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COVER. Honeybees are the most frequent insect visitors to Queensland's sunflower crops. See 'The need for bees in sunflowers' in this issue. Photograph by A. J. Ernst.

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Management of the breeding pig

STOCKMANSHIP can be defined as a sound combination of knowledge and experience plus an understanding of animals, their needs and their behaviour.

A good stockman must have the ability to make timely and sensible decisions based on his experience and knowledge.

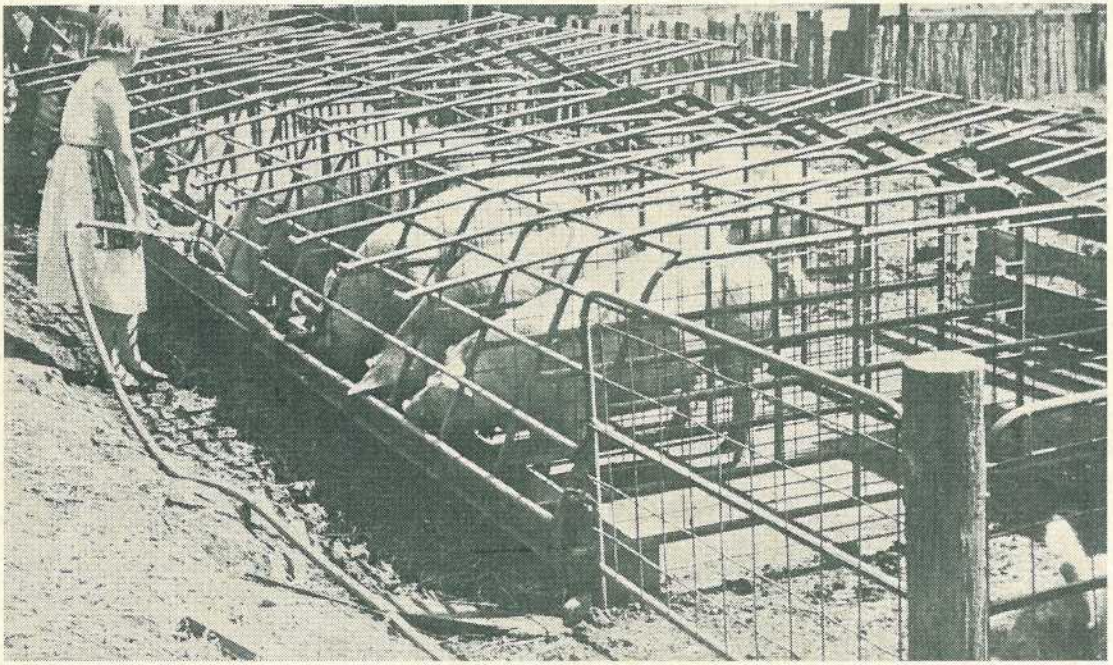
The importance of close attention to mating management has been emphasised in part I of this article. Sound mating management is undoubtedly an important and vital key to success in pig breeding, but it is only the first step. Good management must follow, providing for the birth of satisfactory litters of pigs and their growth and survival to profitable market weight.

Management of the pregnant sow

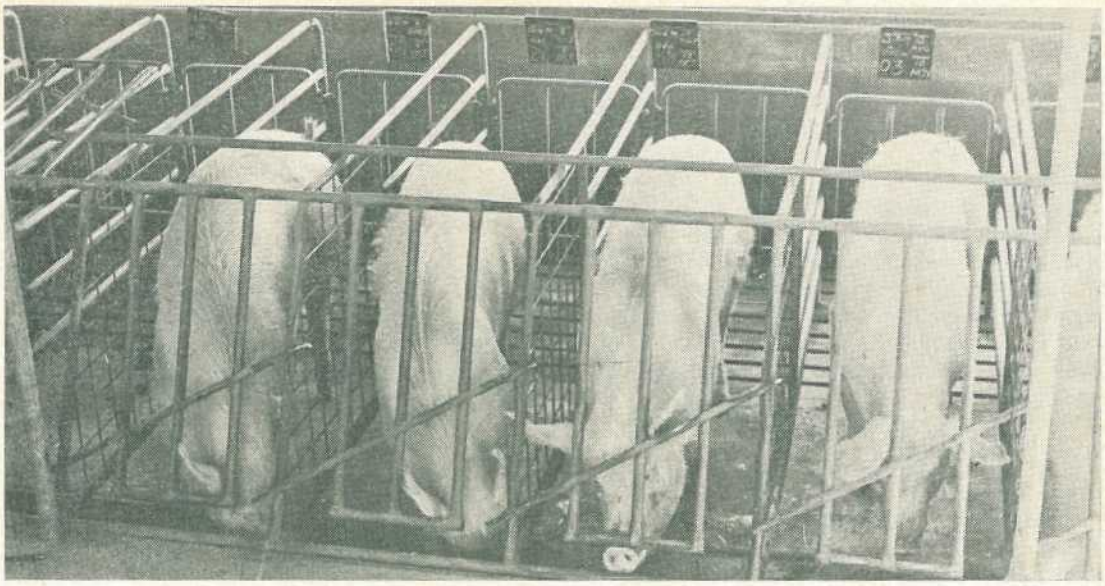
The duration of pregnancy in the sow ranges between 110 and 118 days with an average of 114 days and it has been observed that between 80 and 90% of sows farrow in the range of 112 to 116 days following service.

The pregnancy or gestation phase of the sow's breeding cycle puts few demands upon the stockman's time and skill. This is in contrast to the comparatively shorter but more management-intensive mating and lactation phases.

Theoretically, as long as she has access to shelter, food and water, the pregnant sow should be well able to look after herself. However, under intensive housing conditions



Sow feeding bails ensure that each sow receives a fair share of feed without being bullied by dominant sows in the group.



part II

by D. B. Preston, Pig and Poultry Branch.

she is entirely dependent upon the stockman for her every need. Hence, it is not surprising that the breeding efficiency in any given herd tends to reflect the standard of management applied.

Housing

Gestating sows require a warm, dry lying area free of draughts, dampness and wide fluctuations in temperature. Ideally, the ambient temperature in dry sow quarters should range between 18 and 20°C.

It is thought that heat stress may have some influence on embryo survival, particularly in the week following conception. It has been shown, for example, that prolonged exposure to temperatures of 32 to 37°C after conception coupled with 50% relative humidity reduces litter size.

On the other hand, although dry sows are able to tolerate cold conditions fairly well in late pregnancy, without any apparent effect on litter size, they invariably need more feed to maintain body warmth.

Sows housed in groups are able to compensate for cold conditions by huddling together. Providing them with bedding material helps to conserve feed energy which would otherwise be expended in maintaining body temperature.

Individually feeding grouped sows prevents bullying at the trough and ensures each sow receives a fair share of feed. Ideally, the penned groups should consist of between four and six sows but groups may be larger where access to a paddock is provided. A single battery of feeding bails may be used to feed several groups of sows in turn.

Confinement stalls and tethers represent an important step forward in dry sow management giving the stockman control of feed intake and the opportunity to regulate each sow's body condition, weight gain and general well being. Under practical conditions, sow confinement stalls should provide a lying area of 2·2 x 0·65 m or 1·45 m².

Photograph above. Dry sows should be fed according to their individual needs. The board on each stall shows the sow's number, expected farrowing date and the amount of food given.

Stalls and tethers are normally cleaner when the rear half of the floor area is slatted. Feed and water is dispensed in a trough at the front of the stall. Alternative watering methods include nipple drinkers and drinking straws.

Concrete flooring in confinement stalls should be neither too rough nor too smooth. Abrasive floors cause excessive hoof damage while slippery flooring may predispose to leg injuries or prevent sows from rising or lying down with ease. The floor fall should not exceed 1:25 as excessive slope and smoothness of concrete floors are thought to be associated with the incidence of rectal prolapse among stalled sows.

Feeding levels in pregnancy

Sows consume feed at differing rates according to appetite and individuality. In a group situation, the swift eaters and the aggressive members gather more than their share of total feed dispensed at the expense of the slower and timid sows.

The potential benefits of individual sow feeding are well recognized, giving the opportunity of adjusting feed intake according to size, weight and individual needs of each sow. Unfortunately many pig farmers fail to employ individual feeding facilities in the fullest sense, being content to allow a similar quantity of feed to each sow irrespective of individuality. The results are little better than group feeding, promoting weight gain in some sows and allowing weight loss in others.

This is illustrated by a Queensland trial some years ago, in which pregnant sows gained an average of 22·7 kg on 2·27 kg feed daily. However, the range was from a loss of 1·8 kg to a gain of 52·3 kg.

Feeding levels must be considered in the light of each sow's requirements. It is therefore good managerial policy to adopt a flexible approach in feeding dry sows.

Over-conditioned sows, being possessed of good bodily reserves, exhibit a poor appetite in lactation and are prone to farrowing problems. They are often clumsy, with a higher injury and death rate in their litters due to overlying or crushing.

Excessive condition accumulated in gestation is normally depleted during lactation and following weaning. This is considered a wasteful utilization of food energy.

On the other hand, thinner sows generally have a good appetite in lactation, but may lose weight and condition because of the demands of lactation.

The cumulative effect of sow weight loss over successive breeding cycles can result in the development of the 'Thin Sow Syndrome' (T.S.S.). An interesting observation on T.S.S. is that body fat depletion can proceed despite nett body weight gain.

Body fat depletion is often signalled by the appearance of sores on the hips and shoulders of thin sows which are obliged to lie on hard flooring. The more serious consequences of T.S.S. are delayed post weaning oestrus, low conception rate, poor litter size and feeble piglets at birth.

The pregnant sow has a remarkable ability to gain weight on an amount of food which would otherwise fail to support a similar gain in the non-pregnant animal. The phenomenon has been explained at length in the literature, but research is apparently needed to support the theoretical work done so far.

It is clear, however, that the intensively-housed sow despite being possessed of a marvelous metabolism is entirely dependant on the stockman for her every need. Stresses such as cold and damp housing, poor feed and indifferent care impose additional strains on the sow, which could well lead to breakdowns in productivity.

Recommended feeding levels for gestating sows are summarized in table 1.

TABLE 1

ESTIMATED DAILY DIGESTIBLE ENERGY REQUIREMENT OF PREGNANT SOWS
(In kg Feed Containing 13·3 MJ/kg)

Liveweight at Mating	Weeks 1–12	Weeks 13–16	Weeks 1–16
135 kg and under..	1·65	1·86	1·70
168–180 kg ..	1·97	2·12	2·00
205–230 kg ..	2·32	2·48	2·40

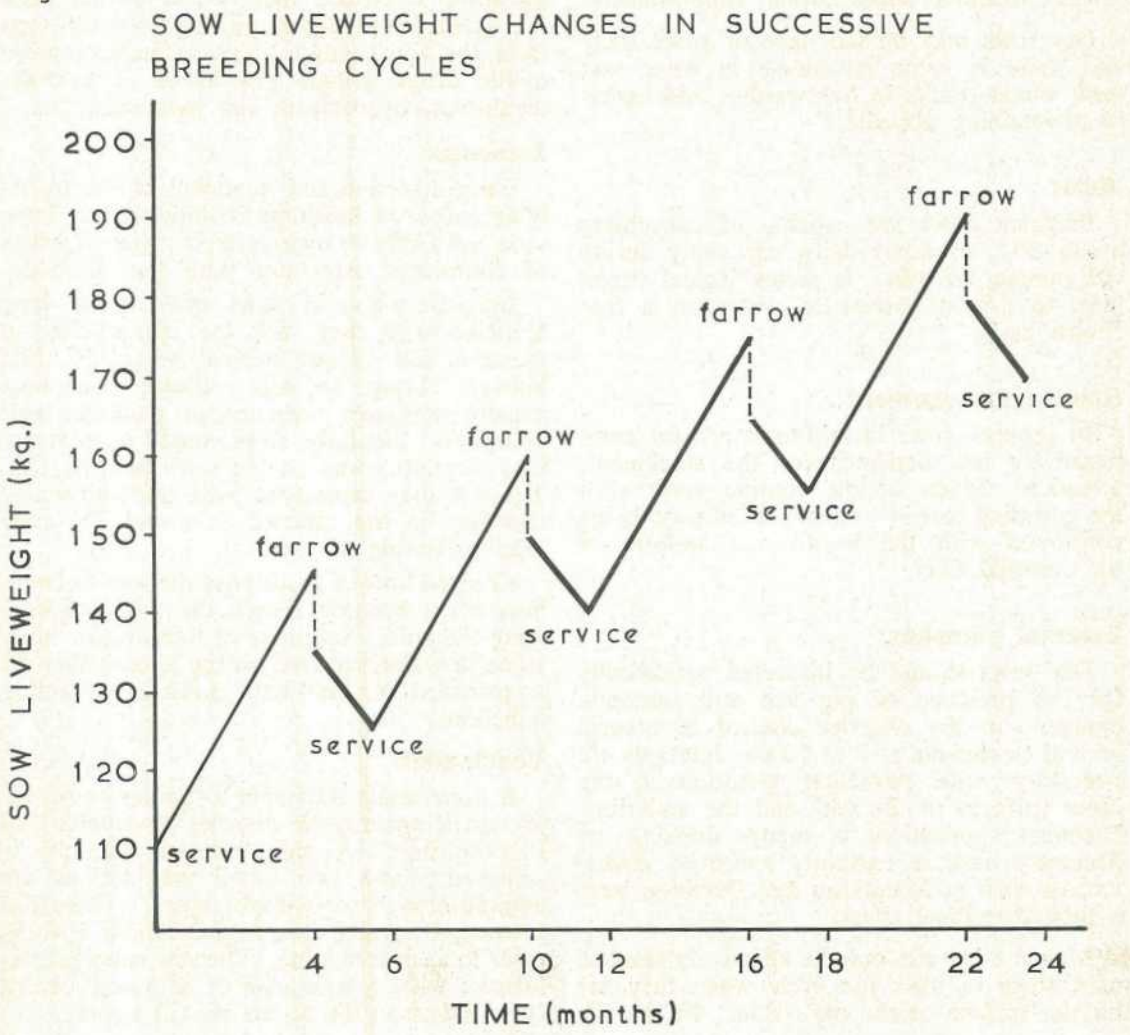
The total feed allowance is considered more important than the amounts fed at particular stages of pregnancy. In practice, it may be wise to adopt an average feeding level of about 1·8 kg daily throughout gestation with additional quantities allowed for such factors as weight and condition of the sow at mating, seasonal conditions, the standard of housing and the quality of feed used.

Occasional checks on piglet birthweight will show if pregnancy feed levels are adequate. Birthweights much below a normal average of 1·5 kg indicate the need to raise gestation feed levels.

Similarly, checks on sow weight gain during pregnancy are often recommended to help determine the adequacy or otherwise of feeding levels. It should be remembered, however, that a wide variation in response exists between sows and therefore weighing a few sows only may not be sufficient as a guide to feeding policy.

Ideally, the sow should show a nett weight gain of 10 to 15 kg during each breeding cycle. That is to say a gain exclusive of the weight of the litter, after birth and uterine fluids. For the average sow this might represent a total gain of about 30 to 35 kg from mating until shortly before farrowing.

Figure 1.



The pattern of live weight change in breeding sows through several breeding cycles is illustrated in figure 1.

Feeding levels in pregnancy should provide for a moderate weight gain by restricting intake of the energy component of the diet but at the same time, levels of protein, vitamins and minerals should be maintained.

In other words, if the total amount of daily food is reduced, the percentage of protein, vitamins and minerals should be increased. Poor quality, low protein diets are not satisfactory in the long run.

Diets containing 16% crude protein and approximately 13·3 MJ/kg of energy are considered adequate under normal circumstances.

Dry sows may be fed once or twice daily and there is some advantage in using wet feed, which results in less wastage and assists in maintaining appetite.

Water

Pregnant sows are capable of consuming up to 20 L of water daily, especially during the summer months. It seems logical therefore, to provide access to water on a free choice basis.

Routine management

In general, sows in mid-term present comparatively few demands for the stockman's attention. Much of the routine work with the gestating sow is strategic in purpose being concerned with the health and welfare of the eventual litter.

External parasites

Dry sows should be inspected periodically for the presence of pig lice and sarcoptic mange. In the effective control of mange, several treatments at 7 to 10 day intervals are necessary, with particular attention to the inner surfaces of the ears and the underline. Frequent applications of mange dressing are necessary because currently approved medicaments such as Malathion and Diazinon have a limited residual effect.

Mange mites can only be effectively reached at a stage in their life cycle when they are on the surface of the pig's skin. In the life cycle of approximately 15 days this occurs between emerging from the skin burrows and the egg laying stage.

A mangy sow infects her litter causing discomfort to the point of ill-thrift in the piglets. Timely treatment of the sow prior to farrowing reduces the risk of mange infestation in her piglets and is most important in view of the sensitivity of some piglets to quite a light infestation.

Internal parasites

Regular de-worming of sows with a suitable anthelmintic drug is good policy particularly where dry sows have access to paddocks. Treatment prior to farrowing is advisable for all sows to reduce their worm burden and the likelihood of piglets picking up worm eggs from the sow's dung. The available anthelmintic drugs include piperazene, levamizole, dichlorvos, hygromycin and parbendazole.

Lameness

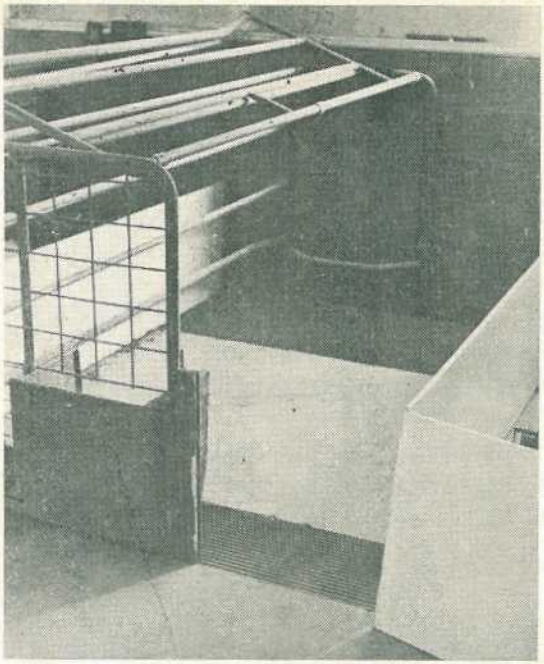
Early detection and treatment of the underlying causes of lameness is important as lame sows are likely to overlay their piglets because of clumsiness associated with the disability.

Intensively-housed sows often grow long toenails since they lack the opportunity to exercise and induce normal wear of their hooves. Long toenails require trimming, usually with tree secateurs or guillotine calf dehorners. Similarly, sows housed on concrete may develop corns on the soles of their feet. The sow may experience pain, discomfort and lameness in the affected foot and the corn requires paring or removal.

Cracked hooves predispose the sow to lameness when bacteria invade the tissues underlying the split. Solutions of formalin or bluestone in water, sprayed on the affected hooves or provided in a foot bath, assist in preventing infection.

Vaccination

It is normally advisable to immunize breeding stock against the diseases Erysipelas and Leptospirosis. A high level of immunity is achieved where two initial vaccinations are administered 4 to 6 weeks apart. Thereafter a strategic booster dose is given about 4 weeks prior to each farrowing. The sow subsequently farrows with a high level of immunity, which is passed on to the piglets via colostrum.



A side entry farrowing crate with the front panel removed and side swung open showing the concrete floor and mesh slats. The pen has been cleaned and disinfected ready for the next sow due to farrow.

Pre-farrowing management

Forward springing sows should be settled into farrowing pens on or before the 110th day of gestation. Expected farrowing dates will have been recorded following conception and reference to these records indicate which sows should be prepared for farrowing, and how many pens will be required.

Before being placed in farrowing pens, each sow should be thoroughly washed with warm soapy water to remove dirt and worm eggs from the sow's coat and udder. In the view of some stockmen, this is no less important than providing a clean, disinfected farrowing pen. Equally important is the provision of a dry pen, rather than one with a recently washed and wet floor.

Forward planning with the aid of records, is essential if full use is to be made of the available farrowing accommodation.

Following introduction into farrowing quarters, sows which have been accustomed to wet feed should continue to be so fed. In addition, the diet should be mildly laxative to prevent constipation. This may be accomplished by substituting bran for about one third of the diet, or adding epsom salts or paraffin oil to the daily feed.

Management of the sow and litter

The care of the farrowing sow and subsequently her litter, requires much greater attention to detail than management during gestation.

The experienced stockman will apply his skills and 'pig sense' in timely attention, in recognizing the difference between normal and abnormal situations and in taking appropriate action according to his assessment of a particular situation.

Farrowing indications

Contrary to the sow's inherent nest-building instinct, modern farrowing houses make little or no provision for the use of bedding. Where bedding is used, it may consist of straw, wood shavings or shredded paper. Sawdust is considered unsuitable because of dustiness which may cause suffocation when inhaled by new born piglets. In the absence of suitable nest building material, the sow becomes restless, chewing wooden slats, metal railings and troughing.

Some farmers, therefore, provide an old sack or small amounts of straw, thus keeping the sow content by partially satisfying her nest building urge.

Nest building may precede farrowing by up to 36 hours, the period varying between sows. As such, it is only a rough indication of imminent farrowing.

Increasing restlessness and irritability may become evident according to temperament with older sows being calmer than maiden sows. A longer settling-in period prior to farrowing seems prudent in the latter case.

Milk may be drawn from the teats 12 to 24 hours before farrowing but this is not very reliable as a precise indicator of farrowing time.

However, recent work in the United States has shown that about 5 hours before the first pig is born, the sow's respiration rate increases from a normal 25 to 30 breaths per minute to a peak of 80.

It is claimed the 5 hour interval is reasonably accurate and does not vary greatly between sows.

Other signs of imminent farrowing are the expulsion of uterine fluids and sometimes the passing of blood stained fluid and/or foetal dung through the lips of the swollen vulva. When these signs are observed, there is a good chance farrowing will occur in about 2 hours. However, it should be stressed that not all sows will show all these signs.

Finally, signs of labour are exhibited by the sow lying prone on one side, twitching her tail with contractions occurring periodically as the sow strains with one or both hind legs drawn up. In attempting to predict the time of farrowing, all the observed indications should be taken into account, rather than any single indication in isolation.

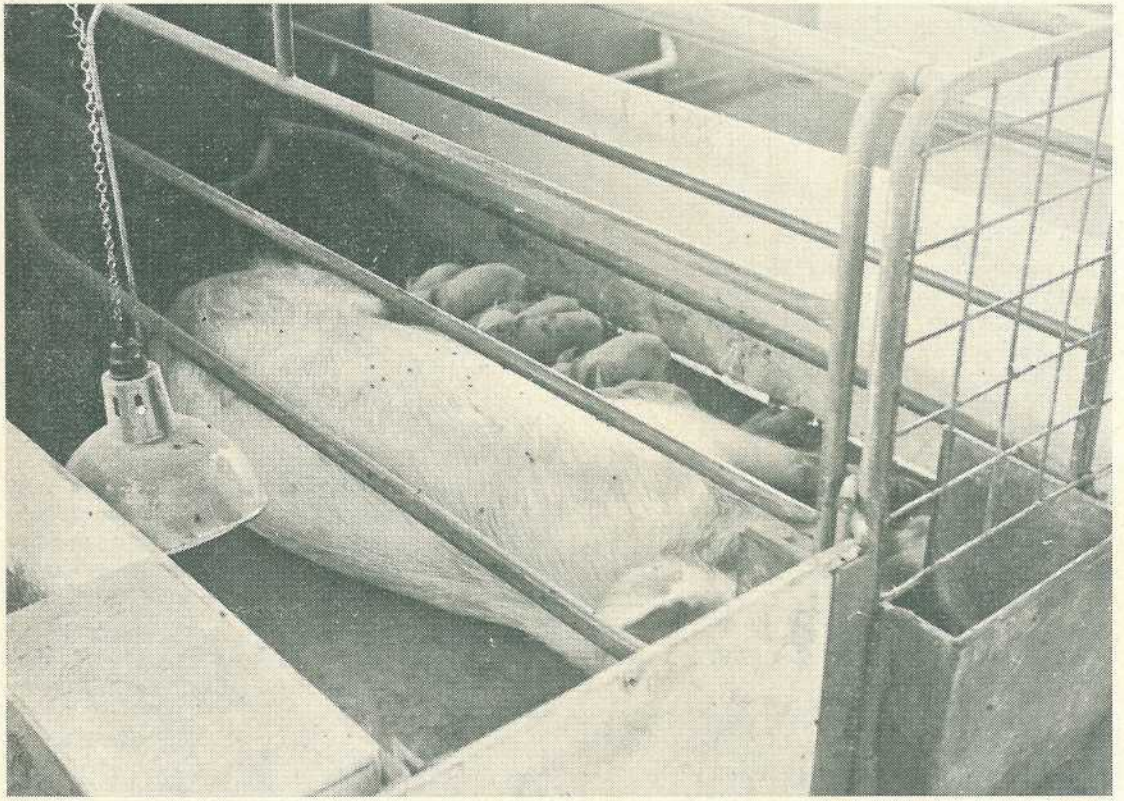
A creep lamp or lamps should be placed safely at the rear of the farrowing crate. This warms the floor area ready for delivery and serves to dry the piglets following birth.

As a rule it makes sense to check on sows in labour at intervals, but as a large majority of farrowings occur without incident, no assistance is normally required. In fact, interference often does more harm than good in all but a few instances.

Farrowing accommodation

The primary objectives of farrowing pens are to provide for:

- Maximum piglet survival
- The welfare of the sow and litter
- A cost and management effective design



Piglets require a dry, warm, draught-free pen and protection from overlying by the sow. The wire mesh slats at the rear of the farrowing crate assist in keeping the floor clean and dry.

In helping to achieve these objectives the farrowing pen should fulfil the following requirements:

SPACE—The sow's movement is restricted, but she should be allowed enough room to lie down comfortably in order to farrow and subsequently to suckle her litter. The minimum space required for a sow and litter will vary according to occupancy period and may for practical purposes be between 3·3 m^2 and 4 m^2.

PIGLET SHELTER—A warm, dry, draught free haven or creep to minimize piglet loss from the effects of cold conditions and the risk of overlying by the sow.

HYGIENE—Floors and walls should be impervious to moisture and capable of easy cleaning and disinfection. Slatted mesh floors should be used for efficient disposal of manure and urine.

FLOOR SURFACE—Should be neither too rough nor too smooth. Rough floors are difficult to clean and disinfect effectively, harbour bacteria and contribute to injuries. Smooth floors also cause injury to both sow and piglets by inhibiting normal movement of the sow.

TEMPERATURE—A sow can tolerate a lower temperature than her piglets and in the case of the newborn, the temperature conditions can be critical to their survival. Supplementary heat is necessary at and for a few days following birth.

FEEDING AND WATERING FACILITIES—Separate feeding places for the sow and the litter. Watering facilities can be shared or separate. Drainage should be provided for water spillage.

EASE OF ACCESS—For the operator to perform routine jobs, supervise and observe his pigs.

COST EFFECTIVENESS—Initial cost may conflict with the fulfillment of other requirements. For example, the use of design shortcuts or cheaper materials may not be consistent with achieving good hygiene or ease of management. In practice, however, it is inevitable that compromises are made in achieving the basic requirements of an effective farrowing pen.

Farrowing

Many sows farrow during the hours of darkness when the piggery is unlikely to be attended. A good manager often does the rounds of the farrowing pens before leaving the piggery for the night, ensuring that preparations are in hand for litters likely to be born during the night.

Farrowing generally lasts between 1 and 8 hours, the average time being approximately 4 hours. The time elapsing between first and last piglets born varies considerably between sows and between farrowings of the same sow. However, it is apparent that maiden sows complete farrowing more quickly than older sows. This may be due to better muscle tone in young sows, making for stronger, more efficient contractions and more rapid expulsion of piglets. An additional factor is that maiden sows farrow fewer pigs than older sows.

Piglets are born at intervals and are presented in either head or breech first position. The umbilical cord, still attached at birth, ruptures during the newborn piglet's unsteady and instinctive efforts to reach the sow's udder to suckle.

Piglets are born with little or no insulating cover of fat and have a large body surface area relative to their size. They are born wet, and body temperature falls fairly rapidly following exposure to a lower air temperature in the farrowing pen. Piglets will gradually restore their body temperature to a normal 39°C, the length of time taken depending on the surrounding air temperature and whether suckling has been successfully accomplished.

Prolonged exposure to cold conditions and failure to obtain an initial suckle results in depletion of blood sugar reserves and possibly the eventual death of the piglet from Hypoglycaemia. It is important to ensure therefore that creep lamps are operating effectively and that the shed temperature is maintained.

The firstborn piglets get first choice of teats, the forward part of the sow's udder being most favoured and more productive than the rear teats.

Piglets usually show preference for a particular teat and the so-called teat order is rapidly established. Weaker, smaller pigs may be relegated to the less productive posterior teats and there is often a battle between piglets for a particular teat. This is the young pig's first experience of the social order.

Completion of farrowing is usually signalled by expulsion of placenta or afterbirth although some placenta may become detached and be expelled during farrowing. Fouled bedding, dead piglets and afterbirth should be removed from the pen following the completion of farrowing.

Over the first few days succeeding farrowing, the sow's rectal temperature should be checked. Normal body temperature of the sow is 39°C but may be 0·5°C higher during and shortly after farrowing. It is also worthwhile to verify the availability of milk by manual means or by observing the behaviour of piglets. Hollow flanked, complaining piglets may signify lack of milk secretion by the sow.

MMA syndrome

Sometimes known as post farrowing fever, MMA stands for Mastistis or inflamation of the udder, Metritis or inflammation of the uterus and Agalactia or no milk.

Symptoms include a foul smelling discharge from the vagina, fever (above 40·5°C), depression and lack of appetite, shivering, restlessness, raised respiration and pulse rate, lack of milk, failure to nurse piglets and lumpy painful udders.

It has been noted that MMA occurs more commonly among intensively-housed sows. Older, fatter sows and small, fat, immature gilts appear to be more suspectible. The condition may appear suddenly, affecting a high percentage of farrowed sows or it may only affect a few sows, and there is apparently no immunity to future attack.

The affected sow usually recovers within a few days but the most obvious and serious effect is upon her piglets. Prompt restoration of milk flow must be accomplished to prevent starvation of the litter.

If restoration of milk flow is unduly delayed despite treatment of the sow, piglets should be fostered temporarily to another sow—preferably one that has recently farrowed. Alternatively, a newly-weaned sow may accept and suckle the piglets for a few days.

Treatment of affected sows should be carried out promptly, the choice of medication made preferably in consultation with a veterinarian.

Savage sows

Savaging of piglets, often with a high number being killed is sometimes seen, particularly among sows experiencing their first farrowing. The cause is obscure, but may involve a nervous disposition, a small pelvic opening coupled with pain or farrowing difficulty. Savaging is often seen as a problem of some magnitude where a large percentage of gilts are farrowed such as in piggeries in the establishment phase.

Baby pigs, particularly those in large litters, compete with one another for teats. Their sharp needle teeth are removed to avoid injury to litter mates and the sow's udder.

When the savaging tendency is noted, piglets should be kept away from the sow until farrowing is completed and the sow calmed down. Tranquilizers or pain killing drugs may be necessary upon veterinary advice to settle the sow more quickly to the task of nursing her litter. Muzzling the sow may be useful in some instances but may only serve to upset her. Any tendency to repeat the savaging behaviour at the subsequent litter should be noted and the sow culled.

Post-farrowing management

Sows may accept food within 12 hours of farrowing but the period varies substantially between sows. It is not unusual for some sows to refuse feed while others have a keen appetite shortly after farrowing.

The newly-farrowed sow should continue to be fed a light laxative diet and allowed access to fresh water. Overfeeding the sow at this stage stimulates a level of milk production which baby pigs are ill-equipped to handle and over indulgence by them can result in a yellowish diarrhoea often referred to as 'milk scour'.

Mild exercise after farrowing is often beneficial for the sow. This helps to prevent constipation and generally tones up her muscular and digestive systems.

The sow feeds her young at approximately hourly intervals signalling meal times by uttering characteristically gentle grunts while lying on one side and rotating her trunk to expose her udders. The nursing period lasts about 5 minutes during which milk let-down occurs for about 40 seconds.

The frequency of feeding apparently does not vary greatly during the rearing period to 5 weeks. However, the duration of milk let-down is shortened to about 20 seconds after 7 days and milk production, reaching a peak at 3 to 4 weeks post farrowing, gradually declines thereafter. Nursing may be initiated by the piglets or the sow, and is often stimulated by sounds in the farrowing house such as those produced by other litters being nursed.

NEEDLE TEETH—Piglets are born with eight sharp milk tusks or 'needle teeth' which should be clipped shortly after birth. A small set of side cutting pliers is handy for this purpose. Removal of needle teeth is particularly important in large litters, to prevent damage to the sow's udder and facial injuries to piglets as they compete with one another for teats.

TAIL DOCKING—Normally carried out at the same time as needle teeth clipping, using the same instrument. In piggeries where tail chewing is a problem, this practice is routine, while in others the need may not arise.

IRON ANAEMIA—At birth, piglets possess a small reserve of iron which is not adequately maintained by the small amounts supplied in sow's milk. Under intensive conditions, piglets are denied access to soil, a natural source of iron, so a supplementary source of iron must be provided before body reserves are depleted and the piglets become anaemic. Anaemia causes ill-thrift and listlessness and predisposes the piglet to bacterial attack.

Supplementary iron is commonly administered preferably in the piglet's neck by means of a single intramuscular or subcutaneous injection of a soluble iron compound. Alternatively, iron preparations may be given by mouth, with repeat dosages required at weekly intervals due to the rapid excretion of excess iron from the piglet's gut. An exception among oral anti-anaemia preparations, iron galactan, requires only a single initial dose giving results comparable to those obtained with injectable iron.

Supplementary iron administration aims at providing enough iron to last until the piglet is able to obtain iron requirements by taking solid food.

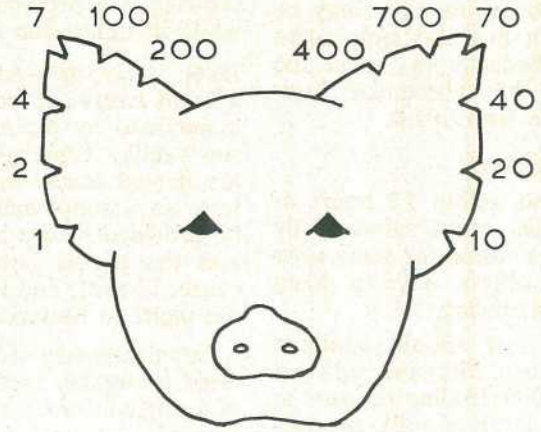
IDENTIFICATION—The most commonly adopted and most effective form of piglet identification is ear notching, although some farmers prefer to use ear tattoo numbers while others use plastic ear tags.

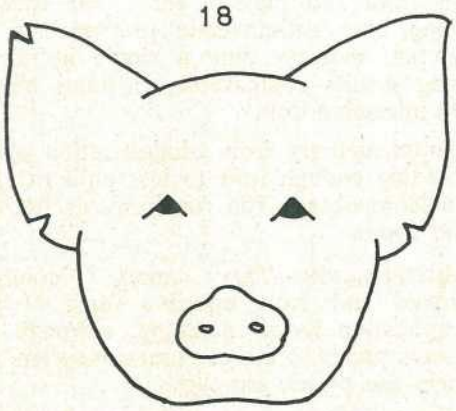
Ear notching systems, of which several are in popular use, simply consist of removing one or more vee-shaped pieces of the piglet's ear with an ear notching plier. The position of each notch in the pig's ear corresponds with a particular number. A recommended system is outlined in figure 2.

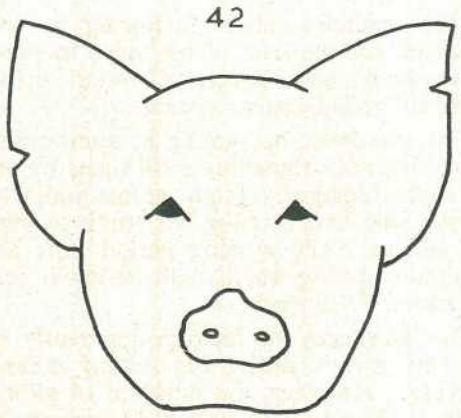
The piglets may be given an identification number which corresponds to the number of the week in which they are born, a number identical to that of the sow, consecutive individual numbers or consecutive litter numbers.

Figure 2.

IDENTIFICATION BY EARNOTCHING







Identification may be carried out at the same time as needle teeth clipping and iron dosage but should preferably be done before fostering.

Whatever the method used, the identity of each pig or litter of pigs should be recorded with other rearing data for future reference, such as in selecting herd replacements on the basis of growth rate or breeding.

PIGLET FOSTERING—Is a practice commonly adopted in herds which farrow sows in batches. Fostering ensures that litter sizes can be tailored to each sow's rearing capacity and that piglets are matched for size. The benefits of fostering are invariably reflected in a better survival rate during the rearing period.

The introduction of extra piglets upsets the original teat order within a litter. Therefore, fostering should ideally take place within 48 hours of farrowing or at least before the teat order is firmly established.

The foster sow is less likely to reject strange piglets before she has familiarized herself with her own litter's characteristic odour. Piglets also become familiar with their dam's odour and a delay may make them reluctant to accept a strange, though willing foster mother.

An additional argument in favour of early fostering is probably the most significant one—the fact that a sow's unemployed teats dry off within a few days of farrowing.

Most sows accept extra pigs fairly placidly, but in some instances, it may be necessary to mix both lots of piglets in a box. The strangers are thus allowed to acquire an odour familiar to the foster sow.

Where possible, reducing the size of maiden litters by fostering is often beneficial, removing some of the strain of lactation from the young sow.

COLOSTRUM—The first milk or colostrum has a high solids content with a comparatively high protein fraction. The globulin portion of the protein contains antibodies which protect the piglet from the prevailing bacterial population in the herd.

Since the secretion of colostrum declines within a matter of 36 hours following birth, it is vital that piglets suckle and obtain this protection fairly quickly.

CREEP WARMTH—Following suckling, piglets gravitate instinctively towards a source of warmth. In the absence of bedding or a warmed creep area, they will lie near or against the sow's udder, thus being at risk from trampling or overlying.

A warm, dry, draught-free area away from the sow tends to reduce the risk of overlying during the first few days of life, a period when piglet losses from this cause are potentially high.

For the first few days after farrowing, it is advisable to continue provision of an artificial heat source. A hover board over the creep area should be used in conjunction with the creep heater, be it an overhead type, on the floor or built into the floor. This helps to conserve warmth over a wider area of the creep and prevents to some extent the setting up of convectional draughts.

Subsequently, depending on seasonal conditions as they affect shed temperature, a creep box shelter or a bag tent may be substituted for the lamp or heater. Alternatively, the hover board is left in place after withdrawing the heat lamp.

CASTRATION—Is no longer required since entire male pigs are accepted for slaughter as porkers and baconers. Where performed, the operation should be carried out hygienically and as early as possible before weaning to avoid setbacks to the piglets.

Feeding the milking sow

The laxative diet mentioned earlier may be discontinued after a few days and the sow's feed allowance increased gradually over the next 7 to 10 days. The feeding level ultimately arrived at should satisfy the sow's maintenance needs and the demands of nursing a rapidly growing litter.

While the objective of feed restriction in gestation is to allow for moderate weight gain, the aim during lactation is to prevent excessive weight loss and depletion of bodily reserves. As explained earlier, excessive gestation gain often results in lactational weight loss through a poor appetite. On the other hand, sows farrowing in moderate condition usually have a good appetite during lactation and are better equipped to cope with a feed intake sufficient to meet the demands of lactation.

In practice, maintaining the body weight of a sow in the face of lactational demands represents something of a losing battle. This is largely due to the wide variation in response between individual sows. Nevertheless, every attempt should be made to prevent weight loss in lactation. Dampened or wet feed often stimulates feed intake while, in some cases, earlier weaning may relieve the strain on the sow.

There is a relationship between lactation weight loss and ovulation. For each 10 kg weight loss during lactation, one less egg is shed at the following oestrus. This may mean fewer pigs born as a result of that particular mating.

Milking sows are usually fed a similar diet to that used in pregnancy, only the daily allowance is raised to cater for the demands of milk production. Each sow may be fed

2 to 3 kg of feed per day for maintenance needs depending on size and condition plus 0·3 kg for each piglet suckled. Thus a sow rearing 10 piglets should receive 5 to 6 kg of meal daily. It is not extravagant, in the opinion of some authorities, to feed sows according to appetite when they are rearing large litters.

Piglet deaths

Surveys have frequently confirmed that between 5 and 50%, or an average of 20% of piglets born alive fail to survive until weaning. It should be possible, under good management conditions to contain pre-weaning mortality to a figure below 12%.

The major cause of piglet deaths is overlying or trampling by the sow. This may account for up to half the pre-weaning deaths occurring within the first 72 hours of life. This is hardly surprising when the weight difference between the sow and her individual offspring is considered. An individual piglet birth weight of about 1·5 kg often represents less than 1% of the dam's body weight at farrowing.

Other factors such as starvation, cold conditions, physical impairment (of sow or piglets), low birthweight, large litters and clumsy sows contribute to piglet mortality by overlying. The careful manager sould seek to recognize the contributory causes and modify his management accordingly.

Stillbirths account for the loss of approximately one pig in every two litters. Taking into consideration the national sow population of more than 300 000 head the industry sustains a staggering annual wastage of piglets due to stillbirths alone.

It is estimated that 80% of stillbirths occur during the farrowing process due to suffocation following premature detachment of the umbilical cord or of the placenta. Stillbirths are more common in litters farrowed by old sows, in large litters, or where farrowing is unduly prolonged.

Piglet scours

Piglet dung is normally dark and firm, breaking into small pieces at or following defaecation. A change in dung colour or firmness often indicates the start of a potential scour problem.

Yellowish diarrhoea shows that baby pigs have had access to more milk than their immature digestive system can comfortably handle. The sow's feed allowance has probably been raised abruptly after farrowing, creating increased milk secretion. The sow's feed allowance should be temporarily reduced and the piglets provided with fresh water in an attempt to relieve the diarrhoea.

Scours caused by *E. coli* bacteria are a common problem encountered among piglets born under intensive housing conditions.

E. coli, together with many other organisms, are a normal inhabitant of the pig's intestinal tract. Many serotypes of *E. coli* have been identified, some causing disease while others are relatively harmless.

Newborn piglets pick up bacteria from the sow, her droppings and from the farrowing pen floor. The effects of *E. coli* infection can be reduced by maintaining good hygiene in farrowing quarters, freedom from draughts and damp floors together with a satisfactory level of supplementary heat.

Good hygiene standards are often difficult to maintain in large farrowing houses where efforts to improve hygiene in individual pens are frequently frustrated by re-infection from neighbouring pens.

This tends to support the argument in favour of smaller farrowing rooms used on an all-in, all-out basis. It follows that improved hygiene levels can be maintained.

Maintaining a closed herd policy with few introductions restricts the entry of *E. coli* serotypes. The breeding herd, particularly the gilts, should be continually exposed to the existing serotypes present in the herd. This allows the development of immunity.

Newborn piglets obtain immunity to disease from the colostrum secreted by the sow early in lactation. Milk also contains antibodies which remain in the piglets intestines providing protection from scouring.

Scouring does not usually account for a high percentage of piglet deaths, but on the other hand, whole litters are commonly affected, requiring prompt treatment.

Early treatment is essential as scouring piglets tend to dehydrate rapidly. The choice of medication to be used in a particular piggery should be made in consultation with a veterinarian.

Diarrhoea among piglets 3 to 4 weeks of age appears to coincide with changes in sow milk composition, a gap between waning maternal immunity and the development of active immunity, and increasing creep food consumption prompted by declining availability of milk.

Usually the stronger piglets within a litter recover more quickly, being less affected by digestive upsets than their less robust litter mates.

Leg and teat injuries

Piglets reared on hard farrowing pen floors are prone to injury of their teats, knees, elbows, hocks and hooves.

The injuries are caused by abrasion and are more prevalent on rough concrete floors. However, friction damaged limbs have also been noted among litters reared on smooth concrete floors and on timber slats, particularly where the slats have become worn and polished. Piglet's legs can also be injured when they become trapped between slats spaced wider than 9 mm apart.

On smooth floors, the sow may experience difficulty in rising or lying down. The sow, in her struggles to rise, may amputate one or more of her hind teats with her sharp hooves. She may also hurt her legs or injure her piglets as well.

In many timber-slatted pens it has been found necessary to attach cleats or a strip of welded mesh on the floor to afford the sow a better footing. Similarly, excessively smooth concrete floors may need etching with acid to achieve a more satisfactory surface.

Since piglets which suckle the lower row of teats often do so in a prone or a kneeling position, the fore teats and knees are frequently injured through friction with the floor.

The damage to their teats is often permanent and the affected glands may be useless for suckling. Since one or more pairs of the fore teats are often involved, the number of gilts available for herd replacement is greatly restricted.

Abrasion wounds of the legs occur most frequently on the knees, permitting the entry of organisms which may concentrate in the joints of the limbs. This produces a crippling, painful swelling. Affected piglets fail to thrive since their movements are restricted and they may be unable to suckle properly, frequently failing to reach a teat during milk let down.

The severity of these conditions can be reduced by ensuring that concrete floors are properly finished during construction. Likewise, timber slats should be carefully laid at the correct spacing and replaced when worn or damaged.

The harmful effects of rough, pitted concrete floors can be reduced by the application of chlorinated rubber or epoxy resin paint. Alternatively, the floor may be capped with a fresh layer of concrete after a bonding agent has been applied to the existing surface.

Creep feeding

The milk yield of the nursing sow rises to a peak at about 3 to 4 weeks from farrowing, followed by a gradual decline in daily yield which is insufficient for satisfactory growth of the litter. If optimum piglet growth rate is to be maintained, supplementary feeding is required.

Creep feed should be palatable and contain ingredients which are readily digested by piglets. A good creep diet usually contains 18 to 19% crude protein and a high level of energy. Fibrous feedstuffs should not be included because the immature pig's digestive system is of limited capacity and cannot readily handle bulky food.

The inclusion of fats such as tallow or lard, vegetable oils or molasses helps to improve palatability, raise the energy level and reduce dustiness. However, these ingredients are often difficult to incorporate in practical diets and storage life of the meal is limited.

Piglets appear to have varied taste preferences and other appetisers such as sugar, cornflakes, rolled oats and artificial flavourings have been used with mixed success.

At about 10 days of age, small amounts of creep feed can be offered to piglets, replacing stale with fresh meal at least daily. The feed is sprinkled on the floor or placed in a shallow dish in the creep area. Evidence of

creep feed intake by piglets can be traced by the presence of grain particles in their dung. The amount of creep feed is increased gradually until voluntary intake rises to the point where a larger feed trough or hopper can be introduced. Since piglets are in the habit of feeding together, the creep trough should ideally be large enough to allow access by all the members of a litter simultaneously.

Piglets should have access to fresh water since the sows declining milk yield seldom provides enough liquid to sustain dry meal intake.

Creep diets are more expensive than other pig diets but their cost is more than offset by the efficient conversion of feed into weight gain by the young pig.

Heavier pigs are easier to wean, suffer less of a setback at weaning and can be weaned earlier, thus relieving some of the lactational strain from the sow.

In later lactation, sow's milk provides some of the piglet's protein needs—therefore the role of the creep diet is essentially a supplementary one. The diet need not be complex or highly concentrated if 5 week weaning is the intention. In fact, nutritionally high-powered, expensive creep diets may create digestive upsets. Such creep 'starters' are useful for enticing piglets to eat solid food when early consumption is required to enable early weaning.

Weaning management

In the last decade, a more precise understanding of the young pig's requirements in terms of housing, nutrition and management has led to the possibility of reducing weaning age from the traditional 8 weeks.

It is common today, to see pigs weaned at ages ranging from 28 to 42 days and occasionally very early weaning at 21 days of age or less. In general terms, earlier weaning means that the standard of management becomes more critical for successful rearing of the piglets.

In theory, a shorter lactation allows for a reduction in the farrowing interval. Queensland Sow Productivity Records show that weaning at 4 to 6 weeks reduces the farrowing interval and also the subsequent litter size but there is a greater annual sow productivity. With very early weaning at 3 weeks or less, subsequent litter size may be markedly reduced and the weaning to conception interval is liable to increase.

Weaning imposes enough of a strain on the young pig and therefore drastic changes in management or feeding should be avoided at this critical period. Where batch farrowing is practised, it is good policy to allow litters of similar age and housed in adjacent pens to mingle freely prior to weaning. This is less stressful than attempting to box pigs together shortly after being weaned.

Through and beyond the weaning period, piglets should remain on the diet to which they have become accustomed during the suckling period.

On the chosen day, sows to be weaned are moved to the mating area while their piglets remain in the familiar surroundings of the farrowing pen for several days.

Feed levels for weaners should be restricted, as they may overeat and have digestive upsets. It is not uncommon for post weaning diarrhoea or, worse still, bowel oedema to appear. These cause heavy losses among newly-weaned pigs.

FIGURE 3

Sow No.	Mating				Notes	Farrowing			Weaning			Notes
	Boar	Date	3 wk. Ret.	Due Far.		Date	Live	SB	Date	No.	Age Days	

Water should be freely available, and in some instances separate water nipples for piglets are provided in farrowing pens. This ensures that the piglets become accustomed to drinking from a nipple waterer, a device commonly used in weaner cages and grower pens. Medication can often be introduced into such watering systems over the weaning period in an attempt to cushion stress.

Weaned pigs should not be denied the opportunity of keeping warm, therefore creep boxes or heat lamps should remain available, particularly in cold weather.

A few days after weaning, piglets may be moved but without undue fuss to weaner cages or pens. They will continue to require close observation to detect break-downs in health.

Hygiene

It is recommended that each farrowing pen be thoroughly washed between occupancies, with scrupulous care taken in the removal of organic matter from flooring, walls and fittings prior to disinfection.

Thorough washing is essential because most disinfectants are ineffective in the presence of organic matter. Hot, soapy water may suffice to scrub fittings and walls but concrete floors often require scrubbing with a solution of caustic soda or washing soda.

Following disinfection, the farrowing pen should be allowed to dry before introducing the next sow.

Herd productivity records

A record of day to day events in the piggery is an invaluable aid to management. Analysis of well kept, accurate records can pinpoint weaknesses in management, assist with forward planning and provide the basis on which culling decisions can be made. Modern pig raising is as much a business as any other enterprise and there is little room for sentiment. Animals which fail to match production targets have to be culled from the herd.

In addition to the mating details mentioned earlier, a record should be kept of each sow's productivity in terms of numbers of piglets farrowed and reared. Other details such as farrowing and weaning dates, stillbirths and weaning age should also be recorded.

Headings for records collected in a pocket book can be drawn up as in figure 3.

A similar, but more comprehensive record is the Pig Production and Breeder Assessment (PBA) system. PBA is both a recording and analysis system developed by officers of the Department of Primary Industries in consultation with pig producers. Besides recording day to day information, the PBA system provides a means of analysing overall herd productivity and the performance of each sow and boar in the herd. The recorded data can be readily summed up and the following factors evaluated:

- Conception rate.
- Pre-weaning mortality and stillbirth rate.
- Average litter size at birth and weaning.
- Average mating interval.
- Average sow age.
- Progressive individual sow performance after each litter.

Summary

- Provide accommodation which is designed to fit the needs of the pigs and the stockman as closely as possible, consistent with capital cost.
- Feed sows individually according to their needs, using a laxative diet around farrowing time and increasing the feed level gradually to cater for the demands of lactation.
- Attend to routine tasks as they arise and deal with disease and other problems promptly.
- Discriminate between normal and abnormal situations and act accordingly. Avoid stressing pigs particularly at farrowing and weaning times.
- Use records as an aid in making timely management decisions.

5—84704

Progress in brucellosis

by P. Muttukumaru, Veterinary Services Branch.

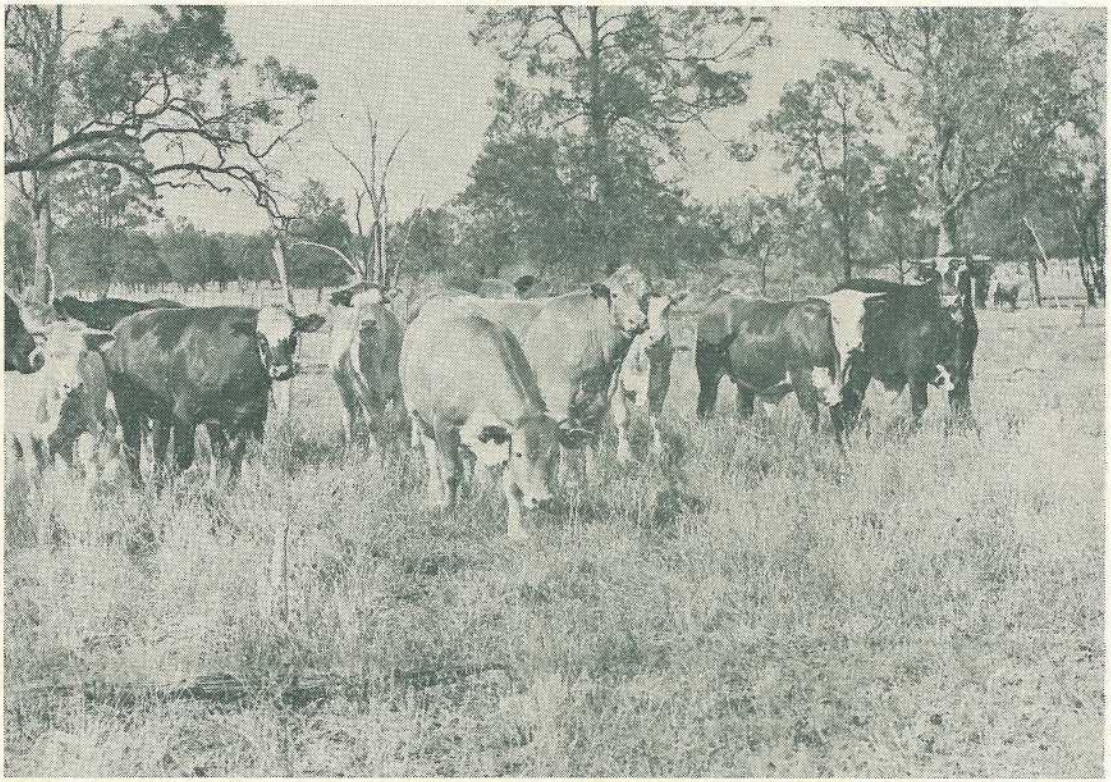
IN 1973, the Queensland Department of Primary Industries started surveying cattle for brucellosis.

In October 1976, funds were allocated for eradication, and it was possible to declare several shires in the north of the State as the North Queensland Bovine Brucellosis Protected Area (N.Q.B.B.P.A.). A test and slaughter programme commenced.

In July 1977, the South Queensland Bovine Brucellosis Protected Area (S.Q.B.B.P.A.) was declared in the southern Downs and the N.Q.B.B.P.A. was extended. 'Protected Areas' are protected by movement controls which regulate cattle movements inside and into the area and reduce the likelihood of transmission of infection. In brief:

- Movements of breeders from non-assessed, infected or restricted herds—slaughter only.
- Movements of breeders from provisionally clear (previously infected which have passed two clean tests 6 months apart) and suspect herds-movement test or slaughter only.
- Movement of breeders from tested negative, monitored negative, accredited free—no movement tests-open sale.

Herds are assessed on either a herd blood test, at least six consecutive milk ring tests, or a high level of meatworks' monitoring results.



A beef herd in the Roma area undergoing eradication testing.

eradication in Queensland

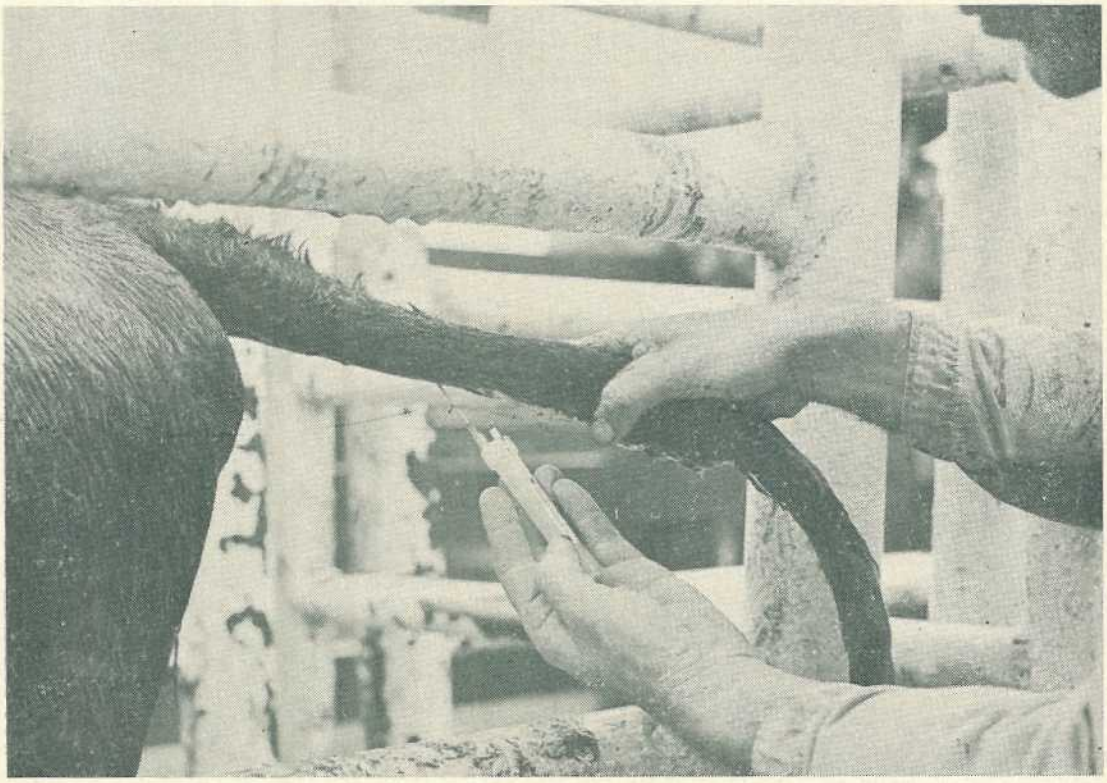
In April 1978, the whole of the State was included in the Protected Area, now called the Queensland Bovine Brucellosis Protected Area (Q.B.B.P.A.)—with the exception of certain shires around Brisbane, Rockhampton, and Mackay, and those shires in the far western area south from Mt. Isa to the South Australian Border.

In December 1978, the remaining three shires around Mackay were included in the Q.B.B.P.A.

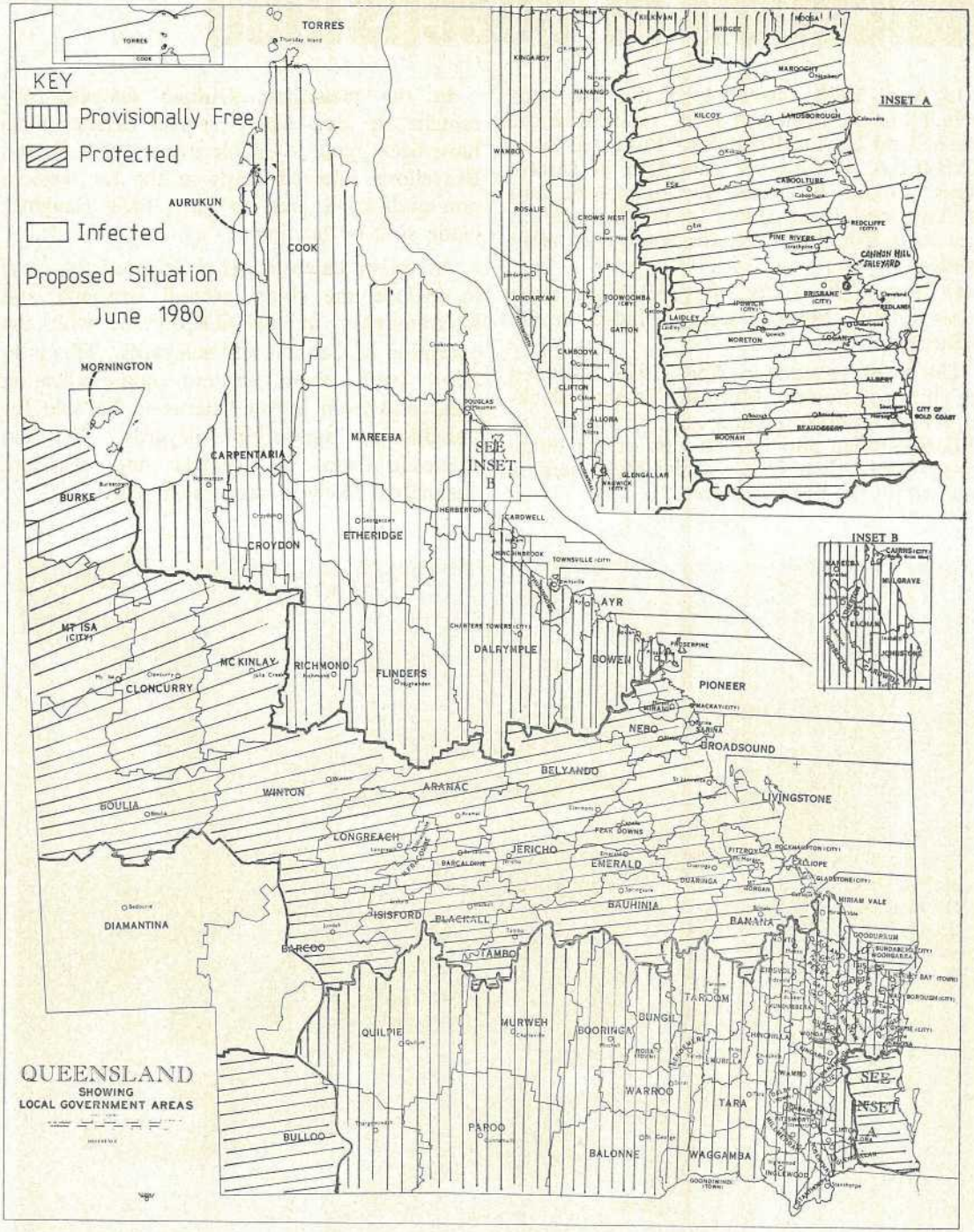
The latest gazettal in April 1979, included the shires of Barcoo, Murweh, Tambo, Blackall, Isisford, and Cloncurry and the portions of Bulloo, Quilpie and Barcoo east of the dingo fence. More than 75% of the State herd is now within the protected area.

In the meantime, Quilpie saleyard will remain an area where special arrangements have been made to enable owners of T.B. and Brucellosis infected herds in the far western non-eradication area to have their slaughter cattle sold by auction.

A further extension is anticipated this year to include the shires around Brisbane and Rockhampton in the Q.B.B.P.A., with the exception of Cannon Hill saleyards. This is to allow cattle from western non-eradication areas and from infected herds to be sold for slaughter at Cannon Hill saleyards. The final extension into the central and southern channels is likely to occur next year.



A demonstration of one of the techniques used in blood sampling in Queensland.



Map 1. Brucellosis eradication in Queensland

For all expansions of the Protected Area, a period of time has been allowed for phasing-in of movement restrictions. During a phase-in period, restrictions are less stringent. This introduces the concept of gradual restriction on the normal marketing of cattle, and gives owners the opportunity to adjust their arrangements.

This invariably generates a burst of testing activity and, so far, the majority of herds have been tested in each area before the transition to full controls. The original areas gazetted always remain under the full restrictions when nearby areas are brought under phase-in conditions.

The modifications in the phase-in period allow untested breeders from infected, suspect or non-assessed herds to be offered at saleyards in the protected area for sale for immediate slaughter (within 5 days), providing they are conveyed direct to saleyards and subsequently to the meatworks and kept isolated from cattle offered for open sale.

Compensation for reactors is at present paid at the following rates:

$220 for bulls, dairy cattle and registered stud beef cows.

$152 for other beef cows.

$128 for heifers 2 to 3 years old.

$96 for weaner females ordered to be destroyed.

Costs of on-property disposal of carcasses may be reimbursed by the Department under certain conditions. Alternatively, reactors may be sold to certain meatworks.

Meatworks have had reservations about processing brucellosis reactors on health grounds and during the earlier stages of the scheme, all reactors were destroyed on the property. Two non-exporting meatworks are now handling the bulk of Queensland's reactors. One export works is taking a few dry cows, and other reactors are processed for petfood or rendered into meatmeal. Although some discounting occurs in all cases, most reactors are now providing some cash return which supplements (and in some cases exceeds) the compensation figure.

The compensation figure is in effect a guaranteed minimum return to the owner. If the cash return from the animal is less than the compensation figure the balance is met from the compensation fund; any excess in return over the compensation figure goes to the owner.

Dairy eradication

The Dairy Brucellosis Eradication Scheme gathered momentum when it was found that exports of certain dairy products could be jeopardized by the changing attitudes of various countries towards the brucellosis status of Australian dairy herds. The blank refusal of two importing countries to accept non-certified produce from Australia in 1977 brought matters to a head.

Steps were immediately taken to organise a voluntary dairying eradication scheme for those herds outside the existing eradication areas, and testing began in mid 1977. This scheme is an 'industry' brucellosis eradication exercise. The suppliers outside the 'eradication area' have agreed to conform to certain conditions imposed on them regarding movements, replacements, fencing etc.

Since 1973, records have been kept of milk ring tests carried out quarterly on bulk milk suppliers to all Queensland factories. Warm milk and cream suppliers have also been tested.

During June 1977, herd records were checked, and herds were assessed as 'infected', 'suspect' or 'clean'. Certain factories were selected, and all suppliers to these factories were approached to join in the scheme. The response was excellent, and as yet, no farmer has declined to participate.

Herds with 'positive' or 'suspect' status are sampled and testing is continued at 30 to 60 day intervals until consecutive negative blood tests are obtained at an interval of 6 months or more, qualifying them for a 'provisionally clean' status. A further clean test after 6 months confirms the clean status, subject to continuing negative milk ring testing.

Animals are identified by means of a plastic numbered eartag supplied by the Department.

Results from blood tests are assessed by private practitioners and reviewed by the Divisional Veterinary Officer before the owner is notified. If any reactors are found, the Divisional Veterinary Officer issues the owner with an order requiring the slaughter of the animal.

When herds were shown to be heavily infected at the start of the voluntary scheme, Divisional Veterinary Officers usually approved a programme of vaccination to

reduce infection in the herd to a level at which test and slaughter was practicable. Reactors were often progressively removed over a period of 6 to 12 months, to avoid loss of production as far as possible. Almost all such herds are now under test.

Since mid 1977, all factories in Maryborough, Rockhampton, Cairns and Toowoomba Divisions and some suppliers to Pauls and Southport factories in the Brisbane region have been progressively incorporated in the voluntary scheme. In spite of initial fears of catastrophe held by some factory managements, it has proved successful. The success is illustrated by the progressive change in State milk ring test results—the total of 761 (25%) positive herds in June 1977 had fallen to 218 (7%) by December 1978.

In December 1978, the remaining dairy herds in the Brisbane region were invited to join the voluntary eradication scheme. The response has been good, and the positive herds in Brisbane had been reduced from a total of 172 in December 1978 to 133 by April 1979. Only 78 M. R. positive herds were detected at their last test in February 1980.

World authority on ticks joins Q. A. C. staff

A veterinarian who is a world authority on ticks and tick-borne diseases is soon to join the staff of the Queensland Agricultural College.

The Director of the College, Dr T. M. Morrison, announced that Dr L. L. Callow, presently Officer-in-Charge of the Tick Fever Research Centre of the Queensland Department of Primary Industries, will be taking up an appointment as Head of the Department of Animal Husbandry of the College from May this year.

Dr Callow holds the degrees of Doctor of Philosophy and Doctor of Veterinary Science, his field of specialization being immunology and epidemology of the tick fevers in cattle.

Following graduation in veterinary science in 1953, Dr Callow took up practice as a government veterinarian in central and southern Queensland. He returned to the University for post-graduate study as the U.G.A. Fellow in 1957. Following appointments as veterinary and senior protozoologist at the Animal Research Institute and periods of further research, Dr Callow was appointed Officer-in-Charge of the Wacol Tick Fever Research Centre in 1966.

At that Centre, he has been involved in the husbandry of well over 200 domestic animals and more particularly in research resulting in the provision of a vaccine to combat tick fever in cattle and the establishment of new diagnostic testing procedures. These have been vitally important for the advancement of animal production and animal husbandry not only in Australia but also in many other countries throughout the world.

In addition, he has participated in a number of international conferences and in consultative work for the F.A.O., in particular in developing countries such as Bolivia, Uruguay, and Mozambique, as well as for Australian Aid in Sri Lanka, Malaysia, Singapore, Indonesia, India and Pakistan.

He is currently involved in the provision of a course on ticks and tick-borne diseases being conducted by the College for the Australian Development Assistance Bureau.

The Director indicated that in his new position Dr Callow will be responsible for the administration, teaching, research and development, and extension programs of the Department of Animal Husbandry. This department offers subjects within Certificate, Associate Diploma, Diploma and Degree courses. He will be actively involved in promoting contact with the farming industry and assisting in animal production and husbandry on College farms.

Fallow deer in Queensland

by A. K. Searle, Queensland National Parks and Wildlife Service

Plate 1. Mature fallow buck shedding velvet; both female and male are of the common brown type in summer coats.

FALLOW deer *(Dama dama)* are introduced animals in Australia with an interesting history.

Originally they came from Asia Minor (Turkey) and in ancient times were collected and displayed by kings and nobility in the Mediterranean area. The species spread from these introductions and today occurs throughout Europe.

It is thought that the Romans introduced fallow deer into Britain and by the times of the Normans they were probably as numerous as they are today.

These deer have been introduced throughout the world and occur as feral animals in north-west Africa, the United States of America, New Zealand, New Guinea and Australia.

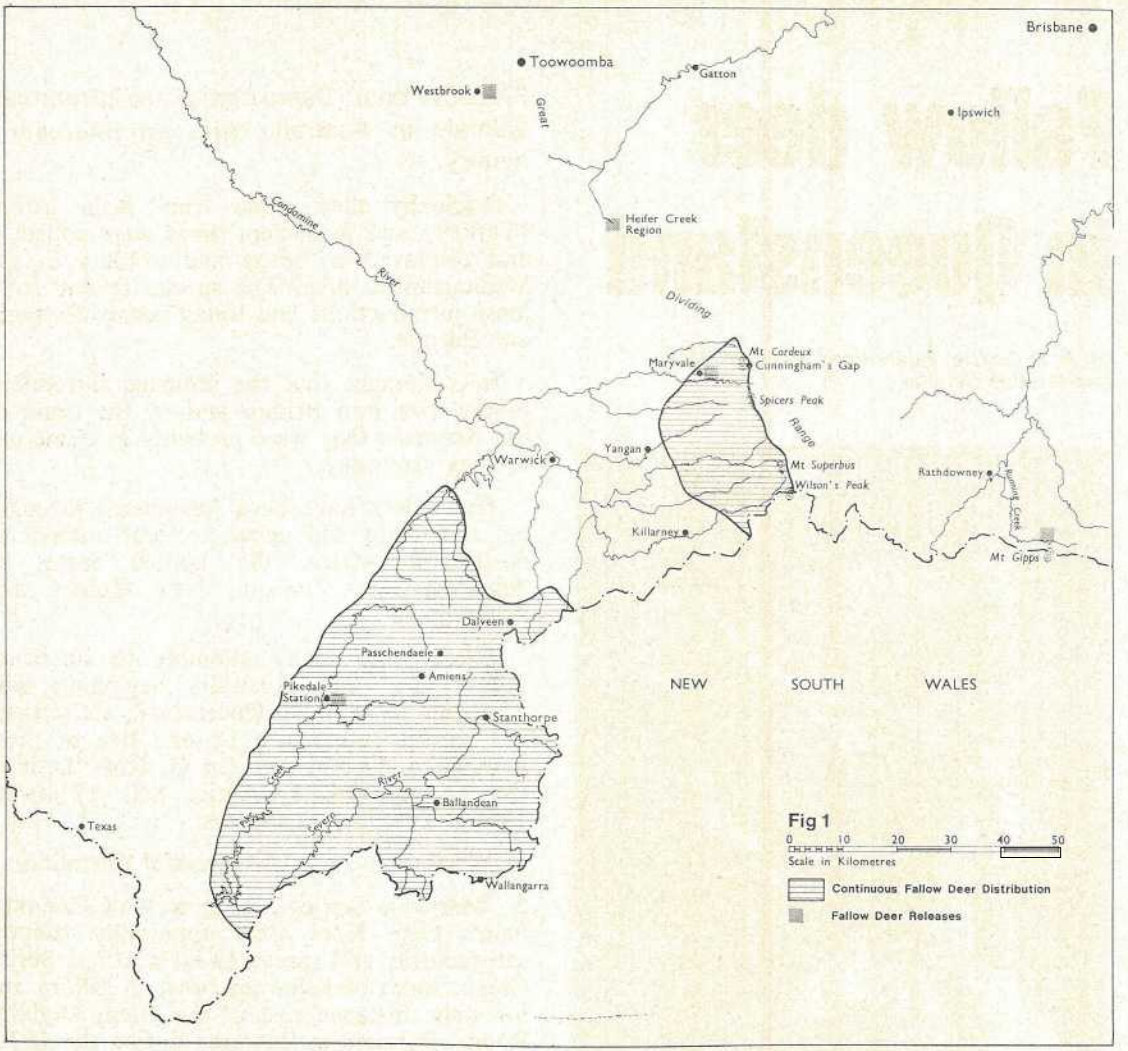
There were many attempts to introduce fallow deer into Australia beginning with Tasmania in 1850. In Queensland, six releases are known (see figure 1) and five of these have been documented (in C. Roff 'Deer in Queensland' Qd. J. Agric. Sci. 17:43-58. 1960). They are as follows:

1. Westbrook area. Unsuccessful liberation.

2. 'Maryvale Station', 8 km west of Cunningham's Gap. Here, deer apparently adapted satisfactorily and spread as far north as Spring Creek, south of Killarney, west to Allora and for some distance east of the Great Dividing Range. Farmers in this area during the 1930s and 1940s reported groups of as many as 40 deer feeding on cultivation and it appears the species was shot regularly until the 1950s. Since then, little has been seen or heard of these, but occasional deer are still reported from the remote, rugged parts of the Great Dividing Range in the region.

3. 'Canning Downs' via Warwick. This liberation was unsuccessful, the deer being destroyed after damaging crops.

4. Main Range near Toowoomba. Little is known of this liberation although fallow deer were reported in the Heifer Creek area until the 1940s. There is no recent report known to the author.



5. 'Pikedale Station'. This liberation, whether deliberate or accidental (folk lore has it that some shearers released deer that were kept on the station) proved moderately successful. Today, animals extend from the Severn River area north to the Herries Range, a distance of some 65 km, with distribution limited to specific habitat types.

6. A release evidently took place in the McPherson Range south of Beaudesert but details are lacking. In recent years, deer have been reported around Rathdowney.

As for deer everywhere, a specific terminology has developed for many aspects of their appearance and behaviour.

Description

A mature male fallow deer 'buck' (plate 1) averages about 91 cm high at the shoulder and weighs about 70 kg. A female 'doe' averages some 80 cm at the shoulder, with a body weight of about 35 kg. Tail length of both sexes is about 33 cm.

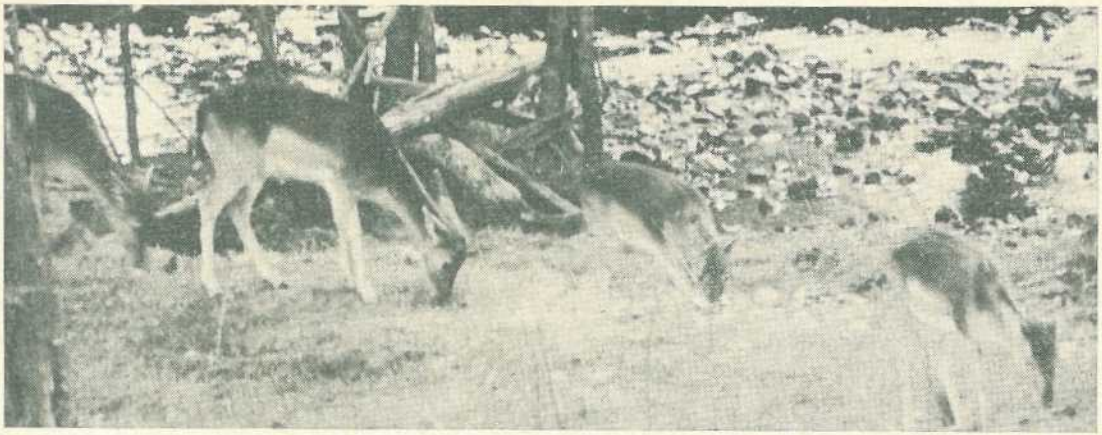


Plate 2. Common brown does in winter feeding along Pike Creek.

In Queensland, three known colour types occur—menil, common brown and melanistic.

MENIL: Coat colour on back and sides pale chestnut; conspicuous white or creamy spots along the sides and flanks with a white rump patch around the tail; belly white to cream. The white spots are conspicuous in both summer and winter coats. This colour type is not common in Queensland.

COMMON BROWN: Coat colour on back and sides chestnut, with a dark stripe down the spine to a dark tail, rump patch white. The summer coat has white spots along sides and flanks; in the winter coat (plate 2), the spots are barely discernible and from a distance the colour appears a uniform pale brown. This is the common colour type in Queensland.

MELANISTIC: Coat dark brown to black with a sooty-brown belly and a rump patch the same colour. Close inspection reveals the presence of extremely faint white spotting. This colour type (plate 3) is not uncommon in the Severn River area.

Plate 3. Melanistic fallow buck in a rutting area near the Severn River.

Fallow deer are alert animals with keen senses of sight and smell. They react quickly to disturbance, particularly by man. The first reaction is to hold the tail erect making the white rump patch clearly visible. The next move is (commonly) to 'bounce' for a short distance holding all four legs stiff without covering much ground, and fully alarmed deer speedily retreat to the nearest shelter. Despite their small size, they are able to clear fences of up to 2 m high with apparent ease.

The adult buck grows and sheds one set of antlers each year; the female is antlerless. The antlers (figure 2) are of characteristic shape, usually described as palmated. Juvenile bucks begin to grow their first set of antlers

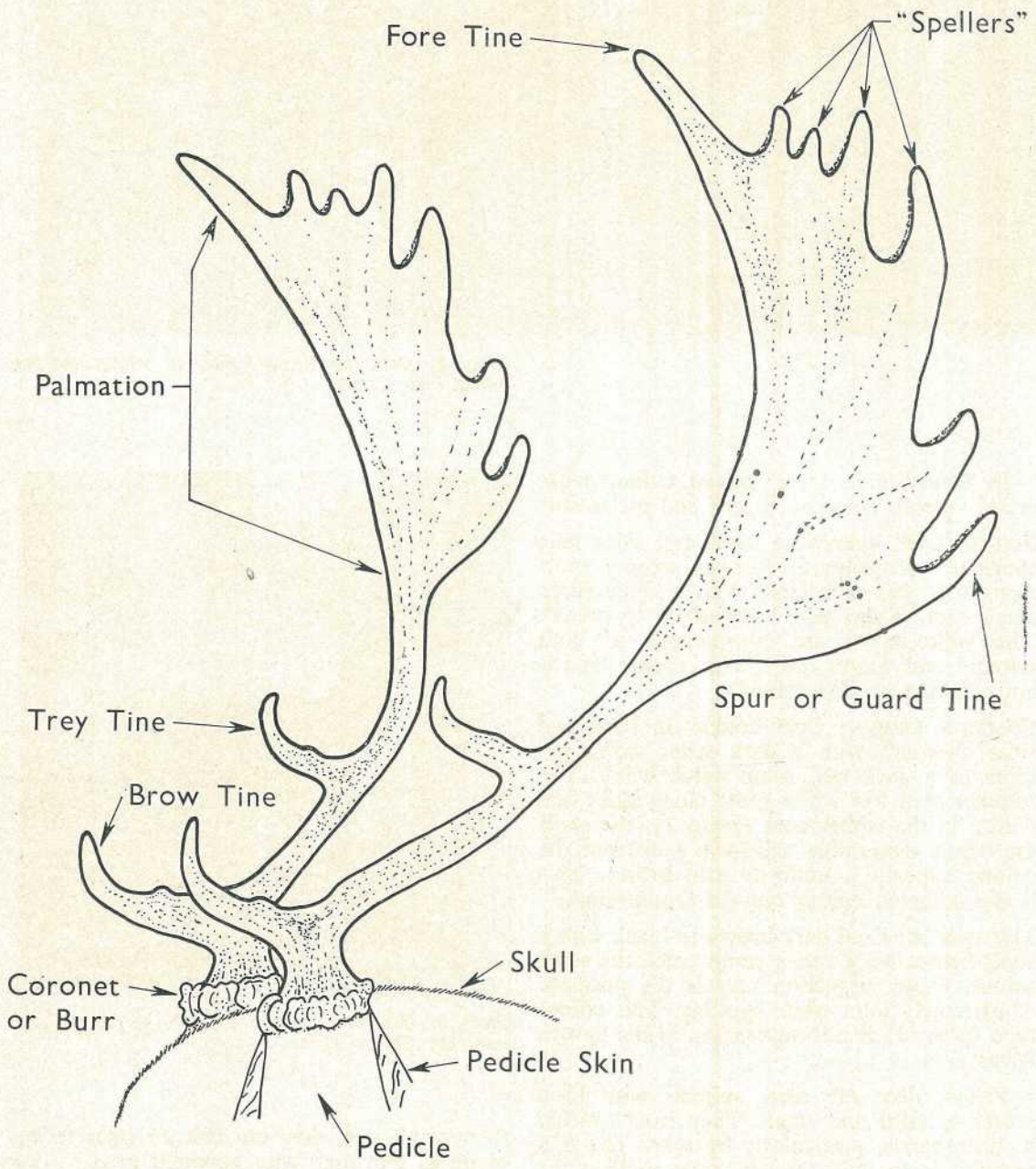


Fig 2
Fallow Deer Antlers

at the age of 10 months. This first set is fully grown at 14 months and is usually a set of single spikes. The second set usually shows a little palmation, and in the third and fourth sets this palmation increases. The largest set of antlers is produced in about the seventh year; the size generally deteriorates in later years.

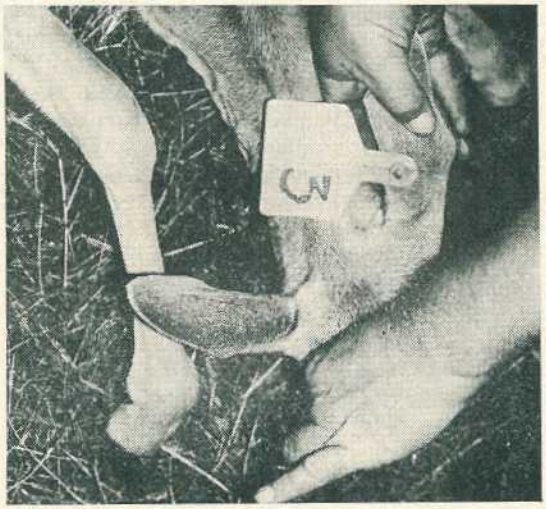
The antlers grow from two bony stumps (pedicels) on the forehead in front of the ears. During growth, the antler is covered by a thick short-haired skin known as 'velvet', which is well supplied with blood vessels. When the antler is fully developed, the velvet loses its blood supply and is sloughed off, assisted by being rubbed on saplings. The period of antler growth is November to February; by early March the antlers are rubbed clean of velvet and are well polished. These antlers are cast sometime in October/November. A skin then grows over the raw pedicel and the new antler begins to grow immediately.

Seasonal activity

The most conspicuous annual activity is the mating season or 'rut'. Towards the end of March, when the mature bucks are (normally) in good condition, with antlers polished and undamaged, they separate and begin to prepare rutting areas. The perimeters of these are defined by 'rub trees' which are bushes and saplings which the buck attacks with his antlers breaking off leaves and twigs and removing bark.

During the second week in April, when mating is due to begin, the buck 'scents' his rutting stand using a secretion from a gland situated below each eye. This is applied by moving the opening of the gland up and down against his 'rub' and other selected trees and bushes. A completed rutting stand may measure 100m in length by 40 to 50m in width, and one buck may establish several that he visits repeatedly.

Once the rut has begun, the buck becomes extremely active continuing to attack and scent his rub trees and forming 'scrapes'—small, dry wallows usually at the bases of these trees. In these, the buck urinates and then stirs the moistened soil with his antlers. The mud so produced is transferred to his flanks. The buck and his stand thus acquire a characteristic odour which together with his rutting call ('groaning')—similar to the rolling grunt of a pig—advertises his presence to the females.



Left. Plate 4. A yard trap for fallow deer being erected at Stanthorpe.

Above. Plate 5. A numbered identification tag being placed on the ear of a fallow deer.

Dawn and sunset are the periods of frequent groaning, although bucks may groan at any time of the day or night. During the rut, the stands are areas of intense activity, the buck walking up and down his stand groaning and stopping occasionally to rub a sapling. Females constantly enter and leave this stand and utter frequent squeals; the buck responds by groaning more loudly. Bucks do not eat during the rut and rapidly lose condition. When the rut ends in late April, they move to remote areas to recover good condition.

With the approach of winter and the accompanying deterioration of natural pastures, the deer are attracted to any available food particularly sown pastures. They form groups usually of identifiable composition which may be all females (plus any fawns), females plus young males (under 4 years) or all mature males 5 to 7 years of age. Yearling deer may also form small groups. The oldest males are rarely seen except during the rut, although under poor seasonal conditions the older bucks may join the younger male groups.

Following spring (September) and the usual flush of growth in native grasses, animals return to the natural range. During October-November the antlers are cast; usually the oldest shed their antlers first. Males then become secretive while the new antlers grow.

The does, on the other hand, still associate in small groups of as many as eight animals. Towards late November and early December pregnant females tend to separate and move to areas suitable for giving birth, which usually occurs during December. A fawn is left hidden by the mother for the first few days after birth while she grazes or browses nearby, returning frequently to check the young. A molested or disturbed fawn will emit a goat-like squeal which brings the mother to its defence.

During the first few days after birth, a fawn will lie still even when approached closely by man, but an older fawn will jump up and run 40 to 80 m and then hide, usually under a grass tussock or sapling, or it may simply flatten itself out on bare ground.

Habitat preferences

Fallow deer generally live in open forest, particularly where there is a brush layer. Generally, there appears to be two seasonal habitat combinations.

In summer, when food is abundant a combination of gullies and shade trees is preferred. One species of tree which provides shelter, shade and fodder in the more agriculturally-improved areas of the Pike Creek region is the wild olive, *Notelaea microcarpa* R. Br.

During winter, the preferred combination is any open forest adjacent to available cultivation or improved pasture. The open forest is used for resting during daylight while the improved pasture provides for feeding at night.

The continuance of fallow deer populations appears to depend upon the availability of winter food, a suggestion made in the light of the present low level of deer populations in the Warwick area compared with the populations recorded in the 1930s. In this earlier period, there were many more dairy farms within fallow deer range where improved winter pasture was always available; today there are few of these, with little pasture. It seems that as winter pasture diminished in extent so did the deer in numbers.

Distribution and abundance

Distribution is illustrated in figure 1, and it seems reasonable to believe that now, 100 years after the original releases, most or all of the habitat in the release district and environs has been fully tested and all suitable areas utilized; it is unlikely that further distribution will occur unaided. The population sizes are unknown, but the animal is quite common in the 'Pikedale' release area and uncommon in the other established release areas.

Conservation

Fallow deer in Queensland enjoy both legal and landholder protection. In recent years, there has been an increased interest in deer conservation from both stalkers (including photographers and hunters) and prospective deer farmers.

Currently the National Parks and Wildlife Service is undertaking a programme of trapping (plate 4), tagging (plate 5) and release of these deer with the aim of increasing the knowledge of population dynamics and movements. This information which will be of value in any future conservation programme for the species.

The need for bees in sunflowers

Why do sunflowers need bees?

The sunflower varieties currently grown in Queensland are not very self-compatible. This means that flowerheads must cross-pollinate in order to set seed.

The job of cross-pollination is done most effectively by honeybees—the most frequent insect visitors to sunflower crops.

In overseas countries where bee populations are low, colonies are introduced into flowering sunflower crops on a regular basis to increase seed set and yield.

What do the bees get out of it?

Over 95% of the honeybees visiting sunflower crops are collecting nectar. Like all nectars, sunflower nectar stimulates brood rearing and provides a store of honey. Colonies placed in commercial crops can store up to 20 kg of sunflower honey per hive.

Other honeybee visitors are collecting pollen. Sunflower crops produce an abundance of pollen which is, however, somewhat low in protein content. In combination with pollen with higher protein from other species, colony reproduction is stimulated. By placing hives near flowering sunflower crops, beekeepers have found that they can increase hive population and hive vigour provided some other pollen plants are available as well. High bee populations and vigour are of course essential for high honey yields.

by R. G. H. Nielsen and B. J. Radford, Agriculture Branch and J. W. Rhodes, Entomology Branch

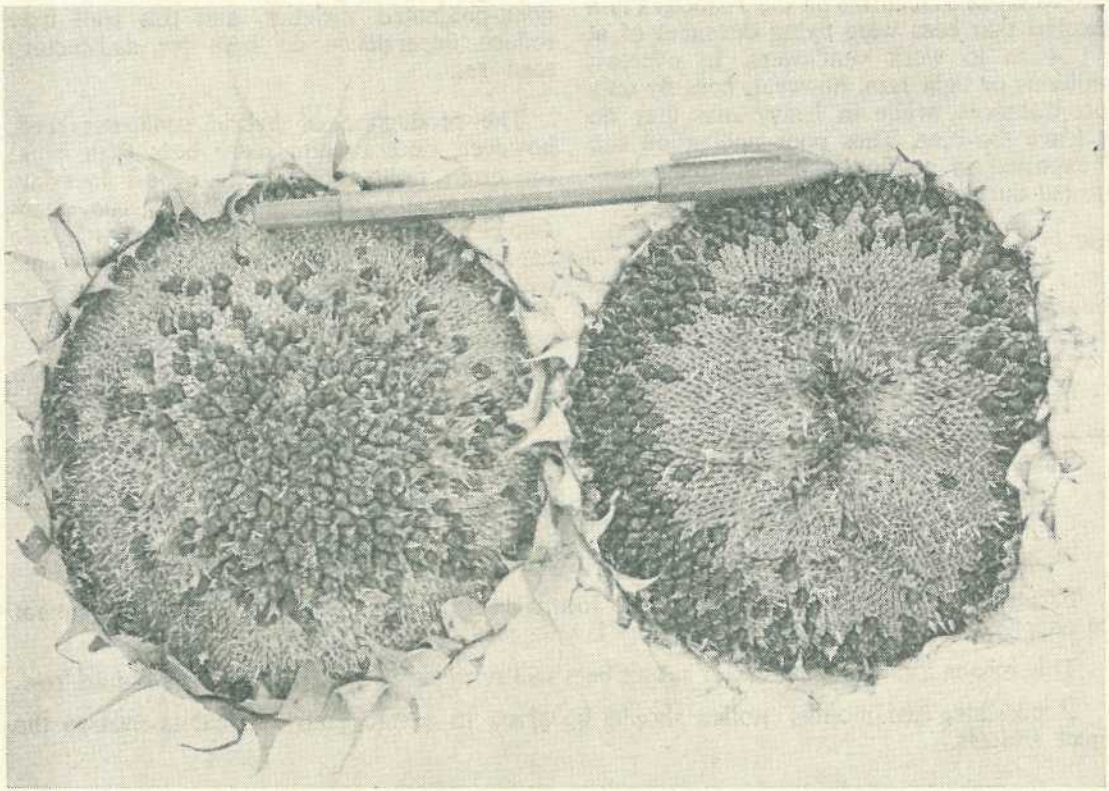


Plate 1. The effect of continuous wet weather on seed set in sunflower heads.

How many bees are needed?

An average of 25 bees per hundred flowering sunflower heads throughout the day will adequately pollinate a sunflower crop. Lower bee densities commonly occur overseas but are rare on the Darling Downs. Hive bees and feral bees (hive bees which have swarmed and become wild) are equally effective as pollinators and cannot be distinguished on sunflower heads.

Growers may wish to check their own pollinator levels in flowering sunflower crops. To do this, simply mark off a length of row containing 100 flowering heads and count the bees working these heads. If there are more than 25, bee numbers are adequate.

Such checks are recommended after insecticides have been used. If counts are low, hives may have to be brought in. Avoid using insecticides on flowering sunflowers whenever possible.

How far will bees fly to work a crop?

Research at Macalister on the Jimbour Plain indicated that bees were flying distances of at least 4 km to work sunflowers. In overcast conditions or light rain, however, bees fly only short distances, while in heavy rain they do not leave the hive. Thus poor pollination can be expected in sunflower heads which have flowered during a prolonged period of rainfall.

How is pollination recognised?

The only reliable way of recognising successful pollination is to open individual seeds and see whether they contain a kernel. If there is no kernel the seed has not been pollinated and will be blown away during harvesting.

Sometimes a ring of lighter-coloured unpollinated seeds can be seen in a head which has flowered during wet weather (see plate 1), but such external evidence of pollination failure is not always present.

Growers often notice very small seeds in the centres of sunflower heads and suspect a pollination problem. Normally, such small seeds are not a result of pollination failure as most can be found to contain small kernels. Seeds in the centres of heads are the last to set and thus are more likely to suffer moisture and/or nutrient stress at grain filling. It is this stress which reduces seed size.

Do hybrid sunflowers need bees?

Growers are familiar with the open-pollinated sunflower varieties grown in the past. Hybrid varieties are now becoming popular because of their rust resistance, uniform maturity and potential for high yield. Many hybrids also possess greater self-compatibility than open-pollinated varieties, and this trait may reduce dependence on bees for satisfactory seed set.

The production of hybrid sunflower seed, however, does require more bees than usual for cross pollination. In a hybrid breeding programme, cytoplasmic male-sterile lines (which produce no pollen) are used as female parents. Blocks of the female parent alternate with blocks of a pollen-bearing restorer line, which restores fertility in the hybrid seed to be sold commercially. Bees must be introduced into such crossing blocks to transfer pollen from the restorer line to the male-sterile line.

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The wattles of South-eastern Queensland

Phyllodes with one prominent vein and heads in axillary racemes

Acacia attenuata

This wattle was first found at Beerwah in 1922. The Latin adjective which means diminishing gradually in width was chosen as the specific epithet. It describes the base of the phyllode which is much narrowed into the petiole.

DESCRIPTION: This is a glabrous shrub 3 to 4 m high which differs from all other wattles in South-eastern Queensland. The juvenile bipinnate foliage can persist on plants, even on the flowering and fruiting branches. The bipinnate leaves have three or four pairs of leaves and can be 13 cm long. There are up to 16 pairs of leaflets which can be 1 cm long. They are oblong to somewhat oblique. No glands are present on the rhachis.

The phyllodes are blue-green and are firm in texture and almost spathulate in shape. They are about 14 cm long and 2 cm broad. The thickened margins and midrib are paler in colour than the phyllode and faint pinnate venation can be seen. A small gland is on the upper margin immediately above the pulvinus. The pale creamy-yellow heads of flowers are 1 cm in diameter and are arranged in axillary racemes up to 7 cm long, with up to 12 heads in the raceme. Microscopic examination shows the petals are pale lemon, the filaments white and the anthers deep lemon-yellow. The flowers have a faint, sweet perfume.

The pod is up to 10 cm long, and 1·5 cm wide. It is flat, with the seeds in a line down the centre of the pod and slight contractions between the seeds. The surface is raised over the seeds on alternate sides.

FLOWERING TIME: This wattle blooms during autumn and early winter.

HABITAT: It is common on the margins of peat swamps in eucalyptus forest and on sandy wallum.

DISTRIBUTION: It grows only in Queensland on the coastal plains to as far north as Maryborough. It is not a common wattle.

Acacia fasciculifera

The specific epithet for this wattle means bearing fascicules or bundles or clusters. It was chosen because the flower heads are clustered together in the axils of the phyllodes.

This wattle is an erect tree which can reach a height of 6 m. It has dark grey, rough and fissured bark, usually a dense canopy with drooping branchlets and pendulous leathery phyllodes. These are bright or dark green, and are shiny with a prominent midvein which is paler in colour, and no evident pinnate venation. The phyllodes are lanceolate-falcate, up to 14 cm long and 3·5 cm wide, with a raised gland often close to the base on the upper margin.

The pale cream flowers are in heads 1·2 cm in diameter which are on peduncles up to 2 cm long. These are clustered in the axils of the phyllodes or arranged in a condensed raceme less than 2 cm long. Individual flowers have pale greenish-yellow sepals and petals, white filaments and lemon-yellow anthers. The overall appearance of the heads is very pale creamy-yellow. They have a sweet perfume which differs from the normal 'wattle' scent.

The pods are flattened and 15 cm long and more than 1 cm broad, with nearly orbicular seeds arranged in a line down the centre of the pod.

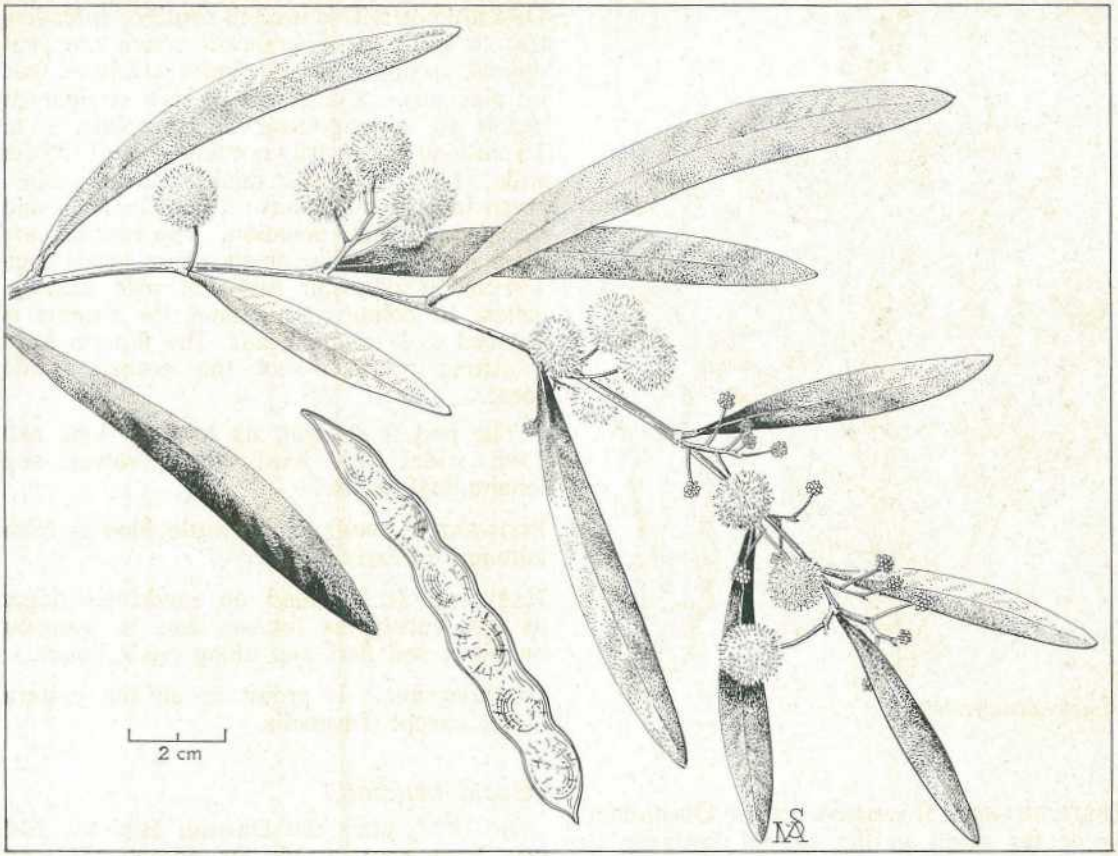
FLOWERING TIME: It is a summer flowering wattle.

HABITAT: It can be found in open eucalyptus forest or softwood scrubs, on ridge tops or creek banks.

DISTRIBUTION: It grows only in Queensland to as far north as Rockhampton. It is also found as far west in Central Queensland as Isla Gorge.

By Beryl A. Lebler, Botany Branch

Acacia attenuata



Acacia fasciculifera

Queensland silver wattle *(Acacia podalyriifolia)*

Podalyria is a South African shrub with a silvery lustre which was widely cultivated in Europe. Its obovate leaves are silky on both surfaces. When Allan Cunningham first found this wattle it apparently reminded him of *Podalyria.*

DESCRIPTION: This wattle is a spreading tree to 6 m and is covered with minute white hairs which give the whole plant a silvery-grey appearance. The phyllodes are obovate, ovate or oblong, 2·5 to almost 4 cm long and 1·5 to 2·5 cm wide. There is a pronounced mid-vein which is produced to form a short mucro. One or two glands are on the upper margin. The racemes are twice as long as the phyllodes or longer, with 10 to 20 globular heads. When the flowers are fully open, the heads are a little under 1 cm in diameter. They are bright golden-yellow in colour and highly perfumed.

The pods are about 2 cm wide, up to 9 cm long and are very flat. They can be either pubescent or glabrous. When young, they are glaucous and velvety to the touch. This is due to the covering of short, soft, erect white hairs. Mature pods are brown and open along one side to reveal the black seeds in a line down the centre.

FLOWERING TIME: The flowering period is winter.

HABITAT: This wattle is common on stony sandstone hillsides in open eucalyptus forests, on sandstone ridges and granite hillsides, but around Brisbane it is found on other types of rocky soil.

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Acacia podalyriifolia

DISTRIBUTION: It is native only to Queensland to as far north in the coastal lowlands as Mt. Morgan, and as far west as Isla Gorge, the Carnarvon Ranges and the Blackdown Tableland.

It has been found in a few localities in the northern interior of New South Wales on the north western slopes. Further south, it has become naturalised in places as a garden escape.

GENERAL REMARKS: This was one of the first native plants brought into cultivation in Queensland. Records show that it was one of the wattles grown in 1885 in the acclimitisation gardens at Bowen Park and in the Botanical Gardens.

Acacia salicina

The Latin adjective *salicina* means 'resembling a willow'. When the explorer Major Mitchell first saw this wattle in 1836 on his survey of the upper reaches of the Lachlan River, he commented on the 'willow-like acacia' with the leaves covered with bloom.

DESCRIPTION: This is a tall shrub or spreading tree to 4·5 m with branches which are pendulous, and drooping phyllodes which are pale or glaucous. The phyllodes are straight or nearly so, oblong-linear to lanceolate, 5 to 16 cm long and usually not more than 1·25 cm wide. They are rather thick in texture, blue-green in colour and have a faint midvein and obscure reticulate venation. The racemes are 4 cm long, with two or six dense heads each 1·4 cm in diameter and are pale creamy-yellow in colour. Sometimes the raceme is reduced to a single head. The flowers have a strong perfume—not the normal wattle scent.

The pod is straight, up to 8 cm long and 1 cm wide with hard, thick valves and longitudinal seeds.

FLOWERING TIME: This wattle blooms from autumn to early winter.

HABITAT: It is found on sandstone ridges in low eucalyptus forests, and is common on black soil flats and along creek banks.

DISTRIBUTION: It grows in all the eastern States except Tasmania.

Acacia bancroftii

In 1877, after the Dawson Highway had just been constructed, Dr Joseph Bancroft found this wattle in fruit along the newly cut road. Later, his son Dr T. L. Bancroft found it at Eidsvold. Although it had been previously known, it had been considered to be a form of *A. penninervis*. In 1918, it was described and named after the Bancrofts, father and son, 'who have done splendid work in the elucidation of the flora of Queensland'.

DESCRIPTION: This is a tree to 6 m high with terete glaucous branches and phyllodes which can be up to 21 cm long and 12 cm broad. The phyllodes are obliquely obovate and have a blunt tip. It is possible to find on the one twig phyllodes with both margins entire, and larger phyllodes with one or two pronounced triangular projections on the upper margins. These can be up to 1 cm long.

A prominent slit gland is just above the pulvinus on the upper margin and there is also a gland on the end of each triangular projection. The phyllodes are blue-green in

Acacia salicina

Acacia bancroftii

Acacia falcata

colour. As many as 20 heads of flowers are in the axillary racemes. These can be 8 cm long. Individual heads are 0·9 cm in diameter.

All parts of the flowers are lemon-yellow and the perfume is very slight. Usually the axis of the inflorescence and the peduncles are glabrous but occasionally short appressed hairs are present. The pod is glabrous and glaucous. It is flattened, up to 20 cm long and 1·5 cm wide with seeds arranged longitudinally.

FLOWERING TIME: It can be found flowering from the middle of autumn to late in winter depending on where it is growing.

HABITAT: This wattle usually grows on stony ridges in open eucalyptus forests often in association with ironbarks.

DISTRIBUTION: It is confined to Queensland and grows to as far north on the coastal areas as Collinsville. It is very common in Central Queensland and has been collected from the Blackdown Tableland and the Carnarvon Ranges. Near Kingaroy, it occurs on deeper and richer soils and the phyllodes are usually green. In South-eastern Queensland, it has only been found in two localities—Yarraman and Pierce's Creek, north-east of Crow's Nest.

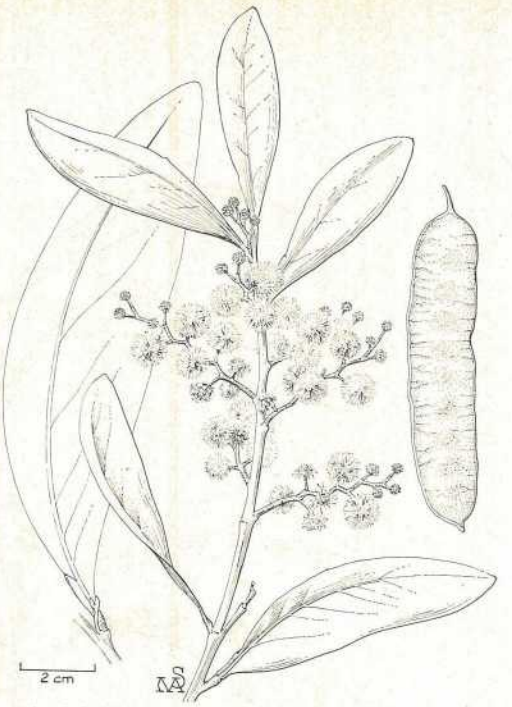
Acacia falcata

The Latin adjective *falcata* means sickle-shaped. It describes the shape of the phyllodes of this wattle.

DESCRIPTION: This is a slender-stemmed glabrous shrub 2 to 3 m high with slightly angular branches. The phyllodes have a blue-green colour and are falcate to almost boomerang-shaped. They can be 17 cm long and 3·5 cm wide and are very narrowed towards the base. A slit-like gland 0·3 cm long is on the upper margins at the base of the phyllode. The main vein is closest to the upper margin and the secondary venation is obliquely pinnate.

The heads of flowers are 0·5 cm in diameter. They are in racemes 5 to 6 cm long with 10 to 20 heads each containing about 20 flowers. The flowers are pale cream and have a slight, pleasant perfume.

The pods are 5 to 7·5 cm long and 0·6 cm wide. They are flat with slightly thickened margins. The walls of the pod are raised above the seeds. The seeds are longitudinal and close to the margin.



Acacia falciformis

FLOWERING TIME: This wattle blooms from autumn to early winter.

HABITAT: It is common in open eucalyptus forests, on dry stony hillsides, on ridges in gravelly soil and on sandstone hills.

DISTRIBUTION: It grows only in Queensland and New South Wales from as far south as Port Jackson to as far north as Herberton.

Acacia falciformis

The Latin adjective *falciformis* means shaped like a scythe or sickle and describes the shape of the phyllodes.

DESCRIPTION: The variant of this species from Mt. Ngunngun in the Glasshouse Mountains is a shrub about 2 m high with glaucous stems and phyllodes. The midrib is closer to the upper margin with a small gland on the upper margin very close to the base. The phyllode is falcate, up to 15 cm long and 3·5 cm wide. In young leaves, there is no subsidiary vein leading to the marginal gland but it is apparent on older leaves.

Minute, appressed, golden hairs are scattered over the inflorescence and also the young shoots. The flower heads are very pale cream, and are in a raceme up to 5 cm long, with a zigzag rhachis. Microscopic examination shows that the petals are very pale lemon, the filament is white and the anthers lemon-yellow. The heads are more than 1 cm in diameter and have little or no perfume. The pod is glaucous, flattened and up to 10 cm long, and less than 2 cm wide. The margins are slightly thickened and the ovate seeds are in a line down the middle of the pod.

FLOWERING TIME: This wattle flowers early in winter.

HABITAT: It is found on boulder-strewn mountain slopes.

DISTRIBUTION: The species is found in all the eastern mainland States to as far north as Mareeba. The variant described differs from plants found in other places in being conspicuously glaucous. The only place it is found in South-eastern Queensland is on the upper slopes of Mt. Ngunngun.

GENERAL REMARKS: This wattle was originally considered to be a variety of *A. penninervis*.

Acacia suaveolens

Acacia suaveolens

The Latin adjective *suaveolens* means fragrant or sweet-smelling. It describes the flowers with their sweet perfume.

DESCRIPTION: This is a slender, erect shrub which seldom exceeds 2 m. It is completely glabrous and is sparsely branched. The branches are compressed and angled and are somewhat winged.

The bluish-green phyllodes are arranged in a vertical plane. They are up to 13 cm long and less than 1 cm wide with a prominent nerve showing as a lighter green line down the middle. They taper gradually from the middle to the base.

The racemes are up to 3 cm long. In the very young stages, the heads are covered with broad imbricate bracts. As the axis of the raceme elongates these bracts fall off. The racemes contain up to nine heads, which, when fully opened are about 1 cm in diameter. They contain six to ten pale cream or lemon flowers which are very sweetly perfumed.

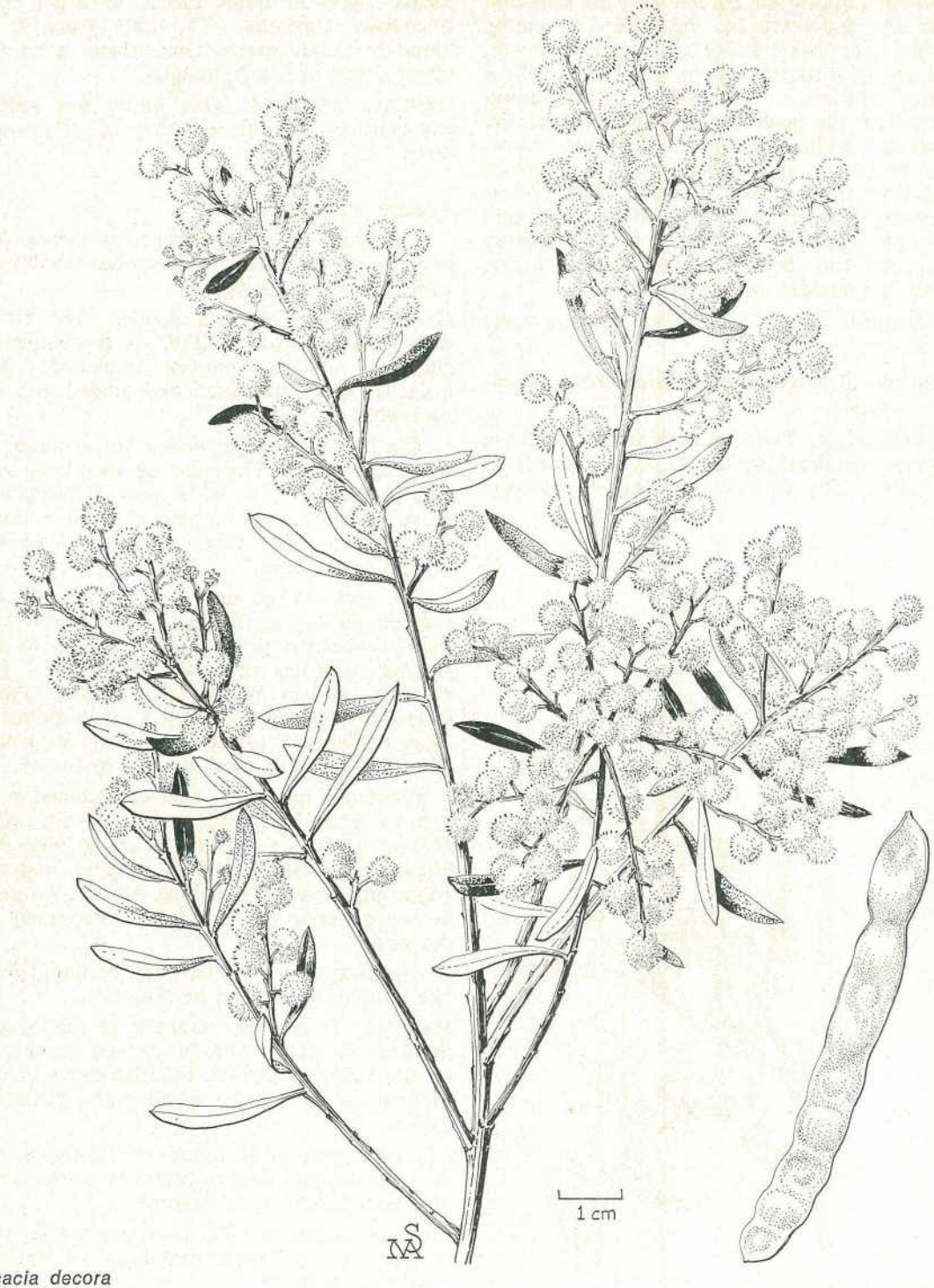
The fruits are oval—oblong flattened pods 2·5 to 4 cm long and up to 1·5 cm wide. Mature pods are covered with a blue-grey bloom (like that found in grapes) and the young pods are very striking because as many as seven seeds are arranged transversely in the pod.

FLOWERING TIME: Flowers can be found from late autumn to the end of winter.

HABITAT: It is most common in the coastal lowlands in sandy soil in wallum scrubs, in open eucalyptus forests, but also grows in the McPherson Range in eucalyptus—casuarina forests.

DISTRIBUTION: It is found in Tasmania and all the mainland eastern States to as far north as Fraser Island and Cooloola.

GENERAL REMARKS: Seeds of this wattle were in the first collections sent back to England from Port Jackson.



Acacia decora

Pretty wattle *(Acacia decora)*

The Latin adjective *decora* means decorative or elegant. It alludes to the attractive overall appearance of this plant. Allan Cunningham collected the seeds of this wattle from Liverpool Plains, west of Tamworth in New South Wales.

DESCRIPTION: This is a very showy shrub which, in Queensland, can grow to a height of 4 to 5 m, with rather thin stems and yellowish twigs. The phyllodes are somewhat glaucous, linear to narrow—oblanceolate and widest above the middle. Only the midvein is prominent, but magnification shows faint pinnate venation. The phyllodes can be as long as 6 cm and as narrow as 0·2 cm but they are usually much shorter and wider. A prominent gland is in the lower half of the phyllode and a second gland is sometimes present.

The strongly-perfumed heads of flowers are bright golden-yellow and are 0·7 cm in diameter. They are arranged in racemes often much longer than the phyllodes, with up to 20 heads of flowers. The inflorescence appears to be glabrous but magnification shows minute, white, appressed hairs scattered over the rhachis and branches. All parts of the flower are bright yellow. The pod is flat and thin, up to 11 cm long and 0·4 cm wide and is constricted between the seeds.

FLOWERING TIME: It flowers in winter and early spring.

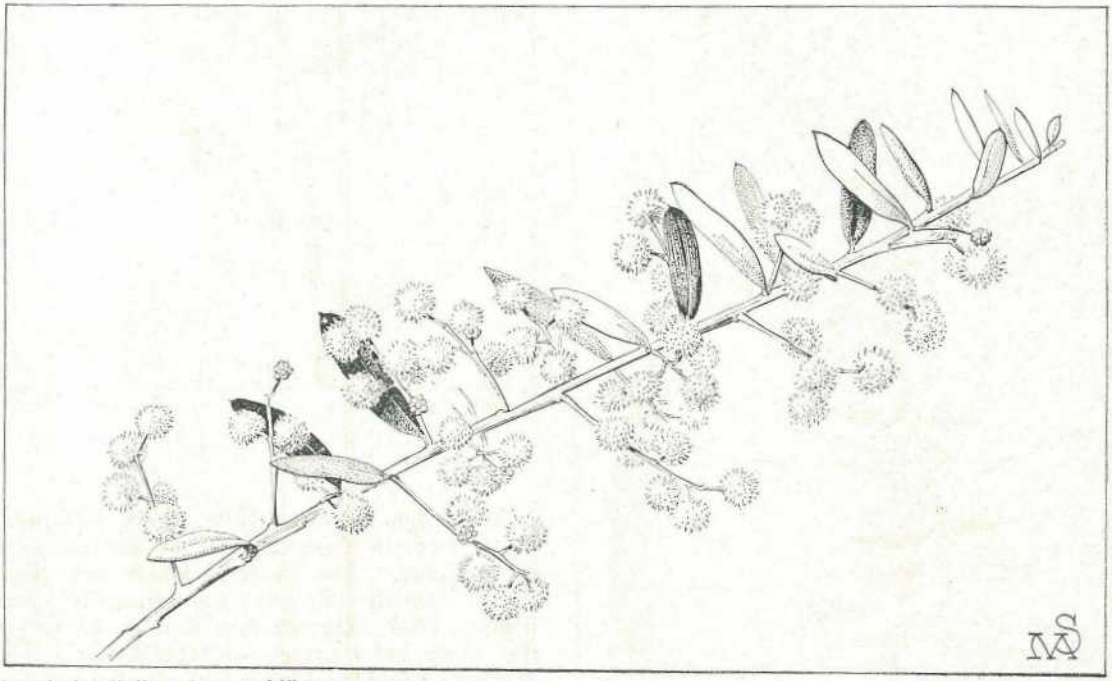
HABITAT: It is found on stony ridges and hillsides, in open eucalypt forest on sandstone ridges or in granitic soil in gullies.

DISTRIBUTION: This wattle is native to Queensland and New South Wales to as far south as the Liverpool Plains and as far north as the Cooktown Laura area.

GENERAL REMARKS: It has been in cultivation for some years and can occasionally be obtained from nurseries specialising in native plants.

Acacia buxifolia subsp. *pubiflora*

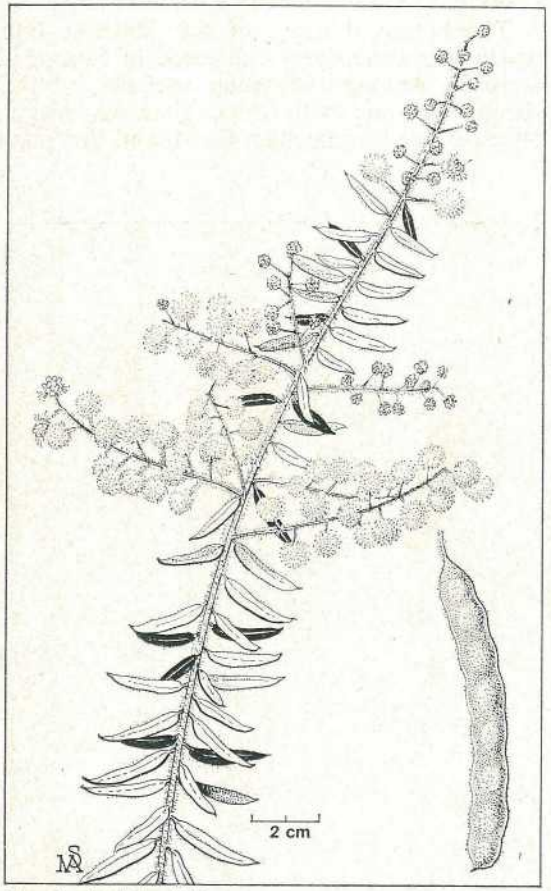
The botanical name of the common box, which was extensively cultivated in Europe is *buxus*. Among the many varieties of this shrub was one with oval, glaucous leaves. When Allan Cunningham first found this plant



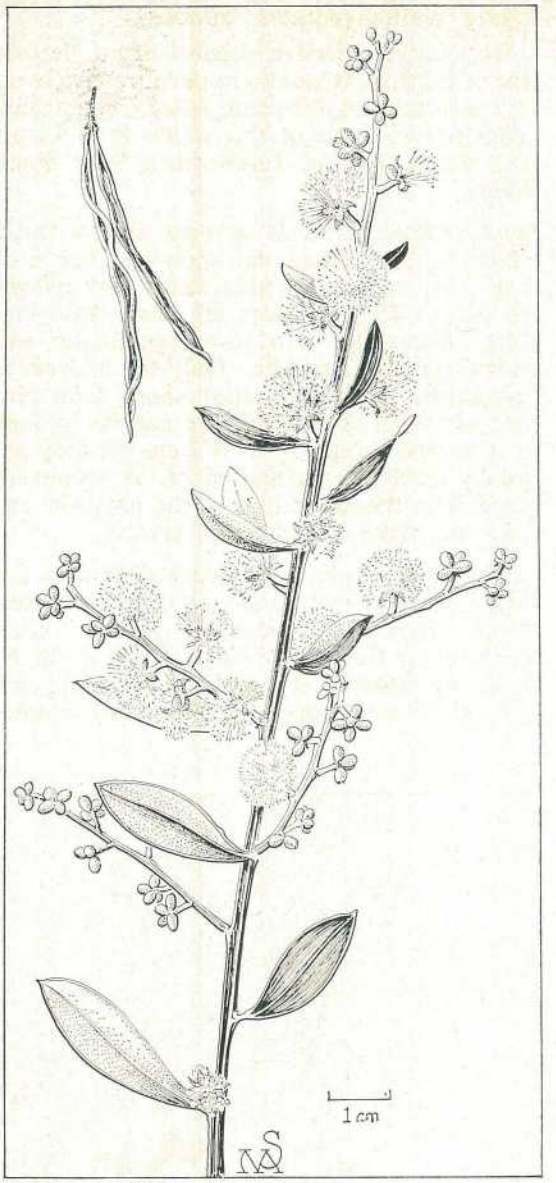
Acacia buxifolia subsp. *pubiflora*

in the Blue Mountains he was apparently reminded of the English garden plant since he gave this wattle a name which means box-leaved. This wattle is regarded as being a subspecies of *A. buxiflora* because hairs longer than 0·1 cm cover the sepals. In *A. buxifolia* only a few hairs are present. The name pubiflora given to this wattle means softly hairy flowers.

DESCRIPTION: This is a bushy shrub to 3 m in height with many firm, red-tinged branches. The phyllodes are blue-green, up to 3 cm long, 0·7 cm wide and are oblong-elliptical to obovate. They are always widest above the middle. The only visible vein, which is closest to the upper margin, is different in colour from the rest of the phyllode. An obscure, sunken gland is on the upper margin about half-way along the phyllode.



Acacia leichhardtii



Acacia myrtifolia

The bright golden-yellow heads of flowers are 0·8 cm in diameter and the flowers have no perfume. The racemes which are much longer than the phyllodes contain up to seven heads. High magnification is required to see the white hairs present on the sepals. The rhachis and peduncles are glabrous.

FLOWERING TIME: This wattle flowers in late winter and early spring.

HABITAT: It usually grows on sandstone in mixed open forest.

DISTRIBUTION: It has been found only in Queensland and grows to as far north as Mt. Playfair, east of Tambo. In South-eastern Queensland, it has been found in the Murphy Creek to Spring Bluff area, at Lockyer and in the hills north-west of Helidon. It also grows on the Darling Downs to as far west as Gurulmundi.

Acacia leichhardtii

In 1844, the explorer Leichhardt, while on an expedition from Moreton Bay to Port Essington, discovered this wattle in the vicinity of the Expedition Range. It was named in his honour.

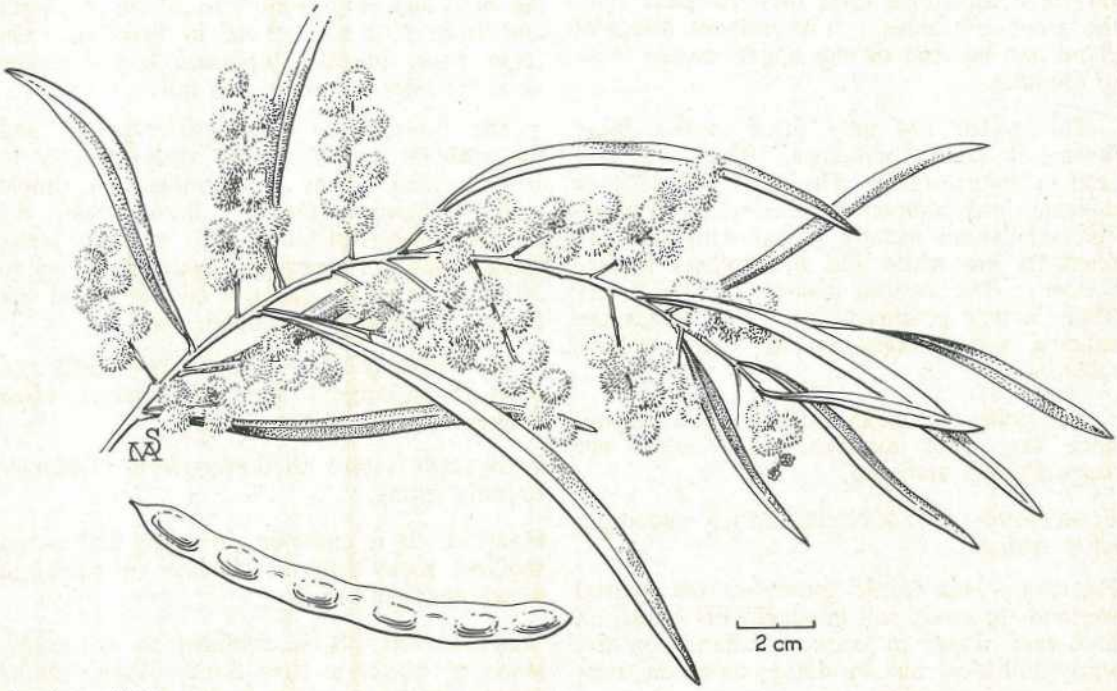
DESCRIPTION: This is an erect, spreading shrub which can grow to between 2 and 3 m high. It has spreading to pendulous branches and linear-lanceolate to obliquely-oblong, dark green, leathery phyllodes less than 5 cm long. The phyllodes are often reflexed on the stems and scattered, long, white hairs spread from the midrib and margins. A denser covering of hairs is found on the stems and the inflorescences.

The heads of vivid golden-yellow flowers are in axillary racemes very much longer than the phyllodes. Each head is 0·8 cm in diameter. Some plants look spectacular in flower as the phyllodes are either very small or have fallen from the plant. The racemes can be 8 cm long, making the tips of the stems look like a panicle of racemes.

The pods are pendulous and brown, 7 cm long, 0·8 cm wide. They are covered by long, silvery hairs and contain up to ten seeds.

FLOWERING TIME: This wattle flowers from midautumn to midwinter.

HABITAT: It always grows on sandstone in sandy soil as an understorey in eucalyptus forest, sometimes on ridges or slopes, sometimes on creek banks.



Acacia neriifolia

DISTRIBUTION: It is found only in Queensland. In South-eastern Queensland, it has been found only in the hills north of Helidon. This wattle also occurs on the Darling Downs, the Blackdown Tableland, the Carnarvon Gorge and Isla Gorge.

Acacia myrtifolia

Seeds of this wattle were among the first seeds of Australian plants sent to England from New South Wales at the end of the eighteenth century. The myrtle of the classics had leathery leaves which were smooth and shining, and ovate to lanceolate in shape. The phyllodes of this wattle were thought to resemble myrtle leaves.

DESCRIPTION: This is a glabrous spreading shrub to 3 m, with angular branches, often tinged with red. The plant has a characteristic appearance as the phyllodes point upwards towards the end of the branches.

The phyllodes are thick and almost fleshy, 3 to 6·5 cm long. They are oblique, narrow-elliptical and are tapered abruptly to end in a point. The nerve-like margins and the mid-rib are conspicuous since they are paler than the green phyllodes. A prominent marginal gland can be seen on the upper margin close to the base.

This wattle has only three to five large flowers in the inflorescence. These are best seen in mature buds. The open inflorescence does not look completely spherical. The petals and sepals are usually tinged with red, the filaments are white and the anthers lemon-yellow. The overall colour of the flower heads is pale creamy-yellow. The heads are solitary and axillary or in short axillary racemes.

The pods are linear, thick and curved and have very thick margins. The seeds are longitudinally arranged.

FLOWERING TIME: It blooms during winter and early spring.

HABITAT: This wattle grows on the coastal lowlands in sandy soil in eucalpytus forest, on mountain slopes in open woodland, on dry stony hillsides and in damp spots on rock ledges on mountains.

DISTRIBUTION: It is widely distributed in all States except the Northern Territory. In Queensland, it is found as far north as the Glasshouse Mountains.

Acacia neriifolia

The botanical name for the commonly cultivated oleander is *Nerium*. When Allan Cunningham first found this wattle at Liverpool Plains it obviously reminded him of the oleander because he suggested a name for the plant which means oleander-leaved.

DESCRIPTION: This is a handsome tall shrub or tree to 9 m high, with spreading branches and usually a compact crown densely covered with flowers.

The form which grows in South-eastern Queensland has dark green glabrous phyllodes. They are linear-lanceolate and have a prominent midvein which is different in colour, and obscure pinnate venation. On the upper margin, there is always one raised marginal gland and sometimes two or three. When only one is present it is at least 0·5 cm from the base.

The phyllodes are much narrowed towards the base and vary from 8 to 13 cm in length and from 0·8 to 1·5 cm in breadth. On some trees, juvenile bipinnate leaves persist until the trees are about 3 m tall.

The flowers are vivid golden-yellow and the globular heads are on peduncles up to 0·8 cm long. They are arranged in simple axillary racemes usually shorter than the phyllodes. In full bloom, this wattle is really spectacular. The racemes can have up to 30 heads and be up to 8 cm long and the flowers are sweetly perfumed.

The pod is flat, straight or nearly so, 8 to 15 cm long, 0·8 cm wide and is often contracted between the seeds.

FLOWERING TIME: It flowers from midwinter to early spring.

HABITAT: It is common on sandy soil or on shallow, rocky soil on hillsides or ridges in mixed eucalypt forests.

DISTRIBUTION: It is confined to the tablelands of northern New South Wales (being fairly common on the granitic areas of the

Acacia penninervis

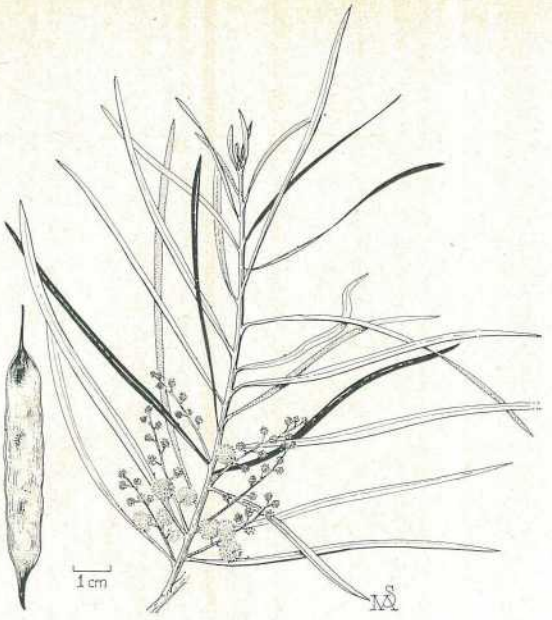
New England Tableland), the inland districts of Queensland to as far north as the Blackdown Tableland and the Carnarvon Range. East of the Great Dividing Range, it grows at Crows Nest, Esk and Yarraman. The inland form differs in having a glaucous bloom on the leaves and branches.

GENERAL REMARKS: This wattle would be an asset to any garden and I do not understand why it has not been brought into cultivation.

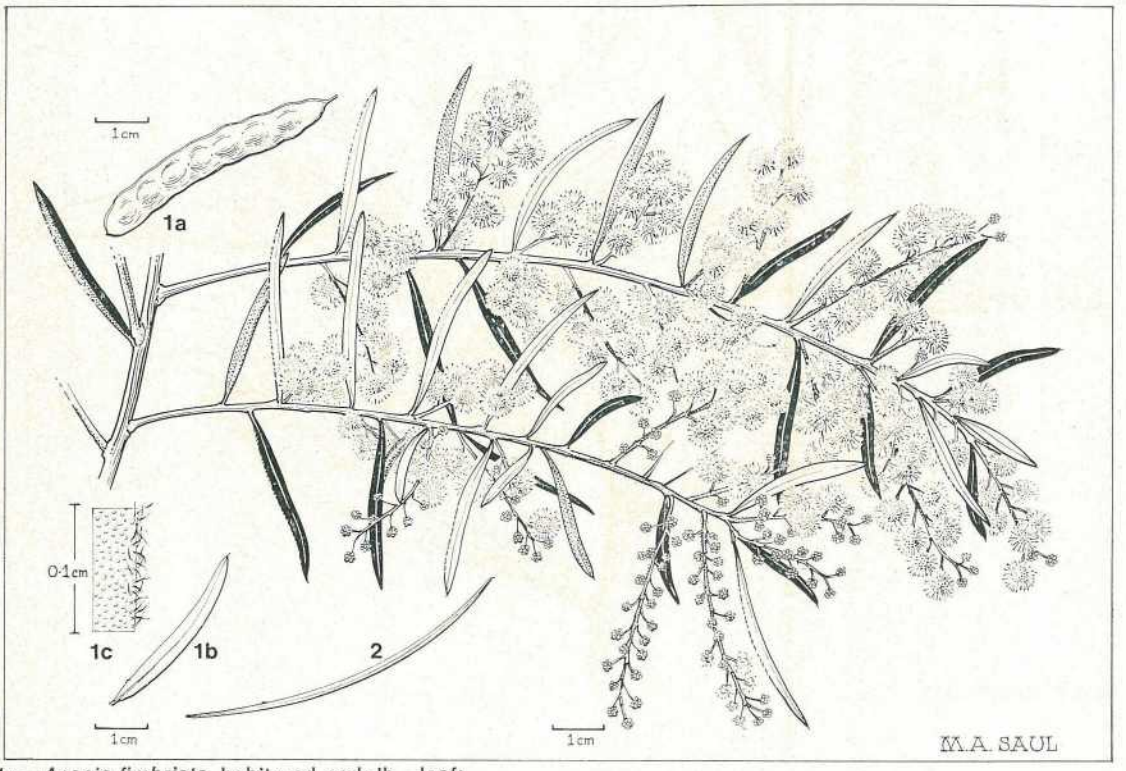
Acacia penninervis

The Latin adjective used for the specific epithet for this wattle means pinnately-veined.

DESCRIPTION: This is a tree to 8 m, but is often a much smaller shrub. The branches are spreading and ascending and in smaller trees



Right. *Acacia adunca*



1a—*Acacia fimbriata*, habit and pod; lb—leaf;
1c—enlargement of leaf showing marginal hairs;
2—*Acacia peraugusta*—leaf

and shrubs form a rounded canopy. The bark is tight and black. The phyllodes are green and slightly leathery in texture. There is great variation in length and breadth, often on the one plant. Whatever the size, the shape is oblong to lanceolate-falcate. They always have a paler margin and midrib and have prominent pinnate venation. On the upper side near the base of the phyllode there is often a short, secondary, prominent vein. This ends in a pronounced gland.

The heads of flowers are almost white to pale cream and are up to 0·8 cm in diameter. They are on peduncles up to 1 cm long which are arranged in axillary racemes up to 10 cm long. The young shoots as well as the inflorescences are glabrous, or, if hairs are present, they are white and not golden.

The pods are flattened and straight or curved with slightly thickened margins. They can be up to 12·5 cm long and 1·25 cm wide.

FLOWERING TIME: Flowers can be found at practically any time of the year except during midwinter.

HABITAT: It grows in a wide range of conditions from mountain slopes in open eucalyptus forest to rock crevices in mountains. It can also be found as an understorey to she-oaks and banksias in sandy wallum or in tea tree scrubs.

DISTRIBUTION: It is found in all the eastern States to as far north in Queensland as the Callide Valley.

Acacia adunca

The Latin adjective *adunca* means hooked, and refers to the small oblique point like a little hook often found on the phyllode.

DESCRIPTION: This is a slender, erect shrub usually 2 to 3 cm high but occasionally reaching a height of 4·5 m. The phyllodes are soft in texture, bright to dark green, linear and up to 17 cm long and 0·3 to 0·5 cm wide. They taper gradually to a blunt tip and also to the base. In South-eastern Queensland, the tip of the phyllode is usually blunt, not hooked. One or two prominent glands are found on the upper margin. The only vein shows as a ridge on both sides of the phyllode.

The loose, pale creamy-yellow heads are 0·9 cm in diameter and are on axillary racemes about 4·5 cm long with ten or more heads. They have little or no perfume.

The pod is linear and flattened, up to 13 cm long and just under 1 cm wide with seeds in a central line.

FLOWERING TIME: This wattle flowers from about midautumn to the middle of winter.

HABITAT: It is found on steep mountain slopes on stony, shallow soil in open eucalyptus forests.

DISTRIBUTION: It is found in New South Wales to as far south as the southern tablelands and Queensland where it grows on the isolated peaks of the McPherson Range and on the Darling Downs around Wallangarra and Stanthorpe.

Brisbane Golden Wattle (*Acacia fimbriata*)

The Latin adjective *fimbriata* means fringed, or bordered with hairs. It refers to the fringe of hairs usually found on the margins of the phyllodes.

DESCRIPTION: This is a shrub or small tree up to 7 m high with a rounded crown and slender branchlets which are angular. They can be completely glabrous or have a very dense covering of short, white spreading hairs, particularly on the flowering twigs.

The phyllodes are rather thin in texture and usually have very short, white hairs forming a fringe on the margins of the phyllodes. This fringe can be seen by holding the phyllode against the light. They are clearly visible under magnification. The phyllodes are straight or slightly curved and have a prominent gland on the upper margin usually near the middle but sometimes 0·1 to 0·6 cm from the base. They are up to 5 cm long and 0·2 to 0·5 cm broad.

The flowers are lemon-yellow and in axillary racemes up to 6 cm long, with as many as 25 heads. These are 0·7 cm in diameter and have a faint, sweet perfume. The rhachis can be glabrous or hairy and the flowers are glabrous. The pod is flat, up to 6 cm long, glabrous, with faint transverse veins, and is raised slightly over the seeds.

FLOWERING TIME: This wattle blooms from late winter to midspring.

HABITAT: It is common in eucalyptus forests along creek banks and on mountain slopes.

DISTRIBUTION: It is found only in New South Wales and Queensland to as far south as the Blue Mountains and as far north as Byfield. In Queensland, it grows as far west on the Darling Downs as Thulimbah. The Darling Downs plants have much brighter flowers than the coastal forms.

GENERAL REMARKS: This wattle, although short lived, is in cultivation.

Eprapah wattle (*Acacia perangusta*)

The Latin adjective *perangusta* means *very* much narrowed. Until recently this wattle was thought to be a variety of *A. fimbriata* with very narrow phyllodes. It is now considered to be a separate species.

DESCRIPTION: This is a shrub or small tree up to 6 to 7 m tall. It has reddish, slender, angular stems which are glabrous. The phyllodes are narrow-linear and completely glabrous, up to 7·5 cm long but always less than 0·2 cm wide. They are 20 to 25 times as long as broad.

The gland is smaller than that in *A. fimbriata* but projects more than the margin. It is situated 0·7 to 1·4 cm from the base. The flowers are paler than those of *A. fimbriata* and usually a lime-yellow colour.

The pod is longer than that of *A. fimbriata* but does not differ from it on other respects.

FLOWERING TIME: It also flowers from late winter to midspring.

HABITAT: It is usually found on creek banks but also grows in rocky soil in eucalyptus forests.

DISTRIBUTION: It has been found only in Queensland to as far north as the Burrum River on the coast and the Carnarvon Gorge inland.

GENERAL REMARKS: Since this wattle has been brought into cultivation it is often used in preference to *A. fimbriata* as its longer narrow phyllodes make it a more attractive shrub.

Agricultural census, 1979-80 season

PRIMARY producers in Queensland are reminded that their annual statistical returns for the year ended 31 March 1980 are now due for lodgment with the Australian Bureau of Statistics, 345 Ann Street, Brisbane, 4000.

The statistics from this collection provide a reliable picture of production trends in rural industry and are extensively used by growers' organisations, government authorities, and private enterprise. It is in producers' own interests that comprehensive and factual information should be available to anyone interested in the advancement of rural industry and the analysis of its problems.

Producers interested in trends in rural industry generally, or in particular segments, are invited to inquire about the Bureau's statistical service relating to the free issue of annual bulletins covering most items of production in Queensland.

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

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

Co-operation in forwarding returns without delay will assist in the completion of the 1979-80 Agricultural Census and early publication results.

Be alert for banana diseases

by F. W. Berrill, Chairman, Banana Industry Protection Board.

THE two most serious diseases of bananas in Queensland are bunchy top and Panama.

Bunchy top can affect all varieties, while Panama is restricted to the Lady Finger and similar tall-growing types.

Bunchy top was first recorded in Australia in the Tweed River area in 1913, and from there it had spread to Currumbin by 1916. By late 1922, there were 112 plantations, representing 500 ha in the Currumbin and Tallebudgera districts, which were infected with the disease.

At that time, little was known about the disease, and control measures were not completely effective. As a result, infection continued to spread northwards, and by 1925 the disease had reached Caboolture. The situation in most southern districts by the end of that year was similar to that in Currumbin where only four plantations out of more than 100 remained in production, and even these were practically finished. In northern New South Wales, the disease had taken a similar toll—there were over 800 deserted plantations, with an approximate total area of 2 000 ha.

In a desperate attempt to save the banana industry a research group was set up in 1924 to investigate all aspects of bunchy top. On the basis of the findings of this group, effective methods for controlling the disease were developed, and restrictions (backed by legislation) were imposed on the movement of banana planting material. These measures are still in operation today (although with some amendments) and they have undoubtedly been responsible for the reduction in the importance of the disease which has been achieved.

However, it is most important to remember that the present relatively insignificant losses from bunchy top result from a conscientious control effort by growers and a co-operative attitude towards Departmental Inspectors. Any relaxation in surveillance could lead to another disaster like that which occurred in the 1920s.

Panama disease is widespread throughout the State and is responsible for considerable loss of production in the Lady Finger variety. It is largely due to Panama infection that the Gros Michel and Sugar varieties have virtually disappeared. Unlike bunchy top, Panama disease can be spread only by means of infected plants and soil and for this reason control measures are aimed exclusively at restricting the movement of planting material from infected sites.

The following descriptions should assist in the identification of bunchy top and Panama infected plants. Control measures for both diseases, and associated restrictions on the movement of planting material, are set out in the Banana Planting Policy issued under the *Diseases in Plants Act* 1929–1972. Full details are available from your local Banana Inspector.

Bunchy top

CAUSE

Banana bunchy top virus.

SYMPTOMS

The most obvious symptom is the development of dark-green flecks along the veins of the leaves producing a 'dot-dash' pattern. This is best seen at the base of the leaf adjacent to the midrib. The dark-green flecks in the veins can often be seen 'hooking' into the midrib from the leaf blade. Affected leaves are more upright and become pale yellow around the margin. The margins are also more wavy than normal.

Growth is reduced and the emerging leaves become choked in the throat of the plant, producing a 'bunchy top' effect. Affected plants are stunted and vein flecking can be seen in the leaf sheaths of the pseudostem as well as in the leaves. Plants affected at an early stage of growth rarely produce bunches. Those affected later may produce bunches which project upwards from the throat of the plant rather than hang. Flecking can frequently be seen in the flower bell.

Bunchy Top

Affected plant showing the typical bunchy top leaf symptom.

Affected sucker. Note the upright habit of the leaves.

Close-up of leaf showing the "dot-dash" pattern along the veins and the "hooking" into the midrib. Leaf is backlighted.

Dark-green vein flecking on the midrib.

Panama Disease

Above left: diseased plants showing the characteristic breakdown of leaves. Above right: cut section of pseudostem showing discoloration of water conducting tissues. Below right: leaf yellowing and dieback—an early symptom of the disease.

SOURCE OF INFECTION AND SPREAD

The virus is spread from diseased to healthy plants by the banana aphid (*Pentalonia nigronervosa*). Aphids feeding on diseased leaves retain the virus for long periods and, if wind-borne, may spread the disease over long distances.

The virus may also be spread in diseased planting material.

CONTROL

- Destroy diseased plants and all attached suckers even if these are not showing symptoms. Plants should be completely sprayed with kerosene or a mineral oil and then effectively destroyed, either by digging out and cutting the butts into small pieces, or by injecting each pseudostem with a 1% solution of 2,4-D. and subsequently spraying any regrowth with a 0·2% solution.
- Use planting material only from a plantation which has been free from bunchy top for at least the preceding 2 years, and complies with all of the requirements specified in the Banana Planting Policy.

NOTE.—Any grower who finds bunchy top infected bananas on his property is required to notify the local Banana Inspector without delay, in addition to carrying out the above control measures.

Panama disease

CAUSE

The fungus *Fusarium oxysporum* f. sp. *cubense*.

SYMPTOMS

The first sign is a marginal yellowing of the older leaves which later turn brown and dry out. They eventually collapse at some point along the leaf stalk or at the junction of the leaf stalk and the pseudostem, leaving a skirt of dead leaves draped around the plant. Death of the parent pseudostem generally follows, but suckers do not necessarily die.

The most characteristic symptom may be seen by cutting through the pseudostem of an affected plant near ground level where a dark-brown to black discoloration of the water conducting tissues is evident. Corms when cut show brown or black lines running through the tissues.

SOURCE OF INFECTION AND SPREAD

The disease is most commonly introduced in planting material. Once established, the fungus persists in the soil for many years. It enters the plant through the roots and grows into the water-conducting tissues of the corm and pseudostem. Spread from a diseased parent plant into its suckers also occurs.

Panama disease affects only the tall-growing cultivars such as Lady Finger, Sugar and Gros Michel.

CONTROL

- Use planting material from only disease-free Approved plantations which comply with all of the requirements specified in the Banana Planting Policy.
- Do not plant susceptible cultivars on land where the disease has occurred.
- Avoid poorly-drained soils.
- If the disease appears in a plantation, cease cultivation and grow a permanent cover crop which can be mown when necessary.

Colour plates and descriptions of the diseases by courtesy of Plant Pathology Branch.

Margins in fattening store cattle

by I. F. Whan, Economic Services Branch

BUYING store cattle and fattening them for resale is a common practice in the better feed areas of Queensland.

This article looks briefly at economic factors influencing the profitability of fattening store cattle.

Factors relevant to the economics of fattening are:

- The buying and selling price of the beast on a unit weight basis.
- The cost of fattening and reselling the beast.

Price relationship—stores and fats

Several studies of the store and fat prices in Queensland saleyards have revealed a relationship between the price of fats and the price of stores. When fat cattle prices are high, store prices are even higher and when fat prices are low, stores prices are lower still. The nature of the relationship is illustrated in figure 1.

For most of the time, the cattle cycle is either generally high or generally low—periods of transition from high to low or vice versa are relatively short-lived. This means that a store fattener will usually buy and sell at relatively low prices or buy and sell at relatively high prices.

The fattening margin

Regardless of which phase the fattener operates in, his fattening margin before costs will be approximately the same for a given weight gain. This is because the high return made on weight added during the high price phase is offset by a loss on the original store weight and because a premium is made on the original store weight during the low price phase to compensate for the relatively low return on weight added.

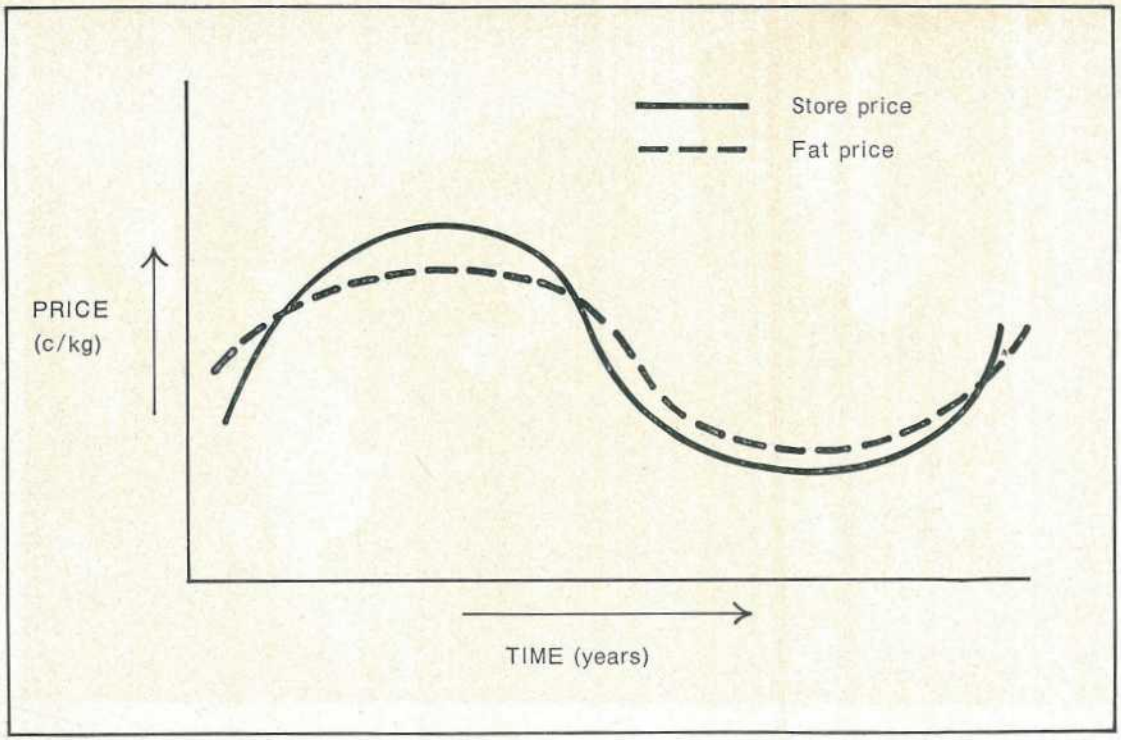


Figure 1. The relationship between store and fat prices.

The only time the fattener makes large gains or losses is when his buying and selling sequence bridges a change in the general price level. For example, big losses were suffered in 1974 when stores were purchased during a high price phase and sold later (as fats) on a low price phase. The reverse situation occurred over the space of a few months late in 1978.

Nature of supply and demand for stores

The question naturally arises as to why the prices of stores and fats exhibit the relationship explained. One explanation is offered by the nature of supply and demand for stores.

The demand for stores is largely a function of the demand for fat cattle; the latter being a reflection of what local and overseas consumers are ultimately prepared to pay for Australian beef. At a particular sale, the demand for stores will also be influenced by the supply and cost of cattle feed.

Due to the structure of our cattle industry, the supply of stores is relatively fixed irrespective of the price being offered in the market. Thus the demand for stores is very volatile, but their supply is comparatively stable.

The combination of these factors forces fatteners to buy stores over a wider price range (in cents per kg) than they receive for fats. When the price of fats is low, store fatteners can only make a profit on their fattening by offering to buy stores at a lower price (cents per kg) than the price for fat cattle. Conversely, when the price for fat cattle is high, fatteners can offer to buy stores at a higher price (cents per kg) than that for fats and still make a profit.

Costs of fattening

Consideration is now given to the cost of fattening and reselling. If the fattening margin is approximately constant for most of the time, it should follow that the individual fattener's profit margin will be tied to his costs. The main cost associated with fattening is growing the feed. Relatively cheap, high quality feed should ensure profitable store fattening over the long-term.

For accurate budgeting, it is desirable to consider feed as costing so much per day or week. In this way, the growth pattern of the fattening beast is taken into account. It would clearly be unprofitable to hold a beast when the cost of adding further weight exceeded the market value of that added weight.

Other costs include transport, selling commission and interest on capital tied-up in fattening stores. Proximity to store and fat markets will obviously affect transport costs but this is not a major consideration with most producers. Selling commission and interest charges are two costs that fluctuate according to the general level of cattle prices.

Conclusion

The studies of store fattening have shown that the amount of weight added, in combination with the phase in the cattle cycle, will affect profitability. During a low price phase, weight added is only critical in terms of making the beast fat and thereby qualifying for a price premium compared with the original store price. Weight added beyond this point will depend on the cost of feed and price of beef.

During a high price phase, more weight can be added because beef prices are high relative to feed costs. It can be expected that during high price periods, fat cattle will be turned off at heavier weights than during slump periods. A factor which mitigates against this tendency is the capital cost involved with holding fattening cattle longer.

TABLE 1

A Budget Format for Cattle Fatteners

Item	Store		Fat	
	c/kg	$/head	c/kg	$/head
		Information		
Price (bought/sold)				
Weight (kg)				
Days on feed				
Interest rate				
		Budget		
Sale Price ($/head)				....(A)
Costs ($/head)		..		
—purchase price		..		
—feed c/day x No. days		..		
—transport and husbandry		..		
—interest cost		..		
—selling commission		..		
Total Costs				....(B)
Net return				.....(A)—(B)

Pastures for Cape York Peninsula

by P. Anning, Agriculture Branch

CAPE York Peninsula (far north Queensland above 17°S latitude) is an area of about 190 000 km² with a sparse population of both people and livestock.

The principal industry apart from mining is beef production based mainly on native pastures. Although the region is well watered and had a large, successful gold rush at the Palmer River a century ago, it remains sparsely settled.

Major agricultural and pastoral development has occurred only in the south-east around Cooktown, 'Lakeland Downs', Mareeba and the Atherton Tableland. Apart from the tobacco industry, this development has been on more fertile soils than occur elsewhere in the Peninsula.

The region covered by Cook, Mareeba, Carpentaria, Aurukun and Torres Shires (247 000 km²) extends beyond this area and has only 28 000 people, of whom the majority live in Mareeba and Weipa and on aboriginal reserves. About 12% of the region (23 000 km²) is retained as aboriginal reserves. These reserves are sited along the coast of most of the Peninsula.

In 1978, Cook Shire, which then included Torres and Aurukun, had 150 000 head of beef cattle, Mareeba 180 000 and Carpentaria 340 000. Thus Cook, the largest Shire in the State, has a much lower density of beef cattle than adjacent southern Shires. This largely reflects the lower carrying capacity of much of its native pastures.

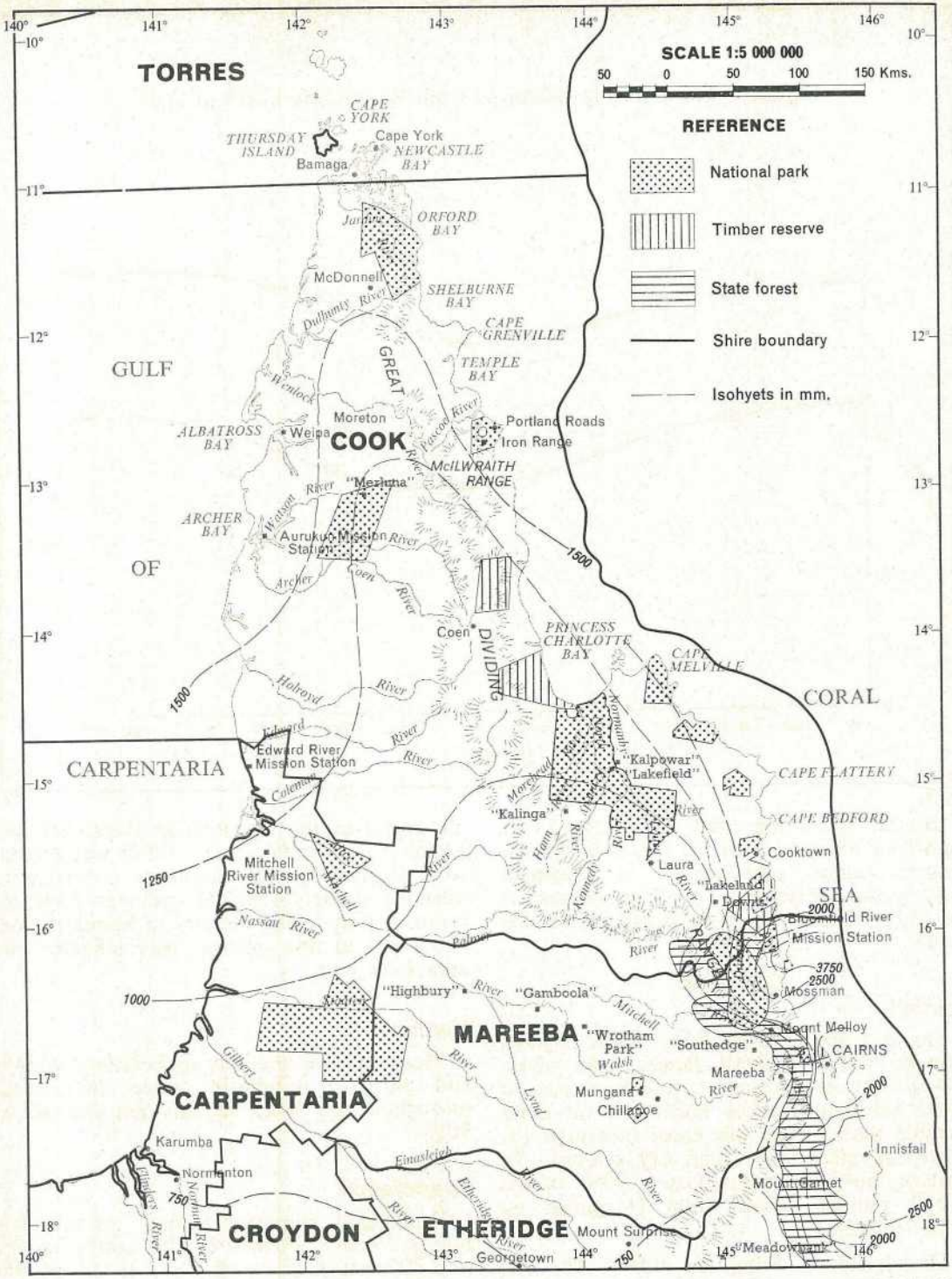
Transport is a major problem, as sealed roads and railway lines occur only in the south-eastern portion of the region. Although development of roads, communications and services is gradually moving northwards, there is little stimulus for rapid development from the low-value agricultural and pastoral production ($1·2 million in Cook Shire in 1978). Most of the region turns off only store stock. However, the mining and tourist industries help justify this development.

Present national parks, state forests and timber reserves are shown in map 1. The Queensland Forestry Department leases grazing rights in areas under its control. However, grazing is not generally allowed in national parks. Temporary grazing rights are available only in cases where they are necessary for the Queensland National Parks and Wildlife Service to obtain new areas. National parks have been set up recently on grazing leases which have been surrendered to the Crown. This programme will probably continue as other remote, uneconomic leases are surrendered.

Physical features

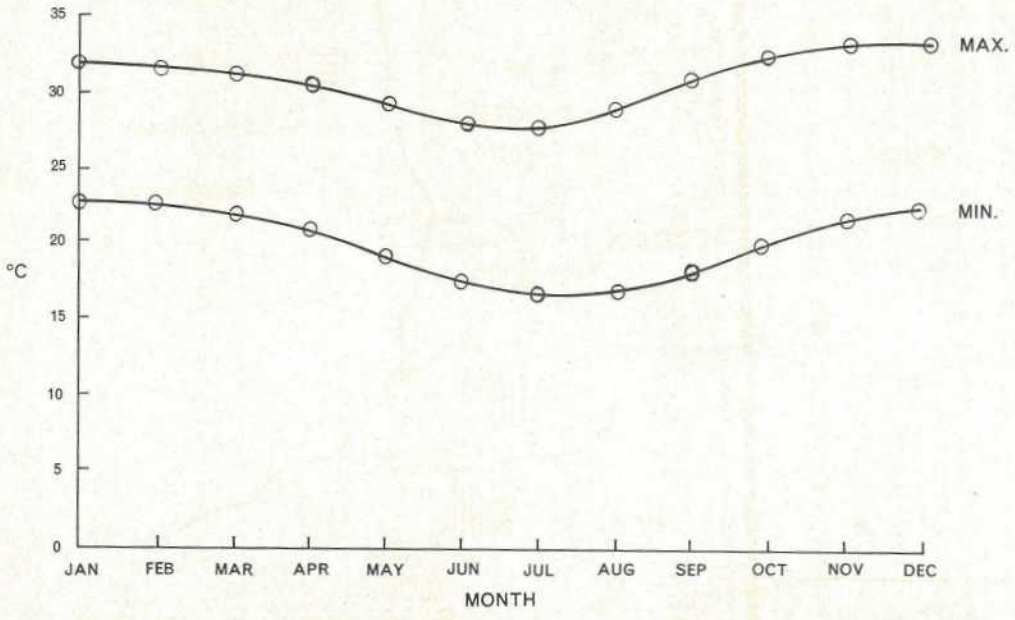
Most of the Peninsula consists of undulating plains underlain by Mesozoic, Tertiary and Cainozoic geological sediments. These plains rarely exceed 150 m elevation, and slope gently westward to the Gulf of Carpentaria. To the south-east, the Great Dividing Range is present as rugged hilly lands composed of Devonian sediments and metamorphic rocks. The highest and most rugged lands in the rest of the region occur as Precambrian and Paleozoic metamorphic rocks to the north and south of Coen. North-east of Coen, maximum elevation is 800 m in the McIlwraith Range. Between Cooktown and Laura, Mesozoic sandstones form a series of mesas.

Most of the surface drainage is to the west (refer to map 1). The main artery, the Mitchell River, with its tributaries the Alice, Palmer, Walsh and Lynd, drains one-third of the region. The Kennedy and Normanby rivers drain the lower east coast into Princess Charlotte Bay. Most rivers run only seasonally, except in wetter areas near the tip and near Cooktown. Deep sands provide continuous groundwater supplies for the Hann River.



LOCALITY MAP **Map 1**

Figure 1. Temperature averages from 12 stations north of 17°S



Coastal rivers are tidal for up to 25 km from their mouths. Near the sea, river systems become more complicated as channels anastomose. Extensive flooding occurs in the lower reaches of most rivers in the wet season.

Climate

Rainfall

The area has a sub-humid to humid climate. Average annual rainfall ranges from about 900 mm in central and southern areas to above 1 500 mm in the north and on more elevated parts of the east coast (see map 1). There are marked wet and dry seasons. In most of the area, approximately 90% of the annual rainfall occurs from November to April inclusive.

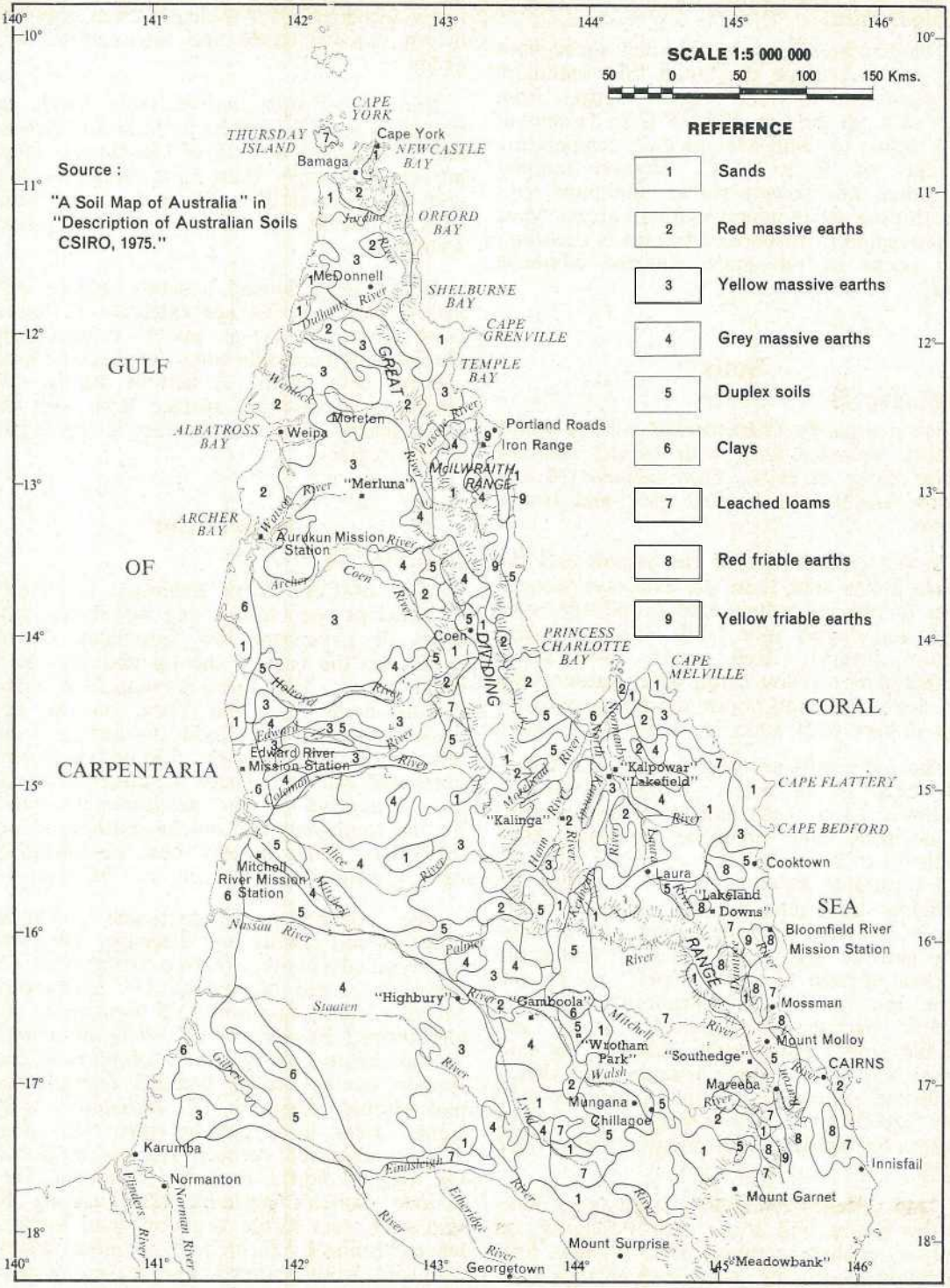
Thunderstorms bring the first rains, and regular falls occur with the normal southern movement of the monsoon in December and January. The area has a reliable wet season, with greatest rainfall variability occurring in inland districts. Tropical cyclones regularly occur, mainly in the January to March period. From one to five cyclones may influence the area each year.

Humidity

Mean relative humidity in February, March and April is generally above 80%, and throughout the drier months remains above 70%.

Evaporation

Estimated average annual evaporation ranges from 2 500 mm in the north-east up to 3 000 mm in the south-west. It far exceeds rainfall in most areas.



SOILS OF CAPE YORK PENINSULA **Map 2**

Temperature

Temperatures are relatively high throughout the year. Average maximum and minimum temperatures for the region range from 28°/16°C in July to 33°/23°C in December (see figure 1), with average daily temperature changes of 9° to 12°C. Highest summer maximum and lowest winter minimum temperatures occur in inland southern areas. Most of the region is frost-free. Mild frosts occasionally occur in the more elevated Mareeba area.

Soils

(see map 2)

Massive earths (structureless soils in which texture becomes finer with depth) are the major group of soils. They include red and yellow earths and leached grey and brown earths.

In the central-west of the region and the Laura plains area, there are extensive associations of red and yellow earths, uniform sandy soils, and duplex soils (soils with contrasting texture layers). Red earths form sandy elevated areas, yellow earths occur further down the slope, and finer, poorly-drained grey earths and duplex soils make up lower-lying areas.

The red earths are well drained and generally deep (3 to 6 m). Yellow earths are shallower (1 to 2 m) and often have mottled B horizons and ironstone nodules. Grey earths (1 to 2 m deep) are seasonally saturated and invariably have mottled B horizons and abundant ironestone nodules. Internal drainage is restricted in some yellow and in most grey earths. All of these massive earths are moderately acid to neutral (pH 5 to 7) and have low levels of phosphorus, nitrogen, organic carbon, exchangeable cations and soluble salts. Phosphorus deficiency is universal and soil analyses indicate that deficiencies of potassium, sulphur, copper and zinc are likely. Soil acidity tends to be greatest in higher rainfall areas towards Cape York.

Deep siliceous sandy soils cover large areas in the centre and lower east Peninsula, as well as smaller scattered areas. These soils predominate in the eastern highlands and central uplands. In the coastal plains and lower Mitchell River areas, leached grey and brown massive earths and fine-textured soils occur.

Friable red soils derived from basalt are limited to some 10 000 ha at 'Lakeland Downs' and a similar area north of Cooktown. These are much younger than most Peninsula soils and are quite fertile. The only other fertile soils are recent alluvial deposits forming river frontages.

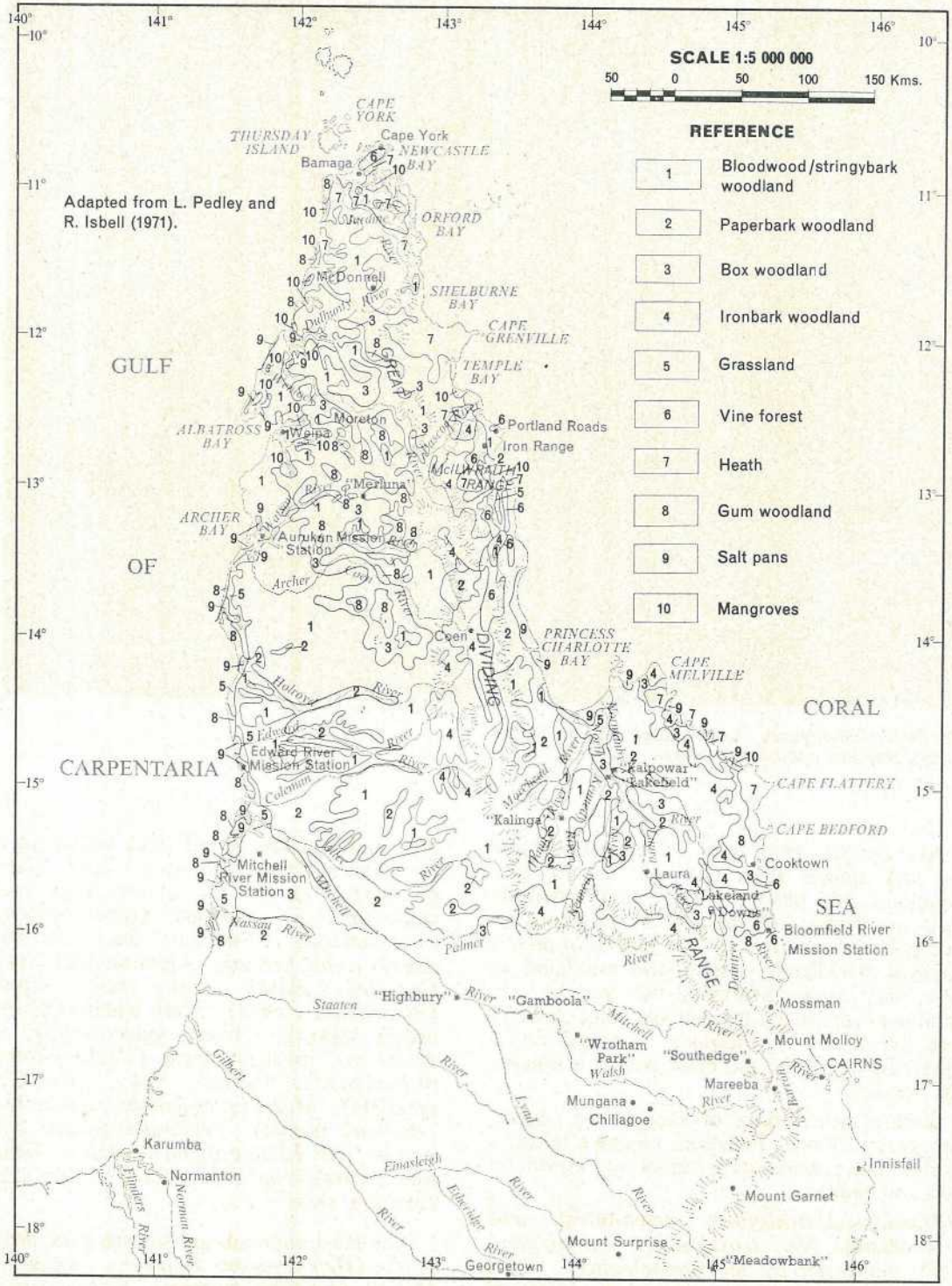
Duplex soils having a sandy surface over yellow clay subsoils are extensive in lower-lying areas bordering major watercourses. Unlike most Peninsula soils, they become more alkaline with depth. A belt of duplex soils having a hard-setting surface layer and red clay subsoils occurs in the central lower part of the region.

Vegetation

(see map 3)

Most of Cape York Peninsula is covered by eucalypt open forests and woodlands, with areas of paperbark low woodland. Heath occurs on the east of the tip and just north of Cooktown. Vine forest is confined to higher rainfall areas, at Cape York, on the east coast from Portland Roads to east of Coen and south of Cooktown. Limited mangrove areas and salt pans occur on the coast, being most extensive on the north-western coast. To the south-west and on the southern shores of Princess Charlotte Bay these are fringed by open grassland on low-lying marine plain.

The dominance of particular eucalypts indicates soil texture and drainage. On level, well-drained country, Darwin stringybark (*E. tetrodonta*), red bloodwood (*E. polycarpa*), Melville Island bloodwood (*E. nesophila*) and gum-topped bloodwood (*E. dichromophloia*) are dominant. Low-lying soils of heavy texture support mainly Molloy box (*E. leptophleba*) and Moreton Bay ash (*E. tessellaris*) while wetter areas have popular gum (*E. alba*) and broad-leaved carbeen (*E. confertiflora*). On rugged country, ironbarks dominate. They include Cullen's ironbark (*E. cullenii*) on shallower, less fertile situations and narrow-leaved ironbark (*E. crebra*) on more favourable soils, while Shirley's silver-leaved ironbark (*E. shirleyi*) occurs on skeletal slopes.



MAJOR PLANT COMMUNITIES OF CAPE YORK PENINSULA **Map 3**

Bloodwood/stringybark open forest with dense understorey and sparse grass layer.

Average density of trees (of diameter above 7·6 cm) ranges from 200 per ha in box woodland, 240 per ha in both gum and ironbark woodland, 360 per ha in bloodwood/stringy-bark woodland to 500 per ha in mixed eucalypt woodland. Paperbark woodland is often very dense, averaging 600 per ha. It dominates seasonally-flooded low lying country, with *Melaleuca viridiflora* (broad-leaved paperbark tea-tree) the most common dominant species.

General descriptions of each broad vegetation group follow. However, complex mosaics of different communities can occur, especially with soil change.

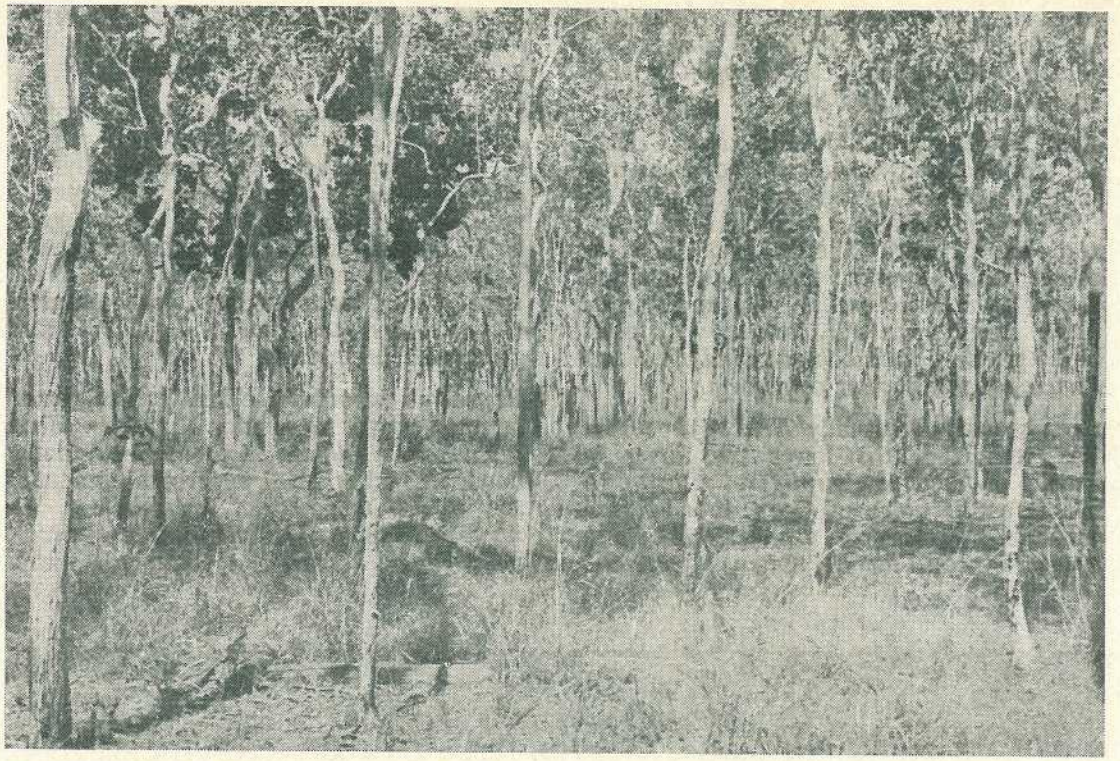
- **Bloodwood/stringybark open-forest and woodland** (*E. tetrodonta/E. nesophila/E. polycarpa/E. dichromophloia*). This is more common than any other vegetation type and consists of tall trees with a layer of smaller trees and shrubs and sparse mid-height grass. A minor large tree component is ironwood (*Erythrophleum chlorystachys*). Smaller trees include *Acacia rothii,* red ash (*Alphitonia excelsa*), *Grevillea glauca* and cocky apple (*Planchonia careya*). Less widespread are brown salwood (*Acacia aulacocarpa*), *A. flavescens,* medicine bush (*Coelospermum recticulatum*), silver oak (*Grevillea parallela*), *Morinda reticulata,* nonda tree (*Parinari nonda*), *Persoonia falcata* and quinine tree (*Petalostigma banksii*). Grass tree (*Xanthorrhoea johnsonii*) is the most common shrub.

The most common grasses are giant spear grass (*Heteropogon triticeus*), wanderrie grasses (*Eriachne* species), *Schizachyrium*

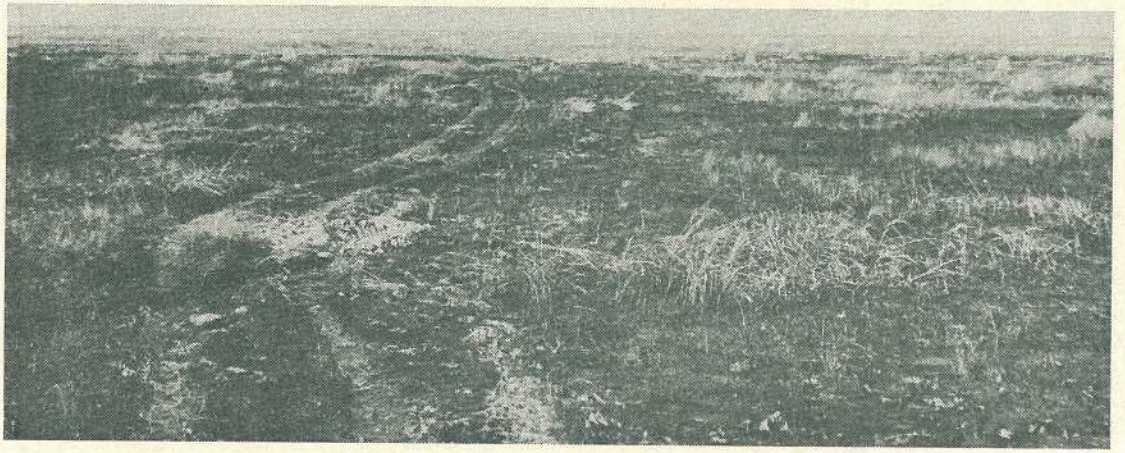
fragile and *Panicum* species. Less constant are plume sorghum (*Sorghum plumosum*), golden beard grass (*Chrysopogon fallax*) and *Thaumastochloa brassii*.

- **Box woodland** (*E. leptophleba*). Here, the most constant species in the lower tree stratum is broad-leaved paperbark tea-tree (*Melaleuca viridiflora*). Few other trees and shrubs occur. There is a dense cover of perennial grasses, including kangaroo grass (*Themeda australis*), giant spear grass, black spear grass (*H. contortus*), forest blue grass (*Bothriochloa bladhii*), and *Pseudopogonantherum contortum*.
- **Gum woodland** (usually *E. alba*). As in box woodland, the lower tree layer is usually of *Melaleuca viridiflora*. On brown friable earths north of Coen, broad-leaved bauhinia (*Piliostigma malabaricum*) is a constant constituent. Often, perennial grasses including blady grass (*Imperata cylindrica*) and most of the grasses in box woodland form a dense ground cover.
- **Ironbark woodland** (mostly *E. crebra/E. cullenii*). Bloodwoods are often present in this vegetation type, especially *E. dichromophloia*. The lower tree layer is generally sparse or absent. Kangaroo grass is the most common grass with wire grasses (*Aristida* species), giant spear grass, black spear grass, plume sorghum, cockatoo grass (*Alloteropsis semialata*) and golden beard grass also occurring.
- **Paperbark woodland.** This is the second largest broad vegetation group. While *Melaleuca viridiflora* is the most common dominant, other small paperbark communities of *M. tamariscina, M. foliolosa, M. nervosa* and *M. acacioides* occur. *Petalostigma banksii* is the common shrub.

Open box woodland and dense native grass cover.



Dense paperbark (Melaleuca *spp.*) *wooodland on seasonally flooded soils.*



Open marine-couch plains, adjacent to Princess Charlotte Bay, burnt in mid year for 'green pick'.

Typical store cattle turn-off from Peninsula native pastures.

The tree density varies greatly, from woodland to savannah. Ground cover is also variable. Hare's foot grass (*Ectrosia leporina*), *Eriachne* species, *Schizachyrium fragile, Thaumastochloa brownii,* and wire grasses are common. Generally, areas which are waterlogged for long periods tend to support annual grasses.

- **Heath.** Heath is 2 to 4 m tall, with *Choriceras tricorne, Jacksonia thesioides* and *Sinoga lysicephala* common to all stands. Other species include *Acacia calyculata, Boronia bowmanii, Fenzlia obtusa, Grevillea pteridifolia, G. glauca, Leptospermum fabricia, Morinda reticulata, Melaleuca symphyocarpa, Neoroepera banksii* and *Xanthorrhoea johnsonii.* No grass cover occurs in this community.

- **Grassland.** This occurs mainly on low-lying marine plains with marine couch (*Sporobolus virginicus*) the dominant species. In drainage depressions, wild rice (*Oryza australiensis*), *Fimbristylis littoralis,* blady grass and *Panicum trachyrachis* occur.

The beef industry

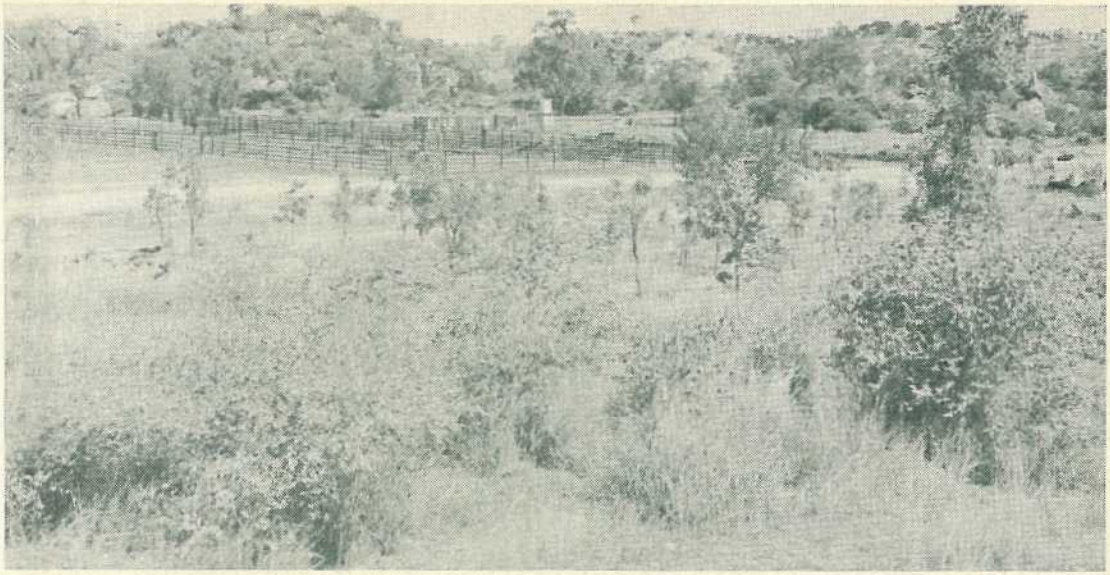
The beef cattle industry in the Peninsula is largely one of minimal management. Stock management is hampered by the low carrying capacity, which raises the mustering costs per head. As well, the investment required per head to provide adequate fences, watering points, yards and dips is increased. The traditional approach to this problem has been 'cattle hunting' where most of the property is unfenced. This system is now less attractive

economically because of the increasing expense of its high labour requirement. Helicopter mustering is used occasionally, mainly on larger properties with high stock numbers and open country. Fencing has become more common in the last decade but generally has been done for specific classes of stock (such as bullock paddocks) rather than over the whole property.

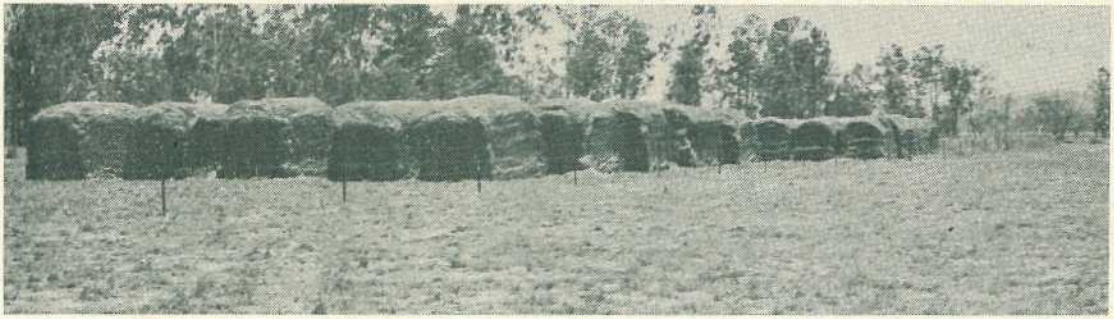
In general, cattle in the area are mustered either once or twice per year for branding, weaning, culling, selection of stock for sale, dipping, etc. Bulls are run in the herds all year round and calvings are spread over the whole year although there is a concentration of calving during the September–March period. Weaning is practised to varying degrees but many breeders suckle calves during

Above. Peninsula road between Musgrave and Coen at its best.

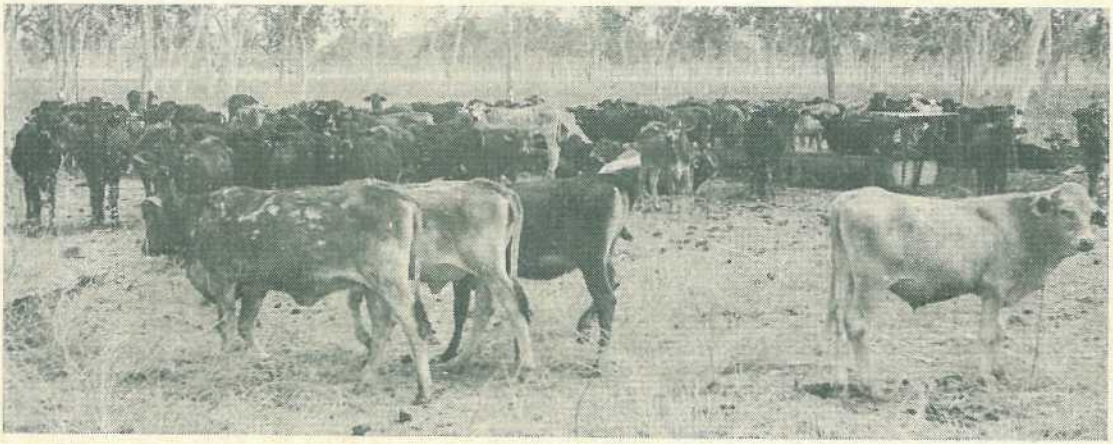
Below. The North Kennedy River closes the road north of Laura for about 3 months of each year.



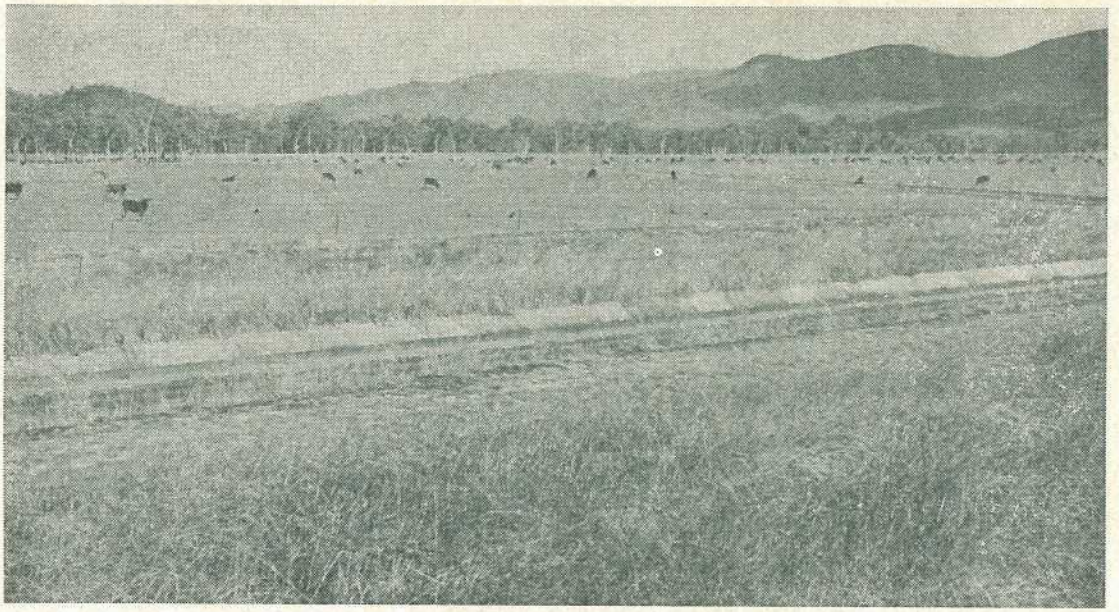
Railway trucking yards at Mungana handle stock from the west of the district.



Townsville stylo hay made from station airstrips is used to feed horses and stock held in the yards.



Weaners receiving supplementary feeding with urea/molasses.



Irrigated pangola grass pastures at Mareeba were mostly changed over to rice production during the slump in beef prices.

the dry season. This lactation stress coupled with the poor level of nutrition provided by the native pastures results in high mortalities of breeders in some years. Annual mortalities of 15% are not unusual among breeding cattle. The combination of poor nutrition, high dry-season weight loss and general low level of breeder management results in low branding percentages, a figure of 40% being not uncommon.

Until the late 1950s, the typical 'Peninsula' beef animal was a small, woolly-coated Shorthorn type, which was poorly adapted to the environment and had little capacity or opportunity to produce beef. The infusion of zebu (*Bos indicus*) blood into cattle in the region has changed this picture and nowadays about 75% of animals are Brahman x British crossbreds. These Brahman crosses are larger than the British types and are better adapted to the heat and nutritional stresses of the tropics. In addition, they have a higher level of resistance to the cattle tick (*Boophilus microplus*) which is endemic in the area.

Most cattle are turned-off as stores although some fat bullocks, 6 to 8 years old off native pasture and 4 years old off Townsville stylo (*Stylosanthes humilis*) pastures are produced. Bullocks off Townsville stylo maintain good condition for most of the year and are in demand for the local retail trade. In general, cull cows and bulls are sold only when export prices for low quality beef are adequate to give a satisfactory return. Annual turn-off rarely exceeds 10% of total herd numbers.

Transporting cattle to markets is a major expense. For about half of each year, commencing in June, road trains can operate (with some difficulty) up to about Coen. However, cattle are generally sold earlier, before losing condition as the nutritive value of native pasture plummets. Generally stock are walked to trucking centres at 'Lakeland Downs' and Mungana for further road and rail transport to saleyards in Mareeba or export meatworks at Mareeba and Cairns. Some bullocks in forward condition are used by the local butchering trade, sometimes after fattening on wet coastal or Atherton Tableland pasture. Sea transport is sometimes used to move cattle, especially from more remote areas. Yards and wharves for loading cattle exist on a number of rivers including the Annie, Stewart and Archer.

Recently a slaughter house has been set up by Comalco at Capelands, just south of Bamaga. This supplies Weipa and provides a financially attractive outlet for stock from north of Coen. The throughput may be increased to supply Bamaga and other aboriginal settlements.

A number of far northern graziers have small grazing blocks close to Mareeba, some with irrigated pastures. Animals are transported down as stores and spelled or finished on these areas. This allows stock to be sold in good condition and gives more flexibility in marketing.

Most stock are run on native pastures, which have very low protein and phosphate levels for most of the year. Phosphorus supplements should be supplied throughout the area and nitrogen supplements are beneficial during the dry season. There is a suggestion that cattle in certain areas may benefit from supplements of salt, sulphur, cobalt and copper. However, the areas and magnitude of responses are not clearly defined. Supplements are rarely used because of the high labour costs of supplying them regularly, and the extensive nature of the area. The cheapest protein supplements in these situations are sown legume pastures.

Graziers generally regard sown pastures as a low priority in property development in the Peninsula. The disastrous slump in returns to beef producers from 1974 to 1978 resulted in a rundown of capital improvements and reductions in staff. Consequently, the standard of property management has declined to a lower level than was normal.

Cropping is carried out on friable basaltic soils at 'Lakeland Downs' and Cooktown. At present, peanuts are the main crop with maize being of lesser importance. In the Cooktown area, tropical legume and grass seeds are produced. Cattle have been fattened on sorghum stubble at 'Lakeland Downs' but sorghum is no longer a major crop there.

Native pasture management

Peninsula pastures provide quality feed for only the first quarter of the year; before the end of the wet season they are rank and protein deficient. In lower rainfall areas, native grasses maintain their quality for longer periods. While grazing will keep the pasture from becoming rank and inedible, native grasses do not survive sustained heavy stocking. Overgrazed areas around yards and homesteads are marked by a dense cover of broad-leaved weeds—mainly hyptis (*Hyptis suaveolens*), pink-flowered Chinese burr (*Urena lobata*), and sida species (*S. cordifolia, S. acuta, S. rhombifolia*).

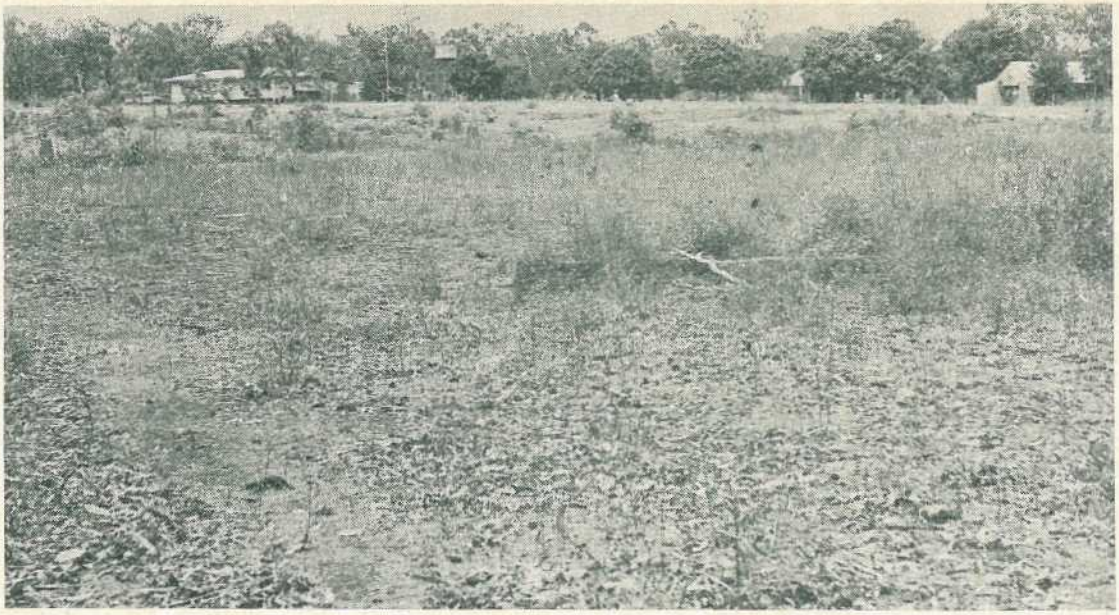
A mixture of different types of country provides quality feed for the longest period of the year. Fertile open box flats have high-yielding, palatable fodder which retains greenness for the first half of the year. Lower-lying, heavier-textured soils provide green pick late in winter from their soil moisture reserves.

Grass on sandy ridges responds most rapidly to spring rain. With several types of country, cattle migrate to select the best possible diet throughout the year. In the dry season, they congregate at permanent watering points. The extent of fencing and the number of watering points determine how much a manager can control the use of native pastures.

Burning towards the end of the wet season is widely used to promote new growth. This practice must be carried out while sufficient soil moisture is present to allow significant regrowth. Fires are lit as soon as the pastures are dry enough to burn. Later burns result in cattle losing weight while attempting to graze tiny green shoots.

Although end-of-wet-season burning is widespread in Cape York Peninsula, burning on more fertile basalt country to the south tends to be carried out at the beginning of the wet season to remove old grass. For example Mr A. C. Hassall, 'Meadowbank', Mt. Garnet, has adopted a practice of only burning his kangaroo grass pastures after the first 50 mm of rain has fallen. Only half of the pasture is burnt in any year. Cattle graze only grass less than a year old and this material is too green to burn. This natural spelling system ensures stability of the kangaroo grass which is highly regarded by local graziers.

Where sown or naturalized legume pastures are present, fires are excluded as they destroy the high protein feed asset. Hot fires can seriously damage legume stands; sown grasses are generally less affected because of their many, low regrowth points.



Typical weed problems (sida, hyptis and pink-flowered Chinese burr) in heavily grazed Townsville stylo areas around homesteads.

Performance of commercial sown pastures

No large scale pasture areas were sown before the mid 1960s. However, Townsville stylo had naturalized in places, especially under heavy grazing on sandy soils with sparse trees around Coen and west of Princess Charlotte Bay. Although American firms sowed large areas (about 5 000 ha in total) of this legume at 'Merluna', 'Lakefield' and 'Kalpowar' stations in the late 1960s, only sparse Townsville stylo stands remain.

This weakly-competing annual legume was swamped by weeds in these high rainfall (more than 1 000 mm per year) environments. Thickets of such broad-leaved weeds as hyptis, pink-flowered Chinese burr, sida and coffee senna (*Cassia occidentalis*) mark these areas.

By contrast, 7 200 ha of Townsville stylo sown after clearing at 'Wrotham Park', has remained highly productive for up to 10 years. In this lower rainfall environment (890 mm), broad-leaved weeds have never competed strongly with the shade-intolerant Townsville stylo. More recently, 'Wrotham Park's' Townsville stylo pasture has suffered less from anthracnose disease than have pastures in wetter regions.

Typical paperbark (Melaleuca viridiflora) *thicket produced after clearing. Check it with roller-chopping. Control with Tordon and deep ploughing.*

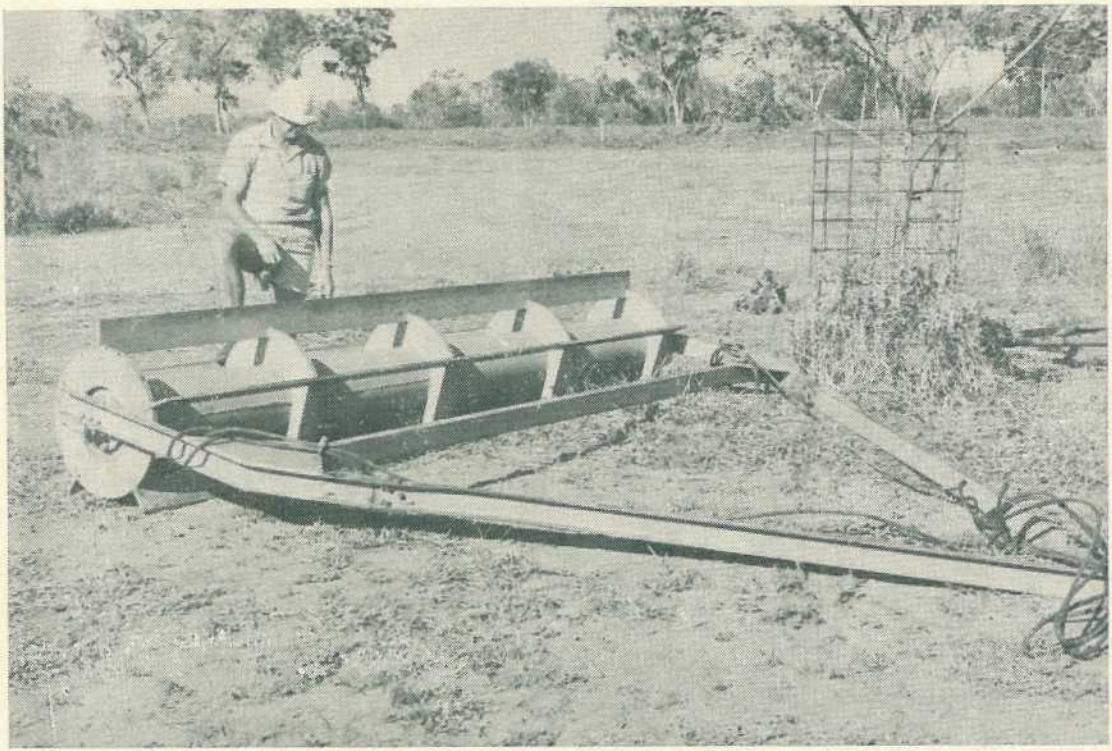
While 400 ha of Townsville stylo were lost after 4 years of heavy grazing at 'Merluna' (about 100 km south-east of Weipa), 800 ha of Schofield stylo (*Stylosanthes guianensis*) pastures remain highly productive and relatively weed-free 7 years after sowing. A mixture of Schofield stylo, Rodd's Bay plicatulum (*Paspalum plicatulum*) and Basilisk signal grass (*Brachiaria decumbens*) sown in 1973 over about 100 ha of uncleared open box woodland is also in good condition. While some 20 ha of Siratro (*Macroptilium atropurpureum*) and Endeavour stylo (*S. guianensis*) were destroyed by overgrazing (about 2·5 yearlings per ha for most of the year), guinea grass persisted.

On 'Kalpowar', at the southern end of Princess Charlotte Bay, a mixture of Siratro and Hamil grass (*Panicum maximum*) covering about 50 ha of cleared river frontage has proved valuable over 8 years. The area is not grazed during the wet season and this appears to be the key to persistence of Siratro in this environment. Other sowings of this legume, for example at 'Merluna' and 'Kalinga', have disappeared under constant grazing.

Most Peninsula properties have airstrips covered with Townsville stylo. Under regular mowing and heavy grazing, the legume thrives as competition from grasses and broad-leaved weeds is removed. Haymaking is sometimes carried out on the borders of these airstrips.

Timber control

Many of the tree species in the area are remarkably resilient. A century after major settlement in the Peninsula there are few signs of man's attempts at timber removal. Large scale clearing since 1965 on a number of properties is now represented by thickets of young trees, especially *Melaleuca viridiflora* and *Eucalyptus tetrodonta*. Only two exceptions are present, at 'Merluna' (near Weipa)



Roller/chopper used to check young, woody regrowth.

and 'Wrotham Park' (near Chillagoe). As well, 'Lakeland Downs', cleared in the late 1960s, has little regrowth in areas that have been regularly cropped.

At 'Merluna', box/bloodwood/tea-tree woodland was killed by injection of 'Tordon 105'. The trees were pulled, windrowed and burnt 18 months later. The area was then ploughed to 50 cm depth twice and Schofield stylo was aerially sown with 250 kg per ha of superphosphate per ha. The timber regrowth is now (8 years later) sparse over most of the area with the exception of the lower-lying patches where tea-tree is very dense. Thus, if timber removal is desirable in high rainfall areas it is important to poison the lignotubers, to plough to remove seedlings and suckers, and to establish a vigorous pasture species to cover the ground and compete with further seedlings.

The Australian Agricultural Co. cleared 1 200 ha per year from 1967 to 1974 on 'Wrotham Park', 'Gamboola' and 'Highbury'. Early attempts at removing stringybark on sandy red earth soils were unsuccessful because of timber regrowth. The major clearing has been of box, tea-tree and deciduous scrub

Above. Seca and Verano stylos sown in uncleared grassland at Georgetown without cultivation.

Below. Calopo providing high protein winter feed at Kalinga.

(*Terminalia platyptera*). Although no timber poisoning was used, the land was ploughed thoroughly after the trees had been removed. Townsville stylo was aerially sown at 4·5 kg per ha and superphosphate applied at 375 to 500 kg per ha over the next 3 years.

The sown areas are constantly grazed at almost 1 beast per ha and cattle are turned-off in good condition up until October in most years. Under this very heavy grazing, timber regrowth is checked by cattle. At about 5 year intervals, a roller-chopper is used on the tea-tree suckers, killing many and severely damaging the others. More recent sowings by this company have been into uncleared open box and tea-tree woodland, with successful pasture establishment.

In 1974, on 'Southedge' station near Mt. Molloy, 4 000 ha of box/gum/tea-tree country was cleared, ploughed and sowed to a Schofield stylo/American buffel/Siratro/Rodds Bay plicatulum mixture. This pasture is grazed only between wet seasons and has allowed fat bullocks to be turned-off late in the year when prices are most favourable. Regrowth on this area is minor, being restricted by dense pasture growth.

Pasture legumes

The genus *Stylosanthes* provides the best adapted legumes for the area. Until 1970, Townsville stylo (*Stylosanthes humilis*) was the only widely sown legume. Since the 1920s it has been encouraged by graziers sowing seed by hand along stock routes. Animals spread seed in their dung. Heavy grazing allowed this poorly-competitive annual to invade large areas.

The improvement in animal diet from Townsville stylo is greatest in drier areas where there is a clearly defined wet and dry season and no dew in the latter. Thus cattle at Georgetown, in 750 mm rainfall, are fat throughout the year on naturalized Townsville stylo, while those in coastal areas on similar pastures do not perform as well. In the latter areas, material becomes mouldy following occasional rain or dew in the dry season.

More recently, Townsville stylo has been seriously affected by anthracnose, caused by *Colletotrichum gloeosporeoides*. This has weakened stands, especially in coastal districts, and many former Townsville stylo pastures now have little legume present.

Verano Caribbean stylo (*S. hamata*), a biennial, is now being sown in areas previously used for Townsville stylo. With its longer growing period and more competitive nature, coupled with similar acceptability to stock and ability to spread, Verano is a more than adequate replacement for Townsville stylo.

Anthracnose does not seriously affect Verano in most areas receiving up to 1 200 mm average annual rainfall, and it performs well on most soils, except seasonally flooded and black soils. Heavy grazing helps Verano compete with native grass, especially on alluvial flats.

Verano responds to superphosphate but, like Townsville stylo, will persist and spread on infertile soils without fertilizer. This legume performs well in annual rainfalls between 800 and 1 200 mm. In wetter areas, anthracnose and rapid grass growth make other legumes more desirable.

Seca shrubby stylo (*S. scabra*), a perennial, will also grow on a wide range of soils in the region. It will grow in rainfalls up to at least 2 000 mm as it is both disease resistant and a strong competitor. Seca also tolerates infertile soils and responds well to superphosphate.

Cook stylo (*S. guianensis*), a sprawling perennial, requires higher annual rainfall than Verano, and below 1 000 mm survives only on fertile soils. Cook is more nutrient-demanding than Verano and Seca and requires some superphosphate.

There are a number of other legumes which may be used with the stylos in particular situations. Siratro and calopo (*Calopogonium mucunoides*), both twining legumes, grow well on fertile river flats in areas receiving 900 to 1 200 mm of rainfall. In wetter areas, Siratro suffers from the leaf disease, *Rhizoctonia*. Both legumes need superphosphate.

While stock will not eat calopo until late in the wet season, Siratro is usually eaten readily. Siratro should be fenced off and grazed only after the main wet season as heavy grazing in the wet season destroys it. Calopo should not be heavily grazed in April/May when it is seeding.

Other legumes which can be used as closely managed pastures on fertile soils in 900 to 1 200 mm rainfall are Archer axillaris (*Macrotyloma axillare*) and Cooper glycine

(*Neonotonia wightii*). Both are twining legumes and quite intolerant of soil infertility. Highworth lablab (*Lablab purpureus*), a biennial legume grown on better soils for hay or seed, will regrow after harvesting providing fodder in winter and early spring.

Peru leucaena (*Leucaena leucocephala*), a leguminous browse tree, requires highly fertile soils and has performed well in trial plots on basaltic soils receiving 900 to 1 600 mm of rainfall. However, it contains an alkaloid (mimosine) which can cause temporary goitre, ill-thrift and hair loss to stock when leucaena forms the sole diet for long periods. Experience in central Queensland has shown that there is no problem when leucaena is grazed periodically as a protein supplement to grass pastures.

All of these legumes except the shrubby Seca and Peru can be used as high protein hay for feeding to weaners.

The role of sown legumes

In developing legume-based pastures, one may aim at either completely replacing existing pastures or incorporating legumes in them. As the area available per beast is very large, most legume sowings will be aimed at improving native grassland, with the legume acting as a cheap protein supplement. Verano and Seca fill this aim as they combine well with native pastures without requiring timber removal. Large areas can be covered cheaply using aerial sowings.

Although they benefit from cultivation it is not essential, and their fertilizer needs are lower than those of other sown legumes. In selecting legumes for the dry tropics, high value has been placed on their ability to spread, so that large areas may be colonized from small sowings. Verano spreads rapidly but Seca is slower because of its lower seed production in the year after sowing.

Sown grasses

Trials have shown that there are a number of promising sown grass cultivars which are better than native grasses in response to early storms, greenness in the dry season, tolerance of heavy stocking, and ability to suppress weeds and reduce erosion. Grasses also survive fire better than legumes. Establishment failures with sown grasses are common and cultivated seedbeds are needed. Seed quality is a major problem as viability can vary greatly depending on time of harvesting. As well, grass seed deteriorates more rapidly in storage than legume seed. Seed should not be kept more than 1 year after harvest. Thus, in purchasing seed, ensure that the results of seed purity and germination tests are supplied. Store seed under cool, dry conditions.

A wide range of grasses has been tested at many sites in the region. Grasses have been selected for compatibility with legumes, greenness in the dry season, ability to spread, acceptability to stock and persistence under grazing.

None of the commercially available pasture grasses is adapted to the infertile sandy soils of the Peninsula. However, on the yellow and grey earths supporting mostly open box vegetation the following are useful:

- **Creeping bluegrass** (*Bothriochloa insculpta*) cv. Hatch spreads rapidly by stolons and has performed well in trials from near Weipa to Mt. Molloy and west to Mt. Garnet. Hatch has green shoots in the dry season and is adapted to all but very sandy and waterlogged soils.

- **Sabi grass** (*Urochloa mosambicensis*) cv. Nixon was first sown in the Peninsula in the early 1950s. It performs well on fertile soils in rainfalls of 900 to 1 100 mm. However, it tends to hay off early with rapid loss of feed value. Also, Nixon will only spread naturally on fertile soils. Other *Urochloa* lines now under testing are more promising.

- **Rhodes grass** (*Chloris gayana*) cv. Callide is a useful component in pasture mixtures in the region because of its rapid early growth and spread from stolons.

- **Signal grass** (*Brachiaria decumbens*) cv. Basilisk is a soloniferous grass widely used on the tropical wet coast (Mossman to Ingham). It is suited to higher rainfall areas of the Peninsula. Basilisk is drought tolerant and performs well on yellow and grey earths receiving as little as 1 000 mm of annual rainfall. It retains greenness longer than Nixon and is preferable in areas with adequate soil moisture.

- **Paspalum plicatulum** cvv. Rodds Bay and Bryan are two very similar tufted grasses which persist strongly in both high and low rainfalls especially on clay soils. However, they rapidly become coarse and low in protein, and constant grazing is required to maintain nutritious, young, green shoots. Their natural spread is much lower than that of the four previously mentioned grasses.

- **Guinea grass** (*Panicum maximum*) cv. Riversdale is a superior form selected from common guinea grass. It is useful only in higher rainfall areas of the region (1 200 mm plus) and requires fertile soil conditions. The related cultivar, Hamil grass, also fits this niche. Both will persist on fertile river flats in rainfalls down to 1 000 mm and perform well if soil moisture is adequate.

- **Setaria anceps** cv. Kazungula, like the *Panicum maximum* cultivars, requires high rainfall and thus suits high input situations in wetter areas.

- **Buffel grass** (*Cenchrus ciliaris*) cv. American has been sown experimentally and commercially in many parts of the Peninsula. However, this nutritious grass persists only in drier areas (1 000 mm or less) on fertile, well-drained soils. Its ability to spread is negligible and most areas in the region are not suitable for buffel grass.

- **Pangola** (*Digitaria decumbens*) is a stoloniferous, highly persistent, drought-hardy grass which does not produce viable seed and must be planted from runners. With irrigation and nitrogen fertilizer, pangola can provide high yields of quality fodder. Because of the high costs of planting, fertilizing and irrigation, its use will always be for special purposes such as feed for weaners or occasional sick stock. While it is now little used on the wet tropical coast because of major attacks by rust and aphids, these do not seriously affect pangola in drier areas.

A number of other grasses have shown promise in experimental sowings but no cultivars are yet available commercially. The best are *Andropogon gayanus, Hyparrhenia rufa, Brachiaria dictyoneura* and *Urochloa bolbodes*. It is promising that the first three are grown successfully on large areas of infertile soils in the Cerrado of central Brazil. The Northern Territory Department of Primary Production plans to release a cultivar of *Andropogon gayanus* following extensive trials.

Developing sown pastures

In selecting areas for pasture sowing, it is important to choose situations involving the least initial investment and lowest maintenance cost. Choose open country (such as box woodland) on yellow and grey earths and duplex soils, but not areas regularly flooded. Avoid densely timbered areas such as bloodwood/stringybark and tea-tree, because the trees restrict pasture growth as well as possibly involving future high costs of regrowth control.

It is not necessary to clear open timber for pasture growth or cattle mustering. For legumes, burn the area late in the dry season and keep the native pasture regrowth low by heavy grazing for the first 6 weeks after planting. Stock prefer young, green grass to legume at this time. Sow seed on to the uncultivated seedbed in November or December, at a rate of 1 to 2 kg per ha. Heavier sowing rates (up to 5 kg per ha) will provide an earlier legume cover but are not essential in the long run. Cultivation will improve establishment and is necessary where stock cannot check grass growth. A single light treatment with disc harrows is useful, especially in higher rainfall areas.

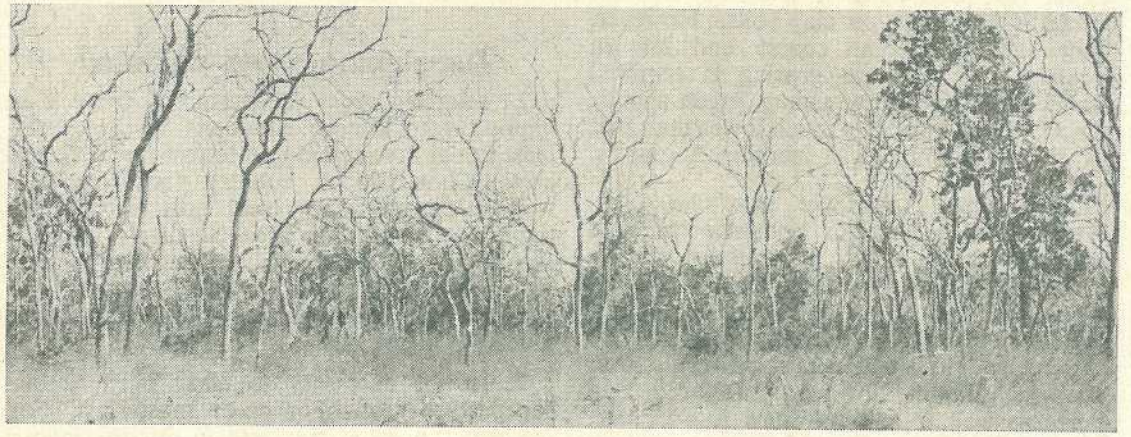
With sown grasses, a cultivated seedbed is essential. Sow grass at 2 to 4 kg per ha with the same quantity of legume seed. Removing open timber is still unnecessary. After sowing legume/grass mixture, exclude stock for the first wet season to allow stand thickening and seed set. Puddling will result if cultivated areas are grazed while wet.

Fertilizer

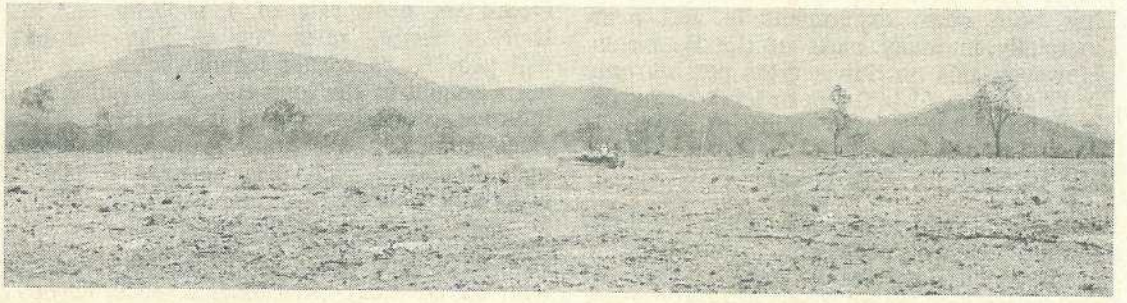
Nitrogen fertilizer at about 50 kg N per ha at sowing improves grass establishment but is not essential. Superphosphate should be applied at a minimum rate of 100 kg per ha on all grass and most legume sowings. Higher rates (up to 500 kg per ha) will give a pasture response. However, because of the high cost of fertilizer and freight to remote areas, these rates are not justified.

Maintenance dressings of 100 kg per ha of superphosphate every 2 or 3 years are beneficial.

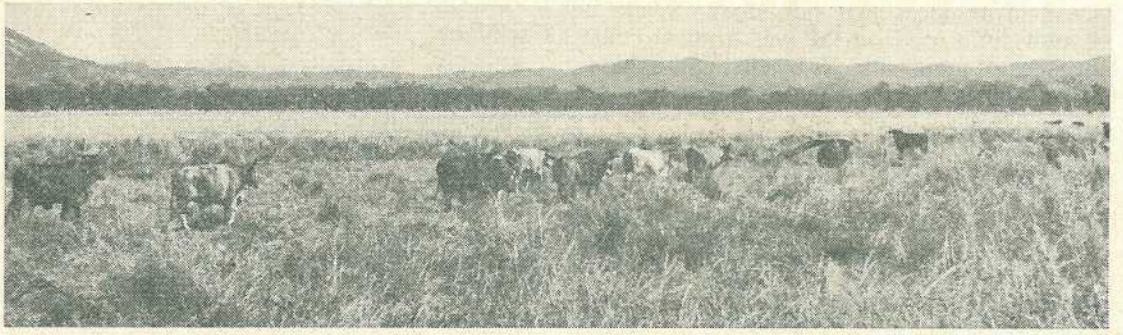
The high input approach to pasture development



'Tordon' treated timber.



Heavy ploughing.



A fully developed legume/grass pasture.

The low input approach to pasture development

Cultivation through open tree cover.

Schofield stylo/Rodds Bay plicatulum low input pastures at Merluna in box woodland.

Endeavour stylo at Kalinga in bloodwood/stringybark woodland.

The individual manager must decide whether to invest a large amount in a small area of land to rapidly produce a dense legume stand or whether to use a low cost system over a much larger area. Low input approaches invest proportionately more in seed than in fertilizer. The immediate return is lower but the long term effect on the whole herd is likely to be greater.

Uses of sown pastures

How should the grazier make best use of sown pastures? For immediate cash returns on the investment in pasture development, use legume-based pastures to finish steers and bullocks for marketing. This is the most common system now practised in Cape York Peninsula (for example, on 'Wrotham Park' and 'Southedge'). Using sown pastures for breeders will increase calving percentages and thus rapidly increase herd size.

Most properties sow small areas (up to 50 ha) before deciding on major investment in pastures. These areas can have a significant effect on stock management. Weaning calves at 5 to 6 months of age avoids mortalities of lactating cows and increases calving percentages by allowing breeders to regain condition earlier. Weaners need good quality feed for rapid growth. While many properties have depended on expensive hay purchased elsewhere for feeding weaners, small areas of sown legume/grass pastures are cheaper and more easily obtained.

Besides this, there is always a need for pasture near the homestead, to feed sick animals, bulls, horses and occasional cows lactating in the dry season, etc. Typically, the close-in small paddocks are overgrazed and weedy. They should be renovated by sowing to legume/grass mixtures with fertilizer.

Research in progress

A continuing program of pasture research is being carried out by Department of Primary Industries scientists based at Mareeba working in close co-operation with CSIRO. Trials in progress cover early species testing, plant nutrition, animal performance, breeding of pulse legumes and pasture seed production. A high priority in this work is based on improving the efficiency of animal production, that is, reducing costs of production and increasing returns. Obviously, the traditional farming approach of large scale clearing and high maintenance costs is far less desirable than the low cost systems suggested in this article.

The levels of fertilizer and/or supplements which are required to increase animal productivity are currently being investigated. Results from grazing work by CSIRO suggest that while Verano and Seca will grow on infertile soils, for animals to benefit it is necessary to supply small amounts of fertilizer (as little as 25 kg per ha of superphosphate annually).

Future trends

Because of the low carrying capacities in much of the Peninsula, most of the region will continue to supply the export lean beef trade. By increasing carrying capacities, sown pasture legumes will reduce the per head cost of fencing, watering and animal handling.

Stock supplied with more protein (a sown legume is the cheapest source) will grow faster and hold condition longer, thus allowing earlier turn-off at 3 years rather than 4 to 6 years of age. Adding sown grasses to legumes will improve pasture stability and increase the period of green feed availability. However, **legume protein is the most obvious immediate need in animal production in the Peninsula.**

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Insect pests of peanuts in southern Queensland

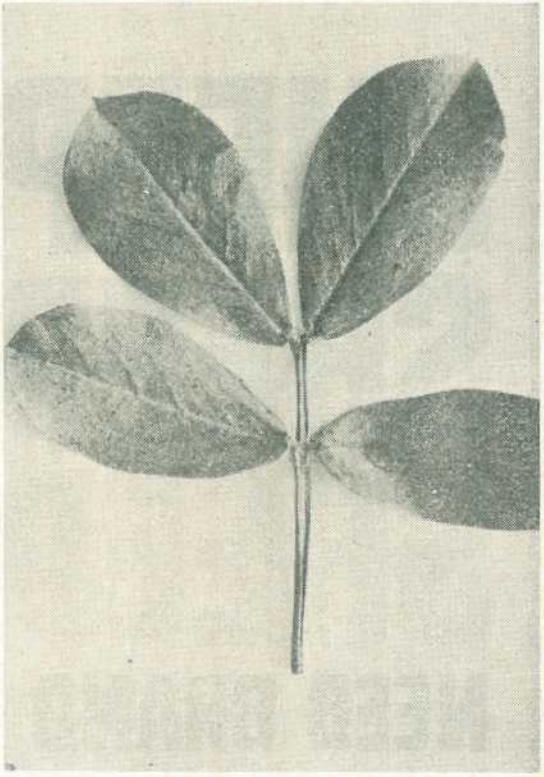
by J. W. Turner, Entomology Branch

PEANUTS are less susceptible to yield loss from insect damage than most agricultural crops of the region.

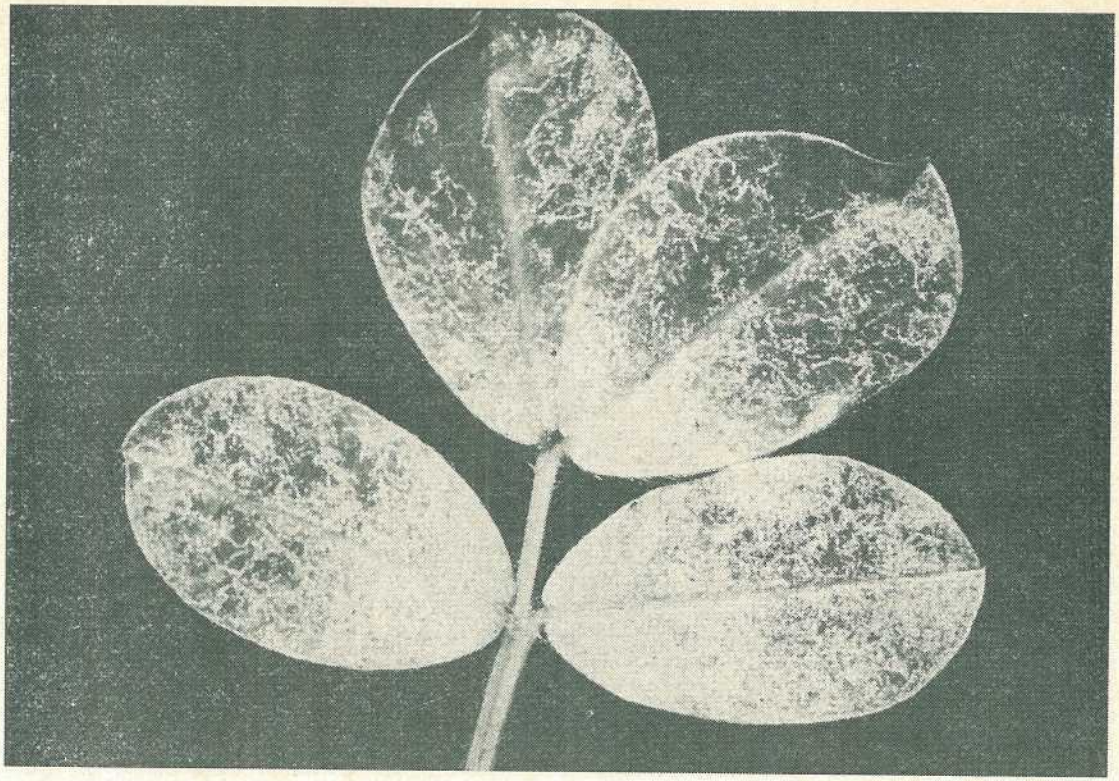
Nevertheless, the crop can on occasion be damaged severely and pest management must be a significant part of the overall management program. It is important, therefore, that growers are able to recognize particular pest species and be able to assess when their populations warrant control.

Peanut mite

The economic losses from peanut mites are mainly associated with young crops during periods of dry weather. Pest activity is usually first apparent as a general yellowing and silvering of the leaves in patches of the crop. As the damage becomes more severe, the lower leaves are shed and some plants may be killed.



Fine leaf stippling and whitening from peanut mite feeding.



Coarse leaf stippling and whitening from vegetable jassid feeding.

The mites are small (0·5 mm long) but are readily seen with the naked eye as oval-bodied, spider-like creatures with four pairs of amber-coloured legs, the first pair of which is held out in front of the body. Their bodies are dark green to black, sometimes with red markings. They have a characteristic habit of falling to the ground when the plants are disturbed.

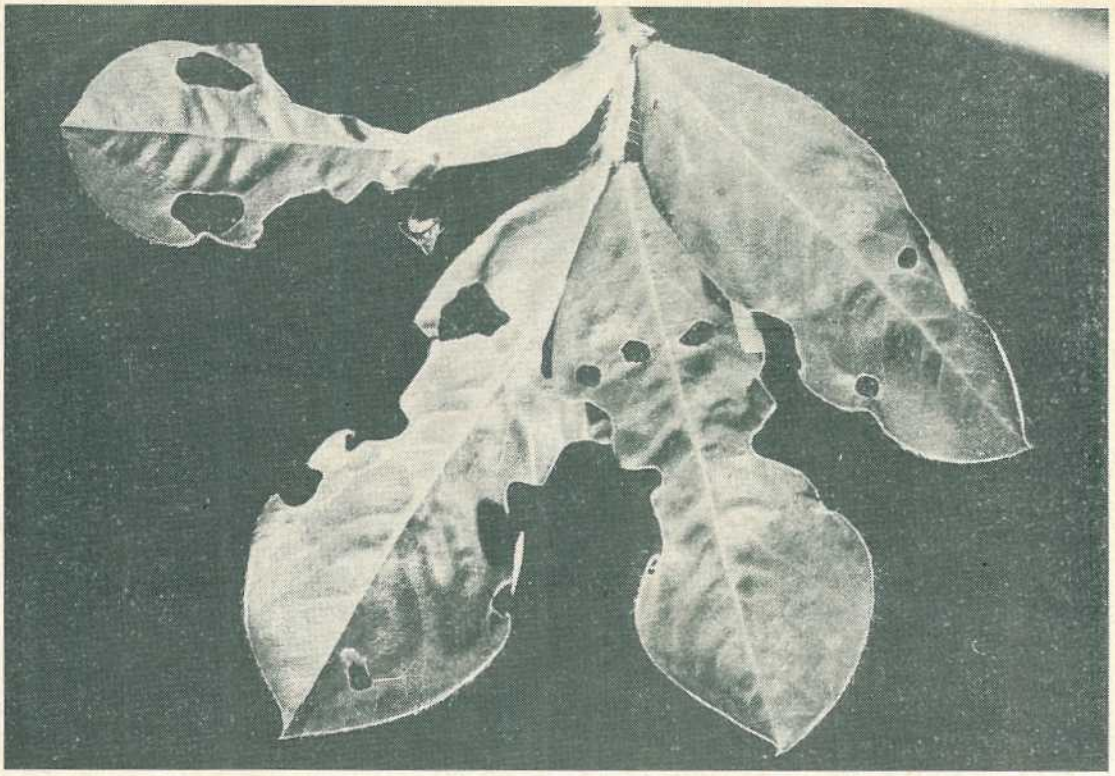
As mites are most common on drought affected plants, control will provide an economic return only when rainfall follows control in time to allow the production of a harvestable crop. Failure to apply a timely application of pesticide, even when reasonable conditions follow a mite infestation, may result in a more uneven crop than would otherwise be expected, as well as a significant yield loss.

When a chemical treatment is warranted, dimethoate spray at 350 mL of 400 g per L concentrate per ha is recommended.

Where control on small plants is warranted, considerable cost savings can be achieved by applying the pesticide through a boom spray with a single nozzle mounted over each row. Dosage can then be calculated on the area actually sprayed rather than the area transversed by the boom spray. Another technique for cost reduction is to treat only infested patches. When this method is appropriate, care should be taken in scouting the area as infestation will be spread beyond the more obviously damaged patches.

Budworms

The native budworm (often known as *Heliothis*) is almost always present in crops particularly during the first half of the growth period. The main attack by these caterpillars is on the leaves of the plant, although they also feed on the growing points.



Budworm damage to peanut leaves.

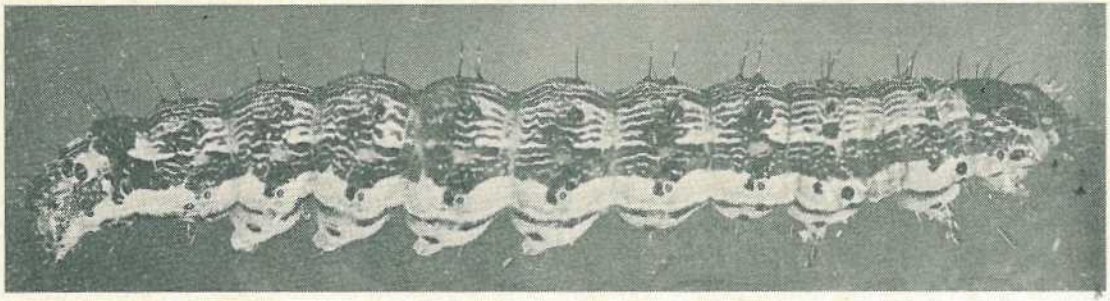
The caterpillars vary in colour from shades of green to brown and measure 40 to 50 mm in length when fully grown.

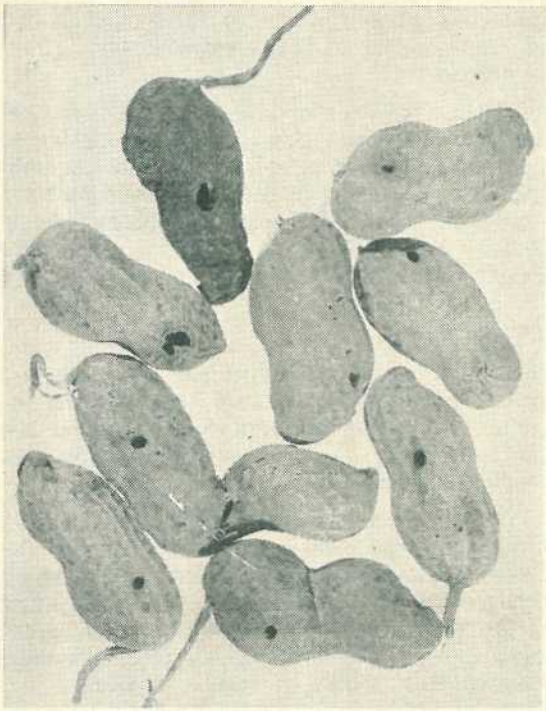
Peanut plants have a remarkable ability to survive defoliation and well grown 8-week-old plants are able to tolerate up to 15 larvae per m of row. Quite often when populations of this level occur, epidemics of a virus disease will eliminate the pests well before the larvae are fully grown.

If an outbreak of native budworms is observed, a careful survey should be made for dead larvae or for larval skins associated with black stains from the breakdown of the body. These contain millions of virus particles which spread to other larvae in the population. When the disease is present it can be anticipated that the problem will soon disappear.

If chemical control is required, endosulphan applied at 2·1 L of 350 g per L concentrate per ha should be used.

Budworm larva.





Peanut pods damaged by lucerne seed web moth.

Another species of *Heliothis,* the corn earworm, also attacks the crop. Larvae of the two species are virtually indistinguishable but differ in seasonal occurrence and feeding habits in peanuts.

The corn earworm is more prevalent in the latter part of the season and feeds on the pegs, flowers and flower buds. The species thus has the potential to prevent crop set and control measures are warranted when there is an average of one caterpillar per m of row during the flowering stage.

Jassids

Both the adult and wingless immature stages of jassids are small, sucking insects up to 2·5 mm in length at maturity. Eggs are laid into the plant tissue and the cycle from egg to egg requires only 2 to 3 weeks during summer, thus rapid population build up can occur.

Two species attack peanuts and as their effects on the plant are different it is important to distinguish between them. The vegetable jassid is bright green and larger than the yellowish-green lucerne jassid. The former has a wide range of hosts and is normally present in the fields earlier than the lucerne jassid.

The vegetable jassid feeds from the cells in the leaves. Leaf cells around the feeding puncture are killed so that feeding is first noted as small white spots on the leaves. With continued attack, the typical jassid stipple pattern emerges.

The lucerne jassid on the other hand feeds in the sap conducting system of the plant and does not produce obvious stippling. It injects more toxic substance into the plant than does the vegetable jassid and blocks the sap flow in the leaves. Thus the lucerne jassid has a more severe effect on the plant than vegetable jassid, producing 'burn' symptoms on the affected plant where the apex of the leaves yellows and may subsequently die.

The removal of sap and reduction of photosynthetic area by jassid stipple have the potential to reduce yield although peanuts are fairly tolerant to such injury. The limited experimental data available suggest that control of vegetable jassid is not warranted until stipple is clearly visible to an observer standing in the field.

Fewer lucerne jassids, however, are required to cause losses because of the toxins and the effect on the sap conducting tissues. When reasonable numbers of the pests (40 or more per metre of row) fly as the plants are disturbed, spraying is considered warranted.

Control can be obtained by applying dimethoate at the rate of 350 mL of 400 g per L concentrate per ha and, as discussed above, economy in use may be achieved when small plants are involved.

Lucerne seed web moth

This pest has caused direct production loss over the past few years from the chewing of larvae on the kernels and also considerable indirect loss following from mould development in damaged pods.

The adults are grey moths with a wing-span of about 20 mm. The forewings are marked with an orange band across the inner third of each and a white stripe along the outer margin from the base to the apex. There is a conspicuous 'snout' on the head. The larvae are reddish-pink.

Several generations of the insect occur per year in rattlepods and lucerne. These are much more favoured hosts and severe infestations in peanuts probably result from occasional 'overflows' of populations from these.

Eggs are thought to be laid on the foliage or flowers of the peanut plant and upon hatching the larvae move into the pods in the soil. The larger larvae infesting the kernels at harvest continue to feed on the peanuts in storage. The insects, however, are not able to breed in the stored nuts.

Currently, it is not possible to predict when infestations of the pests may occur and simple control systems have not as yet been evolved. Where infestations are detected, early harvesting followed by drying and shelling, or fumigation, will limit larval damage. The problem is currently being investigated but the sporadic nature of infestations precludes rapid progress.

White grubs

This name applies to the white larvae with reddish-brown heads, which lie in a typical C-shaped posture in the soil. They are, however, capable of uncurling and moving actively when disturbed. The adults are brown, scarab beetles which emerge from the pupal stage in the soil, sometimes in great numbers, between November and March, and usually after falls of rain. The eggs are laid in the soil at the base of peanut plants and weeds.

The young larvae feed initially in the soil humus and on the roots of the plants. The larger larvae attack the shells and kernels of the peanuts reducing yield and quality and increasing the level of mould in the nuts.

As the majority of adults emerge after the early summer rains, early planted crops are more often damaged than those planted later in the season.

Despite a continuing research programme, satisfactory methods of control of this pest have not yet been developed. There are, however, some techniques which limit the level of damage. Crop rotation is important, particularly when a short term crop such as early sunflowers is used instead of peanuts or summer cereal. Severe, deep ploughing when the soil is left rough for the winter and then broken down to form a seed bed in spring can reduce overwintering larval populations.

Early harvesting of infested areas is recommended to reduce damage from both larvae and mould. It is also important to maintain fallow as weed free as possible before planting and thus reduce the possibility of egg laying under volunteer plants and consequent development of infestation in the crop.

Minor pests

A wide range of additional insect species occurs in peanut crops and most of these are quite harmless to the crop. Some are parasites and predators of the pest species and as such assist in minimizing pest problems.

A few are minor pests which on occasion cause growers some concern. Among the latter is the red shouldered leaf beetle which feeds on a wide variety of plants and during outbreak periods may defoliate small areas of peanuts. The level of damage, however, is such that control is rarely required.

Similarly the green vegetable bug, an important pest of a number of crops, will feed in peanuts but is not regarded as a pest in this crop. Aphids are also present in small numbers in most crops but have not been noted to influence yields. They do, however, carry peanut mottle virus which has a mild effect on the crop.

The scientific names of species discussed are:

Peanut mite ..... *Paraplonopia* sp.
Native budworm ..... *Heliothis punctigera* (Wallengren)
Corn earworm ..... *H. armigera* (Hübner)
Vegetable jassid ..... *Austroasca viridigrisea* (Paoli)
Lucerne jassid ..... *A. alfalfae* (Evans)
Lucerne seed web moth ..... *Etiella behrii* (Zeller)
White grubs ..... *Heteronyx* sp. and other species
Red shouldered leaf beetle ..... *Monolepta australis* (Jacoby)
Green vegetable bug ..... *Nezara viridula* (Linnaeus)
Aphids ..... *Aphis craccivora* (Koch) and other species.

Separating garlic bulbs

by G. H. Malcolmson, Agriculture Branch

CLYDE MARSCHKE, an enterprising small crop producer in the Lowood district of the Brisbane Valley has designed and constructed a machine to separate garlic bulbs into single cloves for planting.

The machine was developed 2 years ago to reduce the time and labour involved annually in the arduous task of 'breaking-up' the bulbs by hand.

The separating of bulbs into individual cloves once took two members of the Marschke family 16 working hours to break up and clean the season's planting requirements of 2 000 kg. Now with the assistance of the bulb separator, two people can handle the same quantity in 4 hours with considerably less physical effort.

The bulb separator has also kept losses of damaged cloves to a minimum. Clyde Marschke estimates that no more than 5% of the sample are damaged.

The garlic bulb separator is a simple piece of equipment, easily constructed at relatively low cost. The unit took Clyde Marschke approximately 2 working days to build, using farm materials and equipment wherever possible. The cost of the materials, if all parts were purchased, including a 0·70 kW electric motor is around $400.

Plate 1. Overall view of the garlic bulb separator in action.

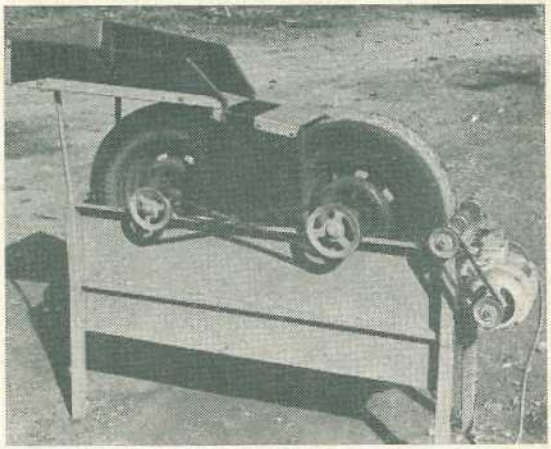


Plate 2. Back view of the bulb separator illustrating the wheel, roller link up with the electric motor.

Construction

The unit consists basically of a metal framework of 38 mm square rounded hollow steel standing 72 cm high x 125 cm long x 33 cm wide.

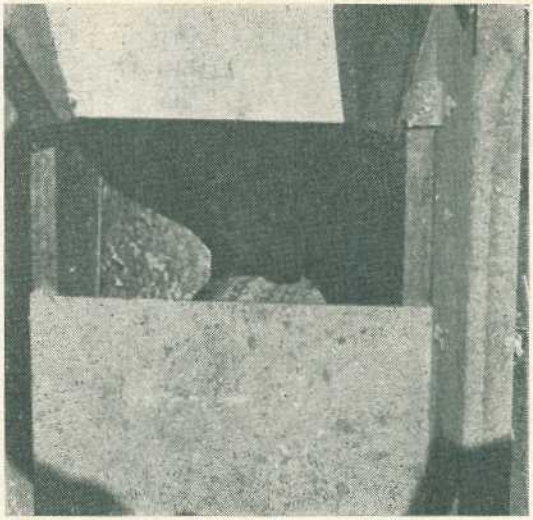


Plate 3. Close up view of the guide plates in the feed shoot.

Plate 4. A sample of garlic cloves separated by the machine.

The upper portion of the framework is 38 mm x 38 mm x 6·5 mm angle iron. The angle iron is preferred because less difficulty is experienced in attaching six 18 mm self-aligning bearings and housings necessary to support the steel shafts of a driving roller and two car wheels.

The framework is also enclosed by 20 gauge sheet metal for safety.

The power source is a 0·75 kW electric motor mounted as illustrated in plate 1. This motor is linked to a 50 mm diameter steel shaft roller by V belts running on 75 mm diameter pulleys (plate 2). It is necessary to steel lathe the roller at each end to fit the 18 mm bearings and pulley.

The steel shaft roller is positioned hard against the front car wheel to provide the main drive. The back wheel is positioned so there is a gap of 12 mm between the two 35 cm wheels. It is also necessary to reduce the inner diameter opening of the wheel hubs down to 18 mm.

This can be easily altered by attaching a steel plate to each of the wheel hubs with an 18 mm diameter hole drilled through the centre for the axle shaft. Once the wheels are centre positioned they are welded to the shaft.

The two wheels are then linked by a cross-over V belt running off a 125 mm pulley on the front wheel shaft to a 100 mm pulley on the rear wheel shaft. The cross-over V belt is necessary in order to have both wheels turning inwards.

The differing pulley sizes are necessary to produce varying wheel speeds so as to assist the feeding through and breaking up of the garlic bulbs. The individual wheel speed generated from a 0·75 kW electric motor via the steel shaft drive roller is approximately 120 r.p.m. front wheel and 144 r.p.m. back wheel.

The tyre pressures vary—the front wheel is inflated to 138 kPa, while the rear wheel has zero pressure. This allows a certain amount of 'give' especially for the bigger garlic bulbs thus avoiding excessive damage to the clove.

A triangular-shaped flat tray is mounted above the back wheel with the narrow end opening directly into the feed shoot. The boxed shoot has inner guide plates, one on each side to concentrate the garlic bulbs on to the tread surface of the tyres (Plate 3). Without these plates, many bulbs would pass through unseparated.

Clyde Marshke stresses that the condition of the garlic bulbs prior to separation is most important. They should be very dry and exposure to the sun for a day prior to separating is desirable as damp bulbs do not separate cleanly.

Conformation of the beef carcass -what value ?

DESPITE an accumulation of scientific data showing that conformation in beef cattle is a factor negatively related to real issues like yield and hard, cold commercial returns, the myth lingers on!

Many 'practical' men together with various industry groups still wish to find a place for conformation among factors objectively describing beef carcasses.

What is there about this character that makes it so hard to place in perspective? Why did it get past inquiring minds and end up in our first attempts at beef carcass classification? Certainly it appeared there as 'weight-length score' but this did not make it any more respectable or useful.

This article looks at conformation—its value in the live animal, its scientific appraisal and its use in carcass description.

Conformation is the manner in which an animal or carcass is formed, structured or shaped. But how important is it?

How does it advantage or disadvantage our cattle in a commercial sense?

We must accept that it does have commercial significance since chamption show cattle are worth more than others. They are champions partly, at least, because of their conformation. You only have to listen to the judges' criteria or their comments to know this is so. They describe length, depth, fill, fulness, fleshing, depth of muscle and so on.

On the hook, conformation does have its commercial impact. Graders for a long time have been placing carcasses in second or third grade because of 'lack of conformation'. And this of course is money. Firsts are always worth more than thirds, unless some ridiculous situation prevails, as it did in the mid 1960s with the U.S. hamburger carcasses.

by E. R. Johnson, Faculty of Veterinary Science, University of Queensland.

Conformation is undoubtedly an economic factor. But let us look at what it means in commercial terms such as yield, trim and taste.

A scientist in the U.K., Luitingh, was the first one to rock the traditionalists' boat. In 1962, he published the results of his experimental work on British breed cattle. He found that the fatter carcasses with superior conformation gave poorer commercial yields. This resulted from the fatter carcasses having a greater proportion of inferior retail cuts (brisket, belly, thin flank) and requiring more trim. His was a brave finding in a world that was conformation-orientated, particularly so with the U.S. grading systems.

However, it did not surprise a small group of Australian scientists who had arrived independently at similar conclusions. Butterfield, a South Australian, working in Queensland, was particularly sceptical of the conformation story in beef cattle. So much so that he painstakingly removed, trimmed and weighed every muscle, bone and various fat deposits in 54 beef carcasses from cattle of various shapes and finishes.

He compared five breeds—Hereford, Poll Hereford, Angus, Brahman and Shorthorn and concluded that:

- Neither shape nor breed influenced the distribution of lean over the carcass.
- With increased fattening, the proportion of some expensive cuts (topside, silverside, round) was slightly depressed.

So Luitingh, using a primal cut (commercial) technique and Butterfield, using an accurate (anatomical) technique showed that fatter carcasses produced lower yields two ways—through changing fat deposition patterns and by a frank loss of lean. The level of fatness above which carcasses start

losing out on yield is not known accurately, and it probably varies among breeds, but it is surprisingly low—somewhere around 18% to 20%.

Australian scientists have been particularly busy and Butterfield's findings have been re-inforced, now in about 15 breeds of cattle.

Meanwhile, extensive work in the U.S., based on wholesale and retail cuts, showed that superior conformation did result in superior yield and therefore, better economic returns.

So where did the truth lie? Here we had good evidence for each of two widely divergent views.

Recent work on the growth and distribution of fat has proved to be the arbitrator. The facts are:

- The distribution of lean does not vary significantly in carcasses of cattle of different breeds and shapes.
- The distribution of bone is similarly invariable.
- Fat is greatly variable in onset of growth, quantity and distribution in different breeds and types.

Since a carcass consists basically of three components, muscle, bone and fat, and the first two are invariable in distribution among breeds, fat is the only one that can explain the differences in findings regarding conformation between U.S. and Australian workers.

It is significant that, in the U.S., boned-out, fat-trimmed cuts form the basis of investigations whereas in Australia fat is entirely removed and 'clean' muscles are studied.

Most recently, Charles and Johnson (1976) using a 'triple' technique of individual muscles, anatomical carcass cuts and primal cuts, showed that in Hereford, Angus, Friesian and Charolais cross-bred steers, carcass shape was not associated with differences in the distribution of lean in wholesale cuts.

Current work on fat growth and distribution shows clearly that the amount of fat and its distribution do influence the conformation or shape of breeds of cattle and their carcasses.

Add to this the different maturity types and it becomes obvious that fat, especially subcutaneous fat, can have a great influence on conformation.

So considerations of carcass fatness cannot be divorced from any evaluation of the importance of conformation in a carcass grading or classification scheme. These vital points must be remembered:

- Fatter carcasses are currently not in demand.
- Fatter carcasses will be associated with lower commercial yields.
- Fatter carcasses will generally be of superior conformation.

In other words, any merit score for superior conformation will be associated negatively with the existing commercial situation.

We have confirmed that conformation in cattle is commercially important. We have looked at the reasons why it is important. The strong implication is that conformation is associated with an appreciable negative component.

While this seems to be the safest point to terminate our discussion on conformation and carcasses, I feel we are obliged to look a little closer at the implications to the beef cattle industry.

A breed has a set of standards. Once a breeder opts for his breed, I guess this implies that he accepts those standards which may be of practical value or of aesthetic importance only.

With respect to the latter category, I think we have to be careful about standards laid down in another country a long time ago.

To keep myself clear of trouble, let me quote the case of an Englishman who examined the conformation of British breeds of cattle whose standards were defined, of course, by Englishmen.

His name was Callow and he produced strong evidence that intense selection for beef-breed type actually resulted in selection for heavier subcutaneous fat deposits which are ideally placed to influence conformation.

If this is an aesthetic 'shape' factor, there can be no argument.

But in Northern Australia, if we find our Shorthorn cattle aesthetically offensive in appearance and seek sires from southern parts of Australia to improve the quality, we may have to be careful.

The 'inferior' cattle may be highly adapted and more profitable in the hostile northern environment.

Aesthetic factors may not translate too well to factors of heat and tick resistance, survival, reproduction and bank balance.

Conformation does not seem to relate to meat quality to any degree.

There could be an effect if poor conformation was brought about by a carcass being old, grisly and tough. Or by a carcass being almost devoid of fat, therefore containing no marbling fat.

Such meat may tend to cook dry. But these two cases would be extreme states.

In the first case, any really aged animals would routinely enter the manufacturing meat trade and in the second case there are few carcasses with no fat.

Furthermore, as we said earlier, Australians generally do not rate marbling highly.

With our state of knowledge today regarding the relationship of carcass proportions to meat and carcass quality, how highly should we rate conformation in grading systems? Consumer trend is for low-fat carcasses so perhaps conformation has become an anachronism.

Carcasses from many cattle in Australia, like some Territory Shorthorns or those from the Peninsula through the Mareeba saleyards, would never win a prize on eyeball grading.

However, for a particular market like the U.S. manufacturing trade, they turn out excellent, high lean, low fat, minimal-waste carcasses.

And what of conformation in our developing Beef Carcase Classification Scheme? In its early stages of implementation, the Scheme contained conformation (in a form)—the weight/length relationship.

This factor described but a handful of carcasses not adequately described by the other classification measurements, sex, dentition, carcass weight and fat thickness. And the emphasis should be on 'handful'. With these latter four criteria in use there seems little point in adding a measurement that generally provides no improvement in carcass description.

In fact, this measurement represents an imposition on the Scheme since it requires equipment, time and labour, and when taken successfully, represents a further impost on the Scheme since it has a negative association with carcass yield. It is therefore pleasing to see that the Australian Meat and Livestock Corporation has recently deleted this measurement from its classification scheme.

Conformation must be seen in perspective. It is a factor that, when viewed on the hoof or on the hook, is rather pleasing to the eye. And we have all been led to believe, from the emphasis in our grading systems, that it was both desirable and commercially important. Not so now. Accumulating scientific information on carcass composition, coupled with modern market demands, show that it is time to cast conformation aside.

Veterinary Surgeons Board Re-appointed

THE Veterinary Surgeons Board of Queensland has been re-constituted for a further 3-year term as from February this year.

The Minister for Primary Industries, Mr V. B. Sullivan, said the four members were: Professor J. Francis, C.B.E., of the University of Queensland Veterinary School, who is the Government representative on the Board; and Messrs S. Goldfarb, Brisbane; S. J. Miller, Warwick and R. R. Pascoe, Oakey, as elected members.

Mr Sullivan added that the Director of the Division of Animal Industry, Mr J. W. Ryley, would remain as President of the Board.

Tickicides investigated

THE Minister for Primary Industries, Mr V. B. Sullivan, said that laboratory tests conducted by CSIRO and his Department on certain tick samples obtained from the field had indicated that a low level of resistance might be present in these samples to the amidine tickicides.

These findings had been made using the so-called packet tests, in which tick larvae were exposed to packets impregnated with the chemical.

Trials using cattle infected with tick larvae obtained from these suspect samples failed to show any control problem when the cattle were treated with the recommended concentration of the tickicides Dipofene, Taktic and Tifatol.

The trials also showed that if the dip strength was reduced below normal, control problems did occur with the suspect field strains.

While standard tick strains only suffered an expected slight reduction in percentage kill when the concentration of the tickicide applied was marginally lowered, there was a serious decline in percentage kill of ticks in these suspect strains.

However, further selection of these strains by treatment with the chemicals did not increase the resistance factor.

Mr Sullivan said that, in short, while these tickicides were used at the correct strength, no control problems occurred.

The lesson for producers then was that it was very important to use the chemicals at the correct strength recommended by the manufacturers to minimize any future tick control problems in the field.

He advised producers to utilize the dip analysis service provided by the D.P.I. to ensure that they keep dips at the recommended strength.

Any control problems should be referred to Veterinary Services Branch Staff for investigation and advice, Mr Sullivan added.

Agricultural Equipment Advisory Committee

THE five-member Agricultural Equipment Advisory Committee, set up late last year to provide a forum for producers, manufacturers and dealers to discuss disputes over farm equipment performance, is now in operation.

The Minister for Primary Industries, Mr V. B. Sullivan, said initial organisational work had been completed and a complaint form drawn up and distributed.

He emphasised that owners of agricultural equipment who believed they had a legitimate complaint regarding the performance, or servicing, of their machinery must negotiate first with their dealer-supplier.

Such negotiations should include utilisation of the Tractor and Machinery Association's Problem Reporting System, details of which were available from producer organisations.

'If they feel they still are not receiving satisfaction, their next step is to fill in the Committee's complaint form and send it to the relevant producer organisation for support and action,' Mr Sullivan said.

These forms are available from any office of the Department of Primary Industries or the offices of the various producer organisations.

Should further negotiations be recommended by any party involved, the Advisory Committee will continue the discussions, with the objective of achieving a favourable conclusion.

Mr Sullivan added that Committee members were: Dr G. I. Alexander, Deputy Director-General, D.P.I., as Chairman, and Messrs George Houen, Queensland Graingrowers' Association Administrator, Brian Dunn, Tractor and Machinery Association of Australia's Executive Director, John Manners, Queensland Canegrowers' Council Legal Officer and Merv. Vining, Executive Director of the Queensland Motor Industry Association.

The Executive Officer was D.P.I. Executive Engineer, Mr Vince Hay.

Seed assures future of Callide Rhodes

by D. S. Loch; Agriculture Branch

Well-managed, high-yielding seed crops have assured the future for Callide Rhodes.

INCREASING quantities of commercial seed now promise a bright future for Callide Rhodes grass.

Since Callide Rhodes was released for commercial use in 1961, increasing recognition of its advantages and its wide adaptation have led to a growing demand for seed, both locally and overseas. Until now, however, the commercial potential of Callide could not be realized because of limited seed production.

Adaptation

Callide Rhodes can be used to advantage over a wide range of country in the 600 to 1 200 mm rainfall belt in coastal and subcoastal Queensland. It grows best on scrub soils and well-drained dark loams, but is also reasonably tolerant of a wide range of less fertile, more poorly-drained soils.

It has, for example, been one of the best grasses for soloth soils which are notorious for their poor moisture relationships. These can range from extremely dry to extremely wet and waterlogged because infiltration is very slow until the surface is moist and because the clay subsoil impedes drainage through the profile.

Callide was originally released on the basis of its outstanding performance in experiments at Biloela Research Station. However, since then, it has been widely tested in numerous experiments and small scale commercial sowings throughout its geographic range. It has proved to be an impressive grass—often the most impressive grass—in a diversity of situations, many of which are listed in table 1.

TABLE 1

SUCCESSFUL EARLY CALLIDE RHODES SOWINGS

District	Site	Soil Type	Approximate Average Annual Rainfall (mm)
Ipswich-West Moreton	Undulla	Soloth	850–900
	Ripley	Solodized solonetz	
	Bryden	Yellow podzolic	
	Eskdale	Granitic sand	
	Linville	Solodic	
Nanango	Hazeldean	Forest	750
Gympie	Wonga	Prairie	1 000
		Solodic	
	Veteran	Red podzolic	1 150
	Gootchie	Soloth	1 000
Biggenden	Dallarnil	Softwood scrub	900
	Coalstoun Lakes	Red volcanic	900
Bundaberg–Miriam Vale	North Bundaberg	Ancient gleyed alluvials	1 100–1 200
	Berajondo	Granitic sand	
	Miriam Vale	Alluvial	
Biloela	Various	Alluvial	700
		Brigalow	
		Softwood scrub	
Marlborough	Ogmore	Brigalow	1 000
Nebo–Collinsville	Nebo	Sandy loam	750
	Havilah	Cracking clay	650
Townsville–Ayr	Millaroo	Sandy loam	800
	Swans Lagoon	Solodic	750
	Lansdown	Yellow earth	900

It has grown well from drier parts of the Moreton region in the south to Ayr and Townsville in the north and has great potential for much of the speargrass zone and for cleared brigalow scrubs.

Throughout its range, Callide will provide excellent pastures for cattle. In addition, it could also become an important component of pastures for horses where a productive, high quality grass low in oxalate is required.

Advantages

Although Callide is a 'giant' form of Rhodes grass and, as such, is larger and coarser in appearance than the older, widely sown Pioneer cultivar, it has greatly superior qualities as a pasture plant.

Pioneer—formerly called 'commercial Rhodes'—has the drawbacks of being early maturing, having a flowering period which covers the entire growing season, and being poorly accepted by stock in mature stages of growth. As a result, it quickly runs to head when growth commences in spring and continues to produce stemmy, low quality, and poorly utilized herbage for the rest of the growing season.

In contrast, Callide remains green and predominantly leafy throughout summer and early autumn. Its main flowering period is in late autumn, although it may also flower strongly in early summer if good rains ensure that growth commences in early spring. A few heads may be produced during the rest of summer and early autumn, but it is not until about mid April that strong head emergence is again seen.

In addition, even when conditions are suitable for flowering, Callide is slower to mature than Pioneer so that leafy, high quality material is available over a longer period.

An outstanding feature of Callide Rhodes is its acceptability to cattle, even during mature stages of growth. There have been many reports of Callide being eagerly grazed while adjacent plots of Pioneer were scarcely touched. Stock will generally select Callide in preference to most other grasses at the same stage of growth, and experiments have shown that mature stemmy growth of Callide is much better utilized than that of Pioneer.

Availability of seed

Seed of Callide Rhodes is now becoming freely available as the results of D.P.I. research are applied commercially.

Early growers soon found that Callide seed is more difficult to produce than Pioneer, and much of the initial seed produced failed to comply with the 20% germination standard then in force. Subsequent research has shown the importance of an appropriate environment and careful crop management in achieving the best possible results. Because of this, Callide is now grown for seed in more suitable districts and under much better management than previously.

To encourage commercial seed production, earlier purity and germination standards for Callide have also been abolished and research will continue to monitor commercial experience until such time as appropriate standards can be set.

With the recent resurgence of interest in seed production of Callide, certification was introduced to guarantee the authenticity of seed sold under Basic or Certified labels because seed of Rhodes grass cultivars is difficult for the average farmer to distinguish with certainty.

This should restore market confidence lost because, in past years, many seed lots sold under the name 'Callide' either have been Pioneer Rhodes or have been heavily contaminated with Pioneer.

Certification was therefore an essential precaution to protect seed buyers, particularly as the superiority of Callide and the greater difficulties of seed production will lead to a continuing market premium for Callide seed. In addition, certification will also minimize the risk of detrimental changes in varietal characteristics likely over a long period of unrestricted multiplication.

Callide Rhodes combines well with Siratro in mixed pastures.

Despite poor seasonal conditions over the last few years, these Departmental initiatives have succeeded and commercial seed production of Callide is now increasing dramatically. In 1977/78, the initial year of seed certification, 1366 kg of seed were labelled and, after final cleaning, certified Callide production for 1978/79 should exceed 10 tonnes of seed, with further increases expected in future years.

Varietal plots at Biloela Research Station showing Callide Rhodes closely grazed (foreground) in preference to mature Pioneer (background) which has hardly been touched.

A small quantity of seed (about 0·5 tonne) of another Rhodes cultivar, Samford, was also harvested during 1978/79, though it will be at least another year or two before substantial quantities are produced. Like Callide, Samford was released in the early 1960s and has similar advantages over Pioneer, but, to date, farmers have not been able to use it because commercial seed supplies were not available.

Buying seed

Farmers should take care in two respects when buying seed of Callide Rhodes.

Firstly, only certified seed is guaranteed true to label. This should therefore be bought in preference to uncertified seed. As indicated earlier, the market premium for Callide seed and the difficulty in identifying this with certainty are strong temptations to the unscrupulous.

Secondly, there are currently no minimum standards in force. Seed of Callide (and also of Samford) Rhodes may be legally sold provided it is clearly labelled with cultivar name, date of seed analysis, actual germination percentage, and actual pure seed content.

Farmers are therefore urged not to buy blindly; instead they should make an informed choice of which line of seed offers the best value for money on the basis of its pure live seed content.

$$\left(\% \text{ PLS} = \frac{\% \text{ purity x } \% \text{ germination}}{100}\right)$$

Suppose, for example, a buyer is confronted with a choice of two lines of seed, line A with 82% purity and 22% germination selling for $11 per kg and line B with 90% purity and 10% germination selling for $9 per kg. When reduced to a PLS basis as follows, line A, although appearing more expensive at first glance, clearly offers the better value for money:

	LINE A	LINE B
% PLS:	$\frac{82 \times 22}{100}\% = 18\%$	$\frac{90 \times 10}{100}\% = 9\%$
Cost per 1% PLS:	$\frac{\$11}{18} = \$0.61$	$\frac{\$9}{9} = \$1.00$

PLS content should also be used to adjust sowing rates to ensure satisfactory establishment. If, for example, line A were planted at 2 kg per ha, then, by the use of a simple ratio, line B would need to be planted at:

$$2 \times \frac{18 \text{ (PLS line A)}}{9 \text{ (PLS line B)}} = 4 \text{ kg per ha}$$

On this basis, comparable planting costs calculated as follows would actually be 64% more expensive for the apparently 'cheap' line B.

Line A: \$11 per kg x 2 kg = \$22 per ha
Line B: \$ 9 per kg x 4 kg = \$36 per ha

Seed cost

While the long period of leafy growth and the attributes of late maturity and restricted flowering make Callide Rhodes such an attractive proposition in pastures, they also make seed production more difficult and more costly than for Pioneer.

As a result, seed of Callide will always be more expensive than that of Pioneer, but farmers willing to spend a little more on pasture establishment will find their additional investment repaid many times over by a more productive, better quality pasture.

Clearly, this is a case covered by the old saying: 'you can't have your cake and eat it too'.

Errata

YOUR attention is drawn to inaccuracies in the article 'South Queensland grain sorghum planting guide 1979–80 season' which was published in the November-December 1979 (Vol. 105 No. 6) issue of the *Queensland Agricultural Journal*.

Page 516

The following paragraphs under the heading 'Sugar cane mosaic virus' are incorrect.

'All grain sorghum hybrids in Queensland are susceptible to the Johnson grass strain of sugar cane mosaic virus. Three types of symptoms occur depending on the hybrid and environmental conditions.

The mosaic (M) symptom is shown by most of the recommended hybrids and, under field conditions, the grain yield of mosaic reactors is little affected.

Red stripe (R.S.) reactors show a conspicuous red striping when infected. Early infection may result in severe stunting and a substantial yield lost.

The red leaf sympton (R.L.) becomes evident when cool conditions follow infection and the mosaic symptoms change to red spots, streaks and areas of dead tissue. Substantial yield loss will result.'

These paragraphs should read:

A Johnson grass strain of sugar cane mosaic virus commonly infects grain sorghum in southern and central Queensland. Three distinct symptoms occur depending on the hybrid and weather conditions.

The mosaic symptom (M) develops in most of the recommended hybrids and, under field conditions, the grain yield of mosaic reactors is generally little affected.

The red leaf symptom occurs in infected plants of specific hybrids following cool weather. The mosaic symptoms develop into red spots, streaks and areas of dead tissue. If severe red leaf disease occurs, substantial yield loss will result.

Red stripe reactors produce a conspicuous red striping. Early infection causes severe stunting and a high level of this disease results in a subtantial yield reduction.

Several hybrids completely resistant to the virus are now available. These hybrids do not produce any of the three symptoms mentioned above and were developed from resistant breeding lines recently released by the Department. Resistant hybrids are designated R in the guide to hybrid characteristics.

Page 520

In the table 'Guide to grain sorghum characteristics' the Hyland Seed Company's varieties Trojan and 4X8 are listed under 'reaction to SCM virus' as M.

These varieties, Trojan and 4X8, should be listed as R.

Deciding when to spray for macadamia flower caterpillar

THIS article describes a technique for the use of specially prepared charts to assist in deciding when to spray for macadamia flower caterpillar.

The method involves taking a sample of flower racemes one by one, examining each for the insect and then entering the running total of infested racemes on a chart. To decide whether or not to spray, the running total is compared with the decision level numbers on the chart. Sprays then only need to be applied if the insect is a problem.

Sampling charts

The charts enable a decision to be made after examining a relatively small number of racemes and such examination should not take more than 30 minutes for any one variety or block.

The macadamia flowers mainly during winter and spring (May to October) and like many tree crops, it produces more flowers than are needed for a crop. Some damage to the flowers can therefore be tolerated without loss of crop. The macadamia flower caterpillar is usually least active in winter and its development is slower at lower temperatures.

As there is not the same urgency to apply sprays in the winter as there is in spring, separate sampling charts have been prepared for use during winter and spring. The numbers in the DO NOT SPRAY and SPRAY decision level columns are based on infestations of 75 and 90% infested racemes respectively for the winter chart, and 45 and 60% of infested racemes respectively for the spring chart.

What chart to use

The change from using the WINTER SAMPLING CHART to using the SPRING SAMPLING CHART should usually be made on about 20 August. However, during a colder season or in colder localities such as on the Blackall Range the WINTER SAMPLING CHART may be safely used until early September.

Some macadamia varieties such as 'Own Choice' may have a flowering in full bloom during winter. THE SPRING SAMPLING CHART SHOULD BE USED WHEN SUCH FLOWERINGS ARE AT FULL BLOOM.

When to start sampling

Sampling for the macadamia flower caterpillar should be done fortnightly from May to mid July and then weekly until about mid September or early October when about 75% of the flowering has reached full bloom. Flowering time varies considerably depending on the variety, locality, and seasonal conditions.

While early flowers during May to mid July usually avoid heavy attacks, sampling during this period will enable detection of any exceptional outbreaks of the flower caterpillar or of minor flower pests.

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by D. A. Ironside, Entomology Branch

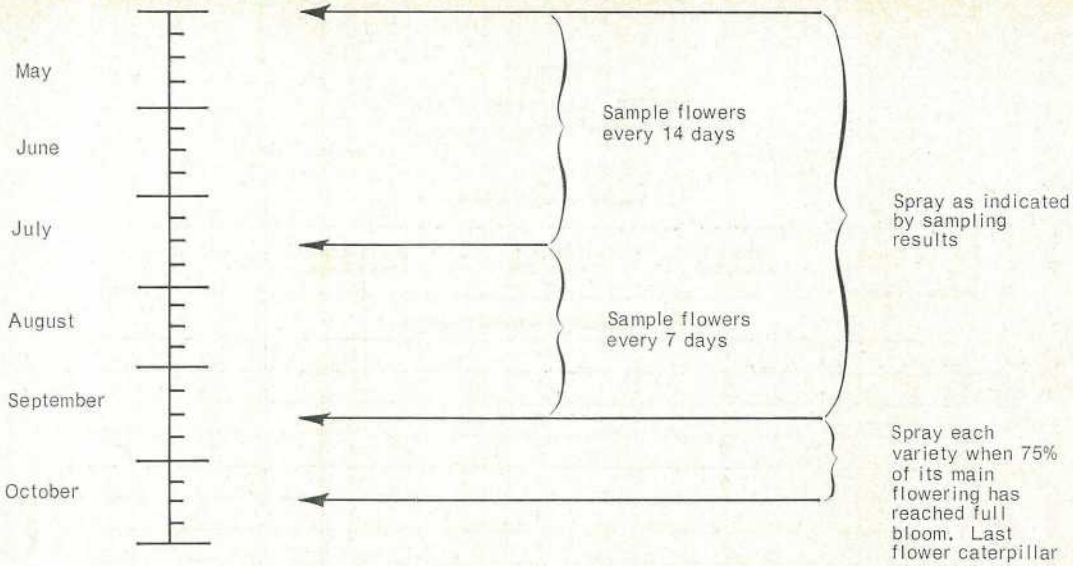

Figure 1. A summary of strategy for control of macadamia flower caterpillar.

Separate sampling for different varieties and aspects

Varieties which differ in time of flowering should be sampled separately because later flowerings are frequently subject to heavier infestations. For example, the variety Kakea (508) usually flowers 2 to 3 weeks later than Keaukou (246) and so should be sampled separately.

It is also advisable initially to take separate samples from different aspects or slopes, as the insect shows a preference for the warmer pockets in a planting during cold weather. Infestations may also be heavier on the edges of large plantings. With experience, a farmer can learn where these 'hot spots' of pest activity are likely to be. The decision to spray can then be based on the areas of highest infestation.

Identifying infested racemes

Finding the eggs is the most difficult part in sampling, but with a little practice farmers can become proficient. A hand magnifying lens (X10 units are readily available) and a X2 or X3 head-band magnifier (available from Herga & Co. Pty. Ltd., Brisbane, and also, possibly, from local watchmakers and jewellers) are of assistance in recognizing the eggs. Using the latter leaves both hands free to hold the raceme while it is being examined.

The egg of the macadamia flower caterpillar is oval and its average size is 0·5 x 0·3 mm (less than half the size of a pin head). It is white when first laid and becomes yellow with the brown head of the larva visible before hatching. Eggs are laid singly or in groups of two or three anywhere on the buds or the raceme's stem and they are often hidden beneath the small bracts between adjacent bud stalks.

A drop of sap on the side of a bud often indicates the point at which a larva has entered. The edges of the tiny entry hole soon become brown and fine larval excrement may protrude from it. Older larvae feed outside the buds and festoon the raceme with webbing, excrement and the remains of damaged buds.

Sampling

Commence sampling during the early stage of bud development when the buds, excluding the stalk, are about 2 mm long. It is important particularly during spring to continue to sample every 7 days until full bloom is passed. If sampling is stopped prior to full bloom, a heavy egg laying may occur undetected and result in considerable damage to the flowers.

TABLE 1

WINTER SAMPLING CHART

MACADAMIA FLOWER CATERPILLAR

DAY: MONDAY DATE: 18 AUGUST 1980

DO NOT SPRAY Decision Levels (75%)	Variety or Block Sampled: Block 1 Var. 508	Block 1 Var. 246	North Ridge Own Choice	SPRAY Decision Levels (90%)
	Running Total of Infested Racemes			
—	0	1	1	—
—	0	1	2	—
0	0	2	3	—
1	0	3	4	—
2	0	3	5	—
3	1	4	6	—
4	1	5	7	—
5	2	6	7	—
6	3	7	8	—
6	←4	8	9	10
7		8	10	11
8		9	10	12
9		10	11	13
10		11	12	14
11		12	13	15
11		12	13	15
12	←	←12	14	16
13			15	17
14			16	18
15			17	19
16			18	20
16			19	20
17			20	21
18			21	22
19			22	23
20			23	24
21			24	25
21			25→	25
22				26
23				27
Decision	No Spray	No Spray	Spray	

When running total equals or is less than this column the decision is DO NOT SPRAY

When the running total equals or is greater than this column the decision is SPRAY

Winter and spring sampling charts for use in macadamia orchards may be obtained from Department of Primary Industries' district offices.

TABLE 2

WHAT INSECTICIDES TO USE

Chemical	Some Commercial Products	Rate of specified products per 100 litres
Acephate,	Orthene 750 g/kg	100 g
Endosulfan,	Endosan, Thiodan each 350 g/L	150 mL
or		
Trichlorphon	Klorfon 600 g/L	85 mL

One to two racemes per tree, up to a maximum of 30 racemes from 15 to 30 trees should be taken randomly and examined. A raceme should be counted as 'infested' if even ONE flower caterpillar egg or any sign of larval activity is detected.

As each raceme is examined enter the running total of infested racemes as shown in the attached chart. If a raceme is infested add one (1) to the running total and if it is not infested enter the running total unchanged.

Continue to sample until a decision is made. Less racemes have to be examined when the infestation is either very high or very low.

How to decide when to spray or not to spray

The winter sampling chart (table 1) has been filled in to give different examples.

(1). At least 10 racemes should always be examined before a decision is made (that is, the running total of infested racemes should reach the broken line across the chart).

(2). Then as each running total is entered, compare it with the numbers in the same row of the decision level columns on the left hand and right hand sides of the chart.

(3) a. When the running total equals or is less than the number in the DO NOT SPRAY column on the left hand side of the chart, stop sampling, the decision is NOT TO SPRAY this week.

b. When the running total equals or is greater than the number in the SPRAY column on the right hand side of the chart, stop sampling, the decision is to SPRAY.

(4). Should the bottom of the chart (30 racemes be reached, sampling stops and you make a decision. The decision then during the winter should be NOT TO SPRAY this week, unless flowering is at full bloom, and during the spring the decision should be to SPRAY.

Spraying at full bloom

Irrespective of spray decisions made on the basis of the chart, it is advisable to apply one spray as an insurance when at least 75% of the main flowering has reached full bloom, since that is often the time of heaviest infestation. This will be the last flower caterpillar spray for the season and sometimes it will be the only spray applied. It will also help control fruit spotting bug or banana spotting bug.

Other comments on spraying

In South-eastern Queensland, spraying for flower caterpillar is usually not needed before late August to early September. Sustained attacks, however, sometimes require sprays at 14 to 21 day intervals during cold weather and at 10 to 14 day intervals during spring. The incidence of other pests such as red-shouldered leaf beetle, lacebug, hairyline blue butterfly or black citrus aphid may occasionally necessitate spraying.

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Some diseases of important agricultural pests

AMONG the natural enemies of many of our serious insect pests are disease micro-organisms. A number of the resultant diseases are capable of causing heavy mortality, with minimal disruption to the other forms of natural control, when damaging pest populations build up.

Visible evidence of disease often indicates that the pest will be controlled naturally on the crop without additional insecticide treatment. Hence, it can pay the grower to be aware of the diseases when they occur. But detection often requires careful inspection as evidence is often short-lived, or is not obvious to the casual observer. Some examples of insect diseases are given:

Heliothis nuclear polyhedrosis (NP) virus disease

This occurs commonly in populations of *Heliothis* on sorghum, lucerne and peanuts and other crops. Infected insects tend to go to the top of the plant and break down, liberating a sticky virus-laden fluid. A commercial preparation of the virus from the United States is being tested on cotton, sorghum and navy beans in Queensland.

Pasture grub milky disease

This occurs naturally in pasture grubs in soil in Australia, and is caused by a bacterium which multiplies in the blood, giving the insect a milky appearance. Commercial preparations of the bacterial spores are available in the United States for use against Japanese beetle larvae—a serious, introduced pest of pastures and crops in that country.

Lucerne aphid fungus disease

This disease can bring about the collapse of blue-green aphid populations on lucerne and other pasture legumes, particularly after a period of moist, overcast weather or irrigation. This disease is spread by spores 'fired off' from infected insects.

Looper *Nomuraea rileyi* fungus disease

This fungus attacks a variety of caterpillars, including loopers, armyworms, *Heliothis* and cluster caterpillars. The infected insects become anchored to the plant and eventually covered with a green, velvety layer of spores. Like all fungal diseases, it is favoured by moisture. Studies in the United States are presently aimed at artificially initiating disease outbreaks by the fungus in caterpillar pests in soybean crops.

by R. E. Teakle, Entomology Branch.

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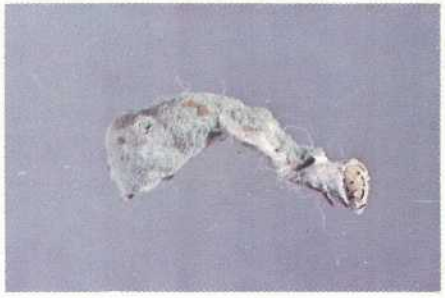
Natural nuclear polyhedrosis virus disease in Heliothis punctigera *on lucerne.*

Nuclear polyhedrosis virus disease in Heliothis armigera *on sorghum after spraying with a commercial virus preparation.*

Blue green aphids (Acyrthosiphon kondoi) *on lucerne. Brown individual is infected with* Entomophthora *sp. fungus disease.*



UPPER—Milky disease in pasture grub (Rhopaea *sp.), flanked by healthy pasture grubs. CENTRE—* Entomophthora *sp. fungus-killed aphids on the underside of white clover leaf. LOWER—*Nomuraea rileyi *fungus disease in green looper* (Chrysodiexis eriosoma) *from soybean.*