a malady that every sorghum grower fears in these regions. Once a sorghum crop lodges it is good for sheep and cattle grazing and nothing else. It is not possible to harvest it properly with present day machinery. **Three medium–late maturing hybrids, DeKalb E57, Pioneer Sunlover 1 and the Department's Q5161 have good resistance to lodging and a high yield.** The open-pollinated variety, Alpha, has good lodging resistance but much lower yield. It still is extremely popular in central Queensland but is gradually losing its support. Departmental trials have shown for years that with good sub-soil moisture E57 can outyield Alpha by 20% yet many farmers have sound reasons why they still prefer Alpha.

Planting rate

Recommendations for planting are made on the basis of established plants per hectare rather than on number of kg/ha. It is up to the farmer to make this conversion himself from information given in the recommendations. The Central Queensland Highlands has the lowest recommended rates of 35 000–70 000 plants/ha compared with 75 000–90 000 for the Callide and Dawson and 50 000–100 000 for South Queensland brigalow lands.

Much attention has been given to row spacing and plant spacing within the row. In a detailed Central Queensland study a wide range of populations from 37 000 to 185 000 plants/ha gave satisfactory yields over a wide range of growing conditions. Row spacings

of 36, 71 and 107 cm did not affect grain yield to any extent overall although there were differences due to row-spacing treatments in several trials.

In the South Queensland brigalow belt very wide rows are being used commercially with success to achieve, at least up to the present, greater consistency of yield. Applying a technique developed by a local farmer Mr. D. R. Uebergang, growers in the Miles district are planting twin rows at approximately 2 m centres. The theory behind this procedure is that high populations in the rows cause strong competition early in the plants' growth. A strong root system develops as a result which can later utilize the water stored in the wide inter-rows.

Fertilizer application

Recommendations for application of nitrogen and phosphorus fertilizer based on soil tests are available. They are probably being accepted more readily in the more favoured south-eastern section of the brigalow lands than in those of harsher environments.

Diseases

Diseases are extremely important in grain sorghum and a major aim of the Departmental sorghum improvement programme is to produce varieties resistant to important diseases.

All varieties now being grown in Queensland are susceptible to the Johnson grass strain of the sugarcane mosaic virus which can cause severe yield losses on occasion. Some varieties are more susceptible than others, however, and information on these is given in the varietal recommendations published each year in the July issue of the *Queensland Agricultural Journal*. Departmental and University of Queensland scientists have combined to develop resistant parents of hybrids which are in an advanced stage of testing.

Head smut is another serious disease. There are, however, a number of resistant hybrids available for planting.

Insects

Midge is the most serious recurring insect problem and one of the major production problems of grain sorghum. A range of agronomic and insecticidal methods have been formulated to combat the pest. (See Further Reading list).

Sunflower

Improvement in prices offered for high oil sunflower seed in the past two seasons has led to increased acreages being sown in parts of the brigalow belt considered marginal for sunflower production.

In Central Queensland some really good crops have been harvested and while prices remain attractive the area sown will probably remain high unless there is some serious production problem. Being a high value crop it can be profitable to grow sunflower at greater distance from rail heads than lower valued crops such as wheat or sorghum.

Sunflower is weakly tap-rooted and does not tolerate hard pans in the soil. It is not such a voracious seeker of water as safflower but nevertheless has a high moisture requirement considering its short growing season. It should therefore be accorded the same privileges offered other grain crops regarding seed bed preparation and adequate soil moisture supply.

Tolerance to lower soil temperatures and to frost in the seedling stage allows sunflower to be sown early in the season. In this way most of the growth of the crop occurs before summer heatwaves. The main risk with early planting is that if spring rains are insufficient serious moisture stress with accompanying loss of yield will occur. Later sowings are often preferred or—if early planting rains do not fall—are often necessary. A serious problem often associated with late sowing is rust attack which can devastate yields. Hybrid varieties are available which are currently rust resistant. As long as they remain resistant they should be preferred for sowing particularly with late sowings.

Planting rates should err on the low side. A population of 30 000–50 000/ha should be aimed for. The crop may be sown through a combine at 135 cm or through a combine or row crop planter at 90 cm (approx.). Row cropping will not normally result in any yield loss. In fact, in stress years row crops should outyield broadcast plantings. In addition if weeds are troublesome row cropping gives the opportunity for their control by inter-row cultivation.

One of the most serious problems in sunflower production is the inability to get an even stand, and any measures the grower can take to achieve this will pay dividends.

As mentioned earlier hybrid varieties available are currently rust resistant. They also provide stands of even height and maturity—important points to remember when it comes to harvesting. Current open-pollinated varieties are variable in this regard. In terms of yield there is no clear local evidence to suggest that in the absence of rust the hybrid varieties are superior to open-pollinated varieties of similar maturity.

For harvest the header requires adaptation with fitting of finger trays to the comb. A wide variety of modified types of trays is available commercially. Heavy losses can occur at harvest and extreme care is required to avoid them.

The sunflower crop is not very satisfactory from a soil conservation point of view as crop residue post-harvest is much lower than with grain sorghums.

FODDER CROPS

Oats

Oats is grown mainly for cattle fattening during the cooler months and is widely used in the southern brigalow areas and to a lesser extent in northern brigalow areas for this purpose.

Oats varieties are usually classified according to their rate of growth as either quick or slow maturing.

The varieties Bentland and Minhafer are examples of quick-maturing types which have an erect plant habit, and high early growth rate. These often present grazing management problems under normal seasonal conditions.

Algerian and Camellia on the other hand, have a slower growth rate and are semi-prostrate in habit. They are usually easier to manage in a forage sequence than the quick-maturing types.

Recommendations for the various regions for planting months and planting rates for the various recommended varieties are given in the January issue of the *Queensland Agricultural Journal* each year. Information is also provided on agronomic characters and disease resistance of recommended varieties and varieties which may be sown if seed of recommended varieties is not available.

Forage Sorghums

Forage sorghums are well adapted to the State's brigalow lands. A range of hybrid forage sorghums is available for planting over an extended period from August to March. In addition, the open-pollinated sweet sorghum, Sugardrip is popular, particularly for late summer plantings when a "stand-over" fodder crop is required.

Sorghum almum (Columbus grass), a grass-headed sorghum type is still used by some land-holders, however there is always a danger that a planting of *Sorghum almum,* which tends to be a perennial in the northern brigalow lands might contain, as a contaminant, some Johnson grass seeds. The reason is that *Sorghum almum,* a harmless plant, is a very close relative of Johnson grass. In fact, the seed of *Sorghum almum* is indistinguishable from that of Johnson grass, a very serious weed, which produces strong underground rhizomes difficult to eradicate. Johnson grass plants emerging could go unnoticed alongside their close relative for quite a long time and then be difficult to eradicate.

Lablab

This forage crop is of particular value in the northern section of the brigalow belt. The variety Rongai has advantages over other leguminous forage crops such as cowpea which has declined in popularity. These advantages include freedom from pests and diseases and a long production season extending through the autumn into winter. The variety Highworth developed in the northern brigalow lands at Brigalow Research Station has a shorter growing season though its forage production is similar to that of Rongai. Its main advantage over Rongai is its reliably high seed yield over a wide range of environments.

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Looking back—

SOME interesting items that appeared in issues of the Q.A.J. 75 years ago, in January and February, 1901.

• A departmental officer reported success with an experiment in hail protection conducted at the Biggenden Station Farm on 7th November.

When at 5.15 hail began to fall heavily, intermixed with a few drops of rain, for want of any heavier weapon I took an ordinary breech-loader, and fired four shots straight upwards at about half-minute intervals. In less than two minutes the hail ceased altogether, and was replaced by an abundant shower of heavy drops.

A subsequent inquiry revealed the fact that both south and north of the farm the hail had been considerably heavier without any rain whatever.

• This comment from a leading article shows the extent of change that has taken place in the poultry industry.

Large poultry farms have already had an attraction for lovers of poultry breeding, yet those who have tried it generally pronounce the poultry farm to be a delusion and a snare. Why is this? A farmer's wife has twenty or thirty hens and a rooster or two. She has plenty of eggs and chickens; the birds are all healthy. They roost usually in the open air—wet or dry, cold or hot; yet they rarely suffer from disease, unless a general epidemic should occur. Her hens are a clear source of profit for they live almost entirely on the unconsidered trifles they pick up on the farm. They have what is essential to health—unlimited run of the paddocks, and keep themselves strong and healthy by chasing grasshoppers and ceaseless scratching in the farmyard.

• Commenting on the large number of recipes given as a certain cure for a dog "gifted with egg-eating propensities" the editor admitted . . . *but we can recall but one remedy which has proved effectual—a shot-gun.*

• Ploughmen were advised that it had been proved that, as a rule, the *plough horse is shod with too heavy shoes, and that the animal could do more work with less fatigue if lighter ones were substituted.*

• An article on farm hygiene discussed the topic: *Can we protect ourselves against fever?* Farmers were urged: *We must absolutely preserve ourselves from mosquito bites, at least about two hours after sunrise and after sunset.* Washing the body with eucalyptus vinegar was suggested as a means of bringing about this happy situation.

• Some thousands of Sisal hemp plants had been planted round the island of St. Helena, Queensland's penal establishment. They were growing vigorously and *if any proof were wanted of the adaptability of our climate to this valuable plant, it is plainly furnished here.*

• Because of the high price of cotton in the United States, a plea was made to Queensland farmers *to revive the Industry in this State.*

• On the subject of planting potatoes readers were advised: *The Americans, always alive to the necessity for economy and efficiency in agricultural operations, no longer plant and cultivate potatoes by hand. The whole work of cutting the tubers, planting, cultivating, and harvesting the crop is done entirely by machinery and horses.*

MOHAIR

MOHAIR is produced by the Angora goat. It is a speciality fibre which is being used as an all-the-year round fibre because of its light weight, warmth, and lustre.

by R. J. ANSON, Sheep and Wool Branch.

The combined production of the major producing countries of the world South Africa, the United States, Turkey and Lesotho is estimated at some 13 000 metric tonnes greasy mohair annually. Production of mohair in Australia is only 1·5 metric tonnes but is gradually increasing.

Britain is the largest single buyer of greasy mohair, followed by France, Italy, the Netherlands, Japan, Switzerland, Spain and West Germany.

Mohair is strong, soft, brilliant and lustrous. Good mohair appears bright and shiny. The length is an important factor as is the absence of kemp or coloured fibres. Mohair in the raw state (greasy) contains very little grease or yolk and scouring of yields in excess of 85% can be obtained.

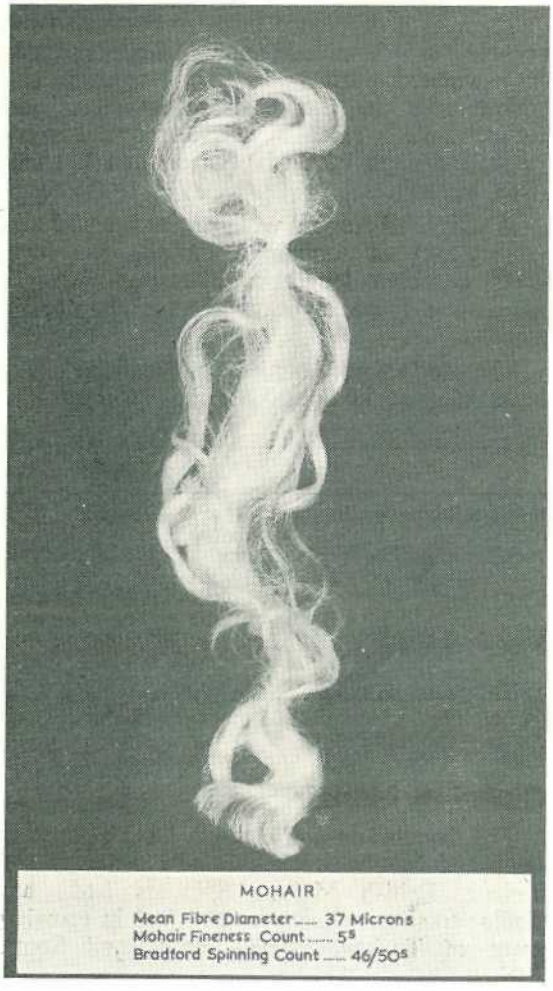
Uses

Large quantities of mohair are used in the manufacture of upholstery, blankets, light weight travelling rugs, women's and men's light weight worsted suitings, shawls, and stoles. In the industrial field there are paint rollers made of mohair.

The longer coarser mohair is blended with the lustrous Lincoln and Leicester wools for brilliant type fabrics. Noils (short fibres removed from the long ones in the combing process) are used for carpets.

The best mohair is produced by young goats—up to 18 months of age. Kid mohair is fine and soft, and is obtained at the first and second shearing. The relation between age and fineness in South African Angoras is shown on the next page.

Good weight type of Mohair.



RELATION BETWEEN AGE AND FINENESS OF MOHAIR

Shearing	Age (Approx.)	Mohair Fineness Counts	Bradford Spinning Counts	Maximum Fibre Diameter (microns)
First ..	6 months	7's and 8's	56's to 60's	30
Second	12 months	6's to 7's	50's to 56's	33
Third	18 months	5's	46's to 50's	37
Fourth	2 years and older	4's	40's to 46's	40
		3's	36's to 40's	43
		Below 3's	Below 36's	Over 43

In Australia at present the overall quality of mohair is lower than it is overseas because older goats are kept for breeding and to maintain numbers.

Staple length

There is a difference in price between good combing length mohair suitable for processing into worsted yarn and short length mohair which goes to the cheaper woollen yarn industry. It is essential where practicable not to shear mohair which is shorter than 127 mm (five inches).

A well-bred Angora will grow at least 25 mm (one inch) of mohair a month, producing good combing length at shearing. Angoras are shorn twice a year at intervals of 5-7 months.

The following length classifications have been adopted in South Africa.

Designation	Length
Good combing length ..	152 mm to 179 mm (6 inch to 7 inch)
Medium combing length	127 mm to 152 mm (5 inch to 6 inch)
Short length	101 mm to 127 mm (4 inch to 5 inch)
Very short length ..	Less than 101 mm (Less than 4 inch)

(A maximum tolerance of 25 mm (one inch) is allowed in each class)

Classing Mohair

The description and classing lines of mohair suggested by the world's largest processor of mohair, British Mohair Spinners Ltd., are similar to those already established in growing areas of Turkey, United States and South Africa.

Because of the different environments in which it is grown, locally produced mohair embraces all types form the major producing countries. It is important that these numerous types be classed first by the grower into some standard of evenness then by trained mohair classers into recognised matching types for offer to the processors.

To help with mohair classing and reduce the number of bins required Angoras should be shorn in age groups. This practice presents the classer with a visual assessment of mohair that appears to be similar in fibre diameter. Classing should be fairly broad, with few small lines. It could be done by:—

- Age—kid, yearling, or adult.
- Length—long, short, main bulk line being medium length.
- Kemp—remove fleeces that are excessively kempy or have long kemp.
- Stains—remove and keep separate.
- Coloured fibres—remove and keep separate.
- Overgrown hair—remove and keep separate.

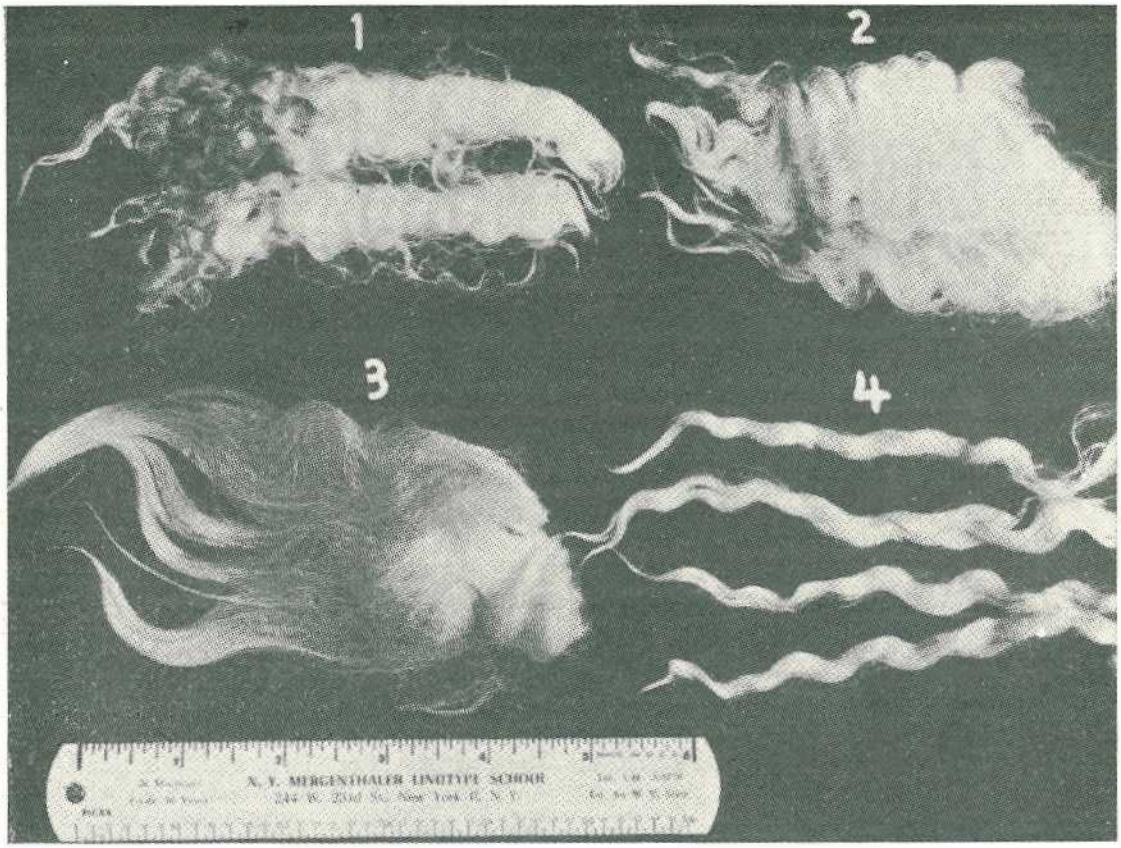
Skirt as lightly as possible, so as to remove only hair with excessive fault or low yield.

Owing to the wide range in fibre diameter which is mainly influenced by age, sorting for length and average fibre diameter can be done visually.

Long or excessive kemp is not easily combed out so it must be isolated and kept apart from the better quality fibre. The presence of kemp has always been a great problem of the mohair trade as apart from being a very coarse fibre it will not take dye and consequently shows up in the finished article. Manufacturers must eliminate kemp from quality mohair garments. This is a costly process which naturally affects the prices in the sale room.

Character

Character usually refers to waviness and type of lock. Type of lock is important to the registered breeder but is of little importance to the manufacturer. However, the following principal types of Angora are determined by the type of lock making up the fleece.



Character in Mohair—(1) Weblock; (2) Flatlock or B type; (3) B type from older goat; (4) Ringlet or C type.

The web lock or intermediate type.

This lock is neither ringlet nor flat. It combines length and fineness with a denser and heavier fleece. Angoras growing this type of fleece maintain quality longer than the ringlet or the flat lock types so in selecting, breeders should aim towards the web lock.

The flat lock or B type

This type of mohair grows in flat locks lying on top of each other. It has a shorter staple, is coarser in fibre diameter, is denser and usually heavier in weight than the C type. Continued selection for this flat lock usually results in a loss of length in the mohair fleece.

B type lock from an older goat showing loss of character

Mohair fleeces coarsen with age. Some of the coarsest mohair usually is found on the underside of the neck, and around the britch region of the animal.

The ringlet or C type

This type falls in long tight locks or curls about the size of a pencil. It has good length, is fine in fibre diameter, but because it lacks density it is light in weight, and in dry seasons heavy penetration of the fleece by dust or dirt occurs.

Picture: Texas Agricultural Extension Service.

Eperythrozoon infection in sheep

by K. N. DADDOW, Pathology Branch, Animal Research Institute, Yeerongpilly and L. B. DUNLOP, Sheep and Wool Branch, Charleville

FOR many years there have been accounts of unexplained ill-thrift and anaemia in sheep, particularly in weaners. Eperythrozoon infection is a possible cause of this.

In 1966 unclotted blood from sheep near Muttaburra was inoculated into sheep at the Animal Research Institute. These sheep subsequently had a rise in temperature and became anaemic. Blood smears showed they were infected with *Eperythrozoon ovis*. This led to the recognition of the disease in Queensland.

What is Eperythrozoonosis?

It is a disease caused by microscopic parasites in the blood. The name Eperythrozoon suggests it is a parasite of red cells, but this may not be so. It is one of the Bartonella group of organisms which are parasites of man, sheep, cattle, pigs, goats, rats, mice, koalas and several other warm-blooded animals.

How can it be Diagnosed?

Field Diagnosis—This may be difficult as there are no characteristic signs or post mortem lesions. *E. ovis* infection must be considered if sheep are unthrifty, don't travel well, and are anaemic. It is then the task of the laboratory to help differentiate between *E. ovis* infection and other causes.

Laboratory Diagnosis—Until recently, the method of laboratory diagnosis was by identifying the organism in stained blood films. By the time the clinical signs were evident, organisms were often no longer visible in blood films. A specific Complement Fixation Test has now been developed at the Institute. Large numbers of sera can be tested and it will identify sheep clinically affected and for some weeks after active infection. It is best applied to sera from several sheep which are sick or which have recently recovered.

How is the Disease Spread?

The source of infection would seem to be older infected sheep. The method of spread is not yet proven but biting insects must be suspected. As the disease is easily transmitted by needle inoculation, there is also a possibility that poor hygiene and procedure during marking, mulesing and vaccination might be a means of spread.

If insects are involved properties on or near watercourses would be likely to have most trouble from *E. ovis* infection and this should occur primarily after summer rain. Field observations by departmental officers and reports by owners and managers tend to confirm this. Observations on a property near Charleville, which is bordered by the Warrego river, confirmed this as the initial sample in November 1974 showed that after recent heavy rain and a large increase in the population of mosquitoes and other insects, lambs become infected with a high infection rate in January and February.

What effect does the Disease have on Sheep?

There is generally an elevation of body temperature. Mucus membranes and muzzle are pale or even white. The blood is thin and watery. The sheep breathe quickly and "tongue" on exertion. Sheep in this condition tire very quickly and typically form a "tail" to a moving mob. Reports often mention sheep dying during a muster. Apart from financial loss, management problems can occur e.g. usage of vehicles and manpower to pick up the "tail". Tired sick sheep hold up the flow of healthy sheep in sheds and yards, often making handling difficult and slow. Reports vary as to whether there is a weight loss during and immediately after initial infection, but it is not likely the sick sheep graze as well as healthy ones. Any infection which raises body temperature may produce a wool break leading to down grading and hence diminished returns.

Though *E. ovis* infection is capable of producing the above effects, it probably exerts its greatest effect when nutrition is poor, or with a worm burden. If the effects of *E. ovis* infection are to be minimised husbandry and management must be good.

Once sheep become infected they remain infected and would appear to be the source of infection for succeeding generations. This is particularly true of infected ewes and their lambs.

PREVENTION AND TREATMENT

If there is infection present in a flock try to have a good paddock for the weaners to avoid any nutritional stress. It is also important not to introduce infection with new sheep coming onto the property if the property is free.

There is no recognised economic drug treatment available, though tetracycline has been reported as a successful treatment. The best treatment at present is to leave affected sheep undisturbed and make available an ample supply of good feed and water.

CHANGING YOUR ADDRESS?

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

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

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

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

Two Swamp Orchids

by BERYL A. LEBLER,
Senior Botanist.

IN 1970 a very beautiful ground orchid was described from a plant collected in Cochinchina—now Laos, Vietnam and Cambodia. It was given the name *Phaius grandifolius*.

The generic name was derived from a Greek word *phaios* meaning dusky and was chosen because of the dark colour of the flowers. An identical plant had been sent from China to England about 1778 and had been grown at Kew Gardens. It had been described incorrectly in 1789 under the name *Limodorum tancarvilleae*. It was later realised the correct name should be *Phaius tancarvilleae*. The specific epithet honours Lady Tankerville, a patron of botany at that time.

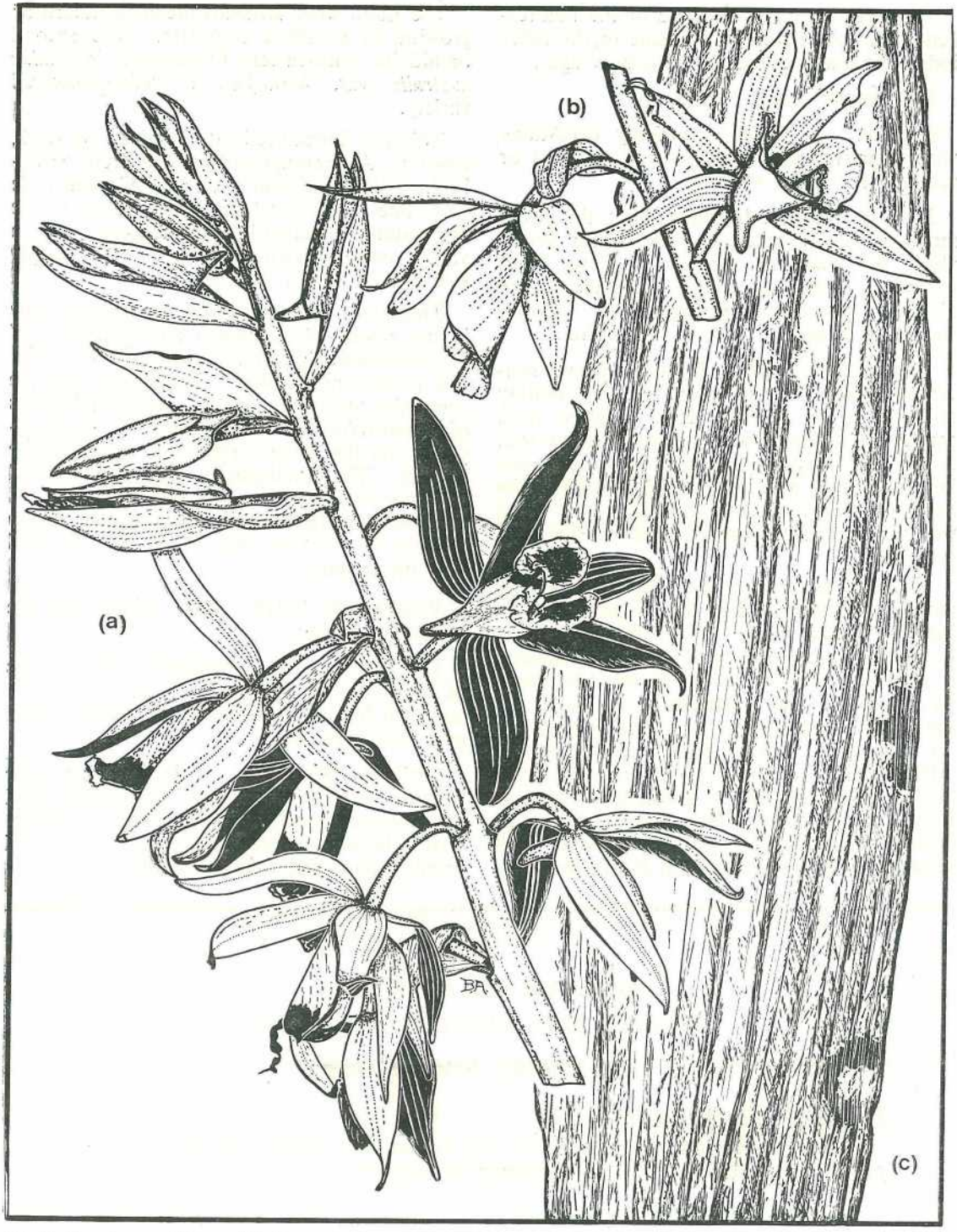
These are the largest ground orchids in Australia. They were also among the first orchids to be brought into cultivation.

The large ovoid pseudobulbs produce several leaves resembling those of aspidistra, but much lighter in colour, thinner in texture and prominently plicate. The flowering scape can be 2 m high but is usually much shorter. Usually only one scape is produced with from three to fourteen large and very showy flowers arranged in a loose raceme at the top.

The scape is firm and green, and up to 1·5 cm in diameter. Paler green deciduous bracts are widely spaced along the scape below the flowers. Each flower is in the axil of a similar bract, on a green pedicel 2 cm long beneath a furrowed green ovary as long as the pedicel.

The buds are white and lie along the cupped bracts, with the spur at the base of the labelleum pointing upwards. When the flower opens the three sepals and two petals spread widely, with the dorsal sepal standing erect and a smaller petal on either side. The outer surfaces are white and the inner reddish-brown. About five longitudinal green stripes on the inner surface contrast with the reddish-brown colour. Usually there is only one green stripe along the centre of the petal.

The sepals are about 5·5 cm long and 2 cm wide and end in a finely pointed tip. The petals are the same length but are narrower. The labelleum is tubular or trumpet-shaped with its sides rolled inwards to fold over the column. It is about as long as the dorsal sepal and is creamy-white on the outside except at the end. There is a broad dark wine-red or crimson margin which is undulate-crispate. The inner surface is suffused with the same colour, with yellow streaks running to the base. The base is produced into a blunt spur less than 0·5 cm long. The firm column is creamy-white, about 2 cm long and 0·5 cm wide. The upper surface which can be seen protruding between the sides of the labelleum is curved.



(a) *Phaius tancarvilleae.* (b) *P. australis* var. *bernaysii.*

In older flowers at the base of the inflorescence the spur points to one side or the other indicating that the pedicel twists as it ages.

FLOWERING TIME. Spring.

HABITAT. It grows in swampy conditions among grasses and sedges in open forests or cabbage tree palm swamps.

DISTRIBUTION. It is found from the Richmond River in northern New South Wales along the coast to the tip of Cape York Peninsula, across the top of Australia to the Northern Territory, through New Guinea, Indonesia, Malaysia to India and China.

GENERAL REMARKS. It can be grown successfully, either as a pot plant in orchid potting mixture, or in a semi-shaded position in a garden in ordinary well-watered garden soil. It is not available commercially and has become a rare and endangered species as its natural habitat rapidly vanishes with road works, land development and sand-mining activities.

There is another orchid, *Phaius australis,* which is similar in appearance and habit to that of *P. tancarvilleae.* It has almost identical flowers, in which the most obvious difference is the shape and structure of the labelleum. In this flower the labelleum is tri-lobed, but the lateral lobes are erect and slightly incurved, so that it is shaped like an open scoop. Although it is reported to be scattered from the Atherton Tableland in northern Queensland to the north coast of New South Wales, the flowers are so much alike it has probably been confused in many places with *P. tancarvilleae.*

The Latin word *australis* means southern or growing in southern countries. The second orchid in south-eastern Queensland is *Phaius australis* var. *bernaysii,* a yellow-flowered variety.

This was introduced into England in 1873, when L. A. Bernays collected it from Stradbroke Island and sent it to Kew Gardens. He was "one of the most active promoters of the Queensland Acclimitization Society and a valued correspondent of Kew". The variety was named in his honour.

This plant differs from *P. tancarvilleae* only in the colour of the flower and the shape of the labelleum. The habit and foliage of the two plants are identical. The flowers are the same size and shape but the sepals and petals of *P. australis* var. *bernaysii* are pale greenish-yellow on the inner surface and white on the outside. The labelleum is deeper yellow and the margins are not as fluted as in *P. tancarvilleae.* It is shaped like an open scoop and the lateral lobes are not inrolled to fold over the column.

FLOWERING TIME. Late winter to the middle of spring.

DISTRIBUTION. It is confined to the swamps of south-eastern Queensland and has been collected from Stradbroke Island, Bribie Island and Noosa Heads.

GENERAL REMARKS. It is now very rare because of the restricted distribution and extensive collecting by orchid fanciers. Naturalists who know where this plant can be found usually guard their secret closely.

Errata. Vol. 101, No. 5, p.604

"Plicatulum finds a place in coastal pastures"

by W. J. BISSET, Agriculture Branch.

Paragraph 7 should read:

The degree of hairyness of the leaf blades and sheaths on mature **stems** provides a reliable means of distinguishing the cultivars.

New exotic fruit fly introductions to Australia

by R. A. I. DREW,
Entomology Branch.

THE fruit fly research unit in the Queensland Department of Primary Industries has been concerned for some time that Australia's northern coastline is under the constant threat of invasion by serious exotic fruit fly pest species, from South-East Asia and Pacific islands.

The Department has been monitoring the more inaccessible Cape York area to detect the presence of infestation in its early stages. All fruit fly specimens collected are forwarded to the fruit fly unit at Indooroopilly for immediate study. Because of its specialist ability this unit also has identified fruit flies for the West Australian Department of Agriculture and the Animal Industry and Agriculture Branch in the Northern Territory.

Two introduced exotic fruit fly species have been detected for the first time in Australia—*Dacus frauenfeldi* (the mango fly) on far Cape York and *Dacus dorsalis* (the oriental fruit fly) on Melville Island. Their introduction could have serious consequences for Australia's fruit industries.

Most of the field work is carried out using traps baited with a powerful male attractant and an insecticide. Specimens also are bred from infested fruit where this is practicable.

The mango fly

(*Dacus frauenfeldi* Schiner)

Specimens of the mango fly, *D. frauenfeldi*, were first collected in far Cape York in September 1974. A subsequent survey by Departmental entomologists revealed that this species was present in an area of more than 1,000 sq. miles. Trapping to date has shown that it is more prevalent in settlements and open forest than in rainforest areas. A comparison of total trap numbers of flies collected showed that more *D. frauenfeldi* specimens were collected than *Dacus tryoni* (Queensland fruit fly).

D. frauenfeldi is distributed outside Australia in Micronesia (Caroline Islands, Marshall Islands); Malaya; Singapore; Indonesia; Stuart Islands; Sabari Island; New Britain; New Ireland; Lihir Island; Bougainville Island; British Solomon Islands.

Available evidence indicates that the species was introduced to the Cape York area within the last 2 to 3 years, probably from Papua New Guinea.

This species evidently attacks a wide assortment of fleshy fruits including mango, breadfruit and guava. It is regarded as a serious pest species overseas and it poses a threat to the Australian fruit industry.

The departmental fruit fly unit is continuing to monitor the northern areas for this species in order to document its spread into new areas.

Eradication, for the present, is not considered to be economically justifiable.

The oriental fruit fly

(*Dacus dorsalis Hendel*)

Specimens of this species were collected on Melville Island, Northern Territory, in August 1975. This is the first record of this species being collected on Australian Territory. It is regarded as one of the six most serious fruit fly pest species in the world and its presence on Melville Island is considered to pose a major threat to the entire fruit and vegetable industries of Australia.

D. dorsalis is widespread throughout the Oriental Region, Micronesia and northern Pacific Islands. Throughout its range it has been taken from more than 250 different host fruits, and it apparently attacks all types of fleshy fruits. It is regarded as the most injurious species of fruit fly in the Oriental region.

The urgent need is to establish the extent of the infestation to determine whether eradication would be practicable.

Editors Note:—

The Primary Industries Department's fruit fly unit has spear-headed an intensive fruit fly trapping survey of Melville and Bathurst Islands and the mainland area around Darwin. More than 250 traps assembled at the Indooroopilly Laboratory were flown to Darwin and are being used in the survey. All flies collected are being identified by the fruit fly group at Indooroopilly.

Wheat and barley planting guide, 1976

compiled by S. R. WALSH, Agriculture Branch

WHEAT and barley varieties recommended for sowing for the 1976 season are listed below.

WHEAT

Timgalen, Gatcher, Oxley and Kite are the grain varieties recommended for 1976.

Stem rust was far more widespread on Gamut in 1975. As this variety is grown mainly in areas more likely to suffer rust attack, it can only be recommended with reservation. None of the varieties recommended are fully resistant to leaf rust. However, Oxley has a useful level of resistance.

Hopps, a dual purpose variety, is recommended for certain situations and localities; it should be noted that Kite and Hopps are restricted to the No. 1 Hard classification.

The recommendations are based on trial results, field performance and susceptibility to disease. Mendos, Tarsa and Spica have been deleted because of their susceptibility to stem rust.

Mendos, Spica and Tarsa had been recommended previously in spite of their rust susceptibility. They were recommended in the main wheatgrowing areas of the State—the Darling Downs, Near South West, Burnett and Capricornia regions—because replacement varieties possessing suitable attributes were not available.

However, Kite, a virtually awnless variety is now available and Kite is known to perform well in areas where Mendos has been grown specifically for this characteristic. Kite has been recommended in preference to Mendos in these areas despite only being acceptable as No. 1 Hard. Farmers may decide, however, to grow Mendos despite the risk of stem rust.

Spica is no longer recommended because of its rust susceptibility. However, its past performance and acceptance in the Prime Hard classification may influence some growers to persevere with it.

In 1975, Tarsa was recommended only in the Near South West region. The performance of Oxley in 1975 was such that it is now recommended as a replacement for Tarsa in all regions.

Quick Maturing Varieties

Timgalen is a medium-early variety released by Sydney University in 1967. It is an awned variety of medium height with strong tillering characteristics. The grain has good milling qualities.

Gatcher appears more subject to nutritional disorders, and therefore is not recommended for some soils of the plains area of the Darling Downs. Gatcher appears more susceptible to yellow spot than other comparable varieties.

Kite is a semi-dwarf tip-awned variety relatively new in Queensland. It is highly resistant to stem rust and has yielded extremely

well in trials to date. Kite may be slightly harder to thresh than Mendos but may be used to replace this variety in the more western areas where an awnless variety may be grazed in the event of a crop failure. The semi-dwarf characteristic is associated with poor emergence if very deep planting is practised.

Songlen is a new quick-maturing semi-dwarf wheat released by the University of Sydney. It is an awned variety very similar in general appearance to Timgalen (one of its parents) but has improved resistance to both stem and leaf rust. To date its yield performance has not been outstanding, averaging about the same as Timgalen and Gatcher. Seed supplies may not be readily available this season.

Mid Season Varieties

Midseason varieties are recommended on a more restricted basis than the quick maturing varieties. They are intended for planting early when suitable rains occur. Except in very reliable districts, or under irrigation, their performance may be poor when sown late.

Oxley is a semi-dwarf awned midseason variety of high yield potential. It is intended for planting mid May to early June on the Downs but may be sown somewhat earlier in the more northern and inland areas.

A new semi-dwarf awned wheat, Timson, has been registered by Sydney University, but is not yet available commercially.

The early sowing of rust susceptible varieties for early grazing is undesirable.

Grain Classifications

Premiums for Prime Hard quality will be paid by the State Wheat Board only on the following varieties:

Gamut	Songlen
Gatcher	Spica
Mendos	Timgalen
Oxley	

Of these, only Gatcher, Oxley, Songlen and Timgalen are resistant to current field strains of stem rust.

Grain from the following varieties is acceptable only as No. 1 Hard or lower grades.

Festiguay	Kite
Hopps	Tarsa

BARLEY

Barley is grown in Queensland principally in the Darling Downs, Moreton, Burnett, and parts of the Capricornia and the Near South West for grain or for grazing.

About 250 000 hectares were grown in 1975 for an expected yield of about 450 000 tonnes. The expansion in area occurred mostly on the central Darling Downs and Burnett areas.

Clipper is the only barley variety that the Barley Marketing Board will accept for classification as Malt I or II. Other varieties such as Prior, Maris Baldric, Zephyr, and Lara will only be accepted as milling classification.

When sown for grain, the crop is planted in the May-July period in the main areas. The earlier planting will mature in the cooler temperatures and produce a better malt quality grain. Frost is a danger with grain crops sown very early.

When planted as a grazing or dual purpose crop, barley may be sown from March to August; the late planting in August will only provide a limited quantity of forage.

Seeding rates vary with the proposed use of the crop, moisture availability, soil type, planting time and variety. Grain crops are sown at the rate of 20 to 40 kg/ha whilst grazing crops are sown at 30 to 50 kg/ha.

This is basic information only. Consult your District Extension Officer for more specific recommendations and fertilizer requirements.

Recommended Wheat Varieties

Region (Shires or Districts)	Planting Time	Variety	Rate (kg/ha)
Darling Downs		NOTE.—(Gatcher is not recommended for some soils on the plains)	
A. Chinchilla, Wambo	May–early June	Oxley	25–35
	May–July	Timgalen, Gatcher, Kite	25–35
B. Central Downs			
Jondaryan, Rosalie, Pittsworth, Crows Nest, Cambooya, Millmerran	mid May–mid June	Oxley	30–45
	June–July	Timgalen, Gatcher, Kite	(60–70 irrigated)
C. Southern Downs			
Clifton, Allora, Glengallen, Rosenthal	mid May–mid June	Oxley	30–45
	June–July	Timgalen, Gatcher, Kite	30–45
D. Inglewood	late April–May	Oxley	30–40
	late May–July	Gatcher, Timgalen	30–40
		Kite	(60–70 irrigated)
Near South West			
A. Murilla, Tara, Taroom	late April–mid May only	Oxley	20–30
	mid May–June	Gatcher, Timgalen	20–30
		Kite	(30–35 July planting)
B. Bendemere, Booringa, Bungil, Warroo	late April–mid May only	Oxley	20–30
	mid May–June	Gatcher, Kite	20–30
			(30–35 July planting)
C. Waggamba	RAINGROWN		
	early May only	Oxley	20–30
	mid May–June	Gatcher, Timgalen	20–30
		Kite	(30–35 July planting)
	IRRIGATED		
	May	Oxley	60–70
	mid May–June	Timgalen	60–70
D. Balonne	RAINGROWN		
	mid May–June	Gatcher, Timgalen	20–30
		Kite	(30–35 July planting)
	IRRIGATED		
	May	Oxley	60–70
	mid May–June	Timgalen	60–70
Capricornia			
A. Rockhampton, Wowan, Alton Downs	May	Oxley	45–50 (Heavy clays)
	May–June	Gatcher, Timgalen, Kite	40–45 (light soils)
B. Banana Shire and Duaringa Shire south of the Capricorn Highway	RAINGROWN		
	mid April–mid May	Oxley	25–40 (light soils)
	May–June	Gatcher, Timgalen, Kite	35–50 (Heavy soils)
	IRRIGATED		
	mid April–May	Oxley	60–70
	May–mid June	Timgalen, Kite	60–70
C. Emerald, Peak Downs, Springsure, Capella, Clermont	RAINGROWN		
	mid April–mid May	Oxley	30–40
	May–June	Gatcher, Timgalen, Kite	40–50 (after June 45–65)
	IRRIGATED		
	May	Oxley, Timgalen, Kite	60–70
	(Planting rate for Timgalen is 5–10 kg/ha less than other varieties)		
Burnett			
Biggenden, Gayndah, Mundubbera, Perry, Eidsvold, Monto, Isis, Kolan, Gooburrum, Miriam Vale, Woongarra, Burrum, Woocoo	late April–May	Oxley	30–60
	May–June	Gatcher, Timgalen, Kite	30–60
South Burnett			
Kilkivan, Kingaroy, Murgon, Nanango, Wondai, Rosalie–(Cooyar only)	mid May–mid June	Oxley	30–40
	late May–July	Timgalen, Gatcher, Kite	30–45

Songlen could be sown "for trial" in districts where Timgalen or Gatcher are recommended.

Region (Shires or Districts)	Planting Time	Variety	Rate (kg/ha)
Near North Coast			
Landsborough, Noosa, Tiaro, Maroochy, Widgee	April–May May–June	Hopps (dual purpose) Timgalen, Gatcher	55–65 45–55
East Moreton			
Caboolture, Pine Rivers, Albert, Beaudesert	April May May–June	Hopps (grazing) Oxley Timgalen, Gatcher	55–65 45–55 45–55
West Moreton			
Moreton, Esk, Gatton, Kilcoy, Laidley, Boonah	April May May–June	Hopps (grazing) Oxley Timgalen, Gatcher	55–65 45–55 45–55

Songlen could be sown "for trial" in districts where Timgalen or Gatcher are recommended.

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
- to 30th June 1967 . . . . $5.00

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.

LIGHT TRAPS

what are they and how do they work

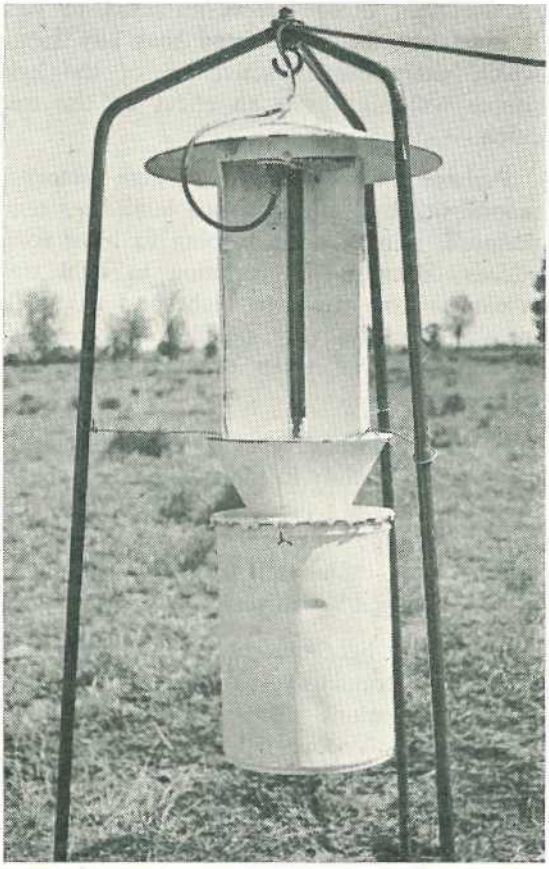
by P. H. TWINE, Entomology Branch.

OF all the problems facing the cotton producer, the threat of severe insect damage is the most significant and costly of all. The fact that the major insect pests are developing immunity to the chemical pesticides commonly used for their control has made this problem no easier.

IN an effort to overcome this problem, a number of techniques has been investigated which offer alternatives to the present methods of pest control.

Irrespective of the mode of action of these new techniques one factor is common to them all—the need to have some idea of the activity of the pest concerned.

There are several methods presently available to follow the activity of insects but perhaps the one most commonly used is that of light trapping. There are many other methods available (sticky traps, water traps,



pheromone traps) with the advantages and disadvantages of each system depending entirely on the situation in which it is to be used.

It must be remembered that each trap is only a method of sampling the activity of the insect and the criteria for usefulness is not the size of the catch alone but rather that the sample which is collected is indicative of the activity of the insect.

The success of light trapping depends on the fact that many insects are attracted to a source of light, particularly light of the "Ultra violet" wavelength. By running the light traps and examining the catch we can then establish when and where our insect populations are active.

Since the usefulness of a light trap is limited to use with those insects attracted to light it must also be appreciated that any factor which alters the attractiveness of the light source will also have an effect on the trap catch.

Perhaps the best known of these factors is moonlight, but cloud cover, humidity, temperature, rainfall are all going to have some effect. Because the variation in light trap efficiency from night to night and from site to site could be very significant, this needs to be considered when evaluating any light trap results.

There are several types of light traps available varying mainly in the type of light source used. Commonly these are the "black light" fluorescent type bulb and the mercury vapour bulbs. Both bulbs emit a certain amount of ultra violet light which serves as the attractant.

The "black light" fluorescent bulb has gained widespread popularity, particularly for survey type investigations since they are less bulky (the mercury vapour light requires a choke) and far cheaper to operate (15 watt bulb compared to the 125 watt mercury vapour bulb.) The differences in efficiency of these two types of bulbs is not a major factor in deciding to use one type in preference to another. The prime consideration is that the source of light adequately attracts the target species.

Generally the trap consists of this attractant bulb and a collecting device. The bulb is mounted vertically above a funnel which guides the insects into a collecting jar where the insects are killed in a suitable agent. Prompt killing of the insects is essential to preserve the catch, since beetles and grasshoppers also captured soon tear up the moths making them difficult to identify.

At present, the methods used to assess the need for control of most cotton pests rely on detection of eggs or larvae or damage in the field. These appear only after there has been moth activity so it would be helpful to have information on the timing of moth flight and the abundance of moths of the main pest species. Such information would alert growers to moth activity in the field and possibly to the potential size of infestation. In this way, field sampling could be intensified at the correct times, and control measures used with greater precision.

Generally, moths are attracted to light in large numbers on still, dark, cloudy nights when temperatures and humidity are high; and in small numbers on cold, windy moonlight nights. Thus because of varying conditions catches must be examined daily. If the number of moths increase intermittently or steadily for a period of many nights, field checking activities should be intensified to determine if egg laying, hatch and larval survival are also on the increase.

Do not apply controls solely on the basis of light trap collections.

Even though moth activity in an area may be intensive, natural factors, such as weather, plant conditions, disease, parasites and predators, may keep field infestations below levels requiring control.

A simple cheap automatic engine cut off

AN ingenious use of an alarm clock and rat trap provides a cheap and reliable automatic engine cut-off.

TIME is one of the most precious commodities on any rural property and any technique or device which will result in a worthwhile saving of time in relation to the cost outlay is worth having.

Mr. W. Gauld, Barkers Creek, Nanango, was concerned with the time taken and inconvenience of having to manually turn off his diesel irrigation engine at a specific time.

When constant irrigation was necessary during dry weather, short absences from the farm sometimes resulted in more irrigation water being applied than was essential for the particular crop.

Travelling to the engine, particularly on cold winter nights was both time consuming and inconvenient.

The ingenious use of an alarm clock and rat trap has provided a simple, cheap and reliable solution to the problem.

Method of Construction

It is firstly necessary to construct a solid square wooden or metal framework with the top bar of the frame set at the same level as the cut off lever on the engine.

An alarm clock is mounted to the bottom bar of the frame. The rat trap is mounted to the top bar of the frame so that the bait holder of the rat trap is situated directly above the clock alarm winding mechanism. A hole is drilled through the base of the rat trap and supporting bar so that a length of fishing line can be connected from the bait holding mechanism straight down to a small hole drilled in the alarm winding key.

The length of the fishing line is adjusted so that when the alarm goes off the line tightens and trips the bait toggle.

A length of plain wire or cord is connected from the cut off lever on the engine to the guillotine on the rat trap and the length of the line adjusted so that the lever is in the off position before the trap is set.

The whole mechanism should be protected from the weather.

Method of Operation

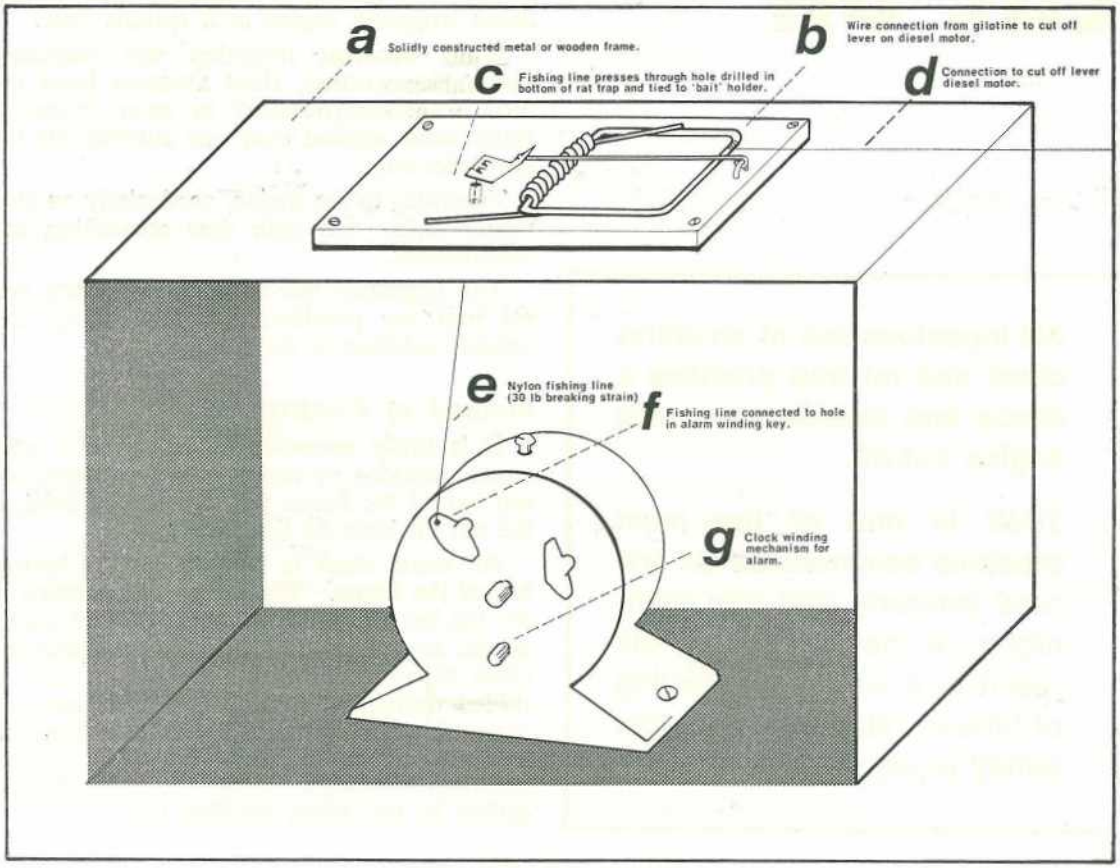
The alarm clock setting mechanism is adjusted to the time when it is desired to stop the engine.

When the alarm goes off the alarm winding key unwinds, tightening the fishing line which immediately trips the bait toggle. This sets the trap off. The guillotine slams over pulling the engine cut-off lever via means of the connecting wire.

Modifications

Adaptations of this simple mechanism could be used for cutting off several different types of engines e.g. use of a mouse trap, use of pulleys between the trap and cut-off mechanism, and use of a spring on the connection from the trap to the cut-off mechanism to take up surplus tension.

An ingenious use of an alarm clock and rat trap.



Second and final section

Classification of Fauna

For legislative purposes fauna has been divided into four classes:

PERMANENTLY PROTECTED FAUNA

The schedule of permanently protected fauna which forms part of the Act has been increased and these now are—

Mammals

Bennets tree kangaroo; Koala; Queensland hairy-nosed wombat; Yellow-footed rock wallaby; Echidna or spiny ant-eater; Platypus; Queensland rat-kangaroo.

Birds

Golden-winged parrot; The paradise parrot.

Provision is now made for fauna species to be declared permanently protected by Order in Council and added to this schedule.

Permanently protected fauna cannot be given an open season, nor can they qualify for a pest destruction permit.

The list of permanently protected fauna is small, containing only those species that require special protection and/or have a special place in the public mind.

Penalties relating to interference with permanently protected fauna are high: First offence—$100 to $1,000; Second offence—$200 to $3,000, plus a penalty of $200 for each fauna.

PROTECTED FAUNA

Although special provision is made for permanently protected fauna, non-protected fauna and aviary birds, the majority of Queensland's 556 birds, 170 mammals, 251 reptiles and 2 butterflies are in the normal course fully protected; for some an open season may be gazetted by Order in Council. The maximum penalty for an offence involving protected fauna is $1,000.

Native species that were previously considered to be pests or vermin are now protected; these include wedge-tailed eagles and all other birds of prey, sulphur-crested cockatoos, rose-breasted cockatoos (galahs), crows, ravens, eastern swamp hens (red bills) and cormorants. All species of deer found in Queensland, i.e. red, fallow, chital and rusa deer, are also protected.

REPTILES AND INSECTS

For the first time in Queensland—and in the case of butterflies for the first time in Australia—the following reptiles and insects are now protected fauna.

Common Name	Scientific Name
Estuarine crocodile	*Crocodylus porosus*
Freshwater crocodile	*Crocodylus johnstoni*
Tortoises	Sub order: Pleurodira
Dragons, geckoes, lizards, skinks, monitors, goannas, snakes	Sub order: Sauria
Birdwing butterflies	*Ornithoptera priamus*
Mountain blue butterfly ..	*Papilio ulysses ulysses*

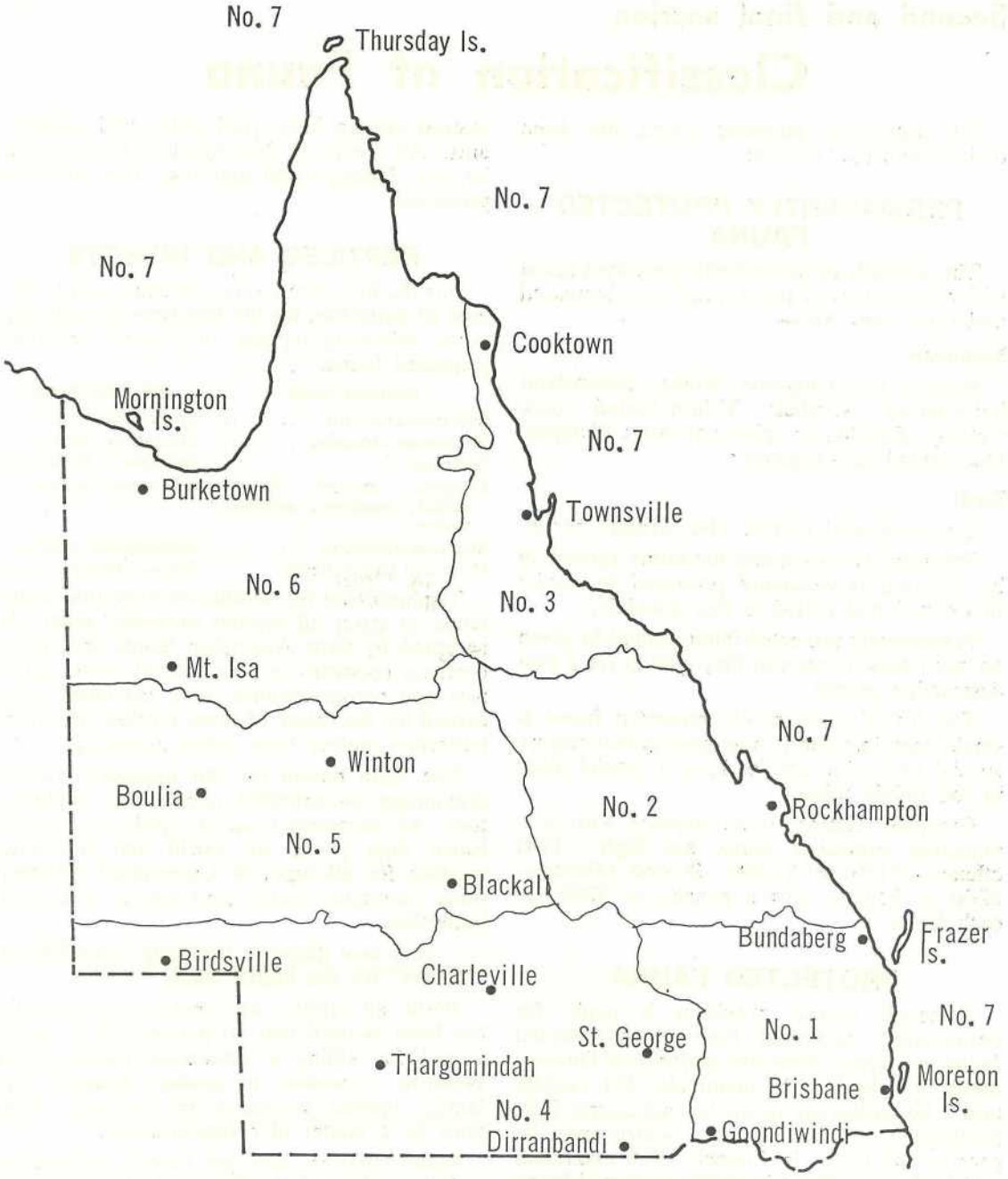
The necessity for wildlife conservation legislation to cover all reptiles including snakes is accepted by most Australian States and many overseas countries; in Queensland some scientists and conservationists were becoming concerned for the future of some reptiles and some butterflies unless these were protected.

The main reason for this approach was to discourage uncontrolled commercial exploitation. An increasing trade in reptiles had established high prices on world and interstate markets for all types of Queensland pythons, some venomous snakes, and several species of butterflies.

It is now illegal to net baby crocodiles as "stuffers" for the tourist trade.

While all reptiles are protected the public has been assured that no person will be prosecuted for killing a venomous snake or an estuarine crocodile to protect himself, his family, another person, or his livestock. This must be a matter of common sense.

Many children have pet lizards and snakes and the policy of the Fauna Authority is not to hinder school children wishing to keep such occasional pets. Thus their interest in wildlife may continue to develop and not be unnecessarily restricted. Several sedentary species are suitable for study purposes and further advice and information on this subject may be



Fauna District No. 7 is a new definition being all that part of the State not on mainland Queensland. It does not, however, include high islands such as Mornington, Thursday, Hinchinbrook, Whitsunday, Frazer, Moreton and some others which are included in the nearby mainland fauna districts. Fauna District No. 7 is designed to identify the habitats and faunas of the marine environment chiefly low islands which are the coral cays of the Torres Straits and the Great Barrier Reef such as Bramble Cay, Raine Island, Michaelmas Cay, Green Island and Heron Island.

obtained from the Curator of Amphibians and Reptiles, Queensland Museum, Gregory Terrace, Fortitude Valley, Q. 4006.

INJURIOUS FAUNA

Special permission may be granted for the taking of protected fauna that is causing substantial damage or injury to any property, including crops or livestock, or causing significant personal loss to the occupier or owner of a holding, or causing or likely to cause injury to a person in any place such as at an aerodrome. To avoid undue delay, fauna rangers are empowered to issue these permits locally. Conditions and restrictions may be imposed on any such permit.

INJURED FAUNA

Previously it was an offence to take care of injured fauna. Provision has been made in the current Act for injured, sick or emaciated permanently protected fauna or protected fauna to be taken care of by a person provided a fauna officer is notified within 24 hours of the taking or of the date when the fauna was first kept or of the earlier taking, keeping and release.

The Conservator or authorised officer will then give the necessary directions related to the welfare of the fauna.

HUNTERS AND OPEN SEASONS

Species of fauna are not generally distributed throughout Queensland and the State has been divided into seven fauna districts for practical convenience. This allows conditions such as open seasons to be applied to a part or parts of the State without involving the whole.

SHOOTER'S PERMITS

It is now obligatory for a hunter to have an open season fauna (shooter's) permit in all cases where an open season is declared. A shooter includes a person who is a bow hunter.

Species	Open Season	Fee		Quota, Bag or Other Conditions
		Personal	Sale	
		$	$	
Grey kangaroo, Red kangaroo	To be declared after annual consideration. There will be no continuously fixed open seasons as in the past and districts will be listed.	5.00	25.00	To be determined at time of issue of permit. See current open season Order in Council for details.
Wallaroo		5.00	25.00	
Whiptail wallaby		5.00	25.00	
Wild ducks		5.00	..	
Quail		5.00	..	
Snipe		..	..	

In all instances a prescribed application form must be submitted with the prescribed fee for an open season fauna (shooter's) permit.

Conditions of issuance of a permit will depend on the applicant having permission from the landholder or the authority controlling the land to enter the land for the purpose of taking fauna.

An open season fauna permit will not relate to a sanctuary, refuge or reserve.

Generally spotlights are prohibited but in the case of permits for kangaroo, wallaroo or whiptail wallaby, permission to use a spotlight will be granted.

In all permits issued, the general conditions under which fauna may be taken are specified; the disposal of the fauna is subject to provisions such as tagging that may be imposed. Thus methods of hunting may be prescribed in a permit; these include prohibition of the trapping and selling of wild ducks and the purchase of tags in the case of some marsupial skins.

NON PROTECTED AND PROHIBITED FAUNA

Non protected fauna and prohibited fauna include species that may be serious pests of the agricultural or pastoral industries. The following list also includes species which are potentially harmful to native fauna species and/or their habitats. None on this list is indigenous, all having been introduced. The date alongside each species is the approximate date of introduction into Queensland. These species are often referred to as "exotics".

List of Non Protected Fauna

BIRDS

Feral pigeon (Late 19th century)	*Columbia livia*
Indian spotted dove (1912) ..	*Streptopelia chinensis*
Sparrow (1869–1870)	*Passer domesticus*
Starling (1869–1870)	*Sturnus vulgaris*
Indian myna (1883)	*Acridotheres tristis*

MAMMALS

Hare (Late 19th century) ..	*Lepus europaeus*
Rabbit (1866)	*Oryctolagus cuniculus*
House mouse (Late 19th century)	*Mus musculus*
Norway rat (Late 19th century)	*Rattus norvegicus*
Ship rat (Late 19th century) ..	*Rattus rattus*
Dingo (Pre-European Man) ..	*Canis dingo*
Fox (Approx. 1900)	*Vulpes vulpes*
Feral cat (19th century) ..	*Felis catus*
Feral pig (Pre 1870)	*Sus scrofa*
Feral goat (Late 19th century)	*Capra hircus*
Feral dromedary (Late 19th century)	*Camelus dromedarius*
Feral donkey (Late 19th century)	*Equus asinus*
Brumby (Mid 19th century) ..	*Equus caballus*
Water buffalo (Late 19th century)	*Bubalus bubalis*

These can be destroyed throughout the State at any time of the year subject to restrictions relating to entry to sanctuaries, refuges, reserves and holdings. (See later.)

The keeping of non-protected fauna such as rabbits, dingoes and foxes is generally prohibited under *"The Stock Routes and Rural Lands Protection Acts,* 1944 *to* 1967," unless otherwise specially permitted as in the case of bona fide zoos.

A person shall not keep prohibited fauna unless he is a holder of a special permit.

SANCTUARIES

All islands that form part of the State of Queensland, all National Parks, State Forest Reserves, and many other areas such as private properties have been declared sanctuaries. Sanctuary notices may be displayed and the unauthorised removal of these notices is an offence.

Within the boundaries of properties that are sanctuaries, landholders and their authorised agents are permitted to take non protected fauna without restriction.

Persons may be ordered by authorised officers to leave a sanctuary and it is an offence not to quit a sanctuary when so ordered.

Owners of holdings wishing to have their land considered as a sanctuary are required to make application on a form designed for this purpose.

REFUGES

The Governor in Council may from time to time by Order in Council, for the purposes of conserving one or more species of fauna or for any other special reason declare any land to be a refuge. Fauna refuges are multi-purpose reserves. They are declared for fauna purposes as well as for other activities such as a primary industry. The objective of a fauna refuge is to place greater emphasis on broader habitat reservation. The Governor in Council may by Order in Council specify such terms, conditions or restrictions as he thinks fit with respect to the use of a refuge for a purpose other than fauna conservation.

RESERVES

The Governor in Council may from time to time by Order in Council, for the purposes of this Act, declare land that has been reserved and set apart under the *Land Act* 1962–1973 for Departmental purposes to be a reserve.

Fauna reserves comprise of a limited number of comparatively large areas of land under the direct control of the Fauna Authority as trustee.

Fauna reserves are declared for the sole use of fauna.

Entry upon a reserve without a permit is prohibited. It is also an offence to cause or permit any live animal to enter a reserve, cause or permit a fire to enter a reserve and to disturb in any manner the biological matter or physical environment within a reserve.

PROHIBITED APPLIANCE

The use of poisons specified in Schedule 7 of *The Poisons Regulations of* 1967, and of adhesive substances such as bird-lime, is prohibited. Other poisons, materials and appliances may from time to time also be prohibited.

Dogs may be used only to take fauna during an open season. The control of dogs is often vested in the Local Authority and some of these have relevant by-laws.

FAUNA FOR PARTICULAR PURPOSES

Science and Education

For certain purposes, principally scientific and educational, the taking and keeping of fauna may be permitted. The conditions, provisions and restrictions under which a permit is granted are indicated on the permit. It is illegal to collect or keep fauna in captivity unless authorised by the Act. Application forms are available and a permit to take and a permit to keep (not for exhibition) each command a fee of $5.00.

Zoos, etc.

A circular outlining the conditions and requirements for the construction of cages and enclosures for displaying fauna is available. Plans must be approved before fauna is collected for display. The fee on application for a permit to keep fauna for exhibition by a person other than the Brisbane City Council or other Local Authority is $200.00.

Enclosures, cages and aviaries where fauna are confined whether privately, for public exhibition purposes, or for sale, must be kept clean and in a sanitary condition. Further, all captive fauna must be regularly fed and watered. Where cruelty to fauna occurs, provisions of the *Animals Protection Act* 1925–1971 apply and this Act is administered by both the Police Department and the Royal Queensland Society for the Prevention of Cruelty.

Certain zoos and circuses which contain exotic species are required to be licensed under the *Quarantine Act* 1908–1969 administered by the Chief Quarantine Officer (Animals) of the State Department of Primary Industries, William Street, Brisbane, on behalf of the Australian Government.

Aviaries

All aviaries containing 20 or more birds (other than gazetted aviary birds listed below which may be kept, bred, bought and sold in Queensland without restriction) must be registered annually. There is a separate circular available covering aviculture (keeping, moving, buying and selling).

Gazetted Aviary Birds

Canary; budgerygah (except native green form); Aberdeen or red-headed finch; aurora or crimson winged waxbill; cutthroat or ribbon finch; Cuban finch; red-crested cardinal; zebra finch (except native form); star finch (except native form); doves, ruddy turtle, senegal, laughing, harlequin, pink headed, etc.; cordon bleus; gold finch; green avadavat; green singing finch; green finch; Java sparrow; jacarina finch; Melba or crimson faced waxbill; mannikin (*Spermestes* species); black headed nun or mannikin; nutmeg or spice finch; ruddy or African fire finch; silver bill; strawberry finch; waxbills; Madagascar weaver; masked or namaqua dove; rock dove (all domestic forms); Talpacoti dove; love birds (all species); Indian ring neck parrot; Californian quail; Japanese quail; Chukar partridge; Chinese ring-neck pheasant; golden pheasant; Lady Amherst's pheasant; Reeve's pheasant; silver pheasant; Swinhoe's pheasant; peafowl; white headed nun or mannikin.

FAUNA AND SKIN OR CARCASS DEALERS

A person engaged in professional dealing in fauna or skins or carcasses is required to take out a licence and all premises must be registered. This relates particularly to the kangaroo skin/carcass industry. A permit, licence or certificate to deal in fauna or skins or carcasses does not authorise the holder of such to take fauna. Permanently protected fauna cannot be handled by fauna, or skin, or carcass dealers.

Movement—Intrastate and Interstate

Fauna, except gazetted aviary birds, may be moved only by permit within Queensland. It is also provided that all fauna shall not be exported to another State or Territory unless an export permit has first been obtained and an

import permit granted by the proper authority in the place outside Queensland to which the fauna are being introduced.

In connection with professional dealing, there is also a more detailed circular available which outlines the restrictions.

All crates, bags or bales containing skins must be branded with identifying marks. In the case of kangaroo skins, numbered tags issued by the State Government to licensed shooters must be attached to each skin marketed.

Introductions

The introduction of fauna to this State from elsewhere is subject to special permission. This clause guards against the introduction and liberation of noxious fauna. Penalty: Minimum $200: maximum $3,000.

ROYALTY

Royalty at the prescribed rates is chargeable on fauna taken in Queensland. The rates for open season fauna are outlined below.

OPEN SEASON MAMMALS	cents
Grey kangaroo	20
Red kangaroo	20
Wallaroo	20
Whiptail or pretty face wallaby	20

The person who takes the fauna, the fauna dealer and the skin or carcass dealer, are liable jointly or severally for the payment of royalty, provided that royalty shall not be paid more than once upon any fauna. Power is given for dealers to deduct royalty from monies held as a result of the sale of fauna. It is an offence not to pay royalty and provision is made for the recovery of unpaid royalty. Fauna, including skins and carcasses, may be seized if royalty is unpaid. The maximum penalty for an offence is $1,000 plus twice the amount of royalty involved.

It is noteworthy that early in 1975 three North Queenslanders illegally hunting in the Gilbert River area near Georgetown were each convicted and fined $50 plus $4.25 costs of court and in the case of the 5 plain turkeys (royalty $50 each) and the 9 magpie geese (royalty $5 each) were fined additionally at twice the rate of royalty making a total penalty of $1,932.75.

GENERAL

It is obligatory for holders of authorities issued under the Act to abide by any conditions contained therein and such authorities must be carried when engaging in the business allowed in the permit.

For humane reasons all traps must be inspected at intervals of not more than 36 hours.

A person in possession of fauna may be required to supply proof that the particular fauna was taken or is kept lawfully under the Act.

The forging and uttering of permits and similar actions which may be used to circumvent the true purposes of the Act constitute offences for which a heavy penalty is provided: Penalty $1,000 or imprisonment for twelve months.

Fauna, weapons or other things seized may be detained for a period of twelve months unless it is established at an earlier date that no offence has been committed. Upon conviction for an offence all weapons or fauna seized are automatically forfeited to the Crown. (See definition of "appliance".)

Unless expressly provided, right of entry to land is not granted by the issuance of any permit. The owner or occupier of land may demand the name and address of any person trespassing upon a holding (for the purpose of contravening this Act) and may require the trespasser to quit the holding. It is an offence to remain on the holding if ordered to leave.

Power is provided for the Governor in Council to make regulations and declare Orders in Council not inconsistent with but on all matters necessary for the conservation of fauna in the State. Hence the aforementioned deals only with interpretations of the various enactments to 31st March, 1975.

FEES

Whilst fees are mentioned from time to time in this article the following is a composite list of fees as provided under the *Fauna Conservation Act* 1974 and Regulations.

ON APPLICATION—	$
For an open season fauna permit (personal use)	5.00
For an open season fauna permit (taking for sale)	25.00
For each Kangaroo skin tag	0.20

	$
For a fauna dealer's licence	5.00
For registration of each fauna dealer premises—Class A	100.00
For registration of each fauna dealer premises—Class B	100.00
For registration of an aviary	2.00
For a permit to keep fauna under Part IX—not for exhibition	5.00
For a permit to keep fauna under Part IX—for exhibition by a person other than the Brisbane City Council or a Local Authority	200.00
For a permit to take fauna under Part IX	5.00
For a permit to remove fauna from any place in Queensland to another place or for a permit to move fauna from a place outside Queensland to any place in Queensland—	
Birds (including aviary birds interstate) per bird	0.10
Other fauna	2.00

SOME WILDLIFE AND CONSERVATION BOOKS WHICH MAY BE OF GENERAL INTEREST

CONSERVATION

COSTIN, A. B., FRITH, H. J., Eds. 1971. "Conservation", Penguin Books, Melbourne. 300 pp.

SERVENTY, V. "The Singing Lands", Angus and Robertson.

WEBB, L. J., WHITEHOUSE, D., and LEGAY BRERETON, J., J. Eds. 1969. "The Last of Lands, Conservation Australia", Jacaranda Press.

GENERAL

BLOMBERY, A. M., 1974. "What Wildflower is That?", Paul Hamlyn Pty. Ltd.

BREEDEN, S. and Kay, 1967. "Animals of Eastern Australia", Australasian Publishing Company in association with George G. Harrap Ltd., London.

BREEDEN, S. and Kay, 1970. "Living Marsupials", Collins, Sydney & Lamb.

BREEDEN, S. and Kay. "Tropical Queensland", A Natural History of Australia, Collins, Sydney and Lamb.

FRITH, H. J. "Waterfowl in Australia", Angus and Robertson.

GALL, I. "Going Bush with Ian Gall". Jacaranda Press.

SLATER, P., 1970-1974, "A Field Guide to Australian Birds"—two volumes, Passerines and Non-Passerines. Rigby.

MACDONALD, J. D., 1973. "Birds of Australia", Reed.

TROUGHTON, E. G., 1962. "Furred Animals of Australia", Angus and Robertson.

WORRELL, E., 1963. "Reptiles of Australia", Angus and Robertson.

GOVERNMENT PUBLICATIONS

Obtainable from the Queensland Department of Primary Industries, William Street, Brisbane. Q. 4000

Fauna and Flora Conservation Information, Queensland Department of Primary Industries (free).

LAVERY, H. J., "Wild Ducks and Other Waterfowl in Queensland". $1.18 Post Free (Queensland).

ROFF, C., "Queensland Fauna Sanctuaries". 75c Post Free (Queensland).

ROFF, C., "Honey Flora of Queensland". $3.00 Post Free (Queensland).

Obtainable from the Queensland Museum, Gregory Terrace, Fortitude Valley. Q. 4006.

COVACEVICH, Janette, "Snakes of Brisbane". 25c plus postage.

COVACEVICH, Janette and EASTON, A., "Rats and Mice in Queensland". 75c plus postage.

CLIFFORD, H. T., "Eucalypts of the Brisbane Region". 75c plus postage.

DALE, Floyd D., "Forty Queensland Lizards". 75c plus postage.

VERNON, D., "Birds of the Brisbane Region". 75c plus postage.

Brucellosis-Tested Swine Herds (As at 21 February, 1975)

BERKSHIRE

Clarke, E. J. & Son, "Kaloon Stud", Boonah
Cochrane, S., "Stanroy", Felton
Crawley, R. H., Rockthorpe, Linthorpe
H. M. State Farm, Numinbah
H. M. State Farm, Palen Creek
Handley, Est. J. L., "Meadow Vale", Lockyer
Handley, G. R., "Locklyn" Stud, Lockyer
Kimber, E. R., Tarella, M.S. 805, Mundubbera
Ludwig, A. L., "Beau View" Stud, Cryna, via Beaudesert
Neuendorf, W., M.S. 794, Kalbar
Queensland Agricultural College, Lawes
Research Station, Hermitage
Rosenblatt, G., Rosevilla Biloela
Westbrook Training Centre, Westbrook

LARGE WHITE

Ballon, E. E. & E. Maclagan
Barrier Reef Islands Pty. Ltd., Hayman Island
Batterham, P. & N., Raby Park, Inglewood
Beutel, G. R. and Son, Brookdale Stud, M.S. 786, Boonah
Bool, A. R. and B. E., Rossvale, Crow's Nest
Briskey, R. G. and M. J., Wallingford, Pittsworth
Brosnan, D. J., "Bettafield", Mt. Murchison, via Biloela
Cauley, J. R., M.S. 918, Toowoomba
Cauley, T. P., M.S. Jondaryan 444, Rosalie
Clegg, J. A. & M. A., "Karoma" Stud, Mundubbera
Coleman, C. J., Merriland Stud, Britannia Station, Charters Towers
Corney, F. D. and E. C. W., Pagel, Tara
Cotter, N. J., "Olaroy", Goomeri
Craig, K. F., "Echoes", Bancroft, via Monto
Crawford, B. P. & B. J., M.S. 757, Kingaroy
Department of Aboriginal and Island Affairs, Cherbourg
Diete, E., Ingoldsby, 4343
Duckett, R. and L. M., Fairview, Capella
Duncan, C. P., "Colley", Flagstone Creek, Helidon
Duncan, J. A. & B. L., Ma Ma Creek
Dunlop Meats Pty. Ltd., Coondulla, Robertson Pk., Murray Upper
Eagle, D. R. & J. A., "Walugra", 134 Hogg St., Toowoomba
Fisher, J. & L., Lyndhurst, Jimbour
Flegler, T. C., Wongabeena, Dalby
Fletcher, L., "Par-en-eri" Stud, M.S. 806, Mundubbera
Forster, I. S. & D. E., 112 Drayton Rd., Toowoomba
Fowler, K. J. & B. D., "Kenstan", M.S. 195, Pittsworth
Fowler, K. P., Northlea Stud Farm, 156 Hogg St., Wilsonton, T'ba
Franke, K. H. and B., "Delvue" Stud, Cawdor
Freeman, W. A., "Trevlac", Rosewood
French, A., "Wilston Park", Pittsworth
Gosdon, T. C. & E. A., "Naumai", Dalby
Graham, T., Dunleigh, Highfields
Grayson, D. G., Wodalla, Killarney
Harwood, L. B., Cobar, Tara
H. M. State Farm, Numinbah
Head, G. A., M.S. 825, Ipswich
Hinchcliffe, D. F. & R. K., "Oakview", Milman, 4702
Hockings, J. & M., "Quambi", Kumbarilla
Hudson, R. F. & V. D., "Rondel", Hogg St., Wilsonton, Toowoomba
Jones, K. B. & I. R., "Cefn" Stud, Clifton
Kajewski, C. & D. I., "Glenroy", Glencoe, via Toowoomba
Kanowski, A., "Exton", Pechey
Kimber, E. R., "Tarella", M.S. 805, Mundubbera
Kruger, V. F. & B. L., "Greyhurst", Goombungee
Kuhl, V. and C. A., "The Mounts", M.S. 222, Oakey
Le Gros, W., "Elourea Stud", Marburg
Little, R. S., P. M. & G. W., "Glengarry", Jimbour
Maranoa Stud Piggery, Mitchell
Marsden, M., "Fernflat" Canaga
Mathieson, K. N., "Iderway", Gayndah
Philip, R. J. and M. M., Boolarong Stud, Elimbah
Postle, R. S., G. C. & Son, "Yarallaside" Stud, Pittsworth
Queensland Agricultural College, Lawes
Quilter, P. E., Paga Paga Piggeries, Postman's Ridge
Radel, V. V., "Braedella" Stud, Coalstoun Lakes
Robin, A. B., Blaxland Rd., Dalby
Rosenblatt, G., Rosevilla, Biloela

LARGE WHITE—continued

Research Station, Biloela
Ruge, A. F. & V. M., "Alvir" Stud, Biggenden
Ruge, G. H. & I. E., "Al-Lester" Stud, Woowoonga, Biggenden
Sharp, D. W. & L. J., "Arolla", Lavelle, Q., 4357
Smyth, R., Barambah Rd., Goomeri
Ward, R. J., "The Plateau", Mulgildie
Whiteman, J. H. & A. B., Long's Bridge, via Warwick
Willdo Farming Co., Southbrook
Willet, L. J., "Wongalea", Irvingdale
Williamson, K., Cattermul Ave., Kalkie
Withcott Stud Piggery, Rowbotham St., Toowoomba
Wolfenden, C. B. & J., Rossmoya

TAMWORTH

Kanowski, S. E., Pinelands, via Crows Nest

WESSEX SADDLEBACK

Douglas, Mrs. W. S. & Son, "Greylight" Stud Goombungee
Smith, C. R. & Son, "Belton Park", Goombungee

LANDRACE

Ballon, E. E. & E., Maclagan
Barrier Reef Islands Pty. Ltd., Hayman Island
Batterham, P. & N., Raby Park, Inglewood
Bertolotti, F. E. J. & N. I., "Mascotte", Wallumbilla
Bool, R. A. and B. E., Rossvale, Crow's Nest
Brosnan, D. J., "Bettafield", Mt. Murchison, via Biloela
Cauley, J. R., M.S. 918, Toowoomba
Cauley, T. P., M.S. Jondaryan 444, Rosalie
Clegg, J. A. & M. A., "Karoma" Stud, Mundubbera
Coleman, C. J., Merriland Stud, Britannia Station, Charters Towers
Crawford, B. P. & B. J., M.S. 757, Kingaroy
Crowle, N. & D., Cooranga North, 4408
Diete, E., Ingoldsby, 4343
Duckett, R. and L. M., Fairview, Capella
Dunlop Meats Pty. Ltd., Coondulla, Robertson Pk., Murray Upper
Fisher, J. & L., Lyndhurst, Jimbour
Flegler, T. C., Wongabeena, Dalby
Fletcher, L., "Par-en-eri" Stud, M.S. 806, Mundubbera
Forster, I. S. & D. E., 112 Drayton Rd., Toowoomba
Fowler, K. J. & B. D., "Kenstan", M.S. 195, Pittsworth
Fowler, K. P., "Northlea", 156 Hogg St., Wilsonton, Toowoomba
Fowler, N. E. P. & M. P., c/- Kewpie Enterprises, Kingaroy
Gosdon, T. C. & E. A., "Naumai", Dalby
Graham, T., Dunleigh, Highfields, 4352
Grayson, D. G., "Wodalla", Killarney
Harwood, L. B., Cobar, Tara
Hinchcliffe, D. F. & R. K., "Oakview", Milman, via Rockhampton
Hockings, J. & M., "Quambi", Kumbarilla
Hudson, R. F. & V. D., "Rondel", Hogg St., Wilstonton, Toowoomba
Jones, K. B. & I. R., "Cefn" Stud, Clifton
Kajewski, C. & D. I., "Glenroy", Glencoe, via Toowoomba
Little, R. S., P. M. & G. W., "Glengarry", Jimbour
Maranoa Stud Piggery, Mitchell
Marsden, M. "Fernflat", Canaga
Marsh Pastoral Co., Brymaroo
Nielsen, L. R., "Sunny Hill", Ascot, via Greenmount
Peters, L. A., "Moonlight", Bongeen
Philip, R. J. and M. M., Boolarong Stud, Elimbah
Quilter, P. E., Paga Paga Piggeries, Postman's Ridge
Radel, R. M., Turua Stud, Biggenden
Robin, A. B., Blaxland Rd., Dalby
Rosenblatt, G., Rosevilla, Biloela
Ruge, A. F. & V. M., "Alvir", Biggenden
Sharp, D. W. & L. J., "Arolla", Lavelle, Q., 4357
Trout, L. B. and L. J., "Caminda", Crawford, Kingaroy
Whiteman, J. H. & A. B., Long's Bridge, via Warwick
Willdo Farming Co., Southbrook
Willet, L. J., "Wongalea", Irvingdale
Williamson, K., Cattermul Ave., Kalkie

SEVEN JOBS IN ONE GO

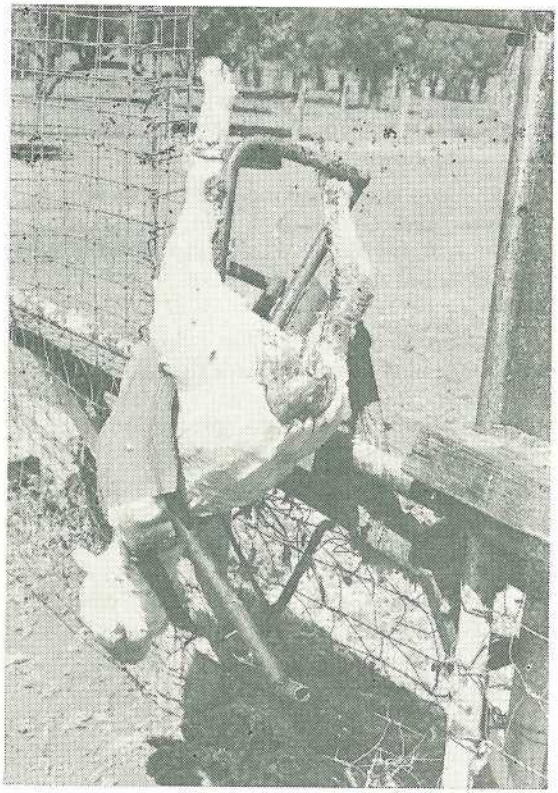
by L. B. DUNLOP,
Sheep and Wool Adviser, Charleville.

Don Pegler of "Trinidad", 200 km N.E. of Quilpie not only does seven sheep-handling jobs at once, he gets through them all in 1 minute 20 seconds.

With lambs from 1 week to 4 months he can crutch and wig, mules, tail dock, ear mark, powder and wean all at the one time with the help of one of his children who only has to "push up".

HIS equipment is an enclosed elevated race with a spring loaded, foot operated, sliding door, a capsizing sheep crush to hold the sheep upside down, a W.A. designed air operated handpiece to crutch the sheep, marking tools, mulesing shears and a powder gun.

Don waits till the lambs are at weaning age before mustering and brings in enough for a day's work. That could be up to 400 in an 8-hour day because he can do up to 50 lambs in an hour.



He said: "There are no medals for picking up sheep nowadays and there are too many bad backs in the country for traditional methods of lambmarking to continue for very long. So I designed this idea to save lifting, sheep handling and hard work. Someone may have done it before me but anyone's free to copy my ideas from me because after he's refined it and added something else, I might copy it back."

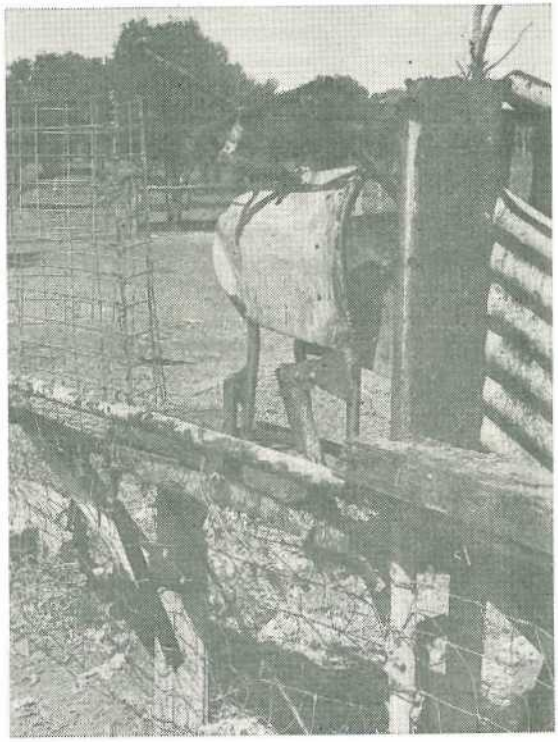
The operation begins with the foot operated door opening at the end of the race and the first sheep being pushed and caught in the crush. The crush is capsized in the same action and the sheep's feet are pointing in the air with the sheep's nose being closest to the ground. This presents the breech and tail in an excellent position for crutching with the air handpiece. The crutchings almost drop into a wool pack which is tied against the race.

Don then only wigs one eye (the other *is* difficult to wig). He rationalises, "People reckon if you do a job you should do it properly but I maintain a sheep only needs one good eye to see." He then radically muleses, tail docks and ear marks the sheep. The blowfly powder is in a paint gun and is operated by the same compressor which is used for the shearing handpiece. He now has a sandblast gun with a plastic cowling which fits over the breech of the sheep. It does a better job and wastes less powder.

The sheep is then swung back on its feet and released. It then has a 1 metre jump into a holding pen, then it goes to meet the world with its mates, all in the space of 1 minute 20 seconds.

Two problems with Don's idea of doing everything at weaning age are that horn growth on wethers may be excessive causing stags, and that lambs have no protection against blowfly until mulesing.

While the design could have a lot more refinements such as a self feeding race and more room to mules the sheep's left leg, it does represent a forward step by a grazier for graziers to reduce work and save costs by combining seven tasks into one.



THE FARM FAMILY

The Fly...

man's biggest health danger

EVER wondered how a fly eats without teeth?

It can't chew, so it vomits the contents of its stomach onto its food, stirs with its syphon-like proboscis, sucks, vomits, stirs, sucks . . . and so on until the food is fit to eat.

At the same time it rubs its hairy legs together, scattering disease organisms which can cause summer diarrhoea, salmonella infection and gastro-enteritis.

Add typhoid, hepatitis, poliomyelitis, tuberculosis, a wide range of "summertime" intestinal infections, and it quickly becomes clear just why flies are high on the list of Queensland's health menaces.

We breed them, we feed them, and we do little or nothing about them.

Before we can control flies we must know something of their life cycle. A fly develops through four distinct stages. First, the egg: one of 500 or more laid by every female in four or five batches during her lifetime, it's white, elongated, about the size of a needle's eye. Within 24 hours the egg has hatched into the second stage—a maggot. Slightly bigger than a grain of rice, it feeds in any available filth for from three to 14 days. It then burrows into a dry, warm place to go through the third stage—pupation. A reddish-brown shell forms —and inside the shell the adult fly grows. When this third stage is over, the fly pushes off the end of the pupa case, burrows back to the surface, walks around to dry its wings—and there it is, hungry for filth, and sugar.

The filth will almost certainly be right where it started life as an egg. And the sugar is in the kitchen, where these filthy insects pay for their food with disease.

The answer is threefold—sanitation, screening, spraying.

Sanitation, a control measure to which flies can never develop resistance, means the elimination of fly breeding sources. This means—

- cleaning up all uneaten pet food,
- wrapping kitchen refuse in four or five sheets of newspaper before it goes into the rubbish bin,
- keeping a tight-fitting lid on the rubbish bin,
- protecting the bin from weather and corrosion.

If you bury your rubbish, wrap it first, then cover it with at least six inches of clean soil before flies can blow it.

Best of all, incinerate all household rubbish in a properly constructed incinerator before burial.

Make sure lavatory pansteads are flyproof.

Put your garden compost in flyproof bins—brick, with a flywire top. Compost heaps are notorious fly breeders.

Keep fowl yards clean. But be sure to protect the manure from flystrike.

Sprinkle manure thinly on garden beds. Cow and horse manure mulched onto garden beds breed billions of flies in Queensland's ideal climate.

We can be certain of one thing—without thorough sanitation we will never control flies.

Follow sanitation by screening doors, windows and ceiling ventilators. Then keep the screens in good order.

Stop flies from coming indoors and you stop flyborne infection. At first sight, total screening may seem expensive, but in the long run you will benefit in two ways—you will protect your family's health, and save dollars in sprays you won't need.

In the kitchen, cover all food, during preparation and at the table. Have a stand-up cover for meat. Keep bottled milk protected by its own sealed cap and protect milk in jugs with covers of finely woven cloth. Serve sliced bread in dishes with covers. Have lids on sugar, jam, honey and butter.

This may sound like elementary precautions but flies infect us through our food, and on a population basis we buy more drugs to cure "summertime" diseases than any similar community in the world. That is because food protection rules are so ignored in so many homes.

When your sanitation is faultless and your house screened, turn to sprays. You will need two kinds—a quick-acting "knockdown" for indoors, and then a powerful residual spray for outdoors, to assist your sanitation measures.

"Knockdown" sprays usually consist of DDT with a quick killer such as pyrethrum added. They are most effective when sprayed directly at the insect. There are several good brands on the market.

Remembering that outdoor sprays should supplement, not replace, strict sanitation, select one of the powerful residual sprays on the market.

Walls, window-frames, door-frames and other areas where flies are seen to rest should be sprayed so that the surface is wet almost to the point of run-off. This will give you a fine crystalline film over the surface which will kill flies landing on it.

But don't expect the flies to drop dead—it may be several hours before that happens, and some distance away. But if the mixture and the treatment are right—they will die.

A word of warning—some insecticides can be poisonous for children as well as flies. Keep unused spray on a high shelf where toddlers can't get it. And wash thoroughly with soap and warm water any areas of skin contaminated by sprays when you're preparing or using them.

To kill maggots in manure and compost heaps, dust with benzene hexachloridepowder or spray with a liquid emulsion containing benzene hexachloride, chlordane, malathion, or, best of all, diazinon, mixed and applied as the manufacturer recommends.

Fly control is not easy. It takes concentrated effort by every individual householder.

One backslider in a community can supply all his neighbours with flies. But effective fly control can be achieved and it must be achieved if we are to reduce sickness and death caused by fly-borne disease.

Gardening notes

Strawberry growing in the home garden

Horticulture Branch.

A PATCH of strawberries in the home garden can be very rewarding. Fruit is picked about 12 weeks after planting the runners, and well-cared-for plants should produce not less than 450 grams of berries in a season. HOWEVER, plantings will not succeed without good management, adequate fertilizer and water and satisfactory control of pests and diseases.

SOILS

Strawberries grow well on almost any type of garden soil but it must be well-drained. The ideal soil is a deep, friable loam with a high organic matter content.

The plant is fairly tolerant of acid soils. However, should the pH (soil acidity) be below 5·5 or if the garden bed has not previously been limed, a light application of dolomite at up to 250 grams per square metre is beneficial. It should be incorporated in the soil several weeks before planting.

VARIETIES

Redlands Crimson is the most important variety grown in Queensland. It yields well and its fruit are borne on long, slender stalks on medium sized plants, making it an easy variety to pick. The berry is very firm at full colour. It is suitable for dessert and jam making.

Phenomenal is an older variety, but still quite popular with home gardeners. The plant is of moderate size with a somewhat rounder leaf. The fruit is normally wedge-shaped with a vivid red colour and good flavour.

FERTILIZING

The fertilizer programme for the strawberries will depend largely on the natural fertility of the soil, and the previous cropping history of the area to be planted. If the garden bed has been heavily fertilized for quick growing vegetables, the suggested quantities may be reduced.

Pre-plant application

Apply up to 200 grams per square metre of a complete fertilizer mixture containing 5% nitrogen, 6% phosphorus, and 4% potash, i.e. a 5–6–4 mixture.

The fertilizer should be thoroughly worked into the soil about 10 days before the runners are planted.

Strawberries also benefit from dressings of poultry or other animal manure. These should be incorporated in the soil at least 6 weeks before planting.

Side dressing

Side dressings of fertilizer are usually needed during the growing period. The fertilizer is applied when flowering begins and this is followed usually at 4 to 6 week intervals.

The 5–6–4 NPK fertilizer used for the pre-plant application is quite suitable for side dressings. Apply the mixture at 100 grams per 3 metres of row.

The side dressing is spread evenly around each plant. Apply it in such a way that no fertilizer comes in contact with the fruit or leaves. Water well after applying the mixture.

ESTABLISHING THE CROP

Planting material

Only well developed disease-free runners from a reliable source should be used. All broken and any dead leaves are best removed and the roots trimmed to about 75 mm before planting the runners.

Planting time

March is the best time to plant. Earlier plantings can be difficult to establish, the plants tend to continue growing vegetatively and are often slow to come into bearing. Late planted crops, on the other hand, make little growth before winter and yields are correspondingly reduced.

Planting depth

Care in planting is essential. The runner should be set with the crown just above ground level. If it is set too low, the crown tends to silt up and the plant either dies or makes unsatisfactory growth; if set too high, the roots may dry out. It is difficult to transplant runners at the right depth unless the soil is in good tilth, is level, and has been allowed to settle.

Plant spacing

Strawberry runners may be planted in single or double rows.

Spacings for single-row plantings are 75 cm between rows and 40 cm between plants in the row.

For double-row plantings, the best spacings are 1 metre between the centres of adjacent pairs of rows, with 40 cm between the two rows in each pair and 40 cm between plants in the row with plants staggered.

Mulching

Mulches are useful for controlling weed growth, conserving soil moisture and keeping the fruit clean.

Reflective polythene (plastic) sheeting is very suitable. It may be placed over the soil either before or after planting. Slits about 100 to 150 mm long are made in the sheet or round holes about 60 mm in diameter are cut or burnt at each plant position to permit insertion of the runners.

When the sheeting is laid after planting, slits are cut at each plant position and the plants are then gently eased through the openings.

Watering

The soil should be moist at the time of planting and the runners should be watered immediately after planting to firm the soil. During the first two weeks after setting out the runners, the soil must not be allowed to dry out at any time.

Once the crop is established, water is applied regularly to keep the plants growing and cropping satisfactorily.

Harvesting

Berries of the Redlands Crimson variety are harvested when completely coloured because at this stage they have developed full flavour and are still firm. On the other hand, the Phenomenal variety may be harvested at three-quarter colour.

PESTS AND DISEASES

Leaf spots and fruit rots of strawberries caused by fungal attack are worst in damp situations. Therefore the strawberry patch should not be established on poorly drained soil or where the plants will be shaded.

If required, a regular fortnightly spraying with captan will prevent the spread of leaf spot diseases.

Grey mould, and powdery mildew are the major fungus diseases attacking the berries. Applications of captan sprays at 10 to 14 day intervals will control grey mould and most other fruit rots. Powdery mildew may be controlled by spraying with benomyl (Benlate (R)) as required.

Spider mites are a common pest of strawberries, especially in warm weather. If large populations occur, plant growth, yield and fruit quality can be reduced. They are best controlled by spraying with dicofol (Kelthane (R)) at 10 to 14 days intervals. It is essential to apply the spray to the undersurfaces of the leaves.

Other pests which may attack strawberries are cutworms and cluster caterpillars. These are controlled by spraying with trichlorphon (Dipterex (R)). Corn ear worm sometimes attacks strawberries and may be controlled by spraying with endosulfan.

If slugs or snails become troublesome, these may be controlled by using one of the proprietary baits.

Use all pest and disease control sprays as directed by the manufacturer and observe the safety measures printed on the label.

The Smallest Enemy

DURING World War 2, a coastal town in Queensland was swept by an enemy almost as powerful as the Japanese.

THE township was involved in the war-effort, and one company in particular was hit by this "enemy". It's official name was *Aedes aegypti* —a cosmopolitan little mosquito.

The fellow caused 27,000 man days of lost work during the war effort for the company concerned.

For it is the carrier of a disease called Dengue Fever, that necessitated at that time two or three visits by a doctor, medicine, and usually about two weeks away from work for the victim.

Luckily, today, dengue and other diseases such as malaria, filariasis are no longer widespread in Australia.

But the tiny pest called the mosquito—and there are about 100 species—still causes mankind to spend thousands of hours of restless nights, and to infect him with illnesses with varying degrees of severity.

Man spends literally millions of dollars to try to eradicate the humble mosquito. Nobody has yet succeeded in this effort.

The mosquito in Queensland this summer will continue to make victims of men, women, children—and even dogs.

There will be people who will suffer from epidemic polyarthritis, which is a mild disease with pain and rash.

Murray Valley encephalitis might occur in some areas, particularly if there is a "wet season" in south-west Queensland.

Pulmonary dirofilarias could affect the lungs of others.

Heartworm larvae may be transmitted from dogs to humans by infected mosquitoes.

Many thousands of people will lie awake at night listening to the buzzing—and awaiting attack from the tiny monster.

The Queensland Health Education Council makes no bones about the dangers of the humble mosquito.

In a pamphlet, it says that the mosquito ranks as one of the greatest killers the world has ever known. Unchecked, its power to affect health is enormous.

An endless chain of disease could commence. For example, if a mosquito bites Mr. Jones who is sick, then proceeds to Mr. Smith, Mr. Smith then becomes sick. Another mosquito bites the sick Mr. Smith and away it goes to somebody else and so on.

Actually, it is only the female of the species which bites humans since it needs blood to mature its eggs.

The male, like many other species, is harmless. He lives on honey, nectar and plant juices.

The female has a very efficient "tool kit" to get your blood—two fine hypodermic needles and two pairs of sharp saws.

With the saws she cuts through the skin. Then with her first hypodermic needle she injects saliva to keep the blood from clotting.

The blood is sucked up through the second "needle" by a pump in her head.

Soon the saliva secretion begins to itch and the skin turns red round the bite.

Mrs. Mosquito meanwhile has packed up her "tool kit" and exited the scene to digest her meal.

Of course, in sucking up her victim's blood, the mosquito will have sucked up germs and parasites in the bloodstream.

These remain in the mosquito's body until she injects them with the salivary solution into her next victim.

The mosquito lays her eggs in water. Some prefer clear, fresh water, others like brackish water, or even salt water.

Some like to live near humans, others prefer the bush or forests.

Some are day biters, others prefer the dead of night. Wind-borne some can travel as much as 30 miles.

The Health Education Council suggests that householders can take basic steps to help control mosquito breeding:

- Dispose of all tins and other receptacles that could hold water;
- Repair guttering and downpipes so that water does not remain to form a pool;
- Screen all openings to tanks;
- Spray all uncovered areas of still water with kerosene or other mosquito larbicide;
- Empty at least once a week, all flower vases and other receptacles containing water; and
- Drain away all kitchen and other water.

If your home is still invaded by mosquitoes after these precautions, you should plan to fix insect screens to all doors and windows.

You should wear clothing over legs and arms at night or use a repellant.

You should sleep beneath a mosquito net.

And during the day you should spray inside closets and under furniture, because that is where mosquitoes rest.

Governments and local authorities have long-recognised the need for control measures and indeed have undertaken huge programmes of spraying to eliminate breeding grounds.

When it is considered, however, that about 3,000 square miles of breeding grounds exist for one species alone in Queensland, the problem is gigantic.

Only with the help of everybody can some small achievements be made against one of the tiniest enemies of mankind.

Stains a problem

- Remove greasy hair marks on your tapestry lounge by spraying them with instant shampoo. Wait for it to sink in, then brush clean with a clothes brush.

- Stubborn marks caused by food-colouring dye come off easily when rubbed with toothpaste, allowed to dry, then rinsed in cold water.

- To remove rust from curtain rings or hooks, boil them in vinegar and water for a few minutes.

Questions and Answers about dairy products

What is pasteurized milk?

Pasteurized milk has undergone heat treatment to kill any dangerous bacteria in it to ensure a safe food with longer keeping-quality.

Unless pasteurized, milk can carry diseases such as tuberculosis and brucellosis from cattle to man.

The most common method of pasteurization involves heating the milk to 72°C for 15 sec. The milk is then rapidly cooled to minimize the loss of the heat-sensitive vitamins B and C.

What is UHT milk?

Ultra High Temperature (UHT) milk has been completely sterilized by heat treatment to kill all living things found in fresh cow's milk. Apart from losing some of the heat-sensitive vitamins, nothing is added to or taken from the milk. The milk is then packed in special plastic-coated cardboard cartons under sterile conditions so that nothing can recontaminate the milk.

Because of this process, the milk can be kept for 3 months or longer without refrigeration. It is ideal for use in the Australian outback.

What is homogenization?

Homogenized milk has been forced at high pressure through an extremely small opening. This divides the butterfat into particles so small that they cannot recombine and form a layer of cream on the top of the milk. Instead, the fat remains suspended throughout the milk.

Nothing has been added to or taken from homogenized milk. The amount of cream in pasteurized, homogenized milk is the same as in normal pasteurized milk but it is evenly distributed through the liquid. In this way, everybody has their share of the cream: not just the person who has the first glass of milk from the bottle.

How is 'Softa' butter made?

Nothing is added to or taken from the cream used to make 'Softa' butter.

A special process of controlled cooling of the cream before churning allows factories to make a more spreadable butter.

'Softa' butter is ideal for sandwiches and has all the goodness of the firmer product.

Why is blue vein cheese blue?

A popular mistake is that copper wire is used to give the blue colour to the soft, blue vein cheese. This is not true. A culture of a *Penicillium* is grown in the cheese, and this gives the cheese its distinctive flavour and colour.

Similarly, the white surface of Camembert cheese should be eaten instead of discarded, as it has quite a pleasant taste.

Why does Swiss cheese have holes in it?

A special starter (a specially-selected type of bacteria) is used to give the sweet, nutty flavour of Swiss cheese, which is especially useful for fondue cookery.

This culture produces a gas, which expands in the cheese leaving the cavities for which Swiss cheese is famous.

Why does Mozzarella cheese have string around it?

Mozzarella cheese, which is used for baking pizzas, was originally made in Italy. Since many foods were stored by hanging from the rafters of the houses in this country, this soft cheese was made into a pear shape with string, so that it could be easily hung.

Australian manufacturers of Mozzarella cheese have followed this tradition, even though today the cheese is usually stored in the refrigerator.

How long can cheese be kept?

Cottage cheese and cream cheese are fresh cheeses and should only be bought as needed. Cottage cheese can be stored in the refrigerator for about 10 days before it being to spoil. Cream cheese loses moisture during storage

and will become dry and unpalatable if kept for long periods.

Cheddar cheese should be removed from the prepack and wrapped in foil or plastic film and placed in an air-tight container. The cheese will not dry out if it is kept in the refrigerator in this way.

Unopened, processed cheese and hard cheeses, such as Parmesan can be kept for as long as 6 months at room temperature if well wrapped.

If mould grows on your cheese, as it does on most foods after storage for long periods in a moist atmosphere, it may be wise to discard the cheese.

Which dairy products should weight-watchers eat?

Natural yoghurt normally has about 3·5 to 3·8 kilojoules per gram (24 to 26 calories per oz.). Real fruit yoghurt, which is the type most people like, usually contains 3·8 to 4·1 kilojoules per gram (26 to 28 calories per oz.).

Since yoghurt has a high protein content, which is essential for body building and repair and has few calories, it is an ideal food for weightwatchers.

Cottage cheese is very low in calories and because it is usually eaten with vegetables such as chopped celery, apple, capsicum, cucumber, cocktail onions, gherkins and grated carrot which have a relatively low calorie content, it makes a tasty lunch or snack for slimmers.

Edam cheese contains less fat than other varieties and so contains fewer calories. This cheese, which is recommended for dieters, can be identified by its cannon-ball shape and red-coloured surface. Edam is often eaten with fresh fruit.

However, dieters should remember that even foods with low calories contents can be fattening if consumed in large quantities.

How should dairy products be stored?

All dairy products should be stored, unopened until needed and eaten as quickly as possible after opening.

Milk is a perishable food and should not be kept in a hot place or in direct sunlight. It is best to keep it stored in a refrigerator when not actually in use. Milk should be stored away from direct sunlight as this causes loss of vitamins.

Homogenized milk can be frozen but this is not recommended.

If milk is needed for camping or picnics, UHT milk can be used. However, once again this milk should be kept cool after opening.

Dairy products with less than 40% butterfat should not be frozen. Cottage cheese and cream cheese should be bought as required and not be frozen.

While shopping, please do not open the lids of cottage cheese containers as this will allow the cheese to become contaminated and the storage life shortened.

Yoghurt can usually be held for about 10 days in the refrigerator before it becomes too acid for most palates.

Cheese should be stored in an air-tight container in the refrigerator but it should be removed about half an hour before serving so that its full flavour is appreciated by the consumer.

Dairy desserts, such as creamed rice or custard, can be kept in the refrigerator for about a week. Once opened, the contents of the carton should be eaten as soon as possible.

The contents should be poured from the carton rather than spooned if the dessert is to be stored for future use. The reason for this is that the spoon will introduce bacteria that will grow and spoil the food within a few days.

Butter should be stored in the refrigerator, preferably in an air-tight container to exclude any odours. Butter will 'pick up' strong odous from other foods.

Is processed cheese as good as cheddar cheese?

Processed cheese consists of a blend of cheddar cheeses which have been heated so that the blend acquires a soft texture. This cheese has a very mild flavour and, for this reason, it relished by children who normally do not like a strong cheese.

The nutritive value of processed cheese is similar to that of Cheddar cheese and, as cheese has a high protein content, it is recommended that children, especially, have at least one serving of cheese a day.

For any further information contact the Otto Madsen Dairy Research Laboratory, 19 Hercules Street, Hamilton, Brisbane.

Take a shortcut...

use convenience foods

Canny Shellfish Risotto—see recipe

THEY'RE instant, snappy, quick and only take a minute, but these recipe ideas are short cuts, unbeatable winners when it comes to avoiding conventional food preparation.

Commercial pastry cases, canned soups, beans and seafoods, frozen vegetables, cake mixes, puff pastry, delicatessen style sausages and dehydrated products have been skilfully evolved into a ricotta fruit mince flan; a cheddar cheesecake; a dumpling chowder thick with vegetables; a pan cooked risotto brimming with seafoods; and a savoury ham and chicken crusted pie.

It all proves "convenience" products are a bonus on any kitchen shelf.

In all recipes a standard 8 oz. measuring cup is used and all spoon measurements are level.

INSTANT FRUITY RICOTTA FLAN

1, 7″ commercial sweet shortcrust pastry flan

1, 10 oz. jar fruit mince

2 tablespoons orange curacao liquer

4 oz. Australian Ricotta cheese

1 egg

Mix 1 tablespoon curacao with fruit mince. Spoon into pastry case. Beat Ricotta cheese until smooth and creamy. Beat in egg and remaining liquer. Spread over minced fruit. Bake at (350°F) for 35 minutes. Serve warm with whipped cream. Serves 6.

MINUTE DUMPLING CHOWDER

The Chowder

1, 15½ oz. can spring vegetable soup

½ cup drained canned sweetcorn kernels

½ cup frozen peas

½ cup frozen chopped onion

2 oz. salami, diced

1 tablespoon medium sherry

Place chowder ingredients in a large saucepan. Add a soup can of water. Bring to the boil. Add the dumplings (see below). Cover, simmer for further 15 minutes or till dumplings are cooked. Serves 6.

The Dumplings

1 cup S.R. flour

½ teaspoon baking powder

Salt and pepper to taste

2 oz. (½ cup) freshly grated Australian Parmesan cheese

2 oz. (½ cup) grated Australian Cheddar cheese

½ cup water

Sift dry ingredients into basin. Mix in grated cheeses and water to make a stiff dough. Divide into 6 dumplings and proceed as directed above.

★ ★

SNAPPY CHEDDAR BEAN PIE

1, 1lb. packet puff pastry

1 packet parsley sauce mix made up as directed on packet

The Filling

Mix together in a bowl:

¼ cup dried onion flakes

4 oz. Australian processed Cheddar cheese, cut into cubes

8 oz. pressed ham and chicken loaf, cut into cubes

1, 10½ oz. can mixed beans, drained

½ teaspoon dried mixed herbs

Salt and pepper to taste

Roll out half the pastry and line an 8″ pie dish. Spoon filling into centre. Roll out remaining pastry to 1″ larger than pie dish. Brush edge of pastry with cold water. Lift pastry over filling. Trim, seal and decorate edges. Brush with cold water. Bake at (450°F) for 25 minutes or till pastry is puffed and golden brown. Accompany with parsley sauce. Serves 6.

CANNY SHELLFISH RISOTTA

1 packet Spanish rice-a-riso
1 tablespoon butter
1 clove garlic, crushed
1, 7¼ oz. can scallops, drained
1, 8 oz. can oysters, drained
1, 7 oz. can shrimps, drained
¾ cup grated Australian Pepato or Parmesan cheese
1 teaspoon dried parsley

Cook rice-a-riso as directed on packet, using the butter and adding garlic just before liquid. When cooked, add drained seafoods and allow to heat through for 5 minutes. Toss through cheese and parsley. Serve immediately, sprinkled with little extra dried parsley. Serves 6.

HASTY CHEDDAR CHEESECAKE

1 packet moist buttercup yellow cake mix
2 cups grated Australian matured Cheddar cheese

Make up cake mix as directed on packet folding in cheese before spooning into an 8″ buttered cake pan. Bake in moderate oven (350°F) for 40 minutes. Turn onto wire rack. Allow to cool. Spoon lemon icing onto centre of cake and allow to drizzle over sides.

The Lemon Icing

1 cup icing sugar
2 tablespoons lemon juice

Warm lemon juice then stir into icing sugar till icing is smooth and will drizzle over cake top. Serves 8.

Rearing pet lambs

LAMBS can be successfully raised as pets and can be a satisfying experience, especially for children.

The main things to remember are—

- Feed small amounts often. Give enough to ensure the flanks are level with the hips. *Do not overfeed.*
- Keep the feeding utensils thoroughly clean.
- Keep the lamb warm.

Feeding

FIRST 2 DAYS. Preferably the lamb should be allowed to suckle its mother to obtain the colostrum or first-milk. If this is impossible, the following mixture should be used:

740 ml (26 oz.) cow's milk
1 beaten egg
5 ml (1 teaspoon) codliver oil or castor oil
10 g (1 dessertspoon) sugar

Normally 4 to 5 feeds a day are given during this period. Milk can be fed either at refrigerator temperature or warmed to baby-bottle temperature.

AFTER 2 DAYS. One of the following mixtures can be used.

1. 600 ml (1 pint) cow's milk
   35 g (1½ oz.) full-cream powdered milk
2. Pure cow's milk
3. Commercial milk substitute such as Denkavite*

By 2 weeks the lambs can be given three feeds a day only.

SOLID FEED. At 2 weeks, lambs can be introduced to solid feed. Suitable mixtures are—

1. Bran 2 parts
   Pollard 2 parts
   Buttermilk powder 1 part
2. 1·5 kg (3 lb.) rolled oats, oatmeal or bran
   0·5 kg (1 lb.) lucerne meal
   60 g (2 oz.) skim-milk powder

Feed an amount the lamb can eat in about 1 hour or slightly longer. As the quantity the lamb eats increases, less milk can be given.

Lambs can be weaned at 6 to 8 weeks.

Water

Clean water must be provided from 3 weeks onwards.

Shelter

Lambs must be kept warm for the first few days (24 to 27°C). Do not burn your lamb with too much heat.

After this initial period, only shelter from wind and rain is needed. Straw bedding in a large dog kennel or tea chest is suitable.

Protect your lamb from dogs. Lambs should be enclosed in a dog-proof enclosure at night.

Worms

Your lamb should be drenched frequently in spring and summer (4 to 5 times) to prevent worm infection. Suitable drenching compounds are available from produce agents and some chemists.

Blowflies

All sheep are subject to fly strike. When struck, the affected area should be clipped and treated with a suitable fly dressing. These dressings are obtainable from your produce agent.

Shearing

Your lamb must be shorn every 12 months.

Tail docking

A lamb should have its tail docked at or before it is 6 weeks old. This can be done by your local veterinarian.

For further information contact Sheep and Wool Branch, Department of Primary Industries, William Street, Brisbane.

* Proprietary Product. (Often these are reconstituted stronger than is normally used for calves—up to 50% stronger.)

Some facts about canned foods

THE common can used in the commercial canning of foods is made from tinplate and consists of three parts: a cylindrical body which has a soldered side-seam, and two ends, which are double-seamed onto the body.

Actually, the "tin" can contains only a very small amount of tin. The tin is normally electrolytically coated onto the steel baseplate in a layer which may be less than 0·001 mm thick.

For some products, internally lacquered cans are used. The purpose of the lacquer is to limit the chemical reaction between the can and contents in products where that reaction would cause excessive corrosion or would harm the appearance or flavour of the product, or both.

How are foods preserved in cans?

Food is spoiled by one or more of the following causes—

1. Action of microbes.
2. Action of enzymes (this can take place in either living or dead animal or vegetable material).
3. Non-enzymic chemical reactions (the most important of which is oxidation).

Preservation of foods in cans is accomplished by destroying microbes and enzymes by heating and by minimizing residual oxygen levels in the can.

The can must be sealed so effectively that microbes and oxygen (or any other substance) cannot enter.

Chemical preservatives are not required in canned foods, except in some special products like refrigerated, canned hams.

How long may canned foods be stored?

During storage of a properly canned product, chemical reactions take place within the product or between the product and the container or both. These are not a health hazard but may, in time, make the product unacceptable in appearance, flavour or texture. The rate at which these reactions proceed depends on the product, the container type, the process and the storage temperature.

However, most properly-processed, canned foods can be stored under room conditions for at least 12 months without serious loss in quality. Canned rhubarb, fruit juices, carbonated beverages and some baby foods are exceptions and normally have a maximum storage life of about 6 months.

Some special products like canned ham, which are marked "Store below 4°C", must be stored in the refrigerator. The ham has not been fully sterilized because prolonged heating makes the texture of the meat less attractive. Some fish products also fall into this category. Maximum storage life for these products varies considerably, and all labels should be read carefully before storing.

Precautions

1. Watch for swollen or leaking cans. This indicates some failure in processing, physical damage to the can, or severe corrosion. The contents should not be tasted. Any doubtful can should be reported to the manufacturer to alert him that other cans may be in a similar condition.

2. Most canned products do not need to be refrigerated, but they should be stored in a reasonably cool place.

3. Canned products should be kept dry at all times to prevent external corrosion, which may eventually cause the can to rust through and the food ruined.

4. Do not store foods in opened cans. Some foods rapidly attack tinplate in the presence of air, resulting in high tin levels which may present a health hazard. The safest procedure to adopt is to transfer the contents to a glass or plastic container before refrigerating.

5. If the contents of any can have an unusual odour, throw them out. Do not taste them.

For further information contact The Sandy Trout Food Preservation Research Laboratory, 19 Hercules Street, Hamilton, Brisbane.

Is your fish fresh?

FISH is one of the most perishable of all foodstuffs. Because of this, the delicate seafood flavours are quickly replaced by objectionable odours and flavours caused by bacteria.

It is important, therefore, to determine the quality of any seafood you buy before you accept it.

This leaflet gives you information you need to determine whether fish, prawns, crabs and oysters are fresh enough for you to enjoy.

Fish

The characteristics of fresh fish and poor quality fish are listed below:—

Character	Fresh Fish	Unacceptable Fish
Eyes	Convex black pupil, transparent cornea	Sunken eyes; milk-white pupil
Gills	Bright red. Seawood odour ..	Bleached or dark brown discoloration; putrid odour
Body slime	Transparent and water clear ..	Thick knotted outer slime with discoloration
Flesh	Bluish translucent flesh, no discoloration of belly flaps	Discoloration of belly flaps
Odour	Fresh seaweedy to neutral odours	Stale, sour, " cabbage water " or " turnipy " to putrid odours
Texture	Firm, elastic to finger touch ..	Very soft and flabby, retains finger indentations; flesh easily torn

Closely examine prawns that are heavily blackened around the head and shell. This sometimes indicates faulty handling. However, if there is no odour, they are perfectly safe to eat.

Specials hints for storing seafood

All seafoods are very perishable, particularly at ordinary domestic refrigerator temperatures. Never plan on keeping fresh fish or prawns longer than a day or so in a refrigerator before using them. Freezing is an excellent method of storing fresh seafoods for up to 6 months.

Flathead and bream should be examined closely because they eat food which cause rapid softening of the gut. Check for softening of this area. If the skin tears easily, the flesh surrounding the gut will be spoiled. As a rule, never buy ungutted flathead.

Crabs

Never accept a dead, uncooked crab.

Crabs and crab meat should have little fishy odour and no disagreeable, ammonia-like taste or odour.

Crab shells should not be slippery.

Prawns

Fresh prawns should not have a bad odour and their meat and shells should not be slippery.

Oysters

The liquor of oysters out of their shell (in bottles or cans) should be clear and there should be no sour smell or other odour.

Oysters in the shell should be alive and the shells should close after being opened.

The amateur fisherman

The amateur fisherman should take a good foam esky filled with party ice on each fishing trip. Storing the fish on ice immediately after catching them is the only way to be sure that you take home fresh fish.

For further information contact The Otto Madsen Research Laboratory, 19 Hercules Street, Hamilton, Brisbane.

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Diseases of apples — 2

POWDERY MILDEW OF APPLES

POWDERY mildew, caused by the fungus *Podosphaera leucotricha*, is the second most important fungal disease of apples grown in Queensland. Most damage from this disease results from long-term effects on tree vitality. When the disease is not controlled, fruit quality deteriorates due to russeting and the trees may become stunted and unthrifty.

Jonathan, Gravenstein and Granny Smith are the cultivars most frequently affected. The disease necessitates regular spraying with fungicides.

This species of powdery mildew also infects quince trees.

Symptoms

Leaves, twigs, buds, blossoms and fruit may be affected by this disease. The leaves show white to light-grey, powdery patches of the fungus which may spread rapidly and envelop both leaf surfaces causing curling, stunting and eventual death. The disease spreads readily to twigs where a similar white, powdery growth develops resulting in stunting and dieback. The tips of twigs are extremely vulnerable to attack and fruit and leaf buds may become coated with mildew failing to develop fully. The following season, blossoms from infected fruit buds are frequently withered and shrivelled and fruit fails to set. Affected fruit show a typical skin russet composed of a maze of fine lines often so close as to appear as a solid patch. The fruit may eventually become misshapen and crack as a result of local hardening of the skin.

Spread

The fungus survives the winter in dormant flower and leaf buds. It resumes growth in spring and infects the new leaves and blossoms particularly from pink stage onwards. Vast numbers of spores are produced which are spread by wind and rain to other trees. Spores germinate in warm, humid weather but not in free water. Consequently powdery mildew is often worst during dry periods, humidity at night being sufficient to allow germination.

The fungus grows down the leaf stalks and twigs until late summer and enters the developing buds where it remains dormant until the following spring. The buds are susceptible for about one month after formation or until they close tightly. This means that susceptible buds are present well into the summer although late-formed ones are generally removed in subsequent pruning.

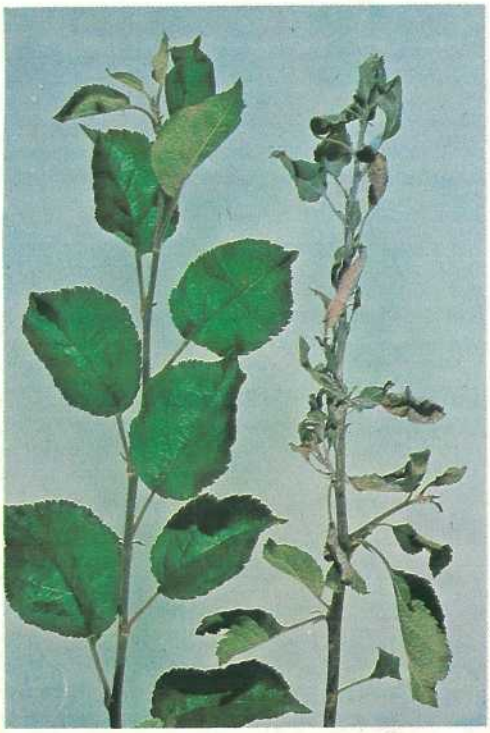
Control

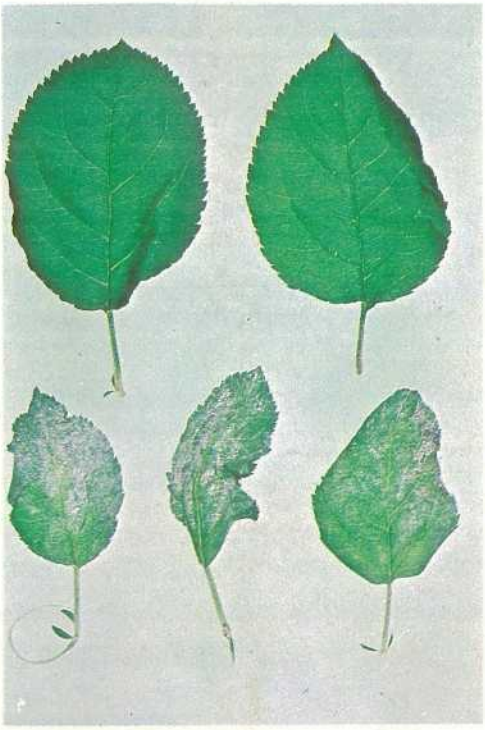
Control of powdery mildew depends on protecting during summer the foliage and the fruit and leaf buds forming for the next season, and then during winter removing any mildewed growth. Spraying with fungicides according to the control schedule achieves the former objective while winter pruning of diseased buds and shoots achieves the latter. As many infected terminal buds as possible should be removed in winter provided that it does not interfere with tree management. in addition, all diseased blossom trusses should be removed in the spring.

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 APPLES - 2





POWDERY MILDEW. Upper left: affected twig on right compared with healthy twig. Upper right: healthy and mildewed leaves compared. Lower: affected Jonathan fruit showing russeting.