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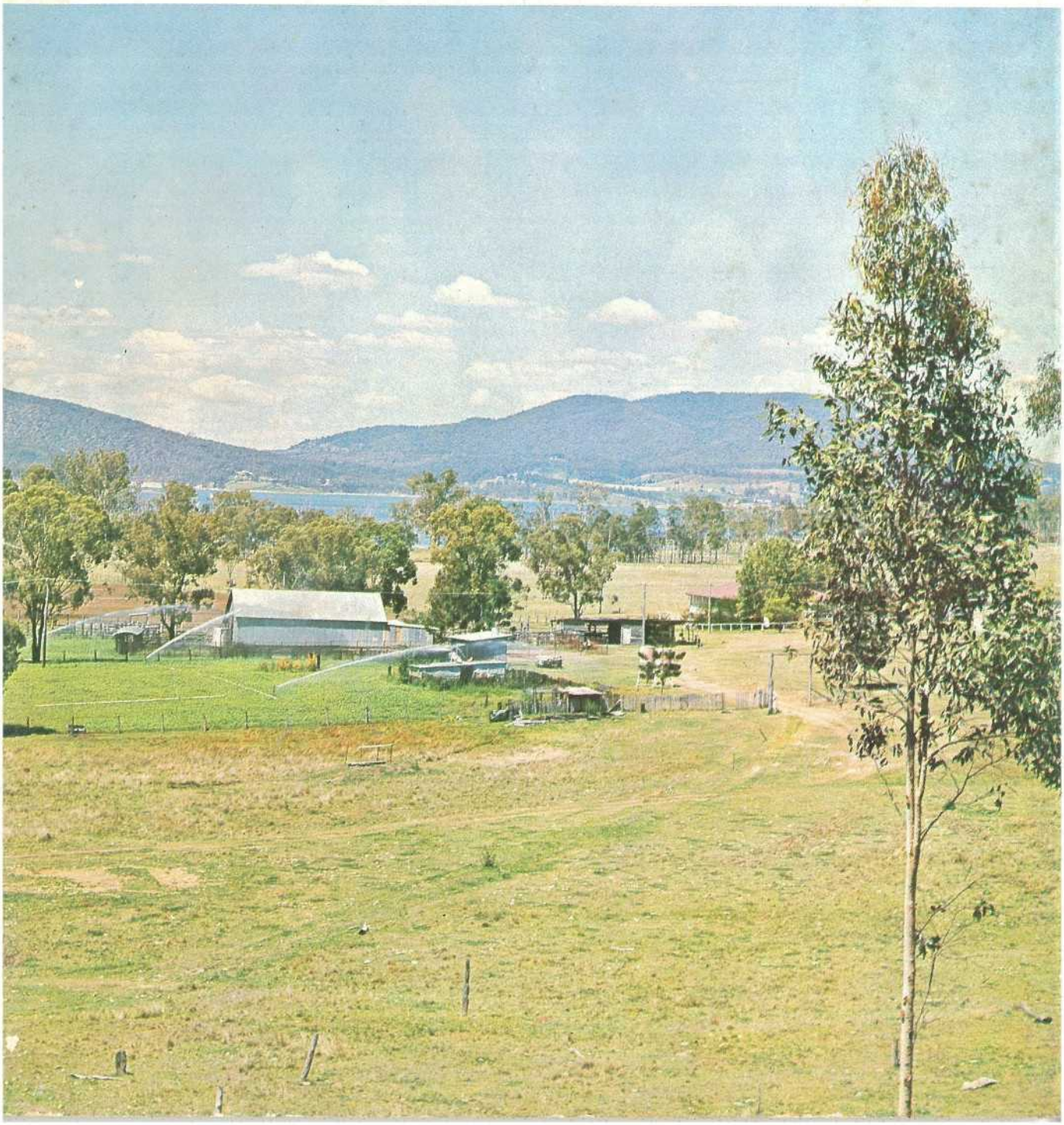
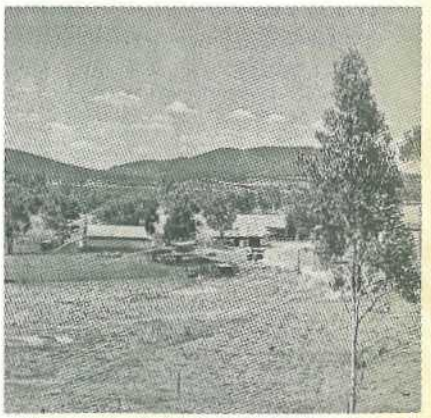


DEPARTMENT OF PRIMARY INDUSTRIES



Irrigating a fodder crop in the Boonah district. The Moogerah Dam is in the background.

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QUEENSLAND AGRICULTURAL JOURNAL

Contents

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New wildlife laws

NEW fauna conservation regulations and provisions have come into operation with the 1974 Fauna Conservation Act.

The Minister for Primary Industries (Hon. V. B. Sullivan, M.L.A.) said the main new provisions were—

- Increased penalties up to $3 000 for major breaches of the State's wildlife laws.
- The protection of all native birds, mammals and reptiles, including the two crocodile species.
- Liberalization of regulations covering the keeping and selling of aviary birds.
- Provision for introduction of a tagging system to control further the commercial kangaroo harvest.
- The requirement of hunters to obtain a permit to hunt wild duck and quail during open seasons.
- Increased royalties for fauna taken for commercial purposes.
- Appointment of Conservator of Fauna to be responsible for the day-to-day administration of the Act. The first Conservator is Dr. G. W. Saunders, Director of the Fauna Conservation Branch, Department of Primary Industries.

Mr. Sullivan said Queensland had special responsibilities in the Conservation of Australian fauna. The State had the continent's most diverse and numerous fauna. No other State in the Commonwealth possessed a wildlife heritage equal to that in Queensland. He added that he was now satisfied that Queensland had the laws to protect and conserve that fauna.

Agriculture in the South Burnett—1

THE South Burnett district in south-eastern Queensland covers an area of some 11 600 km² at an average elevation of over 300 m above sea level.

The region embraces the Shires of Kingaroy, Nanango, Wondai, Murgon and parts of the Rosalie and Kilkivan Shires.

History and Population

Following settlement in the 1840s and from small pioneer beginnings, intensive agricultural development did not occur until the late 1800s and early 1900s. Some 13% of the area is now cultivated mainly for summer crops. Some 75% of the State's peanut crop and 80 to 90% of the navy bean crop are grown and marketed within the district.

Kingaroy, at 427 m above sea level, is the main town housing some 5 000 of the district's 24 000 population. Other smaller centres are Murgon, Nanango, Wondai, Yarraman, Blackbutt, Kumbia, Goomeri, Cooyar and Proston.

An aerial view of typical South Burnett agricultural land.

Kingaroy is the centre for the Peanut Marketing Board and the Navy Bean Board. Several small farm machinery factories specializing in peanut and navy bean machinery are in Kingaroy and nearby centres. The larger stock feed firms are located at Kingaroy and Proston. There are dairy factories at Murgon, Nanango, Kingaroy and Tansey.

The South Burnett Meatworks Co-operative Association is located at Murgon as are small bacon factories at Yarraman and Kingaroy. About 20 sawmills handling hardwood and some softwood are sited in various parts of the district.

As in other regions and in other parts of the world, agriculture in the South Burnett district is undergoing changes and farm profitability depends on economic production and efficient marketing.

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by R. G. WILSON, J. M. ROBINSON, A. HODGE, Agriculture Branch; R. R. FANNING, Dairy Division; W. J. EDWARDS, Beef Cattle Husbandry Branch; and D. B. PRESTON, Pig Section.

Topography

The district is a strongly undulating region of hills, valleys and plateau remnants.

Drainage is relatively rapid and flows are, in the main, south to north through the Boyne-Stuart River and Barkers-Barambah Creeks drainage systems into the Burnett River. Smaller drainage systems include Cooyar Creek which flows east into the Brisbane River. Run-off from the Durong district flows both north and south-west to the Condamine River system.

Soil erosion by water and wind has been a problem and considerable attention has been given to control measures since the second World War. To date, more than 50% of the arable area is under some form of soil protection.

Climate

The district is claimed as one of the safest summer crop regions in Queensland. The subtropical climate consists of moist summers and moderately dry winters. Some 70% of the annual rainfall is received during the months October to March. Thunderstorms occur in the spring and summer and contribute much of the region's rainfall.

Tropical cyclones also influence the rainfall pattern. From 1911 to 1960, 22 tropical cyclones passed over or close to the region, usually inducing heavy run-off and the flooding of drainage lines and flats.

Rainfall fluctuates greatly, the annual average being 750 mm. It varies from 700 mm at Durong to the west to 1 250 mm near Manumbar to the east. Kingaroy recordings during the driest and wettest years were 402 mm (1957) and 1 406 mm (1947) respectively.

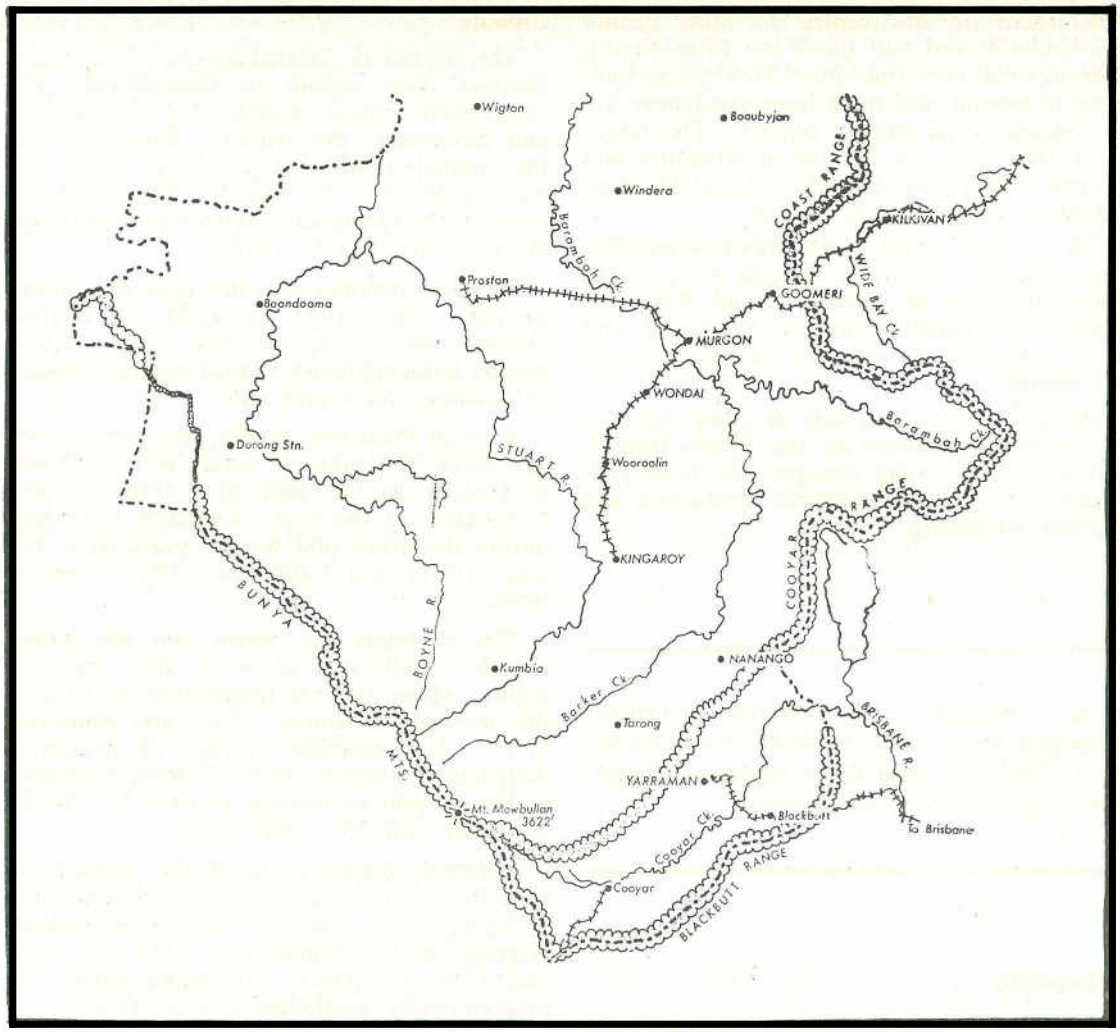
The summers are warm and the winter climate usually one of warm days and cold nights. Mean ambient temperature is 17.2°C, the average maximum 24.6° and minimum 10.6°. The monthly average of maximum daily temperatures exceeds 27° from November to March with an average of over 30° for 15 days and over 35° once a year.

Although higher parts of the district are frost free, there is an average of 24 heavy and 48 light frosts a year from April to September. Average relative humidity is 71% (9 a.m.) and 47% (3 p.m.). Prevailing winds are predominantly south-east and south-west.

Soils

The most intensive development in the district is concentrated in narrow areas of upland ground (5 km to 21 km wide) which stretch from Kingaroy to Yarraman and Kumbia in the south and to above Proston in the north.

The fertile red to red-brown soils of this main agricultural belt consist of the remnants of ancient volcanic flows. 'Islands' of similar origin occur at the Tablelands near Murgon, at Brigooda and elsewhere. They are locally referred to as 'scrub' soils. Native vegetation is softwood–vine scrub. Bottle trees are often associated with the soil type particularly in the drier sectors.



These soils of moderate elevation, less than 600 m above sea level, are classified as red and brown friable earths. The acidic, red friable earths are the chief soils. They are relatively deep soils and on the slopes little differentiation into horizons is discernible in the profile. On the hilltops, a less fertile, light-textured, red soil, locally described as 'snuffy', overlies a moderately acid and more fertile shallow B horizon.

Although more acid-tolerant crops (Red Spanish peanuts and oats,for example) are grown on them, the snuffy soils are more suited to sown pastures and Duboisia (corkwood). Kikuyu grass (*Pennisetum clandes-*

Automatic pot-watering equipment at the J. Bjelke-Petersen Field Station.

tinum) and the *Panicum maximum* cultivars, Petrie (green panic), Sabi and Gatton panics, as well as *Setaria* spp. (the Kazungula cultivar) usually flourish on this soil type. The normal red earth soils support a wide range of crops such as Virginia Bunch peanuts, maize and sorghum, and sown pastures.

The lower slopes and valleys show evidence of fairly recent inundation and deposition of soil-forming material. The soils of these areas are generally of a heavier, better moisture-retaining texture than the scrub soils and have a clearly defined clay subsoil. The colour varies from a bright red similar to the scrub soils to various shades of brown. The general fertility level is lower than that of the scrub soils.

The native vegetation is hardwood forest and the soils are known as 'forest' soils. They are moderate to slightly acid in reaction and support a wide range of summer and winter crops. Rhodes grass (*Chloris gayana*) cultivars, particularly, thrive on this soil type.

Agricultural development on forest soils, though slower than on scrub soils, has accelerated considerably in recent years through the increasing scarcity of better class land and improved techniques of crop production.

On some slopes, areas of fertile, heavy-textured, dark-grey soil occur immediately below the red scrub soils. These grey to dark-grey soils are derived from limestone formations underlying the lava flows. They often carry a mixed vegetation of scrub and hardwood species.

About 12 000 ha of largely fertile alluvial soil of mixed origin occurs on the flats adjoining the watercourses. These soils are generally dark grey and of light to moderate texture. Many of the heavier cracking clays, periodically waterlogged, are more suited to the establishment of pastures of the *Panicum coloratum* culcultivars, Pollock, Burnett and Bambatsi Makarikari grass. Some of the moister areas flourish under paspalum and white clover. Liver and stomach flukes can be a problem on poorly drained flats to the east. About 4 000 ha are under irrigation.

The largest soils group is the hilly, less fertile and moderately acid, hard setting loamy soil with mottled yellow clayey subsoil. These forest soils lie east and west of the main agricultural belt. They are somewhat of mixed origin but, in the main, derived from granitic and granodiorite parent material. Some are highly saturated with aluminium. It is mainly poor quality grazing country. Native vegetation is narrow-leaf ironbark. Some of the better soils are being cleared for short term agriculture such as oats for winter feed and peanut culture.

Apart from other small pockets, the main brigalow soils (about 10 000 ha) are located in the district's far western sector near the Dividing Range. These fertile clay soils with moderate to strong gilgai formation are used for farming and grazing. Sown pastures which include Rhodes grass, various panics and buffel grass excel on this soil type.

Between the main agricultural belt and the eastern boundary of the district, there is an area of good quality grazing and farming country, the Goomeri volcanic-metamorphic formation. Fertile soil has developed in the valleys of an ancient, rocky landscape from deposited material of glacial origin. The native vegetation is forest.

At the source of the Stuart and Boyne River systems (foothills of the Bunya Mountains), brown, dark-red or dark-grey, cracking clay soils of moderate to high fertility have developed. Much of the range area is steep, rough and readily eroded and only suitable for grazing and/or forestry. Sulphur and phosphate applications can assist annual medic and native grass production on this terrain. Lower sections and valleys are highly fertile and are used for grazing and crop production. The native vegetation is hardwood forest.

Soil Fertility

The major soil deficiencies in the district are phosphorus and nitrogen with lesser emphasis on calcium, sulphur, potash and the minor elements. Lack of timely moisture during the growing period can prevent the greatest benefit being obtained from fertilizer on crops and pastures.

Fertilizer use is increasing as fertility levels decline and as poorer soils are developed.

Phosphorus deficiency can result in depraved appetites in stock grazing the poorer country and reduced crop yields on the arable soils. Older developed areas are often more prone to the defect. Where phosphorus is the main deficiency, superphosphate alone is used. On

less fertile soils, both grain and forage crops may require a complete fertilizer, a nitrogen-phosphorus or, as in some legume crops, a superphosphate-potash blend. Both high and low analysis fertilizers are in use at rates varying from 125 to more than 250 kg per ha.

Some of the red scrub soils particularly the hill top and 'bastard' scrub areas are often highly acid. Sulphur deficiency coincides with some of the lighter (granitic) and heavier darker soils. Spectacular responses to sulphur or sulphur-impregnated compounds have occurred particularly on legumes in a number of locations in the district.

Potash deficiency is becoming more noticeable and, on some peanut soils (usually forest), a calcium-potash imbalance has resulted in a higher 'pop' (empty pods) incidence in the more popular Virginia Bunch peanut variety.

In row crop production, the fertilizer is placed near the seed usually as a band slightly below and to the side of the seed row. The aim is to minimize the tendency of some soils to convert phosphates into an unavailable form. A new trend in legume grain production is to pre-fertilize at a heavier rate the previous gramineous crop (maize, sorghum) or apply the required plant nutrients during pre-planting or pre-emergence herbicide application.

Row cropping, because of the sloping terrain, is general in this district. Contour farming now accounts for more than 50% of the cultivated area and only through the application of intensive erosion control or soil management practices is the crop production area made suitable for permanent land use.

Land values are closely related to the system of farming and available resources. The recently-introduced Marginal Dairy Farm and Rural Reconstruction Schemes also influence sales and values. The average undeveloped and developed forest grazing land varies from $25 to $100 per ha. Scrub grazing country brings $70 to more than $120 per ha and improved peanut land at $200 to $370 per ha.

Land Use

Agriculture in the district is changing. Major changes are the phasing out of low income earners and either the enlargement of properties or more intensive farming.

Property size has changed under current economic pressure. The average area is more than 120 ha for agricultural farms and 600 ha for pastoral units.

As costs rise, to maintain or improve their standard of living, farmers are increasingly aware that only crops in demand should be produced. Some smaller farms are monocropped to peanuts annually. Peanuts, though bordering on over-production, are more reliable climatically than the more sensitive navy bean. Soybeans are finding their place largely on heavier soils unsuited to peanut production. Soybean and navy bean acreages and returns have increased many times over since the 1960s.

Tractors have increased in horse power and speed. Wider tillage (depending on the contour layout) and faster harvest equipment, as well as grain drying equipment and storage facilities, have been introduced.

Farming systems vary according to farm size, economics, climate, topography, soil type and fertility. Monoculture or short 2-year (three-crop) rotations is practised with the occasional sown pasture on the larger farms. There is some evidence of a need for a temporary pasture phase in the crop rotation. The economics of this introduction creates resistance, more so with the small farmer.

Over the 1967-72 period, rural holdings in the district declined by nearly 4%. Cultivated areas increased about 20% and the irrigated acreage around 12%. Data to 1971 (five shires) were: rural holdings 2 300; area 11 600 km^2; cultivation 122 000 ha; irrigated 4 000 ha; beef cattle 240 000; sheep 4 000; dairy cattle 66 000 and pigs 75 000.

The dairy industry has declined considerably. The 1 300 suppliers in 1967 had dwindled to 700 by 1972. Herd numbers decreased by 40% (1967-72) whereas beef numbers rose by a similar percentage.

The approximate allocation of land in the region to various land uses is: cultivation 12%, native pastures (about half improved) 60%, introduced pasture 12%, and forestry, roads and townships, 16%.

Duboisia leaf (corkwood) production is increasing on the poorer scrub soils.

Crop rotations involve peanuts, navy beans or soybeans with grain sorghum or winter cereals and, at times, sown pasture, mainly Rhodes grass.

There is a trend away from the more disease-prone legumes to gramineous crops in the peanut rotation. There is increasing use of urea or mono-ammonium phosphate and molasses (roller drum lickers) to enable cattle to make better use of mature native pastures during the winter.

Grass burning for the unhindered green pick is an annual event occurring August-September.

Irrigation is limited because of the lack of sufficient underground water and the unreliability of streams and waterholes. Some 3% of the cultivated land is irrigated. Water quality varies with seasons. State and Shire-sponsored as well as private water schemes (Proston, Boondooma-Durong) are supplying domestic and stock water to properties and small towns. A shortage of water, either as rainfall or in natural storages, is a major factor limiting primary production in the South Burnett.

Beef Cattle

Beef cattle production is an important industry in the District. There has been a swing away from dairying in recent years and figures for March 1972 showed a beef cattle population of 246 000 head for the five South Burnett Shires.

Several stud herds in the district cater for most types of British and exotic breeds. Herefords are still the majority group but crossing with exotic types is gaining popularity especially in the ticky areas.

The wide range of soil types dictate the size of cattle holdings but they generally range between 800 and 6 000 ha. The previously buoyant cattle market increased the number of holdings on which beef cattle are run and they have been incorporated with most forms of agricultural and pastoral enterprises.

Holdings are used for both fattening and breeding and a combination of the two is quite common. The beef enterprises are based mostly on native pastures but improved pastures are playing an ever-increasing role.

Crop fattening is carried out with both summer and winter forage crops but is largely controlled by seasonal conditions. Opportunity lot feeding is practised by some producers when a favourable situation occurs.

Supplementary feeding is carried out mainly with non-protein nitrogenous mixtures when warranted and the stock water situation is quite reasonable in most areas.

As the northern area of the South Burnett is tick-infested and the southern sector is clean or tick-free, cattle must be cleaned before they are allowed to enter the southern sector or the Darling Downs. Tick fever occurs periodically as a result of this marginal area between ticky and tick-free sections.

Phosphorous is the main mineral deficiency and reduces reproduction, development and growth rates. Property owners are slowly becoming aware of this major deficiency and are beginning to use supplements to overcome it.

Pig Raising

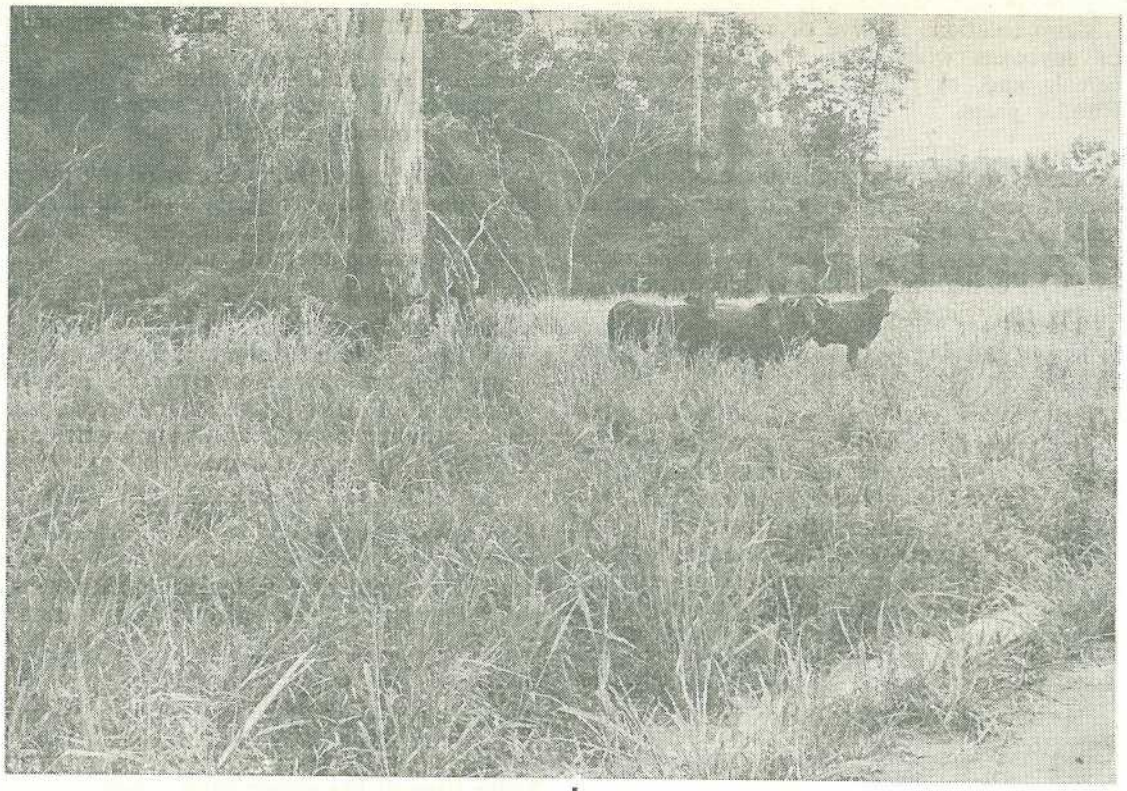
In the last 10 years, the pig industry in the South Burnett has grown from a mere sideline pursuit to a major income-earner on district farms.

The trend has been for an increasing number of pigs to be kept on fewer holdings indicating an accelerated move towards specialized pig keeping. Improved housing, management, breeding and nutrition techniques have resulted in superior quality pig meats being marketed.

The establishment of two stock feed mills in the area has improved the quality of feeds available to pig farmers, but most of all it has meant a reduction in capital costs of building, particularly in feed storage and preparation equipment.

The trend in the dairy industry toward bulk milk supply has resulted in much greater reliance being placed on grains and both domestically-produced and imported protein meals.

After peak production 5 years ago, the district pig industry has stabilized itself on a reduced scale with a decrease in the number of small, sideline enterprises.



Beef cattle on improved pastures.

On the better-managed units, the average marketing age has been reduced by 4 to 6 weeks. Intensification has not been without its problems, the main ones being disease and behavioural abnormalities.

The main breeds used are Large White and Landrace and their crosses. The demand for purebred stock, particularly boars, has been consistently strong and more interest is being shown by commercial pig men in performance-tested stock.

In general, the industry has shown cautious expansion over the last 3 years and, given the continued availability of grains and other feeds and a stable market, this trend should persist.

Dairy Farming

Generally, dairying in the South Burnett is combined with some other form of primary production, such as pig raising, grazing, peanuts and grain.

Properties vary in size from 64 ha to larger than 400 ha. Those within the range 64 to 128 ha are in the more closely settled areas while the larger ones are in districts such as Ironpot-Durong and Boyneside.

The introduction of the Dairy Pasture Subsidy Scheme has created and stimulated a great deal of interest in the change over to new pasture species. Legumes such as lucerne, Siratro and medics are sown with the panics and Rhodes grass. Straight stands of lucerne for both grazing and hay making, lablab bean, oats, panicums, millets as well as crop residues including peanut hay are fed on their own or in combination during the winter and spring.

Silage making is becoming more common but the quantity conserved is only about 10% of the combined amounts of hay and grain.

Mesh silos have had a big influence on the conservation of grain because of their cheapness, accessibility and simplicity of erection.

Local stud breeders have produced both State and Australian champion milking cows. Generally A.I.S. herds predominate, (approximately 45%) closely followed by Jerseys (42%) while about 12% are of Guernseys and Friesians. The swing to bulk milk has brought about a change on some farms where Friesians are being introduced with other breeds.

The decline in the number of dairy farms has not been as marked as a few years ago. The decision of the four South Burnett factories, Tansey, Murgon, Kingaroy and Nanango, to receive bulk milk has been responsible for 163 dairymen switching to milk, and of these 131 have installed bulk milk vats.

Table 1 shows the amount of butter produced during the 1970-72 period.

TABLE 1

Butter Factory	Production April to March	
	1970–71	1971–72
	tonnes	tonnes
Kingaroy ..	847	712
Nanango ..	691	640
Murgon	972	1 003
TOTAL ..	2 510	2 355

The Wondai and Proston factories have closed and these supplies were diverted to Murgon and Kingaroy.

Table 2 shows the number of suppliers to the four factories as at 30 April 1972.

TABLE 2

Number of Suppliers

Factory	1970–71	1971–72
Kingaroy ..	258	218
Nanango ..	214	182
Murgon	329	284
Tansey	22	16
TOTAL ..	823	700

Cheese is manufactured at Murgon and Tansey. The combined output of the two factories for 1971-72 was 769·1 tonnes, a decline of approximately 142·5 tonnes on the previous year.

In addition to butter and cheese, the Murgon factory processes market milk and manufactures milk powder and various calf, pig and stockmeals in the form of concentrates. Both Kingaroy and Nanango factories produce skim-milk and dried buttermilk.

[TO BE CONTINUED]

Margarine Amendment Act

LEGISLATION designed to ensure that housewives know what they are getting when buying margarine now operates in Queensland, the Minister for Primary Industries (Hon. V. B. Sullivan, M.L.A.) said last week.

He said that the Margarine Amendment Act, 1974, came into operation on 12 October.

The main purpose of the legislation was to provide for the correct packaging, labelling and presentation of margarine.

It would make sure, as far as practicable, that cooking margarine was not passed off as table margarine, or saturated fats as poly-unsaturated table margarine, Mr. Sullivan said.

Basically, it provided for a clearer definition of each of the various types of margarine and for the correct labelling of each type with its appropriate description.

Mr. Sullivan added that the margarine industry was now in the position where it needed to consider packaging requirements for the immediate future, having almost exhausted previous stocks.

Nematodes in strawberries

PLANT selection, crop rotation, rogueing and nematocides control root-knot, root-lesion and bud nematodes and increase strawberry yields.

Root-knot nematode

Several species of root-knot nematodes (*Meloidogyne* species) occur in Queensland but only *M. hapla* is a pest of strawberries.

Infested plants have small swellings on the secondary roots and the main roots are short and end in distinct galls. One or more small roots emerge from each swelling with the result that the root system becomes reduced in volume and densely matted. Heavily infested plants are stunted and yield poorly.

LIFE HISTORY. When strawberry runners are planted in infested soil, nematode larvae enter the root tips and a small gall is formed around each. After 3 moults in a period of 3 to 5 weeks, a larvae develops into a worm-shaped male about 1 mm long or a shorter, pear-shaped female, just visible to the naked eye.

The mature female ruptures the surface of the gall and exudes a gelatinous material into which up to several hundred eggs are laid. Larvae normally hatch from eggs in 7 to 14 days and invade new roots or remain in the soil where they can survive in the absence of host plants for up to 2 years.

Numbers, however, often decline rapidly when soil conditions favour natural enemies.

The strawberry root-knot nematode has a wide host range which includes cucumber, peanut, clover, potato, tomato, capsicum and potato weed (*Galinsoga parviflora* Cav.), a common pest on strawberry farms. Unlike most other species of root-knot nematodes, it does not reproduce on grasses.

Root-lesion nematodes

The root-lesion nematodes *Pratylenchus vulnus* and *P. penetrans* cause premature browning and death of strawberry roots. Infested plants may grow satisfactorily until midseason after which they decline and become unsuitable for ratooning.

LIFE HISTORY. Larvae and females enter young roots and migrate through the cortex, puncturing and feeding on cells by means of a hollow mouth spear or stylet. The destruction of cells results in a lesion which may extend to girdle the root. New roots emerge above the lesion and are affected in a similar manner.

Eggs are laid in the tissues by the migrating females and larvae which hatch from them move into healthy tissue or through the soil in search of new roots. The life cycle takes 3 to 4 weeks.

Cowpea, French bean, lablab bean, velvet bean and mung bean are hosts of root-lesion nematodes and should not be grown in rotation with strawberries on infested land.

Bud nematode

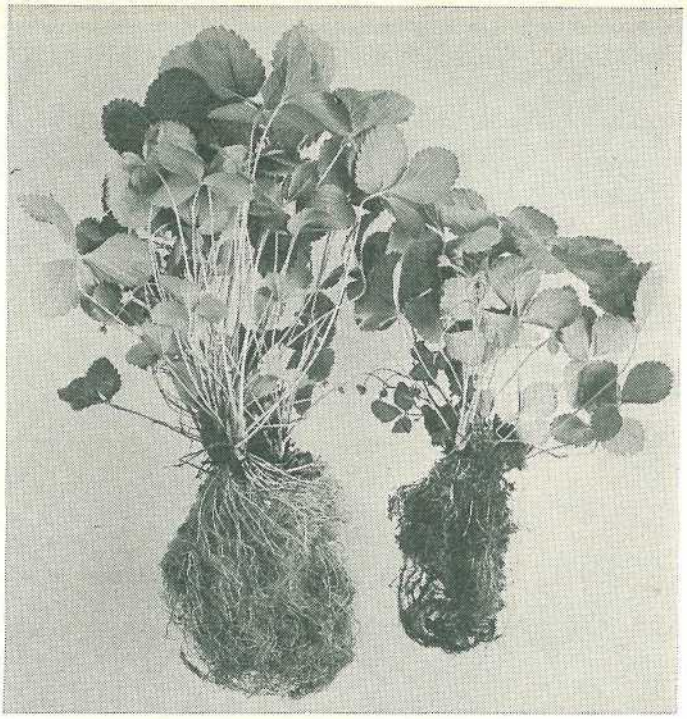
Three species of bud nematodes cause 'crimp' or 'dwarf' in strawberries in Europe and the U.S.A.

In Queensland, the disease is due to *Aphelenchoides besseyi*, the nematode responsible for 'summer crimp' of strawberry in the U.S.A., and 'white tip' of rice in many rice-growing areas of the world including the Northern Territory.

'Crimp' or 'dwarf' was reported from Europe in 1890 and the U.S.A. in 1931. It was first recognized as such in Queensland in 1971 but there is little doubt that it has been present in the State for many years.

Diseased plants are distinguished by their smaller, more compact appearance and the innermost leaves are narrower, more crinkled and darker in colour than normal leaves. Plants which produce badly deformed leaves early in the season usually appear normal by early August and symptoms reappear on runners produced by the parent plants in the following summer.

by R. C. COLBRAN, Assistant Director, Plant Pathology Branch



A strawberry plant infested with root-knot nematodes (right) is stunted and has more dead roots than a healthy plant (left).

In field studies in the Nambour district, plants infested with bud nematodes flowered about 1 month later than and produced half the crop of nematode-free plants. A larger proportion of their fruit was small and misshapen.

LIFE HISTORY. Bud nematodes live in the crown of the strawberry plant between the small developing leaves and flower buds and rarely enter the tissues. Feeding injury results in the growth of deformed leaves and flowers. Runners from an infested plant are usually infested and serve to spread the disease.

The strawberry crimp nematode develops from egg to mature female in about 2 weeks. Unlike most other plant-parasitic nematodes, it can be cultured on many fungi and these may play a role in the survival of the pest in the soil.

Bud nematodes are commonly found between seed and husk in the seedheads of many grasses throughout the strawberry growing areas. The role of grasses in the survival and spread of the disease is now being studied.

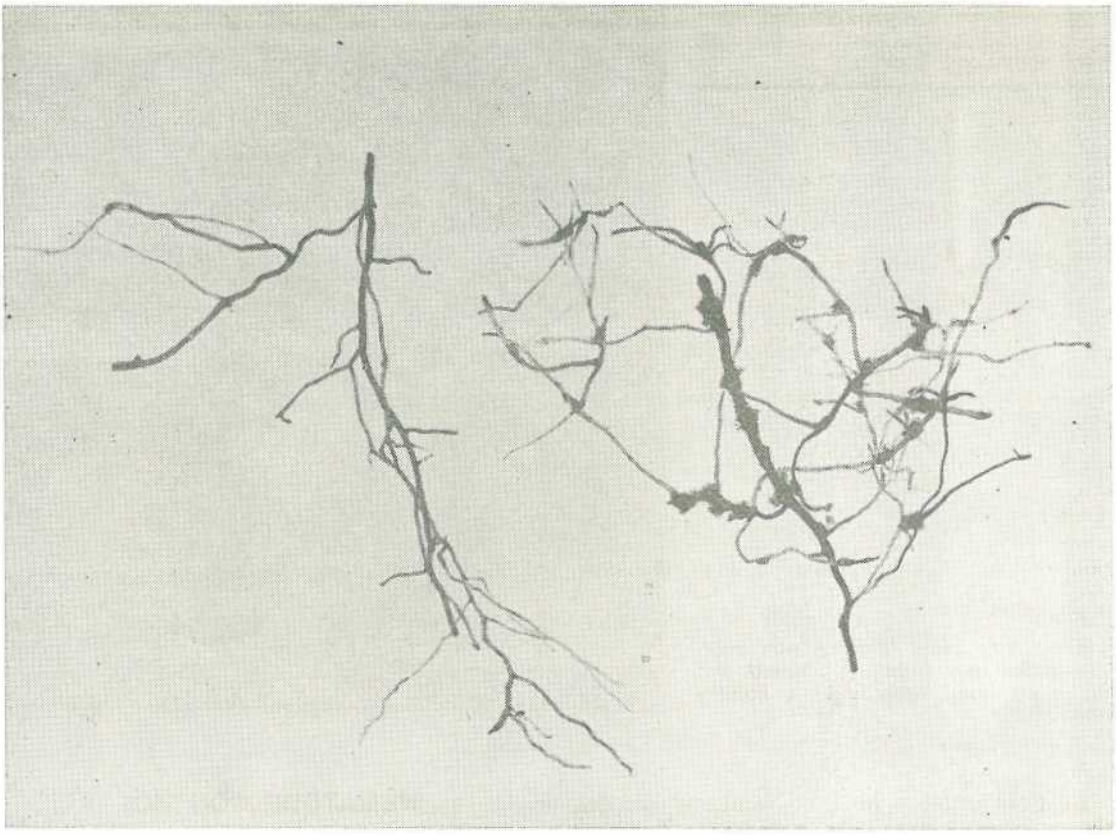
NEMATODE CONTROL

Nematode-free runners

Careful selection of nematode-free runners is the basis of control. Inspect runner beds regularly and remove any plants with 'crimp' symptoms. When runnering begins, cultivate the inter-row spaces and inject DBCP (Nemagon, Fumazone) at 34 litres a.c. per hectare in rows 25 to 30 cm apart and 15 cm deep.

As an alternative or additional method of reducing the infestation of root-knot and root-lesion nematodes in the runners, rake the area between the rows and mulch with borax-free sawdust to a depth of 10 to 15 cm.

In Queensland, the Strawberry Runner Approval Scheme ensures that growers can obtain planting material from virus-tested stock. Every effort is made to keep these runners free from nematodes. The increased usage of 'approved' runners in recent years has resulted in a decrease in the economic importance of root-knot and root-lesion nematodes as pests of strawberries.



Strawberry roots infested with root-knot nematodes (right) have small galls from which small side roots emerge. The roots on the left are from a healthy plant.

Treating runners

PREPLANT TREATMENT OF INFESTED RUNNERS. Nematodes in the roots of runners have been controlled by hot water treatment or dipping in chemicals before planting but, in field trials, these treatments gave the plants an initial setback.

Although treated plants cropped better towards the end of the season, yields were much lower than those from 'approved' runners.

Soil treatment

PREPLANT SOIL TREATMENT. Where strawberries have been grown previously or the strawberry root-knot nematode has been found on other crops, fumigate the soil at least 2 weeks before planting with EDB 15 or DD at 340 litres per hectare. Other formulations of EDB are used at equivalent rates. DD is more effective than EDB 15 at the same rate against root-lesion nematodes.

To use fumigants to the best advantage, the soil should be free from undecomposed plant residues and surface clods and the moisture level should be a little below field capacity. Rolling after fumigation improves nematode control in the surface soil.

In Queensland, strawberries are planted in March and fumigation is often impractical because of periods of prolonged rain. Under such conditions, the non-volatile nematocide

A strawberry plant showing symptoms of 'crimp' caused by bud nematodes. Note the distortion of the inner leaves.

ethyl 4-(methylthio)-m-tolyl isopropylphosphoramidate (Nemacur*) has given satisfactory results but is not yet registered for use on strawberries.

Cover cropping

Plant cover crops which will not increase nematode infestations. On the basis of host range studies, Sudax, maize or oats are suggested as they are unsuitable hosts for both the root-knot and root-lesion nematodes which infest strawberries. Do not plant cowpea, velvet bean or lablab bean.

Postplant treatment

Plants with 'crimp' symptoms should be removed from the area as soon as they are recognized.

If nematode-free runners are planted in fumigated soil, there should be no call for further nematocides unless the crop is being ratooned.

If the plant crop has a light to moderate nematode infestation apply a non-volatile nematocide after the plants have been slashed before the beginning of the second season.

Warning

EDB, DD and DBCP are poisonous to human beings and animals but are not dangerous when the safety directions on the containers are followed.

* Registered trade name.

Dealing with pests of the cabbage family

Entomology Branch Officers.

PEST controls recommended for cabbage, cauliflower, brussels sprouts and other cruciferous crops in Queensland are listed in the tables. Compilations of this kind cannot give comprehensive details on pest identification, cultural approaches to control or accurate data on the timing and need for specific chemical usage. The summary is presented as a reference or guide and details where necessary should be sought from extension officers of the Department of Primary Industries.

Description	Seasonal incidence	Pest status	Damage	Life history	Control
Cabbage moth *Plutella xylostella* The adult is a small greyish-brown moth about 1 cm long. At rest, the wings are held tent-like over the body giving a diamond pattern. The larvae when full grown are green, cigar-shaped, approximately 1 cm long	The cabbage moth appears in two periods: late spring–early summer and late summer–early autumn. Pest populations are not present in the hot months of summer	When present a very serious pest	Initially larvae mine in the leaves then by eating the lower surface cause a window effect, often leaving the upper surface intact. A multiplicity of small holes characterizes later stages of damage	Small cream eggs are laid in clusters along the midrib mainly on the under surface of the leaf. Larvae, on hatching, spend the first instar mining in the leaves. Later stages feed on the leaf surface. Pupation takes place on the plant in a net-shaped cocoon. The life cycle takes about 4 weeks	diazinon 0·05%
Cabbage white butterfly *Pieris rapae* The adult is a medium-sized butterfly, approximately 3–4 cm wingspan, white in colour with a number of black markings. The larvae when fully grown are 2 cm long, and velvet-green in colour	The larvae make their appearance in late spring–summer period	This pest is important in season	Larvae may eat leaf tissue until only the veins remain. Large, irregular holes characterize the damage	The upright eggs are usually laid on the upper leaf surface. On hatching, the larvae begin to feed voraciously. After 3–4 weeks they are fully grown. The adult emerges 10–14 days later	diazinon 0·05% or methomyl 0·025%

Cabbage centre-grub *Hellula hydralis* Larvae when full grown are 1 cm long, cream-coloured with 7 longitudinal brown stripes. The adult has a wingspan of a little over 1 cm, with the forewing grey with distinctive, buff markings	The larvae make their appearance in early summer and continue through to the middle of autumn	Important during the summer months	The young larvae on hatching tunnel into the growing point. The entrance is covered with a mixture of silk and frass. The growing point is destroyed in severe outbreaks	Egg to egg takes approximately 5–7 weeks	diazinon 0·05% or methomyl 0·025%
Corn ear worm *Heliothis armigera* Eggs are pearly-white, dome-shaped, pinhead sized, laid singly on upper or lower surface of leaves. The larvae are pale green to dark brown with longitudinal stripes. The larvae are up to 3 cm long. Adult moths are stout-bodied with a wingspan of 3 cm. The forewing colour can vary from reddish-pink to creamy-yellow	The most active period is in midsummer	Can be a serious pest during midsummer in certain seasons	Initially larvae feed on the outer leaves. As the heart begins to form they may bore into the centre where feeding initiates the formation of a number of small hearts	The eggs hatch in 3–6 days. After 2–3 weeks the larvae are full grown at 3 cm, leave the plant, find their way into the soil where they form a cell in which they pupate. In warm weather the adults emerge in 10–14 days	methomyl 0·025%
Cabbage cluster caterpillar *Crocidolomia binotalis* Larvae when full-grown are approximately 2 cm long and cream in colour. The adults are light-brown moths with a wingspan a little over 2 cm	Larvae make their first appearance in midsummer and continue to be present until the middle of autumn	Important in midsummer	When present, larvae are usually in large numbers and feed on the top of the plant, stripping the leaves to the veins. Rapid destruction of the heart characterizes cabbage cluster grub damage	The females lay eggs in a mass and from this a large number of larvae emerge and feed on the top of the plant. A good deal of silk is associated with their presence. The life cycle takes approximately 6 weeks. The larvae pupate in the soil	diazinon 0·05% or methomyl 0·025%
Cabbage aphid *Brevicoryne brassicae* Small greyish-blue insects which cluster together in dense colonies. Initial stages consist of small groups of adults and variable numbers of green-coloured young. Later they acquire the characteristic mealy appearance	Winged forms make their appearance on plants in early summer in inland areas. They continue to late summer–early autumn	Relatively unimportant on the coast; important in drier inland areas	Feed by sucking sap from plant. In large numbers, the leaves curl and growth is suppressed	Reproduction is rapid with live nymphs being laid	Controlled by regular sprays for more important pests

Description	Seasonal incidence	Pest status	Damage	Life history	Control
Cluster caterpillar *Spodoptera litura* Eggs are laid in groups of up to 300 and covered with scales giving them a fawn appearance. The larvae on hatching are brown with black, triangular markings along each side of the body. When fully grown the larvae are up to 4 cm long. The adult moth is strong-bodied with a wingspan of 3·5 cm which has brown forewings with white markings and grey hindwings	The egg masses are noticeable from mid-summer through to early autumn	Important in summer	The larvae on hatching congregate together and begin feeding between the veins. The older larvae are less gregarious and these can be found in the centre of the plant	The eggs hatch in about 3–7 days and the larvae begin feeding gregariously then, as they grow older, they move away to become solitary feeders moving into and through the head. The mature larvae leave the plant to pupate in the soil	methomyl 0·025%
Green looper *Plusia chalcites* Eggs are small, pearly-white and slightly flattened. On hatching, the larvae are 1 mm long and watery-white in colour with a black head. When fully grown, the larvae are pale green with a typical looper shape, being narrow at the front and broader posteriorly with 2 white stripes running dorsally	The larvae may be present in early spring but are not present in significant numbers after this time	In certain seasons can be of importance; overall a minor pest	In the earlier stages of larval growth, leaf damage has a window effect similar to cabbage moth attack. Later damage is in the form of small holes	Eggs are laid singly on the under-surface of the leaf and hatch in 5 days. The larvae feed for 4 weeks when they seek a site on the plant to pupate. The adult emerges in 10 days	Controlled by regular sprays for more important pests
Rutherglen bug *Nysius vinitor* **Grey cluster bug** *Nysius clevelandensis* Adults are small, greyish-brown, rectangular-shaped bugs approximately 3 mm long. The bugs are characterized by occurring in very large numbers and feed by sucking the sap from the plants	Occur irregularly, usually during the summer months	A very minor pest; at times when they occur in large numbers they become important	In severe infestations, the foliage wilts and with continued attack dies	The small, elongate cream-white eggs are laid in bundles of 2–7 on the flower heads of sow thistles and similar weed plants. The nymphs, which emerge after a week, are miniature adults. In 3 weeks and 5 moults, the adult winged stage is reached. No breeding takes place on cabbages. The bugs migrate to this host	Controlled by regular sprays for more important pests

Onion thrips *Thrips tabaci* Eggs, laid in the plant tissue, are very small and cannot be seen by the naked eye. The young are miniature adults; very small, delicate, elongate, yellow nymphs. Adults are slightly larger than nymphs and black. They have two pairs of narrow fringed wings	Found during summer months	Only a very minor pest; can sometimes damage young seedlings	Causes a silvery appearance to the feeding surface and in seedlings can cause distortion to growing points	Eggs are laid in plant tissue. On hatching, the nymphs, miniature adults, begin feeding, usually in clusters, by breaking open surface cells and sucking up contents. Scar tissue then forms giving a silvery appearance. After a number of moults, the prepupal and pupal stages are reached and these are spent in the soil. The complete life cycle can take from 2–4 weeks	Controlled by regular sprays for more important pests
Cabbage leaf miner *Liriomyza brassicae* The adult is a small black fly, similar to bean fly. The cream-coloured larvae are 1 mm long	Evidence of leaf miner damage may be found at any time during the year. However, they are more prevalent during the summer	Very minor pest	Causes small mines in the leaves, particularly in the seedling stage	The adult female lays her eggs on the upper or lower surface. At the height of summer the life cycle may be completed in less than 3 weeks but may be extended to 12 weeks in winter	Controlled by normal spray programme

As a general rule, weekly sprays of diazinon 0·05% plus methomyl 0·025% will control the pest complex in summer. In winter, diazinon 0·05% usually controls the complex and longer intervals between sprays are possible.

The commercial product names listed hereunder are examples of the particular insecticide available and should not be construed to indicate recommendation of a particular company's product in preference to another which may have been inadvertently omitted.

Common name	Commercial name	Dosage		
		Active constituent	Commercial product	
				Strength of product
diazinon	Diazinon 80 Gesapon 80	0·05%	Approximately 300 ml/500 litres water ..	80% w/v
methomyl	Lannate ..	0·025%	Approximately 140 g/500 litres water ..	90% w/w

Mulga as drought feed for

MULGA *(Acacia aneura)* supplies the only fodder for many thousands of sheep and cattle in the arid interior of Australia in times of drought.

Mulga grows in scattered areas covering some 150 million hectares and stretching from St. George in south-western Queensland across the continent to within 240 kilometres of Carnarvon in Western Australia.

The species exhibits a great deal of variability in growth habit. However, in the field, mulga can often be recognized by its obliquely ascending branches. It is a woody plant with narrow, obscurely veined, greyish leaves. Flowers appear as rather short and slender spikes and the species is characterized by a flat, winged, leaf-like pod.

Results from feeding mulga vary tremendously: from a slow fattening in some cases to a slow death in others. Moreover, it is not there for the taking. Mulga can grow to a height of 10m (about 32 ft.) or more and in most situations has to be cut. As this involves fairly heavy expenditure, mulga feeding must be well planned and based on an understanding of what it can and cannot do.

This article outlines the practical aspects of feeding mulga to cattle in south-western Queensland.

Cattle in store condition have a greater chance of thriving on mulga than poor or weak stock.

cattle

by M. C. WELLER, formerly Beef Cattle Husbandry Branch.

Cattle should not have to turn to mulga in a normal year. If all trees on a property are denuded of vegetation to head height, it suggests overstocking. However when, in one of the all-too-frequent droughts, it does become necessary to use this valuable fodder reserve, survival of stock will depend on the mulga, the cattle and the management.

The Mulga

In theory, mulga has sufficient protein, only just enough energy, and insufficient phosphorus to maintain or hold mature dry cattle. Vitamin A levels are more than adequate.

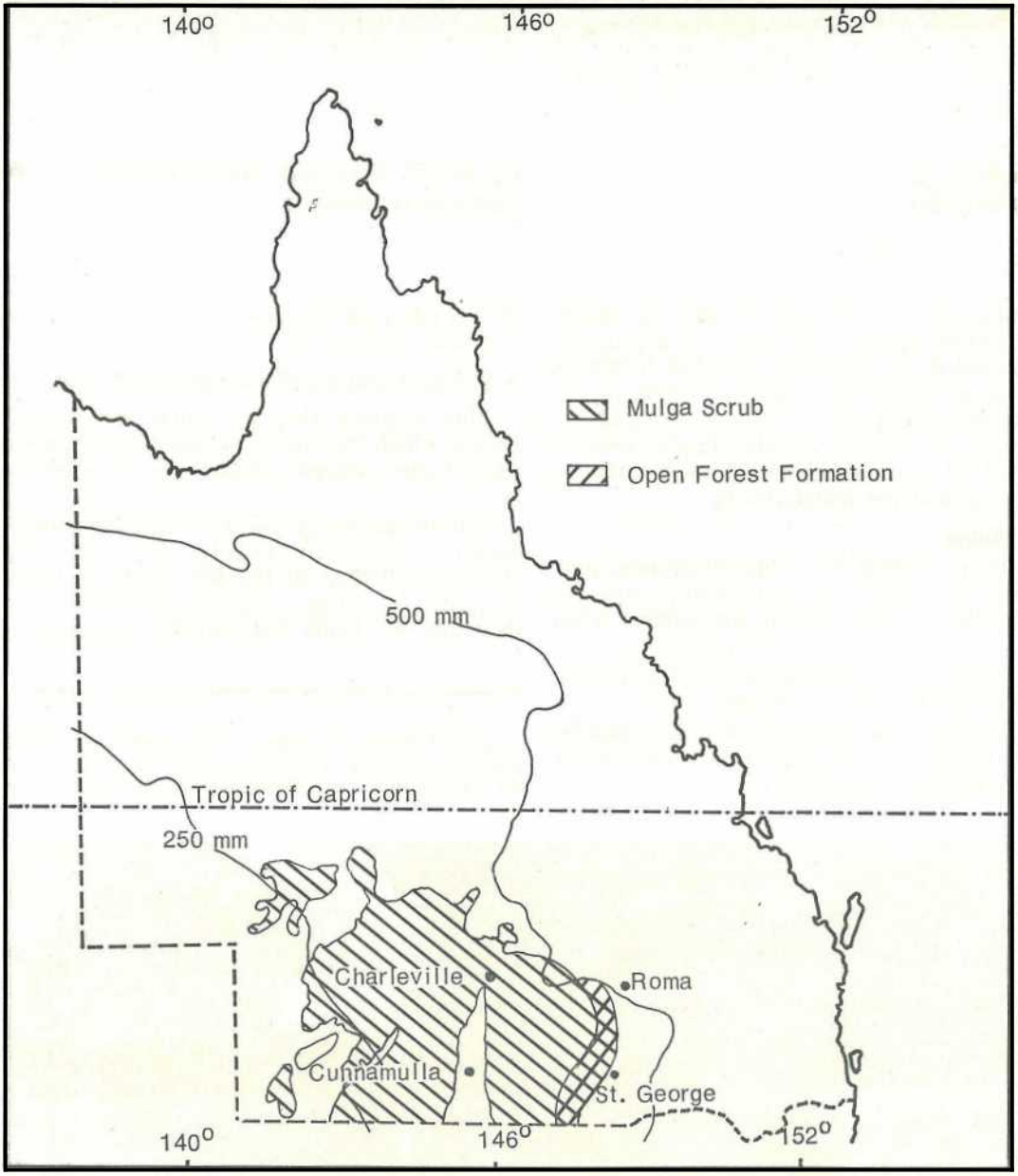
In practice, if everything goes well and without any supplements, it means that:—

- Adult dry cattle will at least hold condition and may gain a little (phosphorus deficiency may become a problem).
- Wet cows will slip and suffer a severe phosphorus deficiency.
- Weaners and yearlings will not do well.

This assumes that all cattle eat enough mulga, which they often do not either because there is not enough available, or they dislike it.

One of the major points is to feed enough mulga. Cattlemen usually judge this by checking whether all the fed mulga is eaten. If cattle are eating everything available, then they are not being fed enough, especially if

A typical stand of mulga in the south-west. Some graziers say it is like 'hay on the coast or silage on the Downs', a valuable drought reserve.



Distribution of mulga in Queensland. Rainfall isohyets for 250 and 500 mm are indicated. (After a map by S.T. Blake)

A mulga tree broken by a bull so that he could reach the higher foliage. Strong stock, especially bulls, can successfully feed themselves if sufficient suitable mulga is available.

they are eating branches more than 6 mm thick. Remember also that there are some trees in every stand of mulga that cattle dislike.

A few uneaten trees does not necessarily mean you are feeding enough: the cattle may still be browsing other trees too heavily. In other words, for cattle to be fed enough mulga, they should be fed a little too much.

Despite all your efforts, cattle still may not eat enough mulga, simply because they dislike it. The reasons could be many and varied:—

1. AGE OF THE TREE. As a general rule old trees are preferred to young trees.

2. LOCATION. Mulga growing in higher rainfall areas (400 to 500 mm) seems to have less appeal than that in the drier areas. Unexplained differences in palatability have also been found within a district, and also between individual trees in the same stand.

3. FRESHNESS. Daily feeding is desirable. This is especially important during the heat of summer when leaves quickly wither. Besides, mulga foliage on live trees steadily dries out as the drought progresses so, in a bad drought, mulga may lose its freshness and become unpalatable. Indeed, severe droughts can kill mulga and under these conditions it is especially important to feed frequently.

Light showers of rain, while being insufficient for grass growth, can be valuable in freshening the mulga. Mulga, and hence the stock, could not survive a long drought without this ability to respond to light showers.

4. DUST. Droughts mean dust, especially where stock congregate, and dusty foliage is certainly less palatable. This may become a problem when pulling mulga with tractors and a chain.

The Cattle

The aim when feeding mulga should be merely to hold the condition of stock. Avoid trying to improve them, as this is sometimes impossible. At the same time, they should not be allowed to slowly lose weight. They could lose too much condition and die before it rains.

A 'mulga basher' in use in the Quilpie district. These machines are useful in open stands of mulga and allow the use of smaller tractors for feeding stock.

The following factors play an important part in achieving this aim:—

1. CLASS OF CATTLE. Adult dry cattle, as mentioned earlier, can be expected to hold their own on mulga with only a phosphorus supplement. Wet cows can usually be expected to slip. This could be prevented by weaning, or by feeding a cheap protein-phosphorus supplement.

Weaners over 4 months old have proven their ability to do well on mulga plus a phosphorus-protein supplement, particularly if they have had previous experience of browsing mulga. Young calves under 4 months cannot be reared on mulga. They are best fed drought rations in yards, though occasionally mulga has been successfully substituted for the expensive hay portion of these rations.

Bulls, and to a lesser extent steers, often do well on scrub. Besides being less susceptible to bossing, they are less likely to suffer from phosphorus deficiency. Often, they are in better condition than the females, are prepared to work the paddock better for ground feed, and are more likely to break young mulga for themselves.

2. CONDITION. Cattle in store condition have a greater chance of thriving on mulga than poor or weak stock. They have more vigour and desire to eat and will also forage the paddock for ground feed, and perhaps break low mulga for themselves when it is available. This is an important point in deciding when to start feeding mulga.

High losses in the past can often be traced to leaving this decision too late, handling poor stock on poor feed and, subsequently, having poor cows trying to calve again solely on a mulga diet.

3. AGE. Very old cattle have no place on a property in a drought. Cows over 8 years old should not be expected to survive on mulga. Instead they should be culled.

Young first-calf heifers can be expected to slip quickly after calving. Every effort should be made to calve them in at least store condition. Calves from this group will probably have to be weaned sooner and the heifers themselves supplemented earlier than mature breeders.

4. PARASITES. Barber's pole worm is a frequent parasite of cattle in the higher rainfall mulga zone (over 400 mm). It is recommended that all young stock under 2 years old be drenched at the start of feeding. The need for a second drench is doubtful as chances of reinfestation are slight when browsing mulga. However, the possibility of reinfestation from bore drains or damp swampy areas should not be overlooked.

Tests so far have failed to find significant worm numbers in the low rainfall mulga areas (120 to 400 mm).

Lice are becoming an important cattle problem in the south-west. There is little doubt that heavy infestations hastened death during recent droughts. Effective preventive measures should be taken in autumn every year, regardless of the feed situation.

When feeding mulga, lice are doubly dangerous. Firstly, the cattle are in lower condition and thus more susceptible to all parasites and, secondly, the congregation of stock in fallen scrub and around waters greatly increases the chances of a rapid lice build-up.

5. ADAPTATION. Cattle bred in the south-west usually take to mulga readily, especially in a dry season, but imported cattle that have never before fed on top feed can be difficult. This can be overcome, at least partially, by protein supplements, and these will be discussed later. An alternative is to use local cattle as coachers.

6. SHEEP. Where both sheep and cattle need mulga, they are sometimes run together. This simplifies feeding, and also reduces wastage of scrub as cattle can reach higher than sheep and thus take forage otherwise uneaten.

Provided enough scrub is fed and waters are adequate, this practice has merit. However, problems can develop. Supplementing the cattle and not the sheep may be difficult and cattle may bully sheep at feed and water points.

The Management

This section covers the how, when and where of feeding mulga, as well as discussing water supplies and supplements.

1. How to feed. This depends on which of the various shapes and sizes of mulga is available, and in what quantities.

• Low mulga. These are small or stunted trees, with plenty of leaf within easy reach of stock. Cattle are quite capable of feeding themselves on this low scrub for long periods, provided there is sufficient scrub, and the stock are in reasonable condition.

This is known as breaking, and strong cattle, especially bulls and bullocks, may break branches and slender trunks up to 75 mm thick to get at the higher foliage.

Some graziers successfully use cattle to break for sheep in the same paddock, provided bullying and the distribution of supplements do not become a problem. Likewise, strong cattle are sometimes useful as breakers for weaker cows and young stock, but similar problems may develop.

• Whipstick mulga. This grows in thick stands with leaves only in the upper portion. Tree trunks are too thick to be broken by stock. For this reason, pushing by a bulldozer or pulling with a cable or chain are the most suitable methods. A dust problem may occur when using this method. Pulled scrub can be difficult to penetrate, especially if the stock are poor or weak. Cleared tracks may be worth while.

• Umbrella mulga. As the name suggests, these trees carry a large amount of leaf, and cutting with chain saws or pushing with a bulldozer are the most efficient methods of preparing them for feed. One good umbrella mulga can carry sufficient foliage for one cow for 1 day.

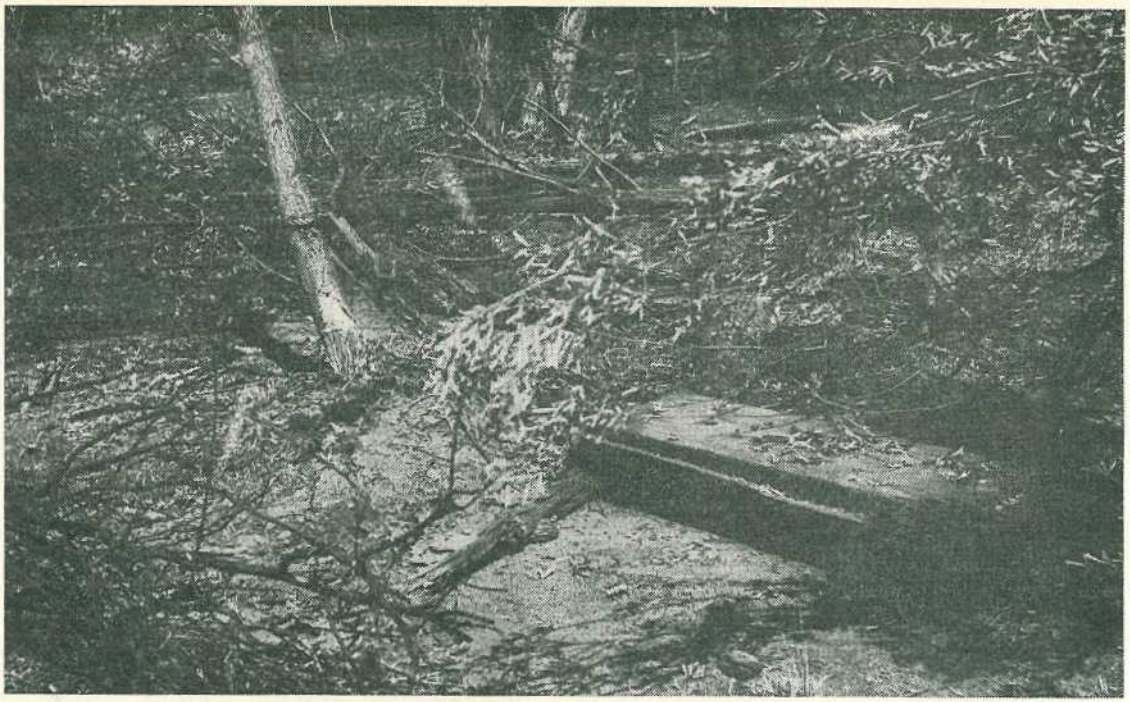
The labour requirement of chain saws can be estimated at about one man full time to 350 adult cattle. This rate requires excellent feeding conditions and spare parts and spare chain saws to avoid breakdowns. If several men are doing the feeding, then 250 to 300 cattle may be a more realistic figure. Of course, if mulga is used as a supplement and dry pasture is also available, the labour requirement is much lower.

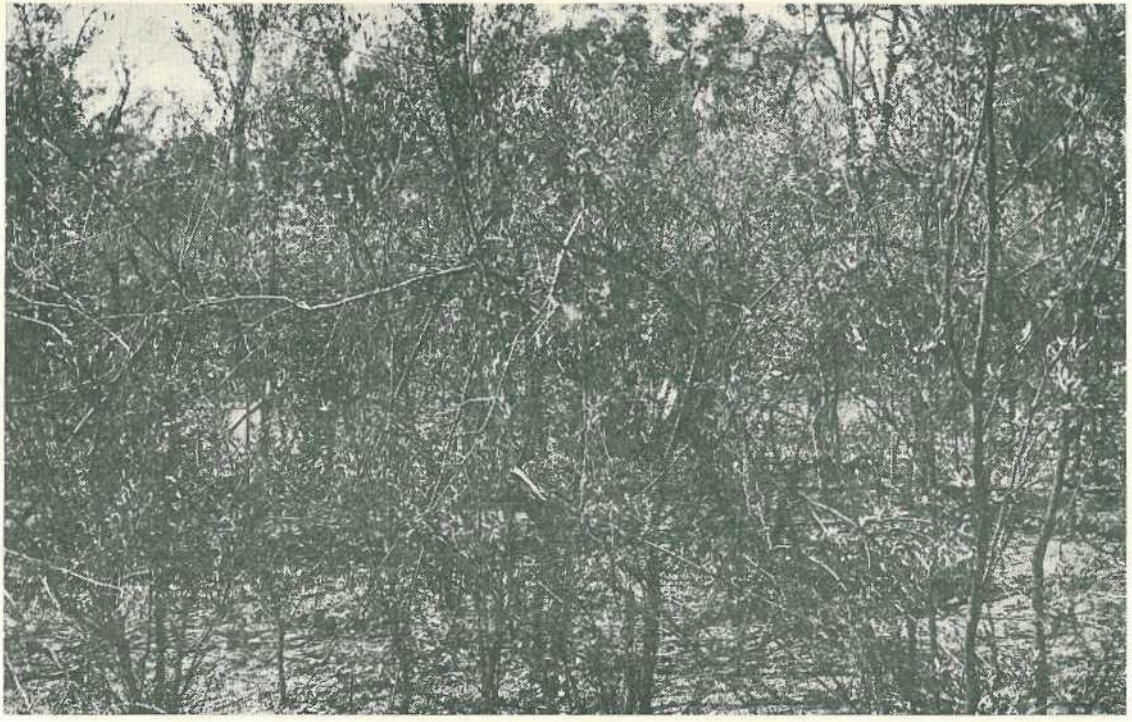
Where a urea-molasses-phosphate supplement has been fed as well as the mulga, the cattle have always responded.

Special problems that may arise when using chain saws include feeding insufficient scrub and unavoidable delays through breakages and accidents. Bulldozers can help overcome these problems and reduce the work load.

• Tall mulga. These usually have thick trunks, and only a little foliage at the top. They are old and apparently very palatable. Because of the scant foliage, tall mulga is not well suited to feeding, but it can be fed. It is felled with either a bulldozer or a chain saw. Similar problems may arise as with umbrella mulga.

In drier areas where mulga is scarce and regeneration is slow, some effort to conserve the available stands is worth-while. Because





TOP. *Pulling the trees down with heavy machinery is the only satisfactory way of feeding big mobs of cattle.*

BOTTOM. *A low-cost 'automatic' supplement: low mulga browsed by cattle.*

One good umbrella mulga tree can carry sufficient foliage for one cow for 1 day. Even after pushing, this tree needs lopping with a chain saw to avoid wastage.

of this, various attempts have been made to feed mulga without killing the tree. Lopping with an axe or small chain saw achieves this aim by cutting out the centre of the tree and leaving a few small lateral branches for future growth. Within about 5 years, the same trees are ready for lopping again. This method of feeding is popular in the Eulo area, west of Cunnamulla.

Graziers in the Quilpie district frequently use a 'mulga basher'. This is a heavy trailer-type machine drawn by a tractor. A protruding beam on both sides of the trailer strikes trees about 2·5 to 3 m about the ground. In many cases, the centre branches are broken but the lower laterals are left unscathed and grow again. This method has the added advantage of requiring only a low powered tractor, but it is not really suitable for thick stands. Wheel tractors mounted with front-end loaders can be used for the same purpose.

Conserving mulga for future droughts cannot be over emphasized. It is a diminishing resource, particularly on 'hard' mulga country. In these areas, if the tree cover is destroyed, the pasture productivity may decline rapidly. As a rough guide, trees should not be killed by pushing or cutting down when densities are below 75 to 100 trees per acre.

Further information on the various methods of feeding is given in Advisory Leaflet No. 1024 'Use of Fodder Trees and Shrubs' by S. L. Everist.

2. WHEN TO FEED. This depends solely on the condition of stock. Poor stock cannot survive an upset such as machinery breakdowns, cold weather, calving, or the many other things that can go wrong in a drought. Begin feeding when stock are in store to backward store condition. Remember that they may take some time to start feeding on scrub, and more still before they begin showing any benefit.

3. WHERE TO FEED. A decision on where to feed mulga within the paddock is naturally determined to some degree by where the mulga is growing, but some thought should also be given to the distance from water. Walking should be kept to a minimum, and certainly no more than 2 miles. Water can be piped temporarily to the mulga stand, and piping taken up after the drought.

It is wise initally to feed away from the water, reserving the closer mulga for later in the drought when the cattle could be poorer. In scrubby country, clearing access tracks between mulga and water points could be worth while, especially if the cattle are poor.

4. WATER. Quality and quantity of water are worth constant attention. If water supplies are low, and particularly if they are fouled with dust, manure, or dead animals, stock are reluctant to drink and may quickly lose condition. Open waters and bore drains can be a trap for weak stock.

It has been claimed that some bore waters with their laxative effect are preferable to surface waters for drought stock.

5. SUPPLEMENTS. The use of supplements is a contentious issue among scrub feeders. Some seem to be quite successful without feeding supplements, while others claim that supplements are essential for success.

- Phosphorus levels in mulga are definitely low for any class of cattle, and after 3 months' feeding on scrub most classes of cattle will begin to show signs of deficiency. These signs include bone chewing, poor coloured rough coats, decreased appetite, and possibly peg-leg. Symptoms may be expected initially in young breeders, and will steadily spread through the breeder herd, young cattle, and finally steers and bullocks. The various methods of feeding phosphorus in licks, or in water supplies are described in advisory leaflets on phosphorus for beef cattle.

- Protein levels of mulga are high according to chemical analysis. Certainly in some cases cattle have performed well on mulga with only a phosphorus supplement. This suggests no deficiency of protein.

However, in all cases where a urea-molasses-phosphorus supplement has been fed as well as mulga, cattle have responded. In some cases, even wet cows have shown a slight weight gain. There has been some evidence of an increase in appetite, an easing of impaction problems, and an improvement in the coat of supplemented cattle. In a small number of cases, cows have calved and been subsequently mated to produce an 80 to 90% calving on scrub plus urea-molasses-phosphorus. Urea-molasses feeding is fully described in Advisory Leaflet No. 704 'Care of Beef Cattle in Drought'.

The decision whether to supplement with protein must depend on cattle performance. If the cattle are holding their own, there seems to be little point in spending money on supplements. However, if cattle are slipping and the reason for this is not apparent, then protein supplements could be well worth trying.

6. IMPACTION. Impaction is always a threat on scrub feed. Through continually eating coarse, fibrous leaves, cattle can progressively become bound up and performance suffers. Impaction may be caused by:—

- Too little scrub being fed and the cattle having to eat twigs and small branches which are much more fibrous.

- Scrub drying out, either through feeding too infrequently or because the live trees are wilting due to the severity of the drought.

- Insufficient water intake because of either poor quality or quantity.

Impaction may be partially overcome by correcting the above problems. Alternatively, urea-molasses may be tried.

7. MOBILITY OF FEEDING EQUIPMENT. This is essential if cattle are to be fed in small mobs in separate paddocks. Agricultural motor cycles are excellent for transporting men and chain saws. Some graziers with bulldozers use an old truck or low-loader to save walking the machine from paddock to paddock.

It is obvious that feeding mulga can be expensive. Various estimates range from 20 to 40c per cow per week. This includes labour, depreciation on machinery and fuel, but not supplements. In the higher rainfall areas, this cost not only covers the cost of drought feeding, but improves the country at the same time.

The cost of feeding scrub and the risks that always accompany drought feeding make it obvious that normal drought management policies still apply: reduce stock numbers where possible, wean, guard against parasites, segregate different classes of stock, and so on. However, if managed correctly, mulga will continue to provide a valuable drought reserve in the south-west.

[Further information on this important forage tree is contained in *Tropical Grasslands* Vol. 7, No. 1 March 1973.]

Bottlebrushes of South-eastern Queensland

BOTTLEBRUSH is a common name often applied to plants in which the stamens, and not the petals, are the colourful and conspicuous part of the flower.

by BERYL A. LEBLER, Senior Botanist.

At various times the name has been used for banksias, melaleucas and callistemons. It should be reserved for the various species of *Callistemon*.

Robert Brown first used the name *Callistemon* in 1814, in the appendix to Flinders' Voyages, for those plants 'with distinct elongated filaments'. It is derived from two Greek words, *kallistos* meaning most beautiful and *stemon* meaning a stamen, and refers to the brush of elongated stamens which are usually a vivid colour.

Bottlebrushes are found only in Australia. They range in size from straggling rigid shrubs to small trees, and have alternate leaves which vary from pointed and terete like pine needles, to flat, 7 to 13 cm long and, in some species, 20 times as long as they are broad. The leaf margins are always entire and, in some species, are thickened and have a distinct intramarginal vein.

Usually the leaves are leathery in texture. In some species, they are narrowed more abruptly to the pointed tip than to the attenuated base. In others, the narrowing to both base and tip is equal. In most species the midrib is prominent, but the lateral venation is often inconspicuous.

Glandular dots are usually present in the leaf tissue, in some species much more profusely and conspicuously than in others. In many species of bottlebrush, the new foliage is beautifully coloured.

The showy flowers are crowded into 'brushes' which are usually large. At first these are terminal. Very soon, however, the axis grows out into a leafy shoot. These plants are a very striking example of a flower in which the conspicuous coloured portion of the flower is not the corolla, but the stamen.

Each flower has five sepals and five petals. There are between 30 and 50 stamens which are quite free from each other or are very shortly united at the base into a continuous ring. This is one of the main characters distinguishing bottlebrushes from tea-trees, in which the stamens are united into five bundles which are opposite the petals. The ovary contains three or four cells, each with many ovules.

For most of the length, the sepals are united into a calyx tube which is joined to the outside of the ovary. The rounded petals alternate with the sepals. A cluster of many, long thin stamens, very much longer than the petals, protrudes from the centre of the flower.

Usually, the staminal filaments are brightly coloured, and each is tipped with a very small anther. The colour of the filaments varies from cream, lemon or pale yellow to pale green, green or bottle green, pink, violet, rich red or deep crimson. In south-eastern Queensland the common colours are crimson, red, cream to pale yellow, greenish white and green.

The fruits are capsules which are usually fairly large and woody. In most species, they remain on the plants for years and finally dehisc in three or four valves, releasing copious minute linear seeds which germinate readily.

Six bottlebrushes are common in south-eastern Queensland: *Callistemon viminalis, C. pachyphyllus, C. salignus, C. montanus, C. pallidus,* and *C. comboynensis.*

Red Bottlebrush

WEEPING BOTTLEBRUSH OR RED BOTTLEBRUSH (*Callistemon viminalis*). The specific epithet for this plant is Latin and means bearing shoots for plaiting and wickerwork. It describes the slender, drooping willow-like branches.

DISTINGUISHING FEATURES. The weeping habit of the branches and the abundant red brushes in which the filaments are joined into a ring at the base so that all the stamens fall together are sufficient to distinguish this bottlebrush.

DESCRIPTION. This tree is the largest of the bottlebrushes. Normally, it is a small tree 4·5 to 12 m high, although in dry situations it is often much smaller and ofter scraggy in appearance. The trunk is covered with a coarse, persistent bark which becomes flaky with age.

The smaller branches are long, slender and drooping. The whole of the young shoot is covered with long, white, silky, erect hairs, easily seen with the naked eye as a fuzz over the surface. These hairs disappear with age and old leaves and stems are quite glabrous. The leaves are crowded together in a very close spiral.

New foliage is light, bronzy-red in colour and this changes gradually to a soft, pale green, and eventually to dark green in the mature leaves. These are rather stiff in texture, and are very variable in size. In some plants, they are as long as 6·25 cm and 0·6 cm wide at about the middle. They taper gradually to both the base and to the acutely pointed tip. The midrib is the only prominent vein but fainter, pinnate veins which run into an intramarginal vein can be seen particularly in the dead leaves. The copious oil dots are easily seen with the naked eye.

The inflorescence is normally terminal and varies in length from 7·5 to 15 cm. It is about 5 cm wide and usually ends in a tuft of young green leaves. The flowers are so widely spaced along the rhachis that the structure of individual flowers is easily seen. Scattered over the rhachis and the sessile green calyx tube are hairs of the same type as those found covering the new shoots.

The calyx tube is 0·25 cm long and ends in five blunt-pointed lobes which are slightly shorter. The rounded petals are cupped and thin in texture, are less than 0·5 cm long, half as wide as long and pale green in colour, although plants have been found in North Queensland with red petals. The showy part of the flower is the bundle of red stamens. They are about 1·85 cm long and are joined together at the base into a short, distinct ring.

When the stamens fall from the flower, the whole bundle falls intact. In the centre of the staminal bundle is the red style ending in a rounded stigma which protrudes beyond the dark red anthers. The capsules are cup-shaped. They are hard and woody, greyish-brown in colour and about 0·5 cm long and as wide as they are long. Usually they do not persist on the plant. Within a few months they dehisc into 3 cells, releasing the seed.

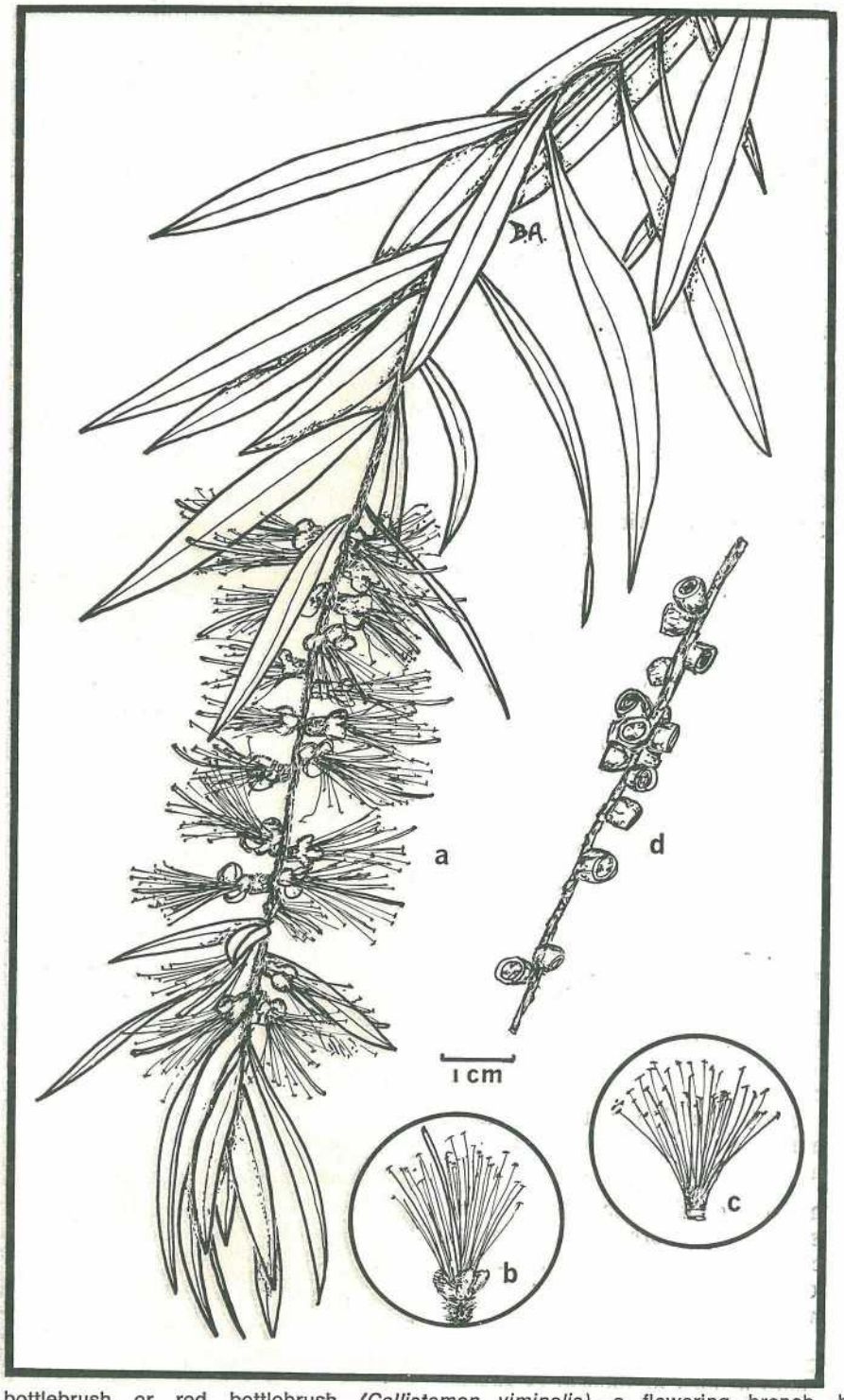
FLOWERING TIME. Spring time.

DISTRIBUTION. From the Clarence River in northern New South Wales throughout the eastern part of Queensland to as far west as Hughenden and the Carnarvon Range.

HABITAT. This plant is common along the banks of creeks, rivers and waterholes.

GENERAL REMARKS. This lovely weeping tree is frequently planted as a street tree. Two dwarf forms have been introduced into cultivation for use in home gardens. The most widely known form is sold under the trade name 'Captain Cook' and has the crimson flowers of the tree seen along the creeks.

The most recent introduction has been registered under the cultivar name 'Rose Opal' which describes the flower colour. It is not crimson but reddish-pink. This plant reaches a maximum height of 1·5 to 2 m.



Weeping bottlebrush or red bottlebrush *(Callistemon viminalis)*—a flowering branch, b individual flowers, c staminal bundle, d fruits.

Wallum Bottlebrush

WALLUM BOTTLEBRUSH (*Callistemon pachyphyllus*). The specific epithet for this plant is a Latin word meaning thick-leaved. It describes the texture of the firm, leathery leaf.

DISTINGUISHING FEATURES. The erect rigid habit of this shrub and the texture, size and shape of the leaves are sufficient to distinguish this bottlebrush.

DESCRIPTION. This glabrous shrub can flower when it is only 60 cm high and, in some situations, it does not exceed this height. Under other conditions it grows to a height of 3·5 m.

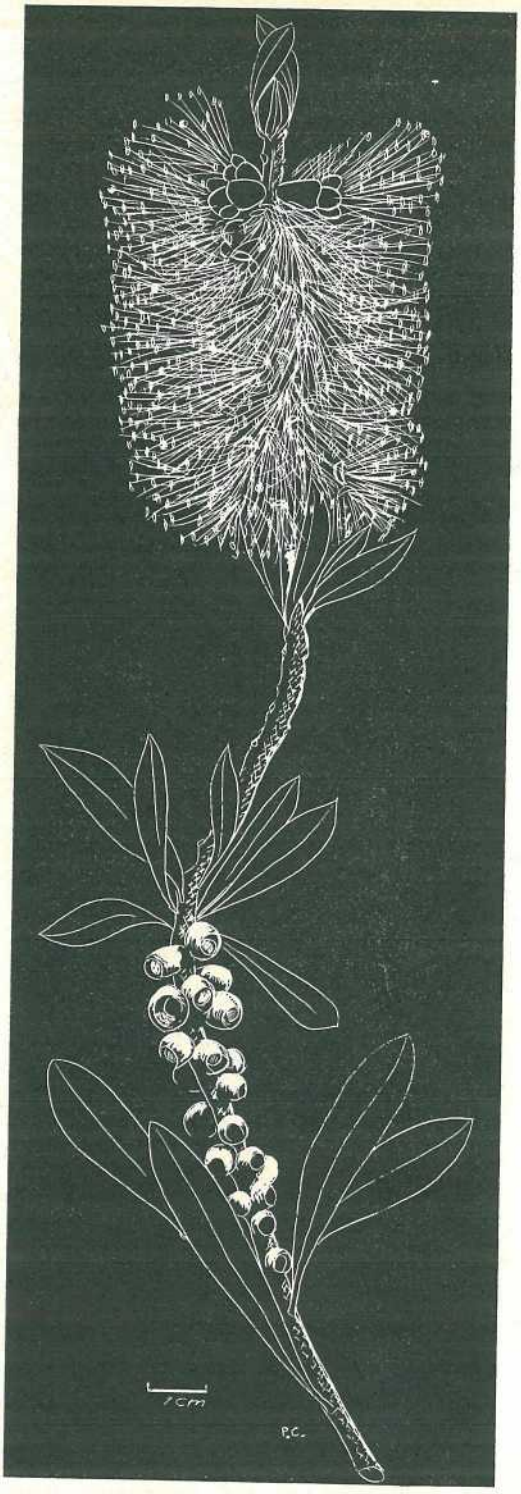
It has stiff, erect branches with sessile dull green leaves. These are oblong-lanceolate in shape and stiff in texture. They are up to 6·25 cm long and 1·25 cm wide and are vertically flattened and point upwards. The blunt leaves are rounded and end in a short, pungent tip. The mid vein, pinnate venation and an intramarginal vein can be seen faintly.

The crimson flower spikes are terminal and 5 cm wide and 6·25 to 10 cm long. Hairs, so short and fine they can be seen only with magnification, cover the rhachis and calyx tubes. The green calyx tubes end in short, green lobes which alternate with green cupped petals. The brilliant red stamens are about 2·5 cm long and end in very small crimson to purple anthers. In the centre of the flower is the thicker red style ending in a yellow-green stigma. The style is longer and thicker than the staminal filaments. The brush ends in a tuft of young green leaves.

Fruits from the previous year's flowering season are lower down on the stem, separated from the inflorescence by a cluster of leaves. These fruits are dull grey in colour, thick and woody, more than 0·5 cm long with a diameter about the same. They are narrower at the orifice than at the middle.

There is a form of this plant which has green flowers. In this form, the filaments are pale green and the anthers are a deeper green. In some districts, both the red and the green-flowered forms grow side by side.

FLOWERING TIME. Intermittently throughout the year, with a flush of flowers in spring and autumn.



Wallum bottlebrush *(Callistemon pachyphyllus).*

HABITAT. It grows on the coastal lowlands in sandy or swampy wallum country.

DISTRIBUTION. From as far south as Byron Bay in New South Wales to Fraser Island in Queensland.

GENERAL REMARKS. Both colour forms have been successfully cultivated. Under garden conditions, the red-flowered form grows into an open, spreading shrub as tall as 2 m, and spreads almost as much, while the green-flowered form develops into a bushy shrub 1·5 m tall with weeping pendulous branches.

White Bottlebrush

WHITE BOTTLEBRUSH OR WILLOW BOTTLEBRUSH (*Callistemon salignus*). A Latin adjective for willowy or willow-like provides the specific epithet for this plant.

DISTINGUISHING FEATURES. The whitish papery bark, the white or green-tinged flowers and the narrow pointed leaves distinguish this tree.

DESCRIPTION. This is a small tree to 12 m high, with a papery white bark which peels off in layers. Trees growing on creek banks often develop more than one stem from ground level and the ends of the branches arch downwards slightly.

The leaves are almost sessile, up to 10 cm long and nearly 0·4 cm wide and are widest at the middle. These leaves are narrowed equally to the base and to the acute tips. In mature leaves, both surfaces are the same colour, and their texture is firm but not leathery. The venation is clearly seen on both leaf surfaces since the midrib, intramarginal vein and the pinnate venation are paler in colour than the rest of the leaf.

Copious oil dots are scattered through the leaf tissue and can be seen under magnification. New leaf growth is tinged with pink and, in some plants, is bright red.

The brushes are not pure white in colour but are tinged with green. They are up to 5 cm long and 3·75 cm wide. Usually, the flower spikes are terminal. On some plants, particularly those growing in mountain habitats, shorter spikes develop beneath the terminal spike in the axils of the four or five leaves closest to the end, producing a compound inflorescence.

Individual flowers have a light green, glabrous calyx tube which ends in five rounded, pale green sepals half as long as they are wide. These soon become tinged with brown on the margins. Five almost transparent, green, cupped petals 0·3 cm long and as wide as they are long, surround a tuft of greenish-white stamens 1·25 cm long. Each stamen ends in a greenish-yellow anther. The green style is thicker and darker in colour than the filaments, but about the same length. It ends in a slightly thicker green stigma. The flowers have a perfume which I find rather sickening and 'mousy'.

The pale brown, woody capsules are found farther back on the stem on older wood. They are 0·4 cm deep and as wide as they are deep. At the end is a small, sunken orifice darker in colour.

FLOWERING TIME. Mainly spring to early summer but occasional flowers are also found at the end of autumn.

HABITAT. It is most common on river flats, banks of streams and creeks, or near water, but it also grows on mountain slopes on the margins of eucalyptus forests, or on exposed rocky slopes.

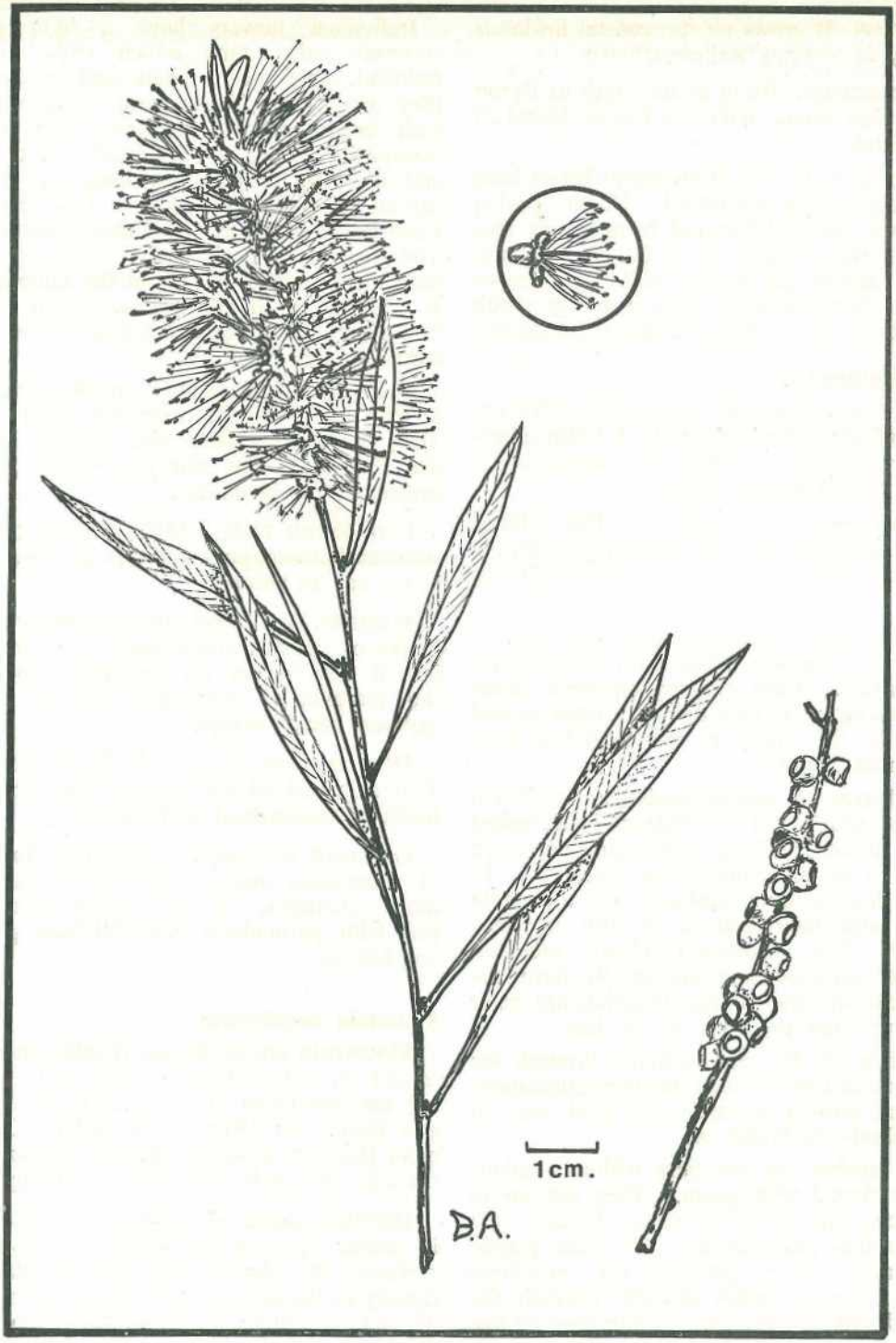
DISTRIBUTION. It grows in South Australia, Tasmania and all the eastern States to as far north in Queensland as Howard.

GENERAL REMARKS. This plant does well in cultivation and is particularly suited to moist situations. It is a small ornamental tree with particularly beautiful new pinkish-red foliage.

Mountain Bottlebrush

MOUNTAIN BOTTLEBRUSH (*Callistemon montanus*). A Latin adjective which means growing on mountains is the specific epithet for this plant. In 1915, C. T. White, Government Botanist, collected the first specimen 'on the edge of scrubs over cliffs at Springbrook'.

DISTINGUISHING FEATURES. The difference in colour between the upper and lower leaf surfaces, the almost total lack of glandular dotting in the leaves, the brilliant red stamens distinct and quite free from one another at the base, and the more or less deflexed fruit clearly distinguish this bottlebrush.



White bottlebrush or willow bottlebrush *(Callistemon salignus).*

DESCRIPTION. This is a shrub with an upright stem which can grow to a height of 3·5 m. In some plants the branches droop. Other plants develop sprawling stems. This is particularly noticeable in specimens growing on cliff faces. The leaves are firm in texture but only the oldest leaves are stiff and leathery. They are narrow oblanceolate in shape, up to 7 cm long and about 0·5 cm wide at the middle, and are tapered more or less evenly to base and apex.

With the naked eye, the lighter green midrib is the only visible vein, but the pinnate venation and the intramarginal vein can be seen if the older leaves are held at an angle to the light. The tip of the leaf is acute but not pungent.

New foliage is brightly coloured and covered with long, erect white hairs. Mature leaves on the flowering stems are blue-green. Those on older parts of the plant are often dark glossy green. The difference in colour between the two surfaces can be readily seen by picking a leaf and folding it obliquely at the middle so that the upper surface is folded down across the lower surface. Even with magnification only a few glandular dots can be found scattered over the leaf. In texture, the leaf is firmer than *C. viminalis* but not leathery like *C. pachyphyllus* and *C. comboynensis*.

The flower spikes are usually short and broad, up to 5 cm long but 6 cm wide. In some plants the spike is twice as broad as it is long. The rhachis can be either glabrous or hairy and the pale green calyx is glabrous. In the bud stage, each bud is cupped in a long, brown pointed bract. Before the flower opens, this bract has fallen.

At this stage of development, the green glabrous calyx lobes faintly flushed on the margins with pink can be seen. By this time, the axis has grown out into a tuft of reddish brown leaves which, like the new foliage appearing before flowering, are covered by spreading white silky hairs. By the time the flower is fully open, the calyx lobes have turned brown. The pale green petals are 0·4 cm long and slightly narrower. The inner surfaces are glabrous, but the outer surfaces are densely hairy. These hairs are short, straight and colourless. As the hairs are more or less erect and not appressed this gives a fuzzy appearance to the petal.

The deep crimson staminal filaments are completely free from one another and end in dark, red-brown anthers. The stamens are about 2·5 cm long and surround the thicker style. This is the same colour as the stamens and ends in a flattened purple-red stigma.

Farther down on the stem on older wood, the fruits can be seen. They are obovoid in shape, grey-brown in colour and are more or less deflexed. They are just under 1 cm long and are almost as wide. The three valves are deeply sunken in the capsule.

FLOWERING TIME. Although the main flush of flowers appears in spring, flowers are produced intermittently throughout the year.

HABITAT. It is found only in mountain districts, usually in the undergrowth of eucalyptus forest near the edges of cliffs or in sprawling masses on the actual cliff faces.

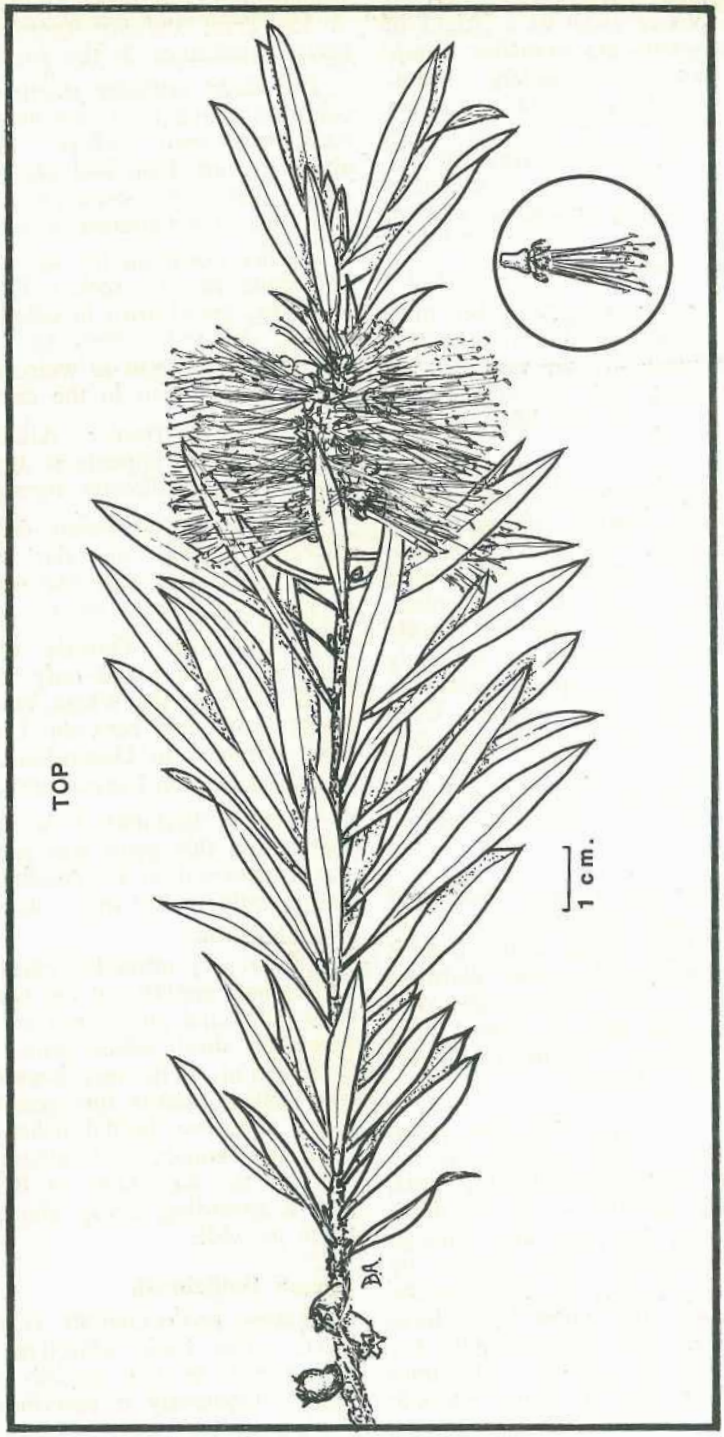
DISTRIBUTION. Outside Queensland, this plant has been found only in northern New South Wales in the Whian Whian State Forest about half way between Lismore and the State border. In Queensland, it is restricted to the Lamington Plateau and Mt. Maroon.

GENERAL REMARKS. It is interesting to note that, when this plant was first discovered, it was considered to be possibly a form of *C. pachyphyllus* with more acute leaves of a thinner texture.

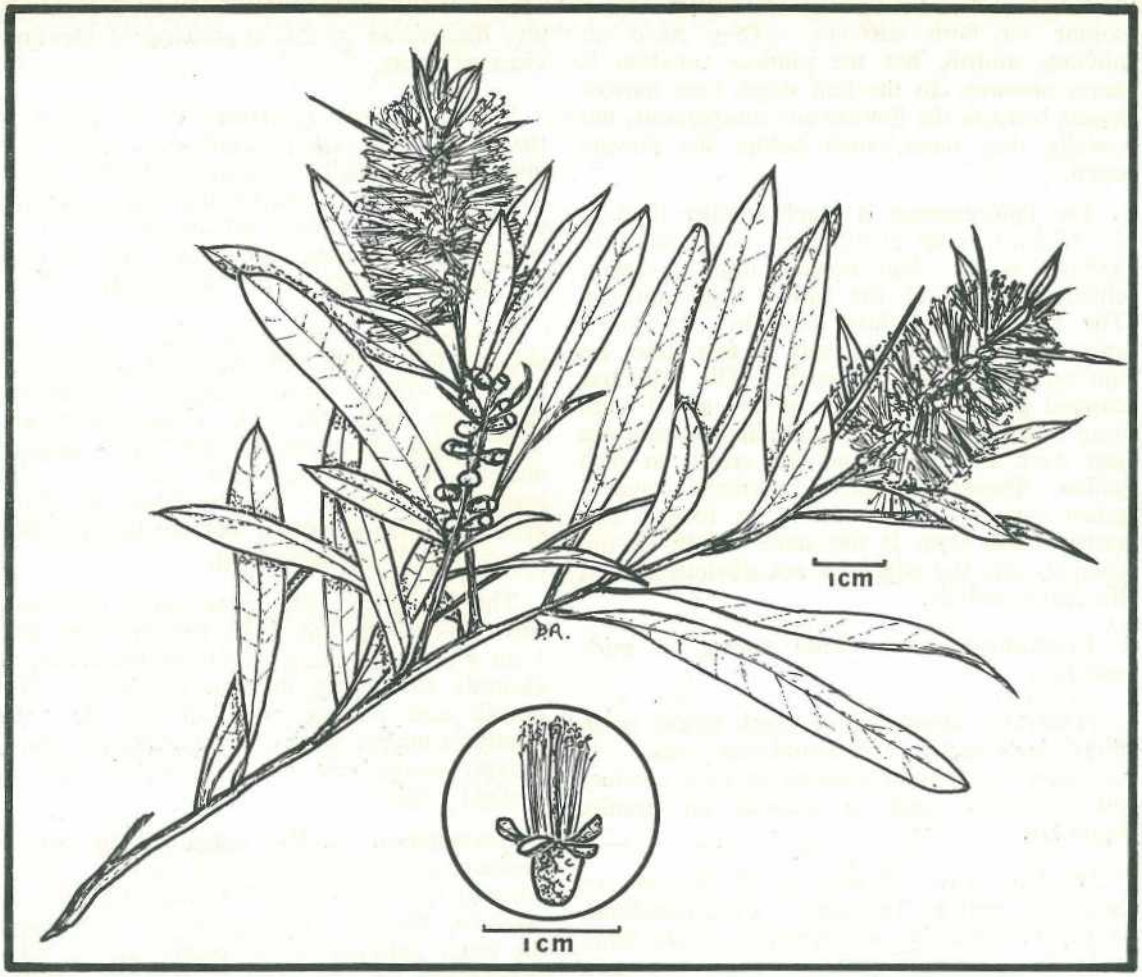
It is a very attractive plant both in flower and in new growth. It has been very successfully cultivated and forms an erect, compact, spreading shrub which grows to a height of 2 to 2·5 m. The very beautiful, bronze-red, new foliage makes this possibly one of the most attractive bottlebrushes in cultivation. Strangely enough, seed gathered from an erect tree on the mountains in Brisbane develops into a sprawling clump about 1 m high and twice as wide.

Lemon Bottlebrush

LEMON BOTTLEBRUSH (*Callistemon pallidus*). The Latin adjective *pallidus* which means pale is the specific epithet for this plant. Obviously it describes the colour of the stamens.



Mountain bottlebrush *(Callistemon montanus).*



Lemon bottlebrush *(Callistemon pallidus).*

DISTINGUISHING FEATURES. The only bottlebrush which could be confused with this plant is *C. salignus* which it resembles in general appearance. It differs in having much shorter brushes of creamy-white to deep cream flowers with much shorter stamens. Its leaves are also much shorter and narrower, and its branches are erect and less drooping than white bottlebrush. In addition, it does not develop brightly-coloured new foliage.

DESCRIPTION. This is an erect, compact, small, bushy tree about 4·5 m high with spreading branches. It has a rather papery bark which is brownish in colour. Of all the bottlebrushes in south-eastern Queensland, this has the least colourful new foliage.

Young leaves are only faintly tinged with pink and soon change to pale green. Very fine, white, silky hairs cover the new leaves. These hairs lie close to both surfaces and form a spreading fringe along the margin. By the time the leaves have lost their pink tinge, the hairs have disappeared except from the leaf margins.

Mature leaves are completely glabrous, firm in texture but not leathery. They are about 6 cm long, just under 1 cm wide at the middle and are tapered more abruptly to the tip than to the base. The leaf ends in an acute tip which is not pungent. Copious oil dots are easily seen as translucent dots by holding the leaf against the light.

The leaves are a rich green, and the same colour on both surfaces. They have an obvious midrib, but the pinnate venation is more obscure. In the bud stage, long narrow bracts beneath the flowers are conspicuous, but usually they have fallen before the flowers open.

The inflorescence is much smaller than in *C. salignus* being about 4 cm long and 3 to 3·5 cm wide. The flowers appear cream, chiefly because of the rather large anthers. The rhachis is slightly hairy but the green calyx tube is glabrous with a few hairs on the brownish rounded sepals. The orbicular cupped petals are pale green and are 0·4 cm long and not as wide. Individual flowers are just over 1 cm long and the cream to pale yellow filaments, which sometimes have a green tint are just under 1 cm long. The rather thick style is the same length as the stamens and the stigma is not obvious among the large anthers.

FLOWERING TIME. Late spring to mid-summer.

HABITAT. Mainly along creek banks or in moist conditions, in mountainous areas. It has also been found growing in rock crevices on mountains and in fissures on granite boulders.

DISTRIBUTION. Found in all the eastern States as well as Tasmania. In Queensland, it grows only in the southern part of the State near the border in such places as Lamington National Park and Springbrook to as far west on the Darling Downs as Mt. Norman and Ballandean.

GENERAL REMARKS. There is one record of a plant collected at Jolly's Falls, north of Stanthorpe, in which the filaments were mauve-pink and the anthers maroon. This was only one plant growing among a population with flowers of the usual colour.

Lemon bottlebrush is also being cultivated.

Cliff Bottlebrush

CLIFF BOTTLEBRUSH (*Callistemon comboynensis*). The specific epithet for this plant is derived from the name of the place where it was first discovered, Comboyne River north of Taree in northern New South Wales. It was discovered in 1926, growing in the crevices of rocks.

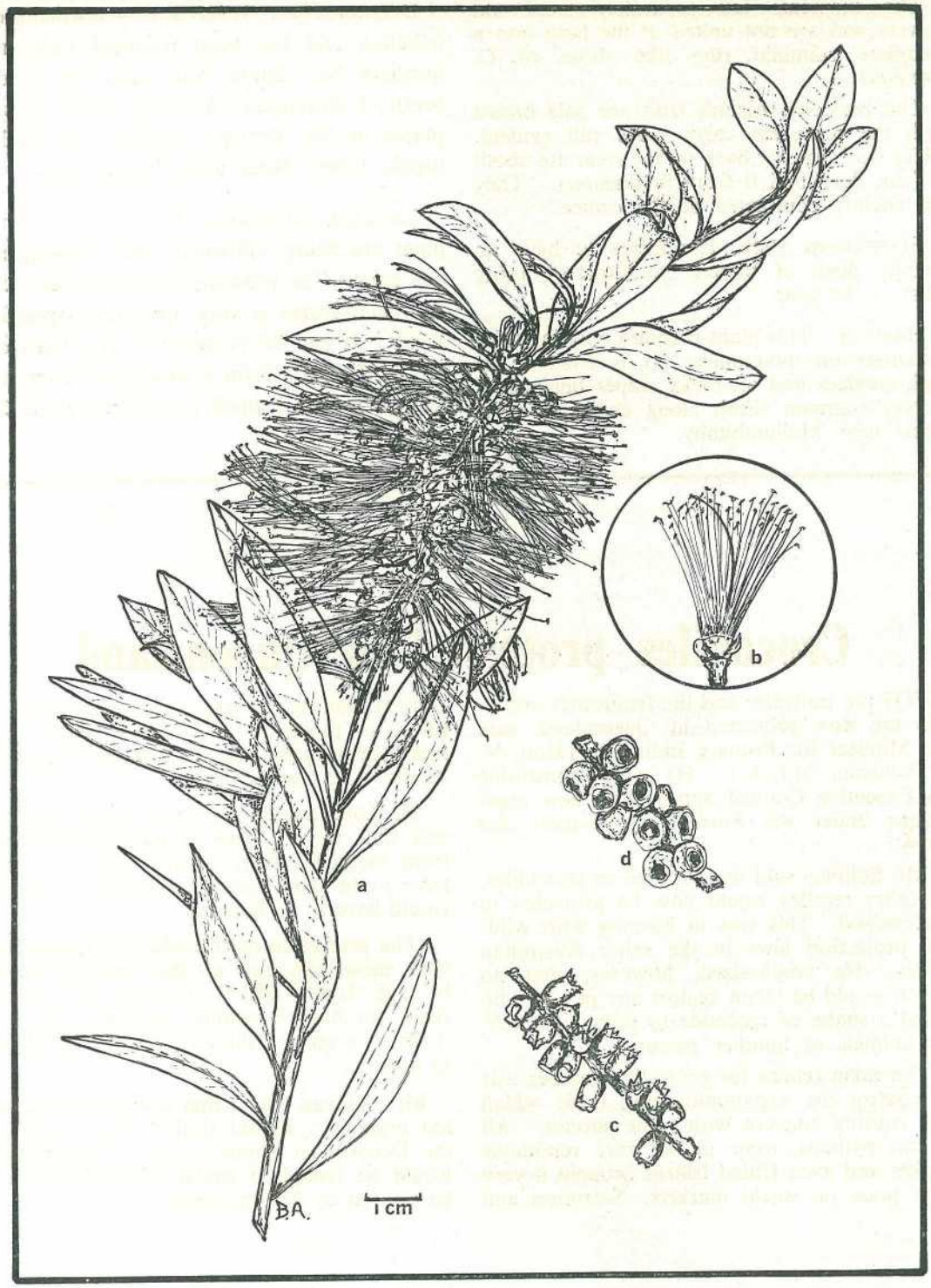
DISTINGUISHING FEATURES *C. montanus* is the only bottlebrush in south-eastern Queensland which could be confused with this plant. The much shorter, broader and leathery leaves with their very copious oil dotting and much larger inflorescences, usually as long as they are broad, distinguish the two plants readily.

DESCRIPTION. This is a small erect shrub about 2 to 3 m tall with grey bark and twiggy branches. In the juvenile stage, the leaves are silky-hairy, and rose-pink to reddish-brown. This colour disappears as the leaves mature and by the time they turn pale green, the leaves are glabrous. Mature leaves are dark green and firm in texture but not leathery like those of wallum bottlebrush.

The leaves are the same colour on both surfaces. They are 5 to 8·5 cm long and 1 cm wide at the middle, and are tapered more abruptly to the tip than to the base. The midrib and pinnate venation can be seen faintly in mature leaves, more easily on young foliage, particularly when the leaf is held at a slight angle.

Examination under magnification shows copious, evenly distributed oil dotting. When crushed, the leaves yield a fragrance said to resemble that of allspice. In the bud stage, the outer surfaces of the petals have a silky appearance as they are covered by closely appressed short white hairs. These hairs disappear with age and, in the old flowers, hairs are confined to the margins of the petals.

The inflorescence is 6 cm long and as broad, and has a silky-pubescent rhachis. The sessile flowers have a silky-pubescent calyx tube which ends in five rounded, straw-coloured sepals with five pale green, cupped petals, which overlap at the base. Although their outer surfaces are covered with silky hairs, the petals do not look fuzzy as the hairs are appressed. The petals are also speckled with oil dots. The stamens are 3 cm long and are a rich crimson with purplish anthers. The style is the same colour as the stamen, but is thicker and much longer. It ends in a globose purplish stigma.



Cliff bottlebrush *(Callistemon comboynensis)*— a flowering branch, b individual flower, c fruits of previous year, d old fruits.

The filaments fall separately from old flowers and are not united at the base into a complete staminal ring like those of *C. viminalis*.

The previous season's fruit are pale brown with the persistent calyx lobes still evident. Older fruits farther back on the stem are about 0·7 cm deep and 0·6 cm in diameter. They are slightly contracted at the orifice.

FLOWERING TIME. It appears to have no definite flush of bloom but flowers during most of the year.

HABITAT. This plant is found only in rocky situations on mountains. It is common in rock crevices and on rocky slopes but also is a very common shrub along creeks in rainforest near Mullumbimby.

DISTRIBUTION. It has a very restricted distribution and has been recorded only from northern New South Wales and the extreme south of Queensland near the border in such places as Mt. Barney, Mt. Maroon, Springbrook, Ivory's Rock and Flinders Peak.

GENERAL REMARKS. Two forms of this plant are being cultivated, one prostrate and one erect. The prostrate form is about 0·5 m high and forms a very spreading, sprawling shrub. It can be propagated only from cuttings. The erect form is propagated from seed and grows into a small erect shrub about 2 m high.

Crocodiles protected in Queensland

BOTH the saltwater and the freshwater crocodile are now protected in Queensland, said the Minister for Primary Industries (Hon. V. B. Sullivan, M.L.A.). He was commenting on Executive Council approval of new regulations under the *Fauna Conservation Act* 1974.

Mr. Sullivan said that, as well as crocodiles, all other reptiles would now be protected in Queensland. This was in keeping with wildlife protection laws in the other Australian States. He emphasized, however, that no action would be taken against any person who killed a snake or crocodile to protect himself, his animals or another person.

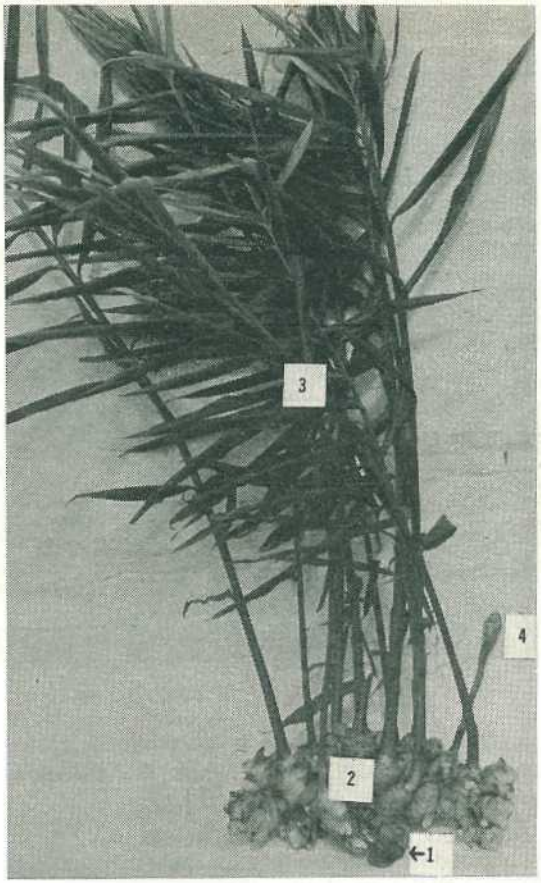
The main reason for protecting reptiles was to control the exploitation and trade which was causing concern with some species. All of our pythons, some of our rare venomous snakes and even frilled lizards brought a very high price on world markets. Scientists and conservationists had expressed concern for the future of many of Queensland's reptiles and had been pressing the Government to include reptiles as protected fauna.

Mr. Sullivan said the effect of the new laws was that reptiles now could be taken only from the wild under permit, royalties would have to be paid, and zoos exhibiting reptiles would have to be licensed.

'The protection of crocodiles in Queensland with mean the end of the "stuffer" trade,' he said. 'It now will be illegal to net northern rivers for baby crocodiles and this will make it easier to police fishing regulations in relation to netting'.

Mr. Sullivan added that shops holding stuffed crocodiles should declare their stocks to the Department immediately. Special permits would be issued to enable existing stocks to be cleared by 31 December next.

Ginger growing in Queensland



A typical ginger plant showing (1) the seed-piece, (2) the rhizome developed from the seed-piece, (3) the leaves and (4) the flower or inflorescence.

GINGER is obtained from the rhizomes of *Zingiber officinale* and *Zingiber mioga*. *Z. officinale* is grown in Queensland and in other major producing countries of the world. *Z. mioga* is grown mainly in Japan.

by A. W. WHILEY, Horticulture Branch.

Ginger is a plant of ancient cultivation and is presumed to have originated in the southern Asian-Indian region. Its medicinal properties are referred to by the early Chinese and Sanskrit writers.

Ginger was in common use in Europe from the ninth century. It is now used extensively as a flavouring, for herbal medicine in Asia, and for perfumes, beverages, and confectionery. It is also used as an ingredient of some curry powders.

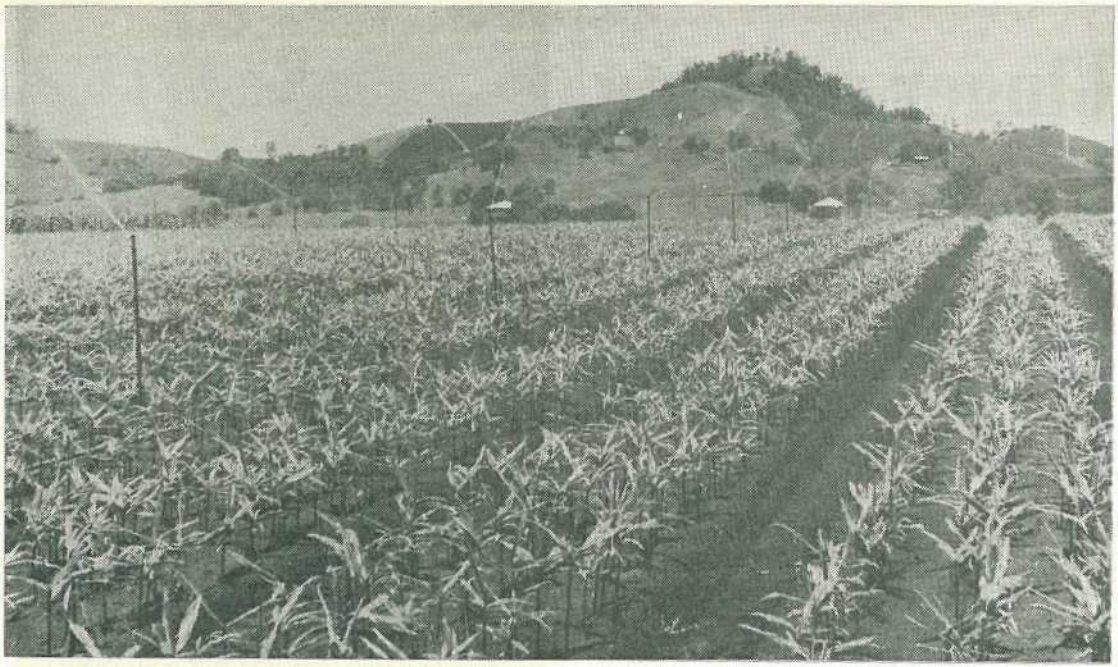
Ginger growing in Queensland began at Buderim in the late 1920s when a small area was established. It did not become a commercial crop until the 1940s when supplies from Asia were stopped during World War II.

A peak in production occurred in 1946 when 766 tonnes were harvested. Later, production declined in the face of renewed competition from ginger imported from south-east Asia.

In 1955, effective tariff protection against imports was granted and most of the 1957 crop was retained to ensure adequate quantities of 'seed' material. From this date, the industry has expanded and, in 1973, approximately 6 260 tonnes of ginger were produced from 112 hectares.

Climate and soils

High temperatures and moderate rainfall during the growing season are essential for the successful cultivation of ginger. These two factors create a high humidity which is



Irrigating the young ginger crop for sunburn control.

required by the crop. It is also beneficial to have a cooler, dry season while the rhizome matures and is being harvested.

Although commercial production of ginger is confined to Nambour and the surrounding districts, the crop should thrive in other areas of coastal Queensland and northern New South Wales.

Meteorological data for the Nambour district, taken from the records at the Maroochy Horticultural Research Station, are given in the following table.

TABLE 1

METEOROLOGICAL DATA FOR A QUEENSLAND GINGER GROWING AREA
(Average for 11 years)

Month	Temperature		Rainfall (mm)	Relative Humidity (%)
	Maximum °C	Minimum °C		
January	28·4	18·8	208	70
February	28·1	19·2	293	71
March	27·0	17·6	297	70
April	25·7	15·1	145	72
May	23·0	11·1	119	68
June	21·3	8·9	86	72
July	20·5	6·9	82	62
August	22·0	7·6	41	60
September	24·1	10·1	54	60
October	26·1	13·7	116	59
November	27·3	15·9	125	58
December	28·2	17·5	153	63
TOTAL	..	..	1 719	..

During winter in the Nambour district, it is not unusual to record temperatures below freezing point. This induces an apparent rhizome dormancy. Growth does not resume until the soil temperature at the 150 mm depth exceeds 20°C. Most favourable growth is obtained at a soil temperature between 25°C and 30°C.

Sunburning of the newly-emerged shoots can be a serious problem during November and December when screen temperatures exceed 32°C. Protection can be given by overhead irrigation at 2·5 to 3 mm per hour. Leaf burn and chlorophyll destruction also occur under conditions of excessive temperature and high light intensity, but the effects on yields are not as serious.

To produce high yields of ginger, the soil should be loose and friable, offering minimum resistance to rhizome development. Gravelly soils, or those with hard pans are unsuitable and should be avoided. Free soil drainage is important as the plant will not tolerate waterlogging. The depth of topsoil should be from 200 to 250 mm, though, where bedding and/or surface mulching is practised, a shallower soil may be utilized satisfactorily.

Land preparation

The preparation of land for the ginger crop should begin in November-December. After the initial ploughing, a cover crop of maize may be planted during the summer, or oats can be sown during the autumn to help build up the organic matter in the soil.

Poultry manure or mill mud (residual material from the processing of sugar-cane) may be incorporated before the cover crops are sown to provide additional organic matter.

Early harvest of ginger.

Late harvest of ginger using an adapted potato digger.

The cover crops are turned in no later than June to allow the organic material to break down. At this stage, further quantities of organic material may be applied at rates of up to 11 tonnes per hectare of poultry manure or 175 tonnes per hectare mill mud.

Six weeks before planting, an application of lime or dolomite may be necessary to raise the soil pH to the most favourable level of 6·5. The soil should then be worked to a fine tilth in preparation for soil fumigation to control root-knot nematodes. A few days before planting, the soil is formed into beds approximately 150 mm high. Contour drains may be installed at regular intervals to minimize soil erosion, if sloping land is planted.

Planting material

Ginger flowers are generally sterile and rarely set seed. Propagation is from portions of the rhizome. These are known as 'seed pieces' and a piece between 50 and 80 g is recommended for planting.

An area for the production of seed ginger is normally selected at the beginning of the season and should receive special attention so that good quality seed, free from nematodes and diseases can be produced.

The seed should be treated in hot water at 48°C for 20 minutes, and before planting the soil should be fumigated with DD or EDB 15. Nemacur* should be applied to the soil after planting, or, alternatively the ground should be covered with a 50 to 75 mm sawdust mulch. Once the ginger begins to stool, movement of persons and implements through the crop is best restricted to a minimum. Any damage to the pseudostem permits disease organisms to enter.

Seed ginger is harvested when the rhizomes are mature, approximately 6 weeks before they are to be used for planting. The rhizomes are stored in hessian bags in a shaded, dry and well-ventilated situation.

The seed is prepared by cutting the rhizomes into pieces. Cut seed can provide entry for fungal diseases, the most important of which is *Fusarium oxysporum*. To prevent infection, the cut seed should be dipped in benomyl (Benlate*) at 250 g of the product in 100 litres of water for 10 minutes.

* Registered trade name.

Planting

The main considerations when planting ginger are: the time of year in relation to climate, the depth of seed placement, and spacing. Although ginger is a perennial plant, it is generally cultivated as an annual crop. Ratoon or standover ginger is usually of a much lower quality than a plant crop, and has a higher fibre content and smaller 'knob' size.

In Queensland, the best time to plant is in September. This allows the young plants to become established before the onset of hot sunburning weather in late October, November and December.

The seed pieces are normally planted in three rows on beds 1·5 m wide. Recent research has indicated that seed piece size and plant and row spacing have no significant influence on yield when a given weight of seed is planted per hectare.

Seeding rates of up to 10 tonnes per hectare appear to be an economic proposition, though most growers plant between 4 and 6 tonnes per hectare.

Knob size is important in the processing of early harvest ginger and the marketing of green ginger. It has been shown that spacing has no effect on knob size, but it will be increased by using larger seed pieces. Seed pieces weighing 70 to 80 g are recommended when knob size is important.

Planting is a mechanized operation and potato planters adapted to suit the irregular shape of ginger seed are used. Four persons with one machine can plant about 0·1 ha an hour.

Fertilizing

Ginger was grown initially without the aid of inorganic fertilizers and substantial quantities of mill mud or poultry manure were used. Today, on most farms, ginger is grown using a basal application of both organic and inorganic fertilizer and several side-dressings of urea or ammonium nitrate fertilizers.

When organic manures are used, recent research indicates that yield responses obtained when more than 500 kg per hectare of urea are applied are not economic. In the absence of basic organic manures, 600 kg per hectare of urea should be used while, on those blocks established under sawdust, 750 kg per hectare of urea may be necessary. Nitrogen is generally applied through the irrigation system in approximately 10 applications. Rates and timing of each dressing are related to the growth rate of the crop and the rainfall in each particular season. However, it is best to apply approximately 30% of the total nitrogen during the first 3 months of establishment with the remaining 70% being applied from early January to April.

Soil analyses before planting have been of assistance in determining the amount of potassium to apply. To date, it can be predicted that a crop grown on any soil type with a replaceable potassium level greater than 0·5 m.e. % is unlikely to respond to additional potassium. Below 0·5 m.e. %, two levels are recognized: less than 0·3 m.e. % of replaceable potassium and 0·3 m.e. % to 0·5 m.e. % of replaceable potassium.

In the lower range, positive yield responses were recorded with applications of up to 650 kg of potassium sulphate per hectare, while above 0·3 m.e. % no responses were recorded with rates above 325 kg of potassium sulphate per hectare.

It is advisable to obtain a soil analysis before planting to determine pre-plant potassium levels, so that accurate quantities of this element can be applied to meet the crop's requirements.

Trials have shown that split applications of potassium gave greater responses than a single basal dressing. A tentative recommendation is that 20% of the total potassium be given as a basal application, followed by 40% in mid November and 40% in early January.

Phosphorus is recommended as a basal application at 1 000 kg per hectare of granulated superphosphate (9·6 % P) or equivalent of other formulations. If the land is to be used for successive ginger crops, it would be advisable to have a soil analysis carried out as, on most farms, this level can be substantially reduced after the first year.

Irrigation

Irrigation is essential to supplement rainfall and to protect young emerging shoots from sunburning during the October to December period.

Irrigation is applied to ensure that the crop receives approximately 10 mm of water every second day from mid January until early March when the most rapid growth occurs.

Overhead sprinkling for protection against sunburn is extemely important in late October, November and December. When sunburning weather occurs, irrigation water is usually applied from 10 a.m. to 3 p.m. daily. This establishes a micro-climate over the crop, cooling both the air and the soil.

A low precipitation rate of approximately 2·5 mm per hour is required to avoid overwatering. To apply this low rate, it is important to have a well-designed and efficient irrigation system to ensure adequate coverage.

To obtain uniform watering at this rate, the sprinkler spacing should not exceed 30% of the wetted circle diameter for the particular sprinkler along the spray line, and the sprayline should be at right angles to the prevailing wind direction.

Secondly, the sprinkler spacing should not exceed 60% of the wetted circle diameter between spraylines.

Although irrigation is the only practical method for sunburn control in commercial plantings, it has some undesirable effects. When rainfall and sunburning conditions are experienced in close proximity, overwatering may lead to excessive leaching of plant nutrients and favour development of diseases. Also, soil temperatures may be reduced below the optimum for growth in the early months of the season.

Weed control

Weed control in ginger is essential to produce maximum yields. In the past, a 50 to 75 mm thick sawdust mulch was used for weed control. Nowadays, with the availability of suitable herbicides, mulching for this purpose has been discontinued.

Diuron is now used extensively for weed control. It has a low water solubility making it extremely persistent in soils, and suitable for use under the high moisture regime required by ginger.

Diuron has a broad spectrum control. It is usually applied with the addition of a surfactant as a pre-emergence herbicide before the ginger shoots emerge. In most situations, 4·5 kg of active ingredient per hectare are used but this may be varied depending on soil type. On sandy soils, lower rates may be used while on clay loams higher rates may be necessary.

Diuron without a surfactant may be applied after shoot emergence but before the leaves break if weed control is still necessary. Excessive rates of diuron will cause stunting, marginal leaf burn and chlorosis of the plant.

After the crop is established, paraquat may be used to control weeds. This chemical is a non-residual, contact herbicide and will kill ginger if applied directly to it. The use of paraquat is limited to spot spraying of weeds between beds and, in the early stages of plant growth, between rows.

Paraquat is best used during calm weather, and the nozzles should be shielded to restrict spray drift.

Harvesting

The time of harvest depends on the product for which the rhizomes are to be used. Ginger for use in confectionery and syruping is harvested before the rhizomes become too fibrous. This is known as early-harvest ginger.

Most other products come from the mature rhizomes, known as late-harvest ginger. The maximum fresh weight of rhizome is reached in early June, 9 months after planting. From then on, there is a gradual loss in weight.

Although there is fibre in the rhizome from the time it begins to develop, the amount is insignificant in the initial stages. As the physiological age of the rhizome increases, so does the diameter and strength of the fibre. It becomes 'commercial fibre' when it can be detected easily by shearing the rhizome with a blunt knife.

Fibrous ginger is unacceptable for processed confectionery because of its reduced palatability. Harvesting of confectionery grade ginger begins when 40% to 45% by weight of the rhizome is free of commercial fibre, and continues down to the 35% level.

Maximum yield is usually obtained at the lower end of the scale as the crop is then more mature. However, since the rate of fibre development may be as high as 1% of rhizome weight per day, growers cannot afford to wait until their readings are too low.

The early harvest begins in late February and continues until late March. The appearance of flower heads is usually an indication of more rapid fibre development.

At early harvest, the tops are green and firmly attached to the rhizomes. The stools are pulled by hand and the tops snapped off. Surplus soil and roots are removed before the rhizomes are placed in bulk bins for transport to the processing factory. Up to 57 tonnes per hectare of early-harvest ginger have been recorded though the industry averages 26 tonnes per hectare.

Methods of harvesting late ginger vary, but most growers use adapted potato diggers to lift the rhizomes. These lift a complete bed of three rows at once. The rhizomes are then picked up by hand and, after surplus soil and roots are removed, the ginger is bulk handled to the factory.

In experimental plots, yields in the vicinity of 120 tonnes per hectare have been recorded. The industry average for late harvest ginger is 37 tonnes per hectare.

Lamb, hogget or mutton?

IN the meat industry, lamb and hogget carcasses are distinguished from one another and from mutton carcasses.

This is done so that consumers can choose the type of sheep meats they want. The definitions of classes are important from the point of view of producers, butchers and consumers to ensure consumer satisfaction and equitable trading.

Prices and quality of the classes generally differ.

Classification into lamb, hogget or mutton is based on the incisor teeth of the animal at slaughter, which indicate its age. Lambs have only milk teeth, with no sign of either of the first pair of permanent incisors showing through the gum. Hoggets have their first pair of permanent incisors, but no sign of either of the second pair. This is so whether the classification is undertaken for export or the local trade.

Classification of sheep carcasses in Queensland is under the general supervision of Department of Primary Industries meat inspectors. Lamb carcasses are ribbon-branded with a dark pink colour and hoggets light orange. Older mutton carcasses are not branded.

These brands can be seen on portions such as chops, shoulders and legs so that consumers can identify them. They contain the letters 'LAMB' or 'HGT' but, even if these cannot be read, the colour tells the story. The dyes used are edible vegetable dyes and quite harmless.

—W. R. RAMSAY, Senior Meat Quality Officer.

Stock returns due on January 1

by Officers of the Division of Animal Industry.

EVERY owner of stock in Queensland is required to submit a stock return on 1 January each year.

This shows the number of animals he owns on that date, and he is required to pay an assessment on his stock in accordance with a rate determined by the Minister for Primary Industries. This is a requirement under the Stock Act.

The Department of Primary Industries maintains a register of stock returns and, in past years, as a service to owners, those whose names have appeared on the register have been supplied with stock and brand return forms for completion and return.

However, in accordance with the legislation, the onus is on the owner to obtain and submit a complete return. All owners who do not receive forms through the mail should make sure that the necessary forms are obtained and submitted. The forms can be obtained from Clerks of the Court or officers of the Department of Primary Industries.

The Act defines an owner of stock as 'the owner, whether jointly or severally, of stock, or the authorised agent of or the superintendent or manager for the owner of stock or the person in charge of stock'. It will be seen that the definition is an all-embracing one so that property managers or persons in charge of agisting stock or drovers of travelling stock are required to submit returns.

The term 'stock' means any one or more horses, cattle, sheep or pigs and includes foals, calves, lambs and piglets.

Because of the time involved in addressing and despatching return forms, the Department is now using a computer to print out addresses. For this purpose, the property index developed by the Veterinary Services Branch is being used. As many owners will be aware, this system identifies properties by gate numbers rather than by individual names. This is a common method of addressing correspondence nowadays as many people will be aware.

As the system of property numbering is still being developed, slight confusion may involve a small number of properties. Wherever this occurs, the assistance of owners in correcting the situation will be much appreciated. Such areas are most likely to occur where stock on one property are owned by more than one person.

At the same time as stock returns are sent out, a brand return form is also forwarded. It is most important that all registered brands and earmarks on a property, whether in use or not, should be shown on these returns and returns must be submitted each year. Failure to lodge a return for 3 successive years can lead to cancellation since there is an urgent need for brands by many owners at present.

The co-operation of all stock owners is sought in complying with these important operations.

An account of the use of the money raised under the Stock Act will be published in a later article.

by K. H. McINTYRE, Sheep and Wool Branch.

Changes in sheep industry over 20 years

QUEENSLAND'S sheep population of 16.2 million in 1952 was the third largest of the Australian States and represented 14% of the national flock.

After reaching a peak of 24·3 million in 1964 it began to fall, and by 31 March 1973 it was 13·7 million, less than 10% of the national total.

The present number of sheep was first reached in 1890 and is the lowest since 1906. Of the six States in the Commonwealth, only Tasmania now has fewer sheep than Queensland.

While the gross value of wool produced in Queensland reached $142 million in 1963-64, in 1971-72 it was worth $60 million. Part of this was because of extremely low prices paid for wool at that time. The amount of wool produced has declined by about 20% during the past 10 years.

About 98% of the sheep in Queensland are pure Merinos and more than 80% are grown in the pastoral zone. There the average annual rainfall is between 250 and 500 mm, which is too low and unreliable for cultivated crops.

The remaining 20% of sheep are grown in the more favourable grain producing areas and in the trap-rock and granite regions of south-eastern Queensland, where rainfall averages between 500 and 600 mm per annum.

The ratio of cattle to sheep has always been higher in Queensland than in other States. Only 65% of properties in the pastoral zone of Queensland derived their entire income from sheep, as opposed to 80% in New South Wales, South Australia and Western Australia (B.A.E. Survey 1965).

The same survey found that 24% of graziers in the pastoral zone of Queensland derived their income from sheep and cattle combined, as opposed to only 14% in the other three States studied.

The present study was undertaken to analyse the changes that have occurred within the sheep industry in Queensland during the past 20 years. Reasons for those changes have been propounded and factors which may influence the sheep industry in the immediate future have been elucidated.

The various shires which are relevant for sheep production in each of the statistical divisions are shown in Table 1. For convenience, the Darling Downs division has been broken into two: Darling Downs west and Darling Downs east. Except in Figure 1, these were the only shires used in the results presented. The shires which were omitted did not have sufficient sheep to be considered important as far as sheep production is concerned.

TABLE 1—THE SHIRES IMPORTANT FOR SHEEP PRODUCTION IN EACH STATISTICAL DIVISION

Division	Shires
1. North-west	Cloncurry, McKinlay, Richmond, Flinders
2. Far West	Barcoo, Boulia, Isisford, Winton
3. Central West	Aramac, Barcaldine, Blackall, Ilfracombe, Jericho, Longreach, Tambo
4. South-west	Bulloo, Murweh, Paroo, Quilpie
5. Roma	Balonne, Bendemere, Booringa, Bungil, Warroo
6. Darling Downs West ..	Murilla, Tara, Waggamba
7. Darling Downs East ..	Chinchilla, Inglewood, Millmerran, Rosenthal, Stanthorpe, Wambo

Sheep numbers by shires

The percentage changes in numbers of sheep during the past 9 years in the 29 more important shires for sheep production are—

Shire	Percentage reduction in sheep numbers from 31 March, 1964 to 31 March, 1973
Murilla, Wambo	greater than 70
Bungil, Bendemere, Millmerran, Chinchilla ..	60 to 70
Waggamba, Murweh	50 to 60
Winton, Rosenthal, Barcoo, Tara, Balonne, Paroo, Quilpie, Booringa, Tambo, Blackall, Ilfracombe	40 to 50
Bulloo, Waroo, Aramac, Barcaldine, Isisford, Boulia	30 to 40
Inglewood, Longreach, Jericho, Stanthorpe ..	20 to 30

The increase in grain growing has probably been a major contributing factor in the decline in sheep numbers in the first eight shires, where falls of more than 50% during the past 9 years have occurred. Cattle numbers have increased too but have been more closely aligned with the decline in sheep numbers in shires within the pastoral rather than the agricultural zone.

Where the decreases in sheep numbers have been less than 30% the shires represented are relatively unsuitable for either cattle or cultivation. The exception to this is the Jericho shire where sheep numbers have decreased steadily during the past 20 years and have been replaced by cattle.

The Jericho shire, together with the Belyando, Peak Downs, Bauhinia and Cloncurry shires, has fewer than 100 000 sheep and Emerald has fewer than 10 000. They have ceased to be very important as far as sheep production is concerned. The same applies to several shires on the eastern Darling Downs: the Clifton, Glengallan, Pittsworth, Cambooya, Allora, Crow's Nest and Rosalie shires have fewer than 10 000 sheep each, while the Chinchilla, Wambo, Jondaryan and Millmerran and Rosenthal shires have fewer than 100 000.

In the Darling Downs Division, the Inglewood, Stanthorpe, Waggamba and Tara shires are the main sheep producing areas. The Bulloo shire in the South-western Division and the Boulia shire in the Far Western Division are of marginal importance for sheep production.

During the past 20 years, the sheep zone has retracted east in the South-West and Far

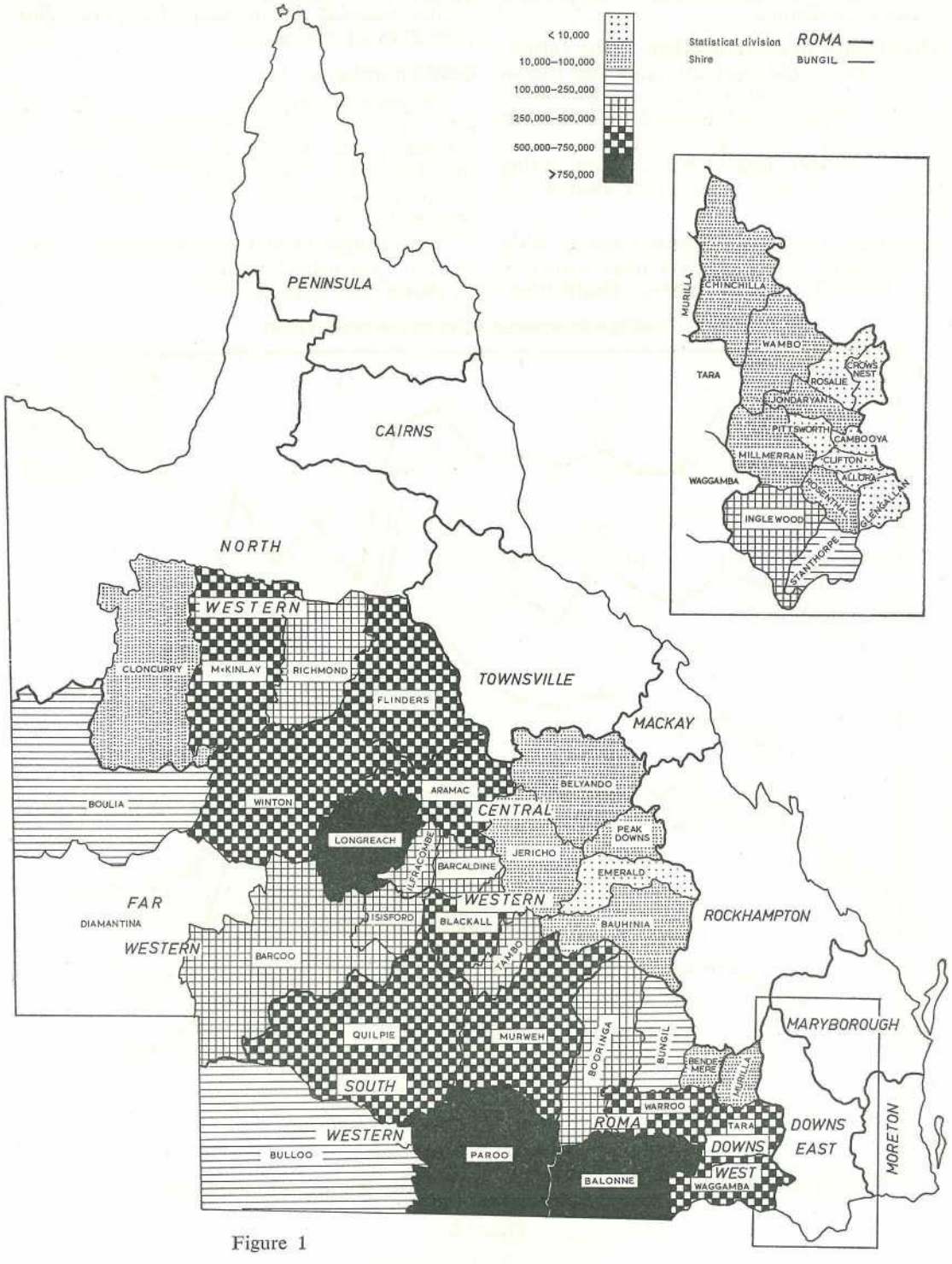

SHEEP NUMBERS BY SHIRES AT MARCH 1973
< 10,000
10,000–100,000
100,000–250,000
250,000–500,000
500,000–750,000
>750,000
Statistical division
Shire
ROMA
BUNGIL
PENINSULA
CAIRNS
NORTH
WESTERN
CLONCURRY
M<KINLAY
RICHMOND
FLINDERS
TOWNSVILLE
MACKAY
BOULIA
WINTON
ARAMAC
BELYANDO
CENTRAL
LONGREACH
PEAK DOWNS
JERICHO
BARCALDINE
EMERALD
FAR
DIAMANTINA
WESTERN
ISISFORD
BLACKALL
BAUHINIA
ROCKHAMPTON
BARCOO
TAMBO
QUILPIE
MURWEH
BOOKINGA
BUNGIL
MARYBOROUGH
SOUTH
WESTERN
BULLOO
PAROO
ROMA
WARROO
TARA
DOWNS
WEST
WAGGAMBA
BALONNE
DOWNS
EAST
MORETON
MURILLA
CHINCHILLA
WAMBO
TARA
CROWS NEST
ROSALIE
JONDARYAN
PITTSWORTH
CAMBOOYA
MILLMERRAN
CLIFTON
WAGGAMBA
ACLAND
INGLEWOOD
STANTHORPE

Figure 1

West; west in the Central West and Darling Downs Divisions, and south in the North-west and Roma Divisions.

The changes in sheep numbers in the various divisions during the past 20 years are shown in Figure 2. Maximum sheep numbers were reached in 1963-64 and declined following the 1965 drought. They then recovered somewhat in 1968-69, and declined again during the recession in wool prices from 1968-69 to 1971-72.

In certain divisions, namely Central West and Far West, sheep numbers have increased since 1970-71 but in others, South-West, Roma and Darling Downs West, numbers have continued to decline. A likely reason for this is that cropping and/or cattle have been more profitable alternatives.

Cattle numbers

Throughout Australia, more cattle are now run on sheep properties than was the case 10 years ago. Of the Australian cattle herd in 1972, 45% were run on sheep properties compared with only 20% in 1967 (B.A.E. Survey 1973).

The changes in total sheep and cattle numbers in Queensland during the past 20 years is shown in Figure 3.

CHANGES IN SHEEP NUMBERS IN DIVISIONS FROM 1952-53 TO 1972-73

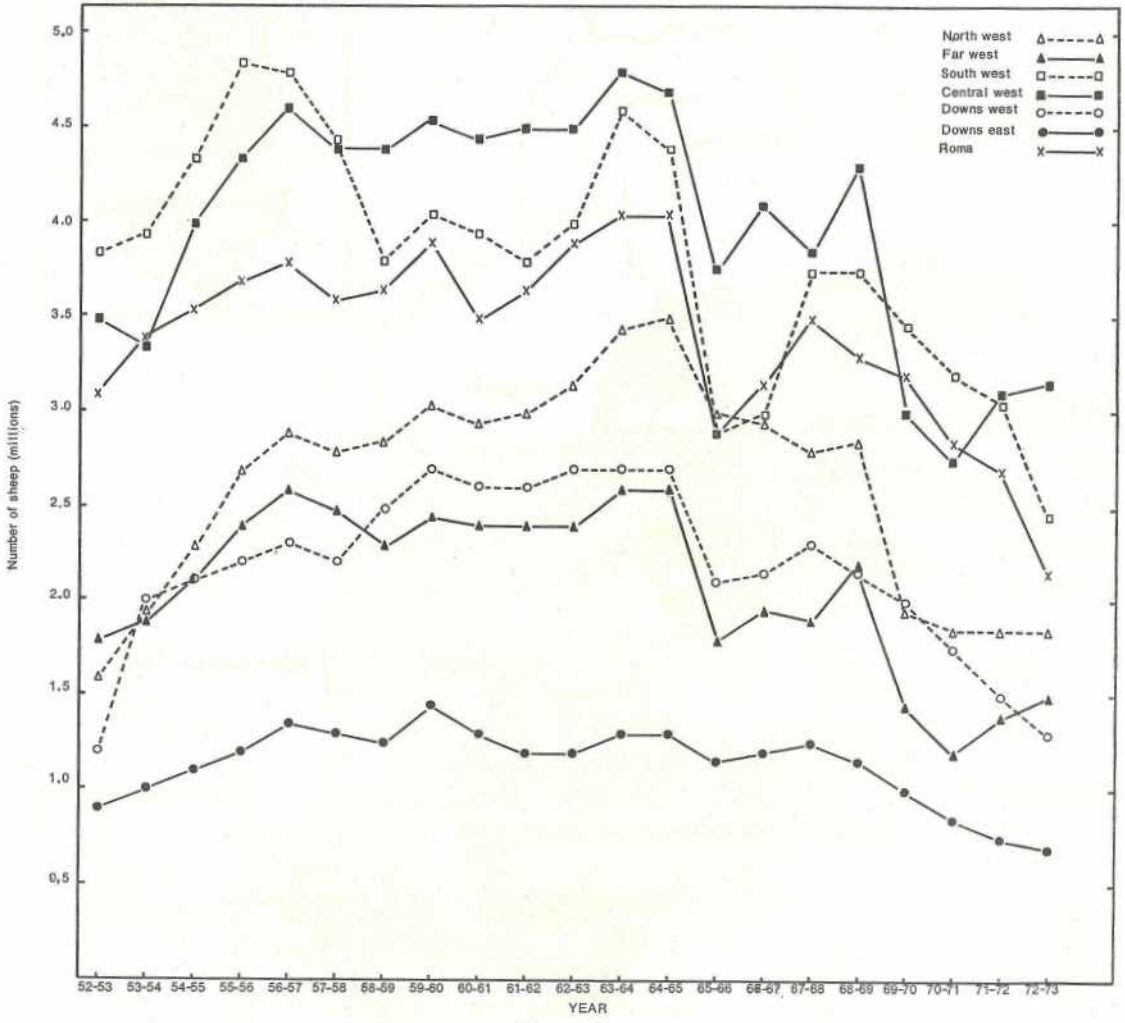


Figure 2

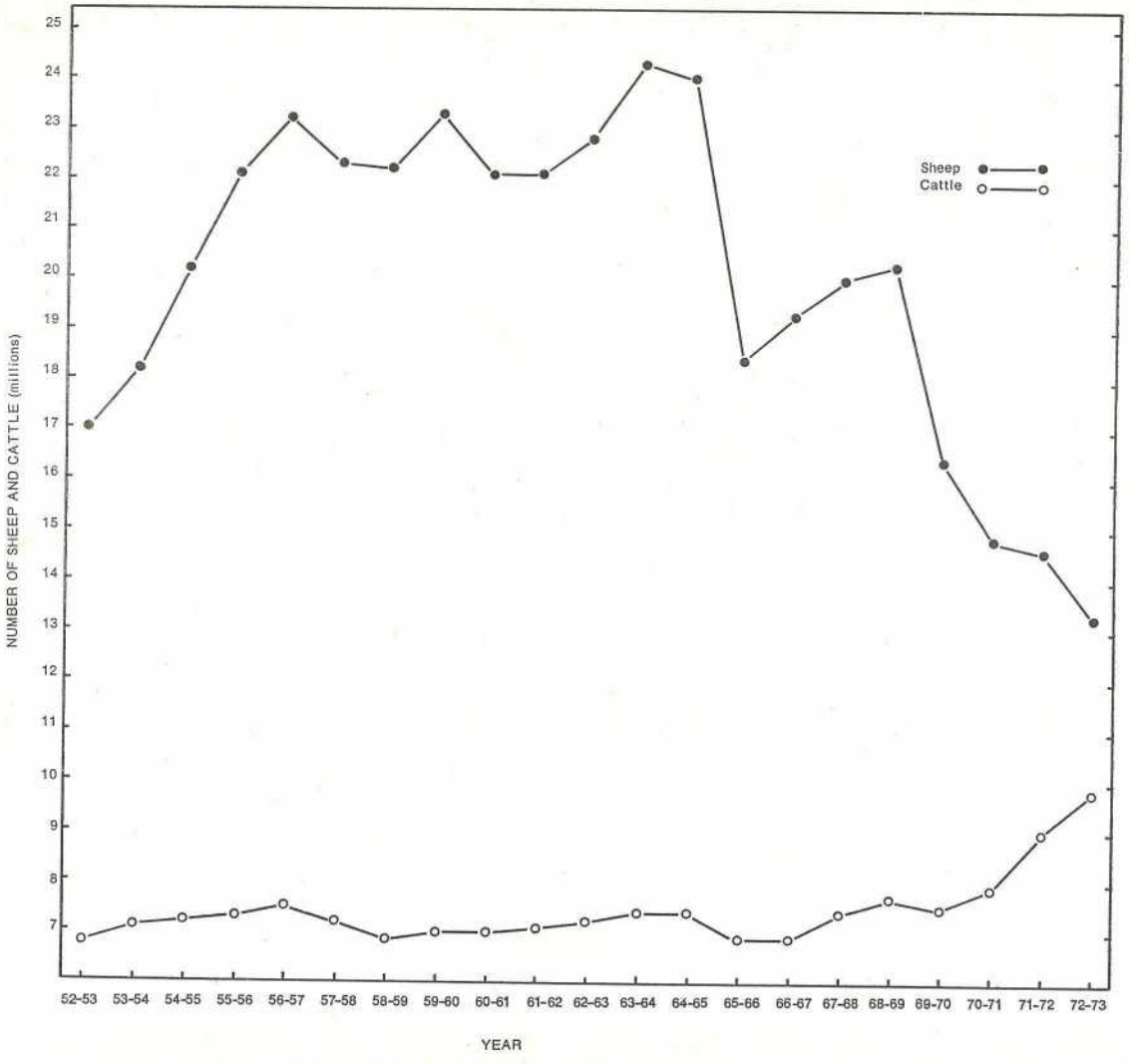


Figure 3

The increase in cattle numbers began in 1966-67 as numbers grew following the losses in the 1965 drought and with the steady increase in beef prices since 1961-62 as shown in Figure 4.

The changes in cattle numbers in each division are shown in Figure 5. The initial increases in 1966-67 (Figure 3) were particularly evident in the South-west, North-west and Roma divisions. These increases were checked during a dry period in 1968-69 but numbers have risen spectacularly in all divisions since 1970-71 when the prices paid for wool were extremely low.

The most pronounced increases in numbers of cattle have been in the North-west, Roma and Darling Downs West divisions.

Where increases in cattle numbers have been smallest, for example, the Far West and South-west, dry seasons pose greater problems for

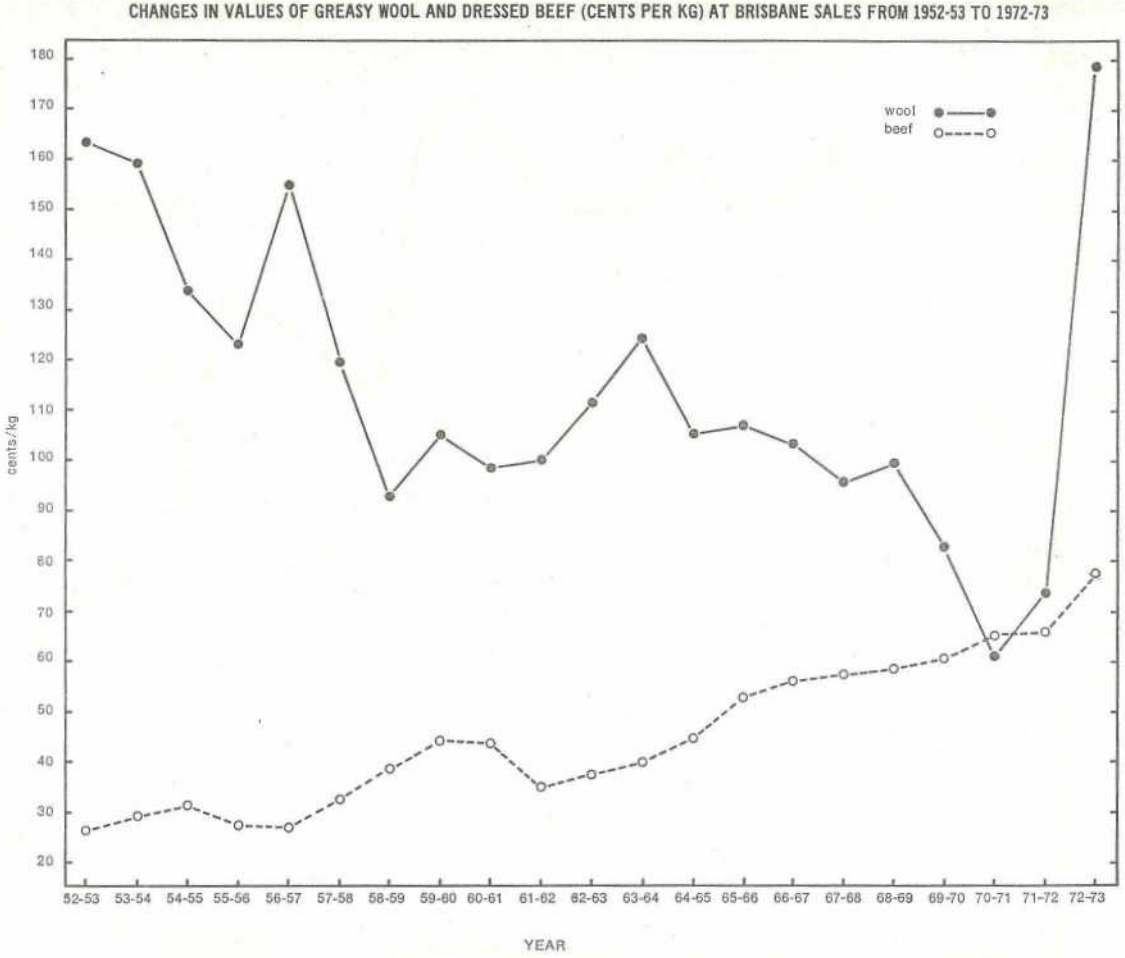


Figure 4

cattle than they do for sheep. Low rainfall averages coupled with poor reliability will probably preclude further large increases in cattle populations in these divisions.

Dry seasons during the past 20 years have affected both sheep and cattle numbers, not only by deaths as a result of feed and water shortages but also by the sale of stock interstate.

To try to minimize the effect of drought and to study the direct relationship between sheep and cattle numbers, cattle numbers were expressed as a percentage of sheep numbers. This was done for each division and the results for the six divisions are presented in Figure 6.

The changes are most pronounced in the Darling Downs east, Darling Downs west, North-west and Roma divisions where sheep numbers have fallen appreciably while cattle numbers increased. Although the percentage of cattle has increased in the Central West, South-west and Far West divisions, the changes have been relatively small, probably because the rate of decline in sheep numbers has been relatively small.

In the divisions most affected, there is every indication that the change will continue but this, of course, depends on the relative values of beef, wool and grain.

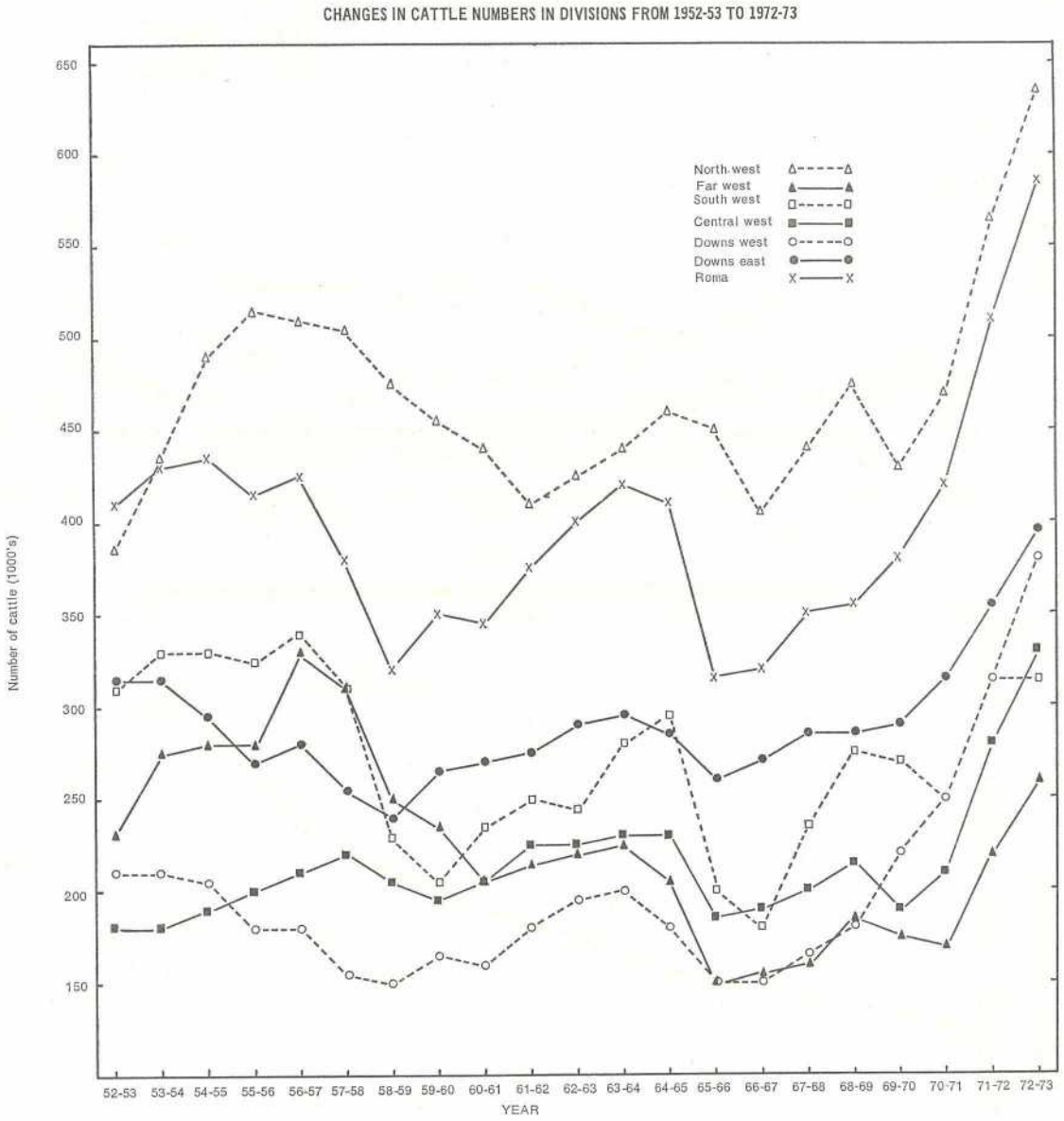

CHANGES IN CATTLE NUMBERS IN DIVISIONS FROM 1952-53 TO 1972-73
Number of cattle (1000's)
650
600
550
500
450
400
350
300
250
200
150
North-west
Far west
South west
Central west
Downs west
Downs east
Roma
52-53 53-54 54-55 55-56 56-57 57-58 58-59 59-60 60-61 61-62 62-63 63-64 64-65 65-66 66-67 67-68 68-69 69-70 70-71 71-72 72-73
YEAR

Figure 5

CATTLE NUMBERS/SHEEP NUMBERS (%) IN DIVISIONS FROM 1952-53 TO 1972-73

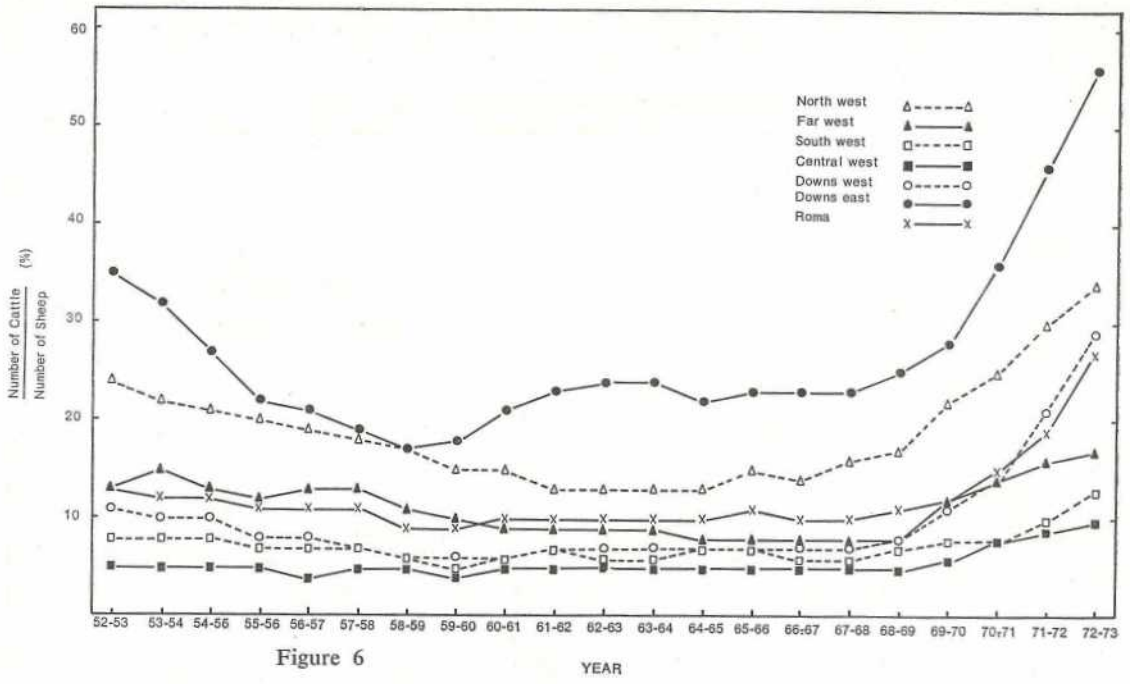


Figure 6

CHANGE IN AREAS UNDER CULTIVATION IN THE DOWNS AND ROMA DIVISIONS FROM 1952-53 TO 1972-73

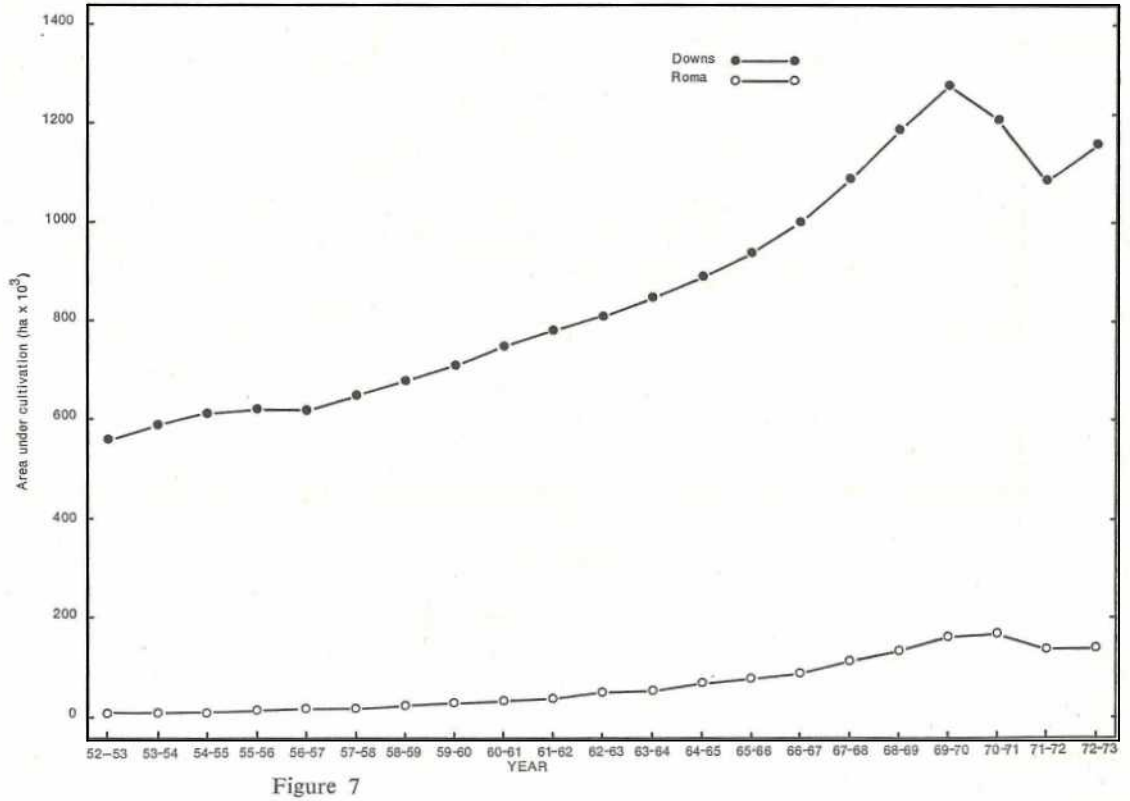


Figure 7

Area under cultivation

It is difficult to ascertain how much the reduction in sheep numbers in arable areas is due to increased cultivation. However, cultivation has certainly increased, particularly in the Darling Downs (East and West) and Roma divisions, as shown in Figure 7. The shires most affected during recent years include Bungil, Bendemere, Murilla, Waggamba, Milmerran, Wambo and Chinchilla. These have all experienced a 50 to 75% reduction in sheep numbers during the past 9 years. It would seem therefore that increased cereal and coarse grain production may have occurred at the expense of wool growing in these shires.

Wool production

The changes in total greasy weight of wool produced during the past 20 years is shown in Figure 8. The figure of 64 860 kg in

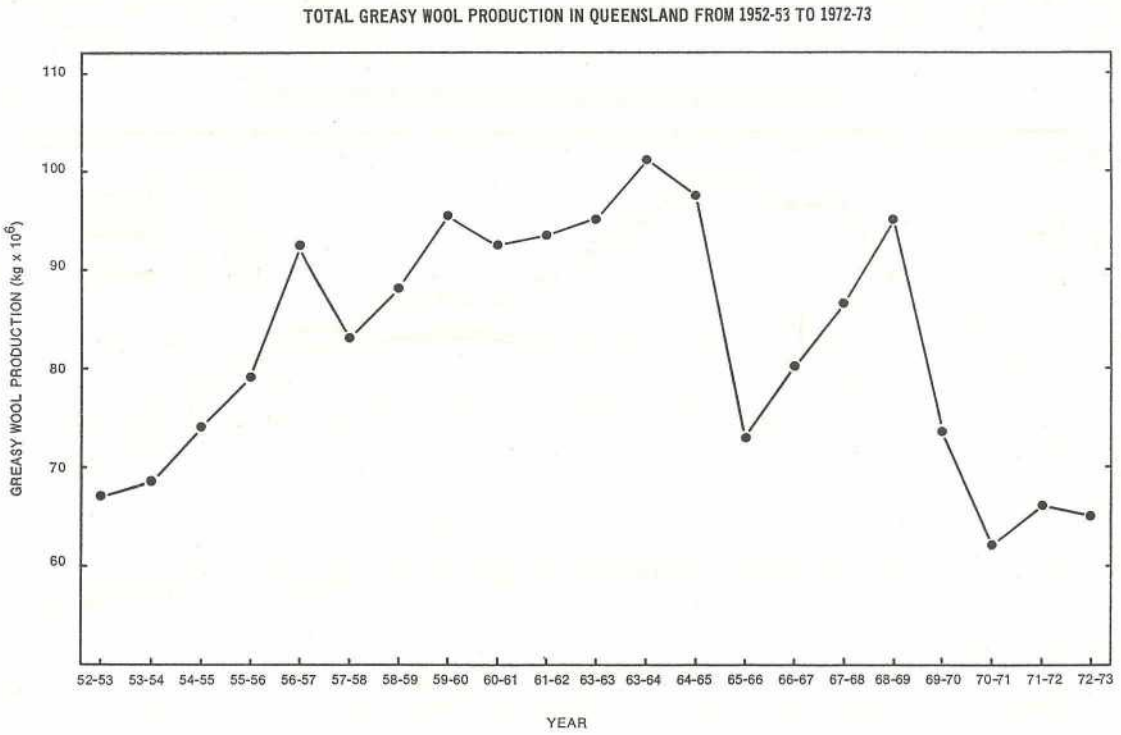


Figure 8

1972-73 was slightly higher than for 1970-71 which was the lowest for the 20 years.

However, present indications are that the lowest level has been reached and that production should increase considerably if prices for wool remain high enough for sheep production to be considered an economic proposition.

Projections of financial returns for 1972-73 indicated that returns from wool and sheep would double because of price increases in wool and meat (B.A.E. Survey 1973).

The average greasy fleece weights have increased generally since 1969-1970 particularly in the Far West, Roma, South-west and Central West divisions. Wool production per sheep has increased probably because of some overstocking before the reduction in sheep numbers and perhaps better seasonal conditions also.

The increased cuts of wool per head were by no means sufficient, however, to offset the rapid decline in sheep numbers and the total quantity of wool produced fell drastically from 1968-69 to 1970-71.

Average greasy fleece weights are currently highest in sheep in the Far West, 4·95 kg, and lowest in the North-west, 4·45 kg, and the Downs East, 4·36 kg. For the other divisions the average wool cut is about 4·75 kg per sheep per annum.

Composition of flocks

The proportion of breeding ewes is around 50% in each division except for the Downs West and Downs East where they are 37% and 27% respectively, because of the relatively high numbers of wether flocks.

The general trend has been an increase in the percentage of breeding ewes since 1967-68, especially in the Downs West, Roma and South-west Divisions. In the others the pattern is variable, probably related to dry seasons and the availability of replacement stock.

Numbers of sheep owners

Statistically, a sheep owner is a person who has more than 200 sheep. The number of sheep owners has declined steadily since 1959-60 from 6 500 to 4 500 in 1972-73 (Figure 9). About two-thirds of this fall is

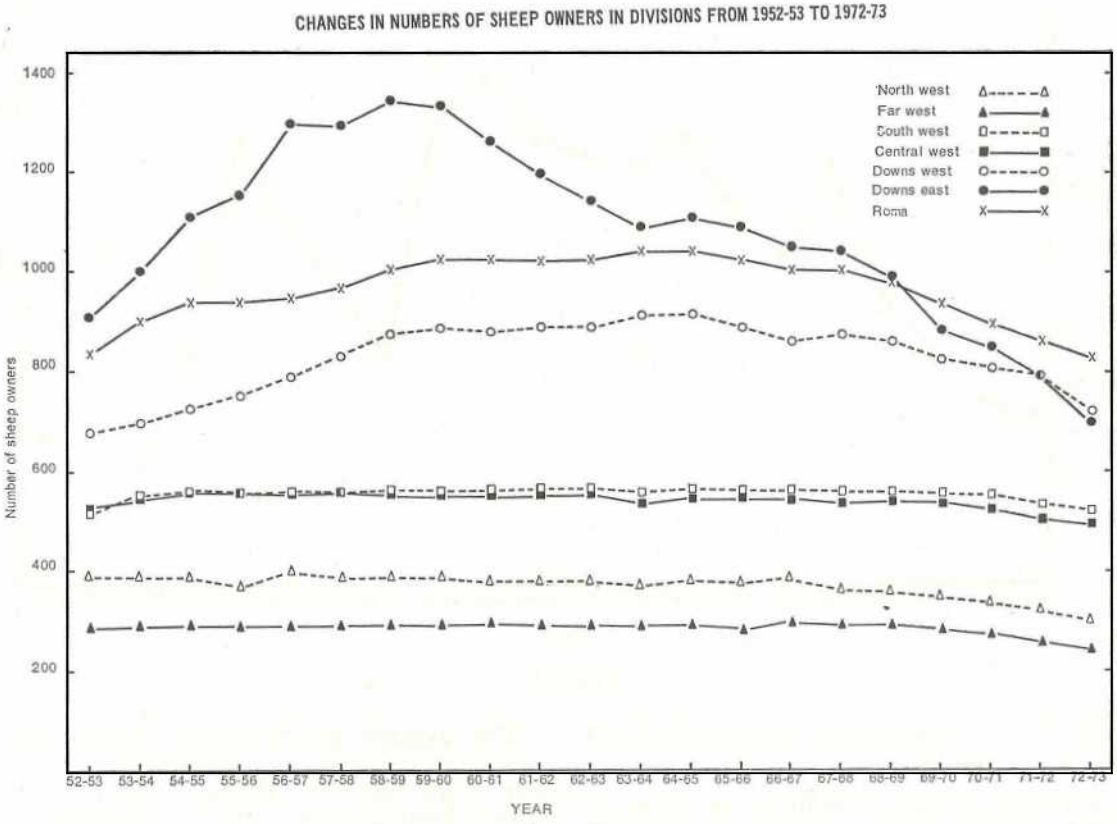


Figure 9

the result of a reduction in the number of sheep producers in the Downs East Division.

In Figure 9, the Downs East Division includes eight shires not now considered important for sheep production. The rest of the decline in sheep producers is through smaller reductions in the Downs West and Roma Divisions since 1964-65. These could well have had few sheep previously and have now changed to grain or grain-and-cattle production.

Small reductions in the numbers of sheep producers in the other divisions have occurred but these would represent about 20% in the

Far West and North West and fewer than 10% in the South-west and Central West. These would have occurred either from amalgamation of properties or a complete change to beef cattle production.

It thus appears that many of the sheep producers who have left the industry during the past 10 to 15 years have been marginally involved in sheep production. Hence it seems likely that the decline of about 40% in sheep numbers during the past 10 years has been mainly because of a reduction in sheep numbers and not the removal of sheep from properties.

However, sheep production may well have changed from being of primary to secondary importance at the expense of farming or cattle production on many formerly traditional sheep properties.

Prime lamb industry

The number of lambs slaughtered in Queensland for human consumption increased from 97 000 in 1951-52 to 355 500 in 1961-62, and to 939 000 in 1971-72. Expressed as percentages of the Australian total, these represent 1·4, 2·5 and 4·2% respectively, and are, at present, the second lowest in the six Australian States.

Most of the lambs slaughtered in Queensland are sent live from interstate, mainly from the New England area of New South Wales. The numbers of sheep other than pure Merinos in Queensland have fallen from 371 000 in 1961, to 325 000 in 1972. This represents only 2% of the total sheep population in Queensland.

From these figures, the number of lambs other than pure Merinos actually grown in Queensland is not likely to represent more than about 15% of the total number of lambs slaughtered each year. Some pure Merino lambs are slaughtered each year for meat consumption. Unlike other States, in Queensland, prime lambs are not reared on improved pastures but they are finished on grazing crops such as wheat and oats.

Future of the sheep industry

The most recent statistics available on sheep and cattle numbers are now more than 12 months old. During that period, beef prices have risen and fallen spectacularly, wool prices have fallen gradually from a peak in 1972-73 and grain prices have risen appreciably. Therefore it is impossible to make accurate predictions for the future because of such instability in prices.

The future of the sheep industry depends very largely on the price paid for wool, the cost of wool production and the availability of labour. At recent prices and costs of production, wool growing has been a reasonably attractive proposition economically.

Sheep numbers have increased in most shires because of good seasons and a renewal of confidence in wool production and despite recent floods and blowfly waves. However, cattle numbers and, in arable areas, the areas under cultivation have also increased. Most sheep producers are maintaining a flexible position by having cattle as well as sheep, and crops where it is possible climatically.

In 1970-71, total costs per sheep-equivalent in the pastoral zone were estimated as $3·07 to $4·51 (B.A.E. Survey 1972). Assuming an average greasy fleece weight of 4·75 kg, this represents a cost of about 80c per kg.

Since 1970-71, costs have risen appreciably so that it would seem reasonable to assume that wool prices would now have to be maintained at least at a level of 140c per kg greasy weight for wool production to be an economical proposition and for confidence in the future of the industry to be maintained.

Labour for shearing and station management is now both very expensive and desperately short, especially in the more remote areas of the North-west, Far West, and South-west divisions. Expenditure on labour and contracts, together with shearing expenses, represent 33% of property costs in the pastoral zone (B.A.E. Survey 1973).

This present shortage of labour could be sufficient to decide people in areas most affected to produce more cattle and fewer sheep, despite reasonable wool prices, because the production of cattle is considerably less labour-intensive than for sheep.

Having both cattle and sheep and thus maintaining a degree of flexibility against price fluctuations in wool and beef will probably be the keynote of success for primary producers in the pastoral zone for the next few years at least.

Share cropping for profit

MANY successful property owners of today started their careers as sharefarmers. For a man with limited capital, this has been a method of accumulating sufficient assets and experience to allow him to buy a property later on.

This article examines the economic basis behind drawing up an equitable sharefarming agreement. Because sharefarming contracts may be required on any of a wide range of properties, implying a diverse and wide ranging set of variables (for example, farm size, soil type, rainfall and so on), it is difficult to design a blue print for sharefarming contracts.

A method of approach incorporating a 'decision model' is presented for each party to follow. It is suggested that the split up of gross receipts to which each party is entitled should be determined by the proportion of each individual's costs to the total cost.

However, since the costs of each party includes opportunity costs related to each individual's forgone alternatives, these costs must be determined separately. This implies an 'area of negotiation' before completing the contract, whereby it may be possible to reach agreements which satisfy the objectives of both parties.

by T. D. WILSON and L. T. WICKSTEED, Agricultural Economists.

Sharefarming agreements have typically been arrived at by rules of thumb based on experience. In share cropping, the most common agreements provide for the sharefarmer to supply plant, pay all cropping costs and be responsible for crop management for which he receives either two-thirds or three-quarters of the gross crop receipts.

With rising costs and the uncertainty attaching to crop yields and returns, it is important to base the sharefarming venture on a thoroughly documented contract based on full agreement between the parties. This can be achieved only after careful and informed study of the economics of the proposed agreement by each party. From the point of view of both, it is important that the sharing of farm income be equitable, and should reflect as near as possible the productivity of resources contributed by each party.

Objectives

The objectives of both the sharefarmer and the owner are—

SHAREFARMER: to maximize the return to capital contributed (that is, plant and working capital) bearing in mind the level of risk involved, after charging a realistic opportunity cost for labour and management input. The objective of the model is to arrive at the minimum share of expected gross receipts to the sharefarmer to meet the above objective.

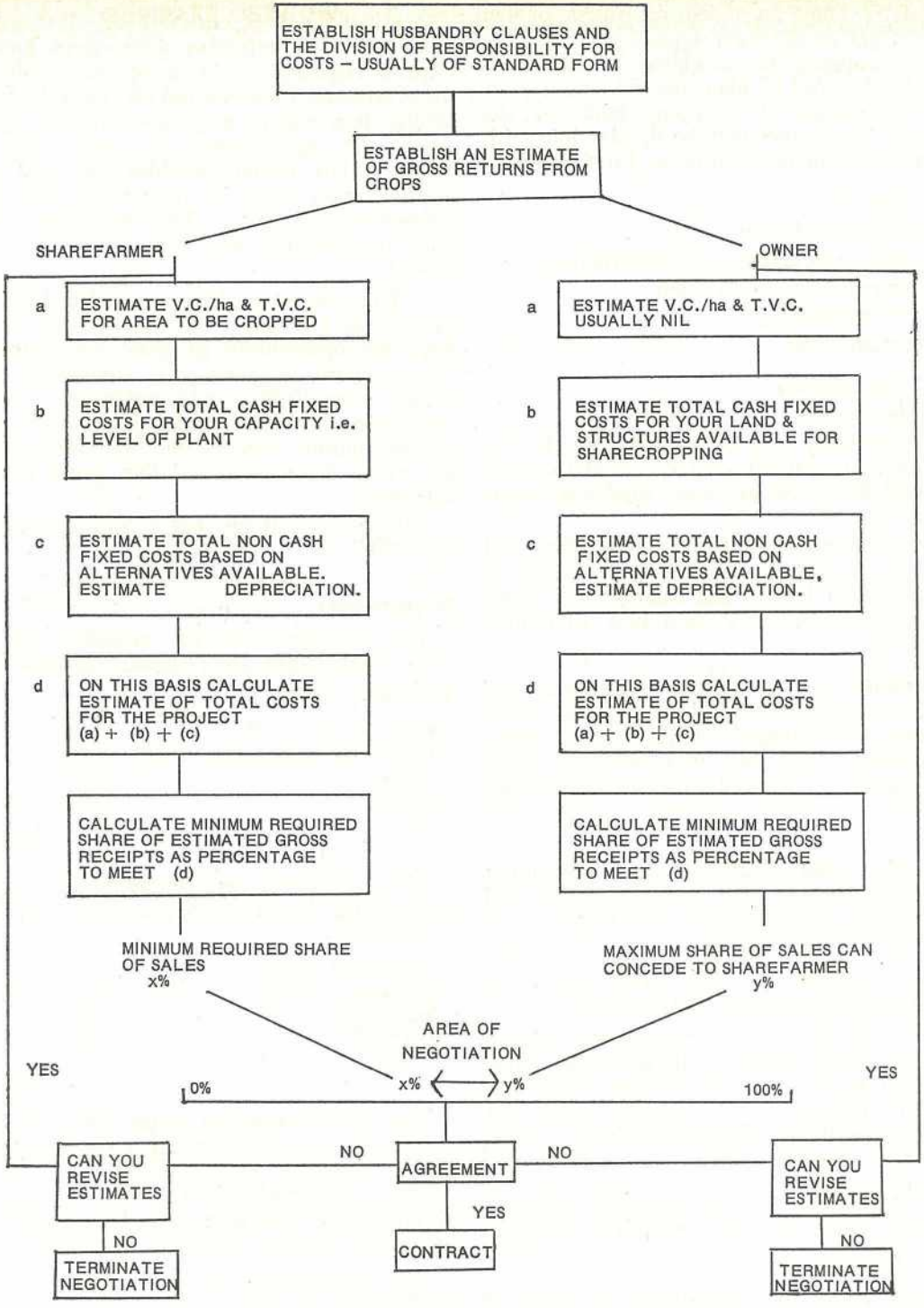
OWNER: to maximize the return to capital contributed and to ensure growth in capital assets (that is land and structures), bearing in mind the level of risk involved. The objective of the model is to arrive at the maximum share of gross receipts the owner is prepared to pay the sharefarmer consistent with meeting the objective.

Costs

The yearly costs of a cropping operation may be classified as follows—

FIXED COSTS. These costs are fixed in relation to a particular level of investment or

Model of procedures and decisions involved in deriving a sharefarming contract. Note that this model and the accompanying example assume that both parties have the same estimate of gross returns. ▸


ESTABLISH HUSBANDRY CLAUSES AND THE DIVISION OF RESPONSIBILITY FOR COSTS – USUALLY OF STANDARD FORM
ESTABLISH AN ESTIMATE OF GROSS RETURNS FROM CROPS
SHAREFARMER
OWNER
a
ESTIMATE V.C./ha & T.V.C. FOR AREA TO BE CROPPED
b
ESTIMATE TOTAL CASH FIXED COSTS FOR YOUR CAPACITY i.e. LEVEL OF PLANT
c
ESTIMATE TOTAL NON CASH FIXED COSTS BASED ON ALTERNATIVES AVAILABLE. ESTIMATE DEPRECIATION.
d
ON THIS BASIS CALCULATE ESTIMATE OF TOTAL COSTS FOR THE PROJECT (a) + (b) + (c)
CALCULATE MINIMUM REQUIRED SHARE OF ESTIMATED GROSS RECEIPTS AS PERCENTAGE TO MEET (d)
a
ESTIMATE V.C./ha & T.V.C. USUALLY NIL
b
ESTIMATE TOTAL CASH FIXED COSTS FOR YOUR LAND & STRUCTURES AVAILABLE FOR SHARECROPPING
c
ESTIMATE TOTAL NON CASH FIXED COSTS BASED ON ALTERNATIVES AVAILABLE, ESTIMATE DEPRECIATION.
d
ON THIS BASIS CALCULATE ESTIMATE OF TOTAL COSTS FOR THE PROJECT (a) + (b) + (c)
CALCULATE MINIMUM REQUIRED SHARE OF ESTIMATED GROSS RECEIPTS AS PERCENTAGE TO MEET (d)
MINIMUM REQUIRED SHARE OF SALES x%
MAXIMUM SHARE OF SALES CAN CONCEDE TO SHAREFARMER y%
AREA OF NEGOTIATION
x% y%
0%
100%
YES
YES
CAN YOU REVISE ESTIMATES
NO
TERMINATE NEGOTIATION
NO
AGREEMENT
YES
CONTRACT
NO
CAN YOU REVISE ESTIMATES
NO
TERMINATE NEGOTIATION

capacity. They are fixed regardless of the crops grown or the area cropped, provided the level of capacity for cropping is unchanged (that is, the level of plant for the sharefarmer and the amount of cropping land for the owner). Fixed costs may be divided into cash and non-cash or notional costs, for example—

CASH COSTS—
- —permanent labour
- —repairs and maintenance of structures
- —insurance and registration
- —administration
- —rent and rates

NON-CASH COSTS—
- —depreciation
- —opportunity cost of capital (that is, the return to capital available from the next best alternative use under similar risk conditions)
- —opportunity cost of operator's labour and management input (that is, the return to the same labour and management input available from the next best alternative use).

VARIABLE COSTS. These costs may be divided into direct and indirect variable costs. However, both categories have in common the characteristic that they vary with the level of output, that is, variable costs associated with any crop will vary in accordance with the area grown.

Variable costs are all cash costs. Examples are: casual labour, fuel and oil, repairs and maintenance of plant, seeds and fertilizer, pest and weed control in crops.

The principles on which costs should be shared may be expressed in this way—

1. Costs should be met in accordance with the responsibility attaching to them, as determined by the husbandry clauses of the contract. That is, the sharefarmer should not be responsible for meeting costs over which he has no responsibility in incurring. For example, responsibility for weed control expenditure in a share cropping arrangement should be determined by reference to the contract.
2. Costs should be accountable in terms of responsibility.

WORKED EXAMPLE

Consider an extensive grain farm on the Central Highlands. In accordance with the usual husbandry clauses and division of responsibility attaching to most sharefarming agreements, the apportionment of costs is set out below. (The owner provides the land and improvements and is responsible for any upkeep on structures. The sharefarmer supplies his own plant and bears all the cropping costs.)

The area to be share cropped is 1 000 ha (valued at $75/ha). The sharefarmer would have the opportunity to grow both summer crops (grain sorghum and sunflower) and winter crops (wheat and safflower). After considering average district yields and commodity outlook reports, the sharefarmer and the owner have estimated that gross returns will be:—

1 000 ha at $50/ha (net of selling costs) = $50 000.

Sharefarmer

The variable costs for cropping on the Central Highlands are estimated as follows—

VARIABLE COSTS

	$/ha
Fuel and oil	$2.50
Repairs and maintenance of plant	2.00
Seed	2.00
Pest control	1.00
Sundry	1.05
	$8.55/ha

The cash fixed costs, in relation to the fixed plant of the sharefarmer, is estimated by him as follows—

CASH FIXED COSTS

Permanent labour	3 750
Insurance	750
Registration	350
Administration	400
	$5 250

The sharefarmer has made inquiries and evaluated other sharefarming proposals available to establish his opportunity costs under similar risks situations. In practice, this may be little more than an awareness or knowledge of returns available to other sharefarmers.

If a large proportion of his plant is leased or financed by hire purchase, then the true rate of interest charged will mark the lower

limit to his opportunity cost. Opportunity costs are assumed to be established as follows—

Labour and management input (that is, salaries payable to managers of cropping farms of equivalent size)	$7 000	
Return on capital (that is, return available from the best alternative offering; for example 20% on capital of $25 000 ..	$5 000	
Depreciation in real terms is estimated at	$6 200	
		$18 250
Add cash fixed costs		$5 250
Total fixed costs		$23 500

The sharefarmer is now equipped with all the cost data required to enter discussions with the owner, that is—

Total variable cost 1 000 x $8.55	$8 550
Total cash fixed costs	$5 250
Total non-cash costs	$18 250
Total cost	$32 050

Therefore, the minimum required share of gross receipts for the sharefarmer to accept this contract is $32 500. Therefore, his minimum required share of sales is: 32 050/50 000 x 100 = 64%

Owner

In accordance with the agreement in this example the owner's variable costs are nil.

The cash fixed costs of the owner in relation to his property are estimated by him as follows—

CASH FIXED COSTS		
Administration	$400	
Repairs to structures	$650	
Rent and Rates	$1 250	
		$2 300

The owner has investigated several other sharefarmers and alternative uses for his capital under similar risk situations to establish his opportunity cost. In practice this may be little more than an awareness of returns achieved by other farmers employing sharefarmers.

The return available from low-risk securities may establish the lower limit. However, in practice, many farmers are prepared to accept a return of less than the yield on low risk securities.

Return on capital (that is, return available from best alternative offerings, for example, 9% on a capital of $75 000 ..	$6 750	
Depreciation in real terms is estimated at	$1 250	
		$8 000

The owner is now equipped with all the cost data required to enter discussions with the sharefarmer. These are—

Total variable costs	Nil
Total cash fixed costs	$2 300
Total non-cash costs	$8 000
Total cost	$10 300

The minimum share of gross receipts required by the owner to accept this contract is $10 300. Therefore, the maximum share of sales the owner can concede to the sharefarmer is $100 - \frac{10\,300 \times 100}{50\,000} = 79\%$

Summary

This example is somewhat simplified in that both parties have the same estimate of yield. The example could be expanded to arrive at a range of possible outcome by using parametric estimates of both crop yields and prices.

After independent investigation of costs and alternatives, the owner and proposed sharefarmer enter negotiations fully informed. In this example, agreement will be reached on the share of gross receipts somewhere between 64% and 79% of sales to the sharefarmer.

The exact point of agreement will depend on the relative bargaining strength of each party but a figure in the range of 69 to 74% would appear equitable in this example.

Consider the situation if 70% to 30% basis were agreed to. Then the share of sales would be:

Owner	30%	$15 000
Sharefarmer	70%	$35 000
		$50 000

The return on the owner's investment in land and improvements as a percentage:

Share of sales		$15 000
Less cash fixed costs	$2 300	
Less depreciation	$1 250	$3 550
		$11 450

$$\frac{11\,450 \times 100}{75\,000} = 15\%$$

This is in excess of his opportunity rate of 9% available from the next best alternative and is therefore acceptable to him.

The return on the sharefarmer's investment in plant and working capital as a percentage:

Share of sales		$35 000
Less variable costs	$8 550	
Less cash fixed costs	$5 250	
Less depreciation and labour and management charge	$13 250	
		$7 950

$$\frac{7\,950 \times 10}{25\,000} = 32\%$$

This is in excess of his opportunity rate of 20% available from the next best alternative and is therefore acceptable.

The return to the sharefarmer's capital is higher than the owner's because of his higher opportunity rate of 20%. This is partly because of the inherent risks of sharefarming and a high return to capital is required to compensate for this.

Note, however, that this works in reverse. In poor years, the sharefarmer's percentage loss is much greater and it is this variability in return which exemplifies the share farmer's risks.

The point at which agreement is reached in negotiation, and the level of capital employed, also contribute to the return on capital which is achieved.

In very poor years, it is possible for the sharefarmer to cut his losses to some extent. For example, during the 1969-70 drought in the Central Highlands, there was very little work to be done on grain properties and some sharefarmers were able to obtain off-farm work to meet standing fixed costs.

SHARE CROPPERS' GUIDELINES

Aspects which an intending share cropper should investigate before entering a share farming contract are:

(1) The current market outlook for the crops he can grow.

(2) The average crop yields in the district and the likely variability in yields.

(3) The term of contract offered. A 5-year contract would involve lower yield risk but higher price risk than a shorter 3-year contract. The weighting attached to each risk will determine the assessment of overall risk by the sharefarmer.

(4) Provision for termination by either party giving adequate notice: compensation provisions for loss on termination.

(5) The size and cost of machinery required. Machinery must be used fully to prevent excessive average fixed costs.

(6) His expected annual costs, variable and cash fixed costs.

(7) The opportunities available as alternative uses for his labour, management and capital to establish his opportunity costs.

(8) The general physical features of the property, for example, soil types and capability.

There are no statutory provisions covering sharefarming contracts in Queensland. Therefore, it is very important that a written agreement be drawn up, preferably by a solicitor.

The agreement or contract document outlines the responsibilities of both parties and should be based on a full understanding and agreement on all aspects. It serves as a final reference in disputes and must therefore be comprehensive enough to cover such points as rights to grazing stubble and compensation for capital improvements undertaken by the sharefarmer. Verbal agreements are often unsatisfactory.

A well-drafted sharefarming contract based on full agreement between the parties can be mutually beneficial and result in an efficient use of available resources.

Hints on freezing meat at home

A freezer in the farm home has made life in the country more comfortable and added welcome variety to country meals.

But getting the best out of your freezer demands careful packing and a knowledge of what you're about.

The Australian Meat Board Food Consultant (Mrs. Tess Mallos) this month gives some advice on freezing meat in the home.

Meat packed and labelled ready for the freezer.

Meat quality

It is most important that the meat to be frozen should be in good condition, but has been allowed to hang for a few days. Your supplier will be able to advise you on this. Lamb should be prepared for freezer storage 2 to 3 days after slaughter; beef should hang in a cool-room for a minimum of 5 days to ensure tenderness.

If, however, the beef has been 'Tenderstretched'—hung from the pelvic bone instead of the shank immediately after dressing—then it may be prepared for the freezer without waiting for the hanging period suggested for beef prepared by the conventional method.

Packing meat for the freezer

Avoid careless packaging for freezing; care will pay dividends. If you have gone to the expense of purchasing a good deep-freeze unit, make absolutely sure any food to be frozen stays at its peak in quality, freshness and nutriments.

Do not merely place the meat in any air-tight container and feel that is sufficient—it is not. Air must be excluded as much as possible around the meat surfaces. Too much air trapped in with the meat causes larger ice crystals to form, leading to more loss of juices when meat is used later.

Also inefficient wrapping, which could expose meat to the very cold temperatures, causes 'freezer burn' to exposed areas—dried-out white patches that lower quality and flavour.

To exclude air, wrap meat closely in clear plastic film which clings to itself. As you wrap, press out air as much as possible. Even if the wrap clings well, seal with tape to ensure the wrapping stays in place; the clinging properties of the film decrease with long storage. After air has been excluded, re-wrap the package in a thicker, moisture and vapour-proof material; or put in an air-tight plastic container.

The filmsy, clinging-type wrap is not thick enough for long-term freezer storage. It doesn't offer enough protection and can tear easily.

Suggested wrappings are: sheet polythene, polythene bags, pliofilm or aluminium foil.

Seal these well with masking tape, the closest product to freezer tape that is readily available. It comes in varying widths and is also an ideal surface on which to write.

Labelling packages

Use a grease pencil or marking pen, ball-point or felt-nibbed pen which is waterproof and does not smudge. Record the cut of meat, weight (optional, though an advantage when checking supplies) and date (most important).

Hints on packaging

'Pad' bones with doubled waxed paper or plastic wrap so that they do not tear main wrapping.

Trim as much fat as possible; the flavour of frozen meat is improved if there is a small amount of fat.

Wrap enough meat in each package for a family meal. This saves on materials used and is far more convenient when it comes to meal preparation.

Separate layers of chops or steak with waxed paper or plastic film for easy separation when thawing and cooking.

Press minced meat as flat as possible before wrapping so that thawing time can be minimized.

Make hamburgers a square shape—if rounded it is very difficult to exclude most of the air. Separate with waxed paper or plastic film and they can then be cooked straight from the freezer.

How to freeze meat

As freezing must be as rapid as possible, it is important that fresh meat should be kept chilled during packaging. If necessary, chill again in the refrigerator after packaging and before freezing.

Set the freezer unit at its coldest point or on 'fast freeze' at least 2 hours before loading (follow manufacturer's instructions).

Place the packages so that air can circulate freely. The amount of meat being frozen at one time should not exceed 10% of the available storage area. When frozen, pack close together and add more packages from the refrigerator. Continue until all meat is frozen, then re-set freezer for normal operation (minus 18° C or 0° F).

Period of storage

If the unit's temperature is constant at minus 18° C beef and lamb can be stored for 12 months; minced meats to 6 months and fancy meats up to 4 months. However, as units are constantly in use for removing goods and for freezing fresh supplies, maintaining a constant temperature is impossible. Because of temperature fluctuations it is a wise precaution to reduce the maximum times given by half.

Check the temperature of a home freezer with a special freezer thermometer; adjust settings to agree with recorded temperatures. Any temperature above minus 18° C shortens the life of food stored.

Thawing and cooking

The latest information on the handling of frozen meats indicates thawing meat for long periods at room temperature can be harmful. Micro-organisms can multiply in the outer layers of thawed meat while the centre is still frozen. Slow-thawing in the refrigerator is preferable. Thawing time varies with the thickness of meat, but eight hours per 500 grams (1 lb.) is the figure on which to base calculations. When slow-thawing, loosen wrapping to allow air circulation around meat.

In an emergency, frozen meat can be fast-thawed by placing sealed package under cold, running water.

Most meats can be cooked from the hard-frozen or partly thawed state, though it is important to check that roasts are cooked at the centre by using a meat thermometer. Keep in mind that the larger the area of cut meat surface, the more 'drip' there will be during thawing, so a steak would be much juicier if cooked from the frozen or partly thawed stage than if completely thawed before cooking.

GRILLING. Use frozen or partly thawed soft frozen meat. Turn with tongs every 2 minutes until meat is thawed and sealed, then proceed as for fresh meat.

PAN GRILLING. Use partly or completely thawed meat so that there is good contact with the heat surface for even browning.

ROASTING. Use frozen, partly or completely thawed meat. Calculate cooking time for fresh meat and add half that time again for frozen meat to give approximate total cooking time. Use a meat thermometer to check that the joint is cooked at the centre.

BRAISING, STEWING, SIMMERING. Use partly or completely thawed meat if recipe calls for browning meat first. Use frozen or partly thawed meat if browning is not necessary.

Home freezing meat can be fun. It can also be a good insurance against unexpected demand on the larder—and by buying well, it can save you money.

S. G. REID, Government Printer, Brisbane

Two crown rot diseases of lucerne

Sclerotium crown rot

SCLEROTIUM crown rot is caused by the fungus *Sclerotium rolfsii*. Although widespread in occurrence, it rarely causes serious losses but is generally restricted to individual plants and is more evident in younger stands.

The main symptom of this disease is a general, light-brown to dark-brown rot extending throughout the stem bases and crowns and into the roots. Characteristic white wefts of the fungus generally cover the surface of the affected tissues.

The fungus causes a similar disease in a wide range of crops grown in Queensland, particularly under high rainfall in summer.

Careful seedbed preparation, with crop residues being thoroughly incorporated into the soil well before sowing, will assist in minimizing losses.

Stagonospora crown rot

STAGONOSPORA crown rot, caused by the fungus *Stagonospora meliloti*, is usually prevalent in lucerne stands more than 2 years old.

Affected plants are usually stunted and occasionally yellow in colour. The disease is recognized by the characteristic reddish streaking and flecking of the internal tissues of the roots and crown.

As the rot progresses, the older, diseased tissues dry and become decayed. Unlike the other crown rots of lucerne, Stagonospora crown rot causes a slow decline of plants over a period of 3 to 4 years.

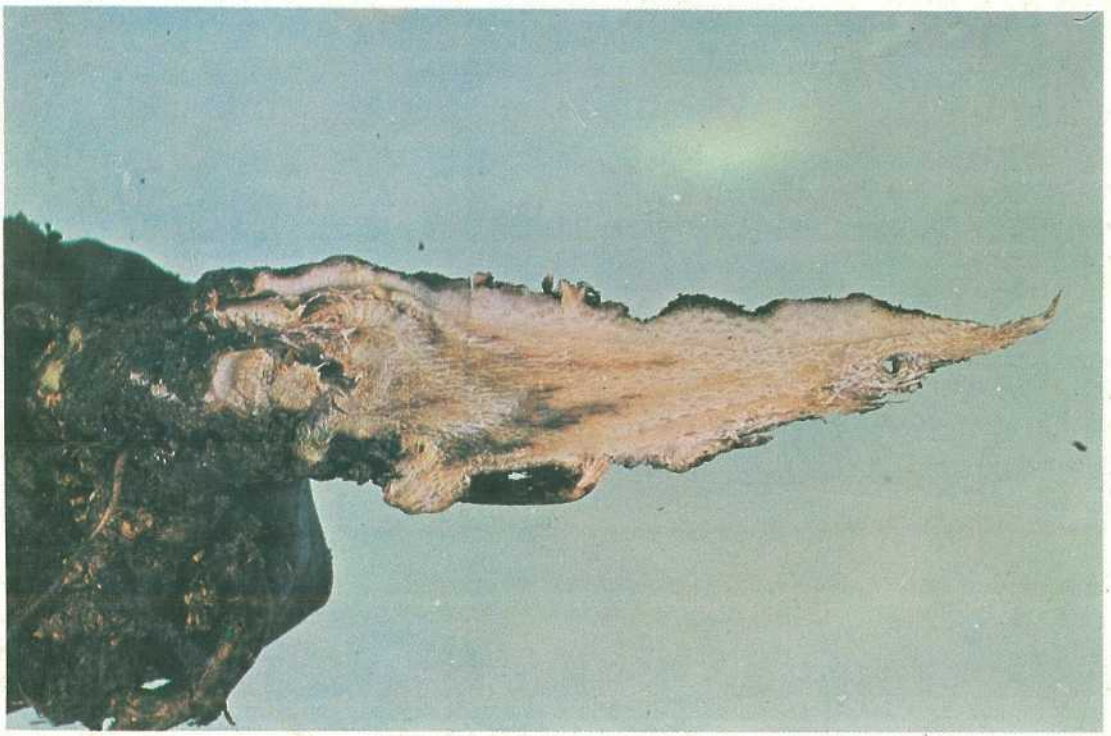
Careful management to prevent undue stress will assist in minimizing the effect of the disease. Overgrazing should be avoided to reduce excessive wounding of the crowns.

— Plant Pathology Branch

Further information, including recommended cultivars and fungicides, can be obtained from your nearest Plant Pathology Branch office or by writing to the Director, Plant Pathology Branch, Department of Primary Industries, Meiers Road, INDOOROOPILLY, Q. 4068.

Diseases of lucerne - 3

Sclerotium crown rot



Stagonospora crown rot