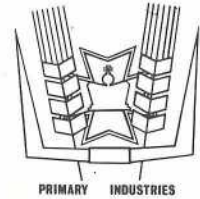


Queensland
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JOURNAL**

MARCH-APRIL 1975 Vol. 101 No. 2



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*This delightful orchid is believed to be a subspecies of **Cymbidium tracyanum**. It was flowering last spring, in the open, in Mr. S.B. Watkins' Toowong garden.*

Acting Editor: D.K. WHEATLEY

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OXLEY . . .



a new wheat variety for Qld.

By J. R. SYME (University of Qld.)
and

D. P. LAW, R. G. REES, R. W. KINGSTON, G. A. THOMAS
(Queensland Department of Primary Industries)

A NEW mid-season wheat variety, the first to come from the Queensland wheat Research Institute's breeding programme, combines high yield with prime hard quality.

The above picture shows Mr Tony Elliott, Mr John Harbison, Dr Jim Syme and Mr Rob Rees inspecting a crop of Oxley wheat growing on Mr Elliott's property at Jondaryan Homestead.

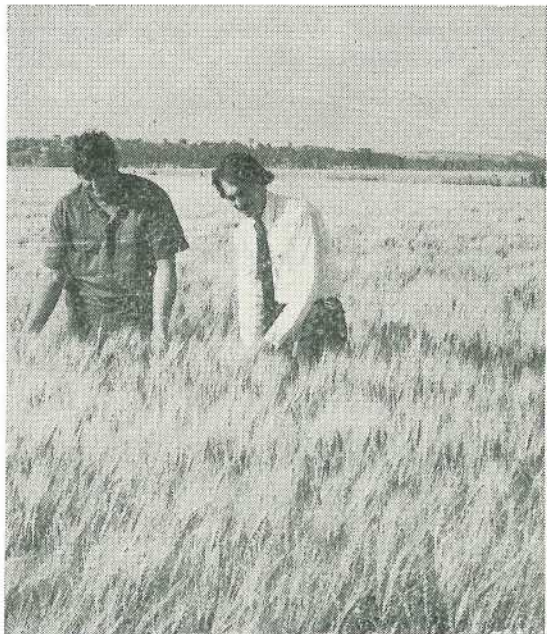
OXLEY is a new mid-season wheat variety from the Queensland Wheat Research Institute, Toowoomba. It was released jointly in 1974 by the University of Queensland and the Department of Primary Industries.

The initial breeding was started by Dr. Syme at the Agricultural Research Institute, Wagga Wagga in 1967, and the selection and testing of the variety was carried out in Queensland.

It has been named after John Oxley, who first explored the Brisbane River 150 years ago.

Mexican parentage

A feature of the variety is its high grain yield, derived from its Mexican semidwarf parentage*. Semidwarf is a term applied to short-stemmed varieties derived from the Japanese wheat Norin 10, first developed commercially in Washington State, U.S.A. This



Mr John Proud and Dr Jim Syme inspect a crop of Oxley on Mr Proud's property near Oakey.

*The pedigree of Oxley is WW80/2*WW15, the two parents being accessions to the Agricultural Research Institute, Wagga Wagga, N.S.W. The pedigree of WW15 is Lerma Rojo/Norin 10-Brevor 14/ /3*Andes, and that of WW80 is Penjamo 62/4*Gabo 56/ /Teszno Pinto Precose/Nainari 60.



Heads of Oxley

character has been used extensively in the massive breeding programme of the International Wheat and Maize Improvement Centre (CIMMYT) in Mexico, from which the parents of Oxley were obtained. Varieties from this Centre were the starting point of the increase in wheat yields often known as the "green revolution" which has occurred in many countries of the world.

Prime hard quality

In Oxley, high yield has been combined with prime hard quality, as shown in Table 1, which summarises the results of Departmental mid-season variety trials in 1973 and 1974. Its test weight, milling yield and baking quality per unit of protein are excellent. Protein percentage is lower than in the other mid-season varieties Tarsa and Festiguay, but within the range of other commercial prime hard varieties. Flour water absorption is lower than ideal, but higher than in variety Spica.

Disease resistance

Oxley possesses the stem rust resistance genes *Sr 5*, *Sr 6*, *Sr 8*, and *Sr 9b*, and when released in June 1974, was to our knowledge resistant to all field races of stem rust in Queensland. New races of rust are continually evolving in the field and single isolates of two races with virulence on Oxley have been reported subsequently from the grass *Agropyron scabrum*. It is anticipated that stem rust may occur on Oxley in the future either through the survival of one of these races, or through the development of other virulent races. Against this eventuality work is in progress at the Wheat Research Institute to incorporate additional genes for resistance in a future release.

Oxley has useful resistance to some races of leaf rust, and a good level of resistance to flag smut.

Maturity time

The maturity (based on flowering time) of Oxley is mid-season, similar to Tarsa, but earlier than Festiguay. This is because Oxley

has a moderate cold requirement, which if not satisfied, delays its development.

This delay mechanism can be an advantage in an early planted crop by reducing the risk of frost damage. However, in a very late planting it will increase the risk of heat and moisture stress and the possibility of stem rust infection through reduced effectiveness of the *Sr 6* gene or development of a new race.

Consequently Oxley can be planted a little earlier than quick-maturing varieties, but it is less suited to late planting or to areas with a short, warm growing season such as in Central Queensland.

Agronomic characters

Other agronomic features of the variety include its better resistance to lodging due to its shorter straw, and its high tillering capacity under favourable conditions. It is not susceptible to shedding before harvest, and it is generally found to be a very free threshing

OXLEY WHEAT—Head and grain of the new variety.

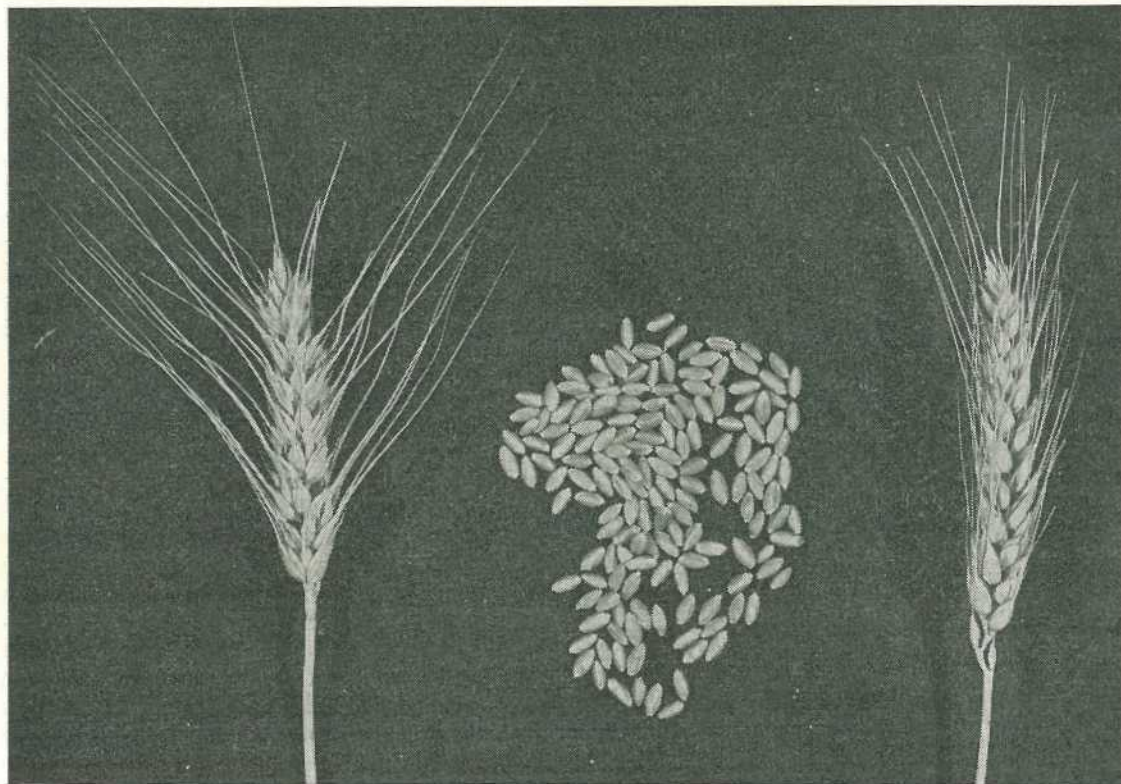
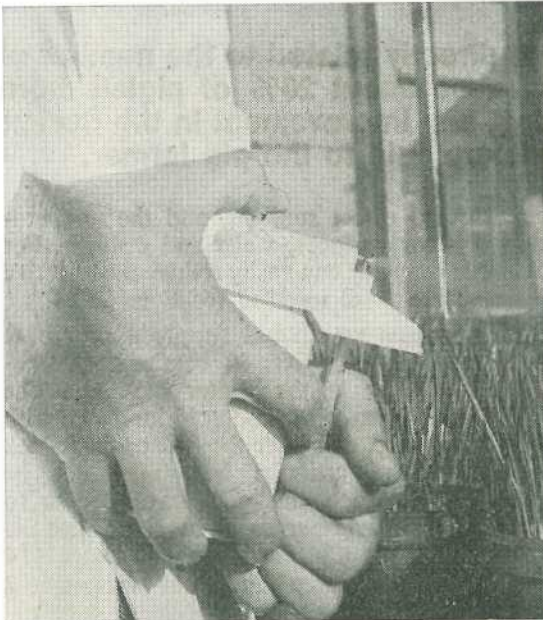


TABLE 1

GRAIN YIELD AND QUALITY IN QUEENSLAND MID-SEASON WHEAT VARIETY TRIALS (KINGSTON, THOMAS AND LAW, UNPUBLISHED)

Variety	Grain Yield		Test Weight	Grain Protein	Flour Yield	Loaf Volume	Baking Score
	1973	1974					
	t/ha	t/ha	kg/hl	%	%	cc	
Oxley	2.54	3.52	75.9	11.9	70.3	708	31
Tarsa	1.87	3.01	73.5	13.0	67.8	737	34
Festiguay	1.62	3.06	72.5	12.9	63.8	682	31

Yield data the mean of 7 sites in 1973 and 12 sites in 1974, quality data the mean of six sites in 1973.



LEFT—Testing rust resistance of breeding programme material by inoculating seedlings with rust spores.

BELOW LEFT—Measuring the volume of pup-loaves made from test baking of wheat breeder's lines.

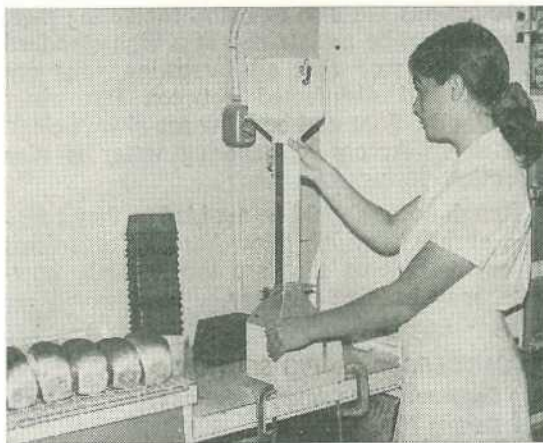
wheat which is readily harvested. The heads are awned and consequently not suitable for grazing after ear emergence.

Morphological characters

Early vegetative growth of Oxley is semi-prostrate, with strong tillering. Leaf blades are smooth and slightly glaucous, with hairy auricles. The straw at maturity is fine and short, approximately 15cm shorter than that of Tarsa. The fully awned heads are square and slightly curved with smooth white chaff. The grain is white and translucent, slightly angular and rather long.

Conclusion

In spite of the probability that a field race of stem rust virulent on Oxley may become prevalent in the near future, the variety has advantages over the other rust susceptible, mid-season varieties, Tarsa and Festiguay. It should play a useful role in helping to increase the level of efficiency of production in the Queensland wheat industry.



In our MAY-JUNE issue we will present a special lift-out feature on wheat growing in Queensland, to bring farmers up-to-date research information, compiled by officers of the D.P.I.

The sow and litter . . .

correct housing means more money

THE profitability of any pig enterprise is directly related to the number of pigs reared per sow per year; and because about 20% of piglets born alive die between farrowing and weaning, any improvement in the design of farrowing pens will represent a monetary gain to the pig farmer.

In most baconer units an increase of 0.6 pigs reared per sow per year has the same effect on profit as an increase of 1 cent per kilogram of pigmeat produced (1.3 pigs per sow per year is equivalent to 1 cent per pound). To achieve satisfactory results, facilities that satisfy the needs of the litter, the sow, and the farmer are essential.

While this article discusses the subject in a general manner, it should always be remembered that each case should be looked at on its individual merits.

Basic Requirements

The Litter

At birth, conserving body heat is a critical problem. This is due to 3 basic factors:

- the baby pig has virtually no subcutaneous fat,
- it has a sparse coat, and
- it has a large surface area from which to lose body heat compared with its volume.

For the first 3 to 5 days of life piglets require an effective temperature of from 24° C to 29° C (75° F to 85° F). Effective temperature takes into consideration not only the air temperature as measured by a thermometer, but also draughts, relative humidity,

exposure to direct sunlight, and the temperature of floor surfaces, walls and ceilings. For example draughts can easily reduce the effective temperature 3° C to 5° C (6° F to 9° F).

This means we should supply a source of artificial heat to piglets in southern Queensland, especially in the winter months. The piglets' ability to withstand cold increases with weight and age, and after the first critical week the source of artificial heat may not be essential, provided the pigs have access to straw bedding, bag frames, or both. At birth the heat output of a piglet is only 4 watts (14 BTU/hr) but is three times that amount at 2 weeks.

Besides the effective temperature, hygienic surroundings are also essential for young pigs. Hygiene can be maintained at a high standard by making sure that all farrowing pens are cleaned and disinfected between farrowings and that the floor and bedding are always clean and dry. Access to drinking water is also essential.

Rough floors should be avoided as they cause skin abrasions which allow harmful organisms to enter. Floors that are too smooth, however, may become slippery.

*By OFFICERS of the PIG SECTION,
Department of Primary Industries,
Darling Downs Region.*

The sow

Because of a greater thickness of subcutaneous fat, and their smaller surface area to volume ratio, adult pigs can comfortably withstand much lower temperatures than piglets. However, these changes in body shape and composition restrict heat loss from the body to the environment with the result that sows may suffer from heat stress at high temperatures. Generally sows are comfortable at temperatures of $21^{\circ}\text{C} \pm 3^{\circ}\text{C}$ ($70^{\circ}\text{F} \pm 5^{\circ}\text{F}$).

Therefore, the ideal temperature for the sow is not the same as that for the piglet. This can easily be overcome by having an overall shed temperature to suit the sows and a micro-climate to suit the piglets by providing a warm creep area.

As well as temperature, ventilation is also important in the farrowing house. In winter, when the farrowing house is shut up to conserve heat, a minimum air flow of $1.0\text{ m}^3/\text{min}$ (35 cubic feet per minute) through the shed should be provided for every sow and litter housed. This flow is the minimum required to remove both excess gases and water respired by the pigs, and so prevent condensation. In summer, a flow of air is needed to remove both the heat input to the shed from solar radiation and the heat given off by the pigs. Because it is absorbing heat, the temperature of the air will rise as it passes through the shed. In order to minimise this rise, the flow should be as large as possible without causing excessive draughts.

Adequate drinking water is essential. Most sows will need about 20 litres (4 to 5 gallons) of cool, fresh drinking water daily for optimum performance. It is important that drinking appliances be designed in such a way that drinker spillage and fouling of water are kept to a minimum.

The Operator

He must be able to handle the sow and her litter single handed for such operations as teeth cutting, tail docking, ear notching and occasional medication, so he deserves congenial working conditions. He must be able to move sows into farrowing crates with a minimum of fuss, and the daily routine of feeding should be made as simple as possible.

If all these things are kept in mind while planning new farrowing accommodation, more time can be devoted to reducing piglet mortalities during the first week of life.

Every owner should aim at providing facilities that satisfy the above requirements at minimum cost. Each \$100 spent per farrowing pen represents approximately 0.5c per kg (0.25c per lb.) of pig meat produced i.e. over \$2/litter.

Getting Basic Requirements

Insulation

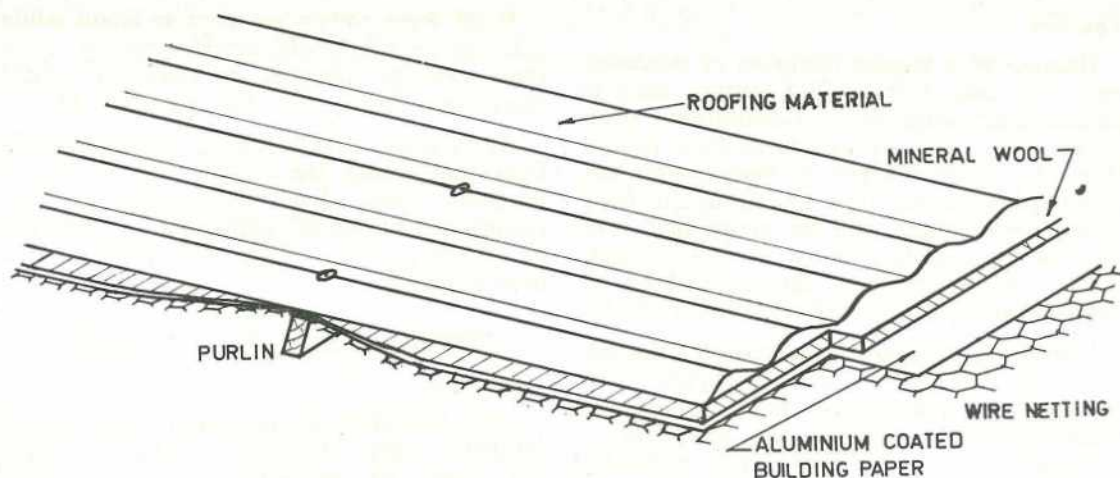
Roof insulation is particularly important in farrowing units. In winter most of the heat lost from an uninsulated piggery passes through the roof, and in summer the largest heat input to the building comes from solar radiation on the roof.

Roofs can be insulated with many materials, but from experience, 2.5 cm (1 in.) of expanded polystyrene or 5 cm (2 in.) of glass wool have proved effective. It is essential to incorporate a vapour barrier, such as building paper with aluminium foil on one side, to prevent moisture inside the building from passing through the insulant. The moisture would condense on the roofing material and wet the insulant, so reducing its effectiveness.

Most insulating materials are subject to damage by rodents, and so it is desirable to seal the space containing the insulant. Glass wool appears to have some resistance to this type of damage.

After the roof, the next most important outlet for heat is through the shutters and walls. Shutters can be insulated successfully by making them a sandwich of expanded polystyrene between two sheets of flat iron or asbestos-cement. Walls may or may not need to be insulated depending on what material is used for their construction. A "sandwich" sheet of polystyrene between two sheets of asbestos-cement is an effective well insulated wall and is easy to construct.

As a general rule it is not necessary to insulate concrete floors as the earth itself is a good insulator, but it is advisable to have a moisture barrier under the concrete. A sheet of .1 mm thick polythene is adequate.



Installation of insulation using glass wool and a vapour barrier.

Ventilation

To make maximum use of natural ventilation in summer, the walls of the farrowing shed should have insulated shutters all along both sides and ends from 1 m (3 ft.) above the floor to the eaves. This allows an unrestricted air flow across the shed. As a general rule, ridge ventilation is necessary in any shed that is more than two pens wide. The ventilation ridge should also have adjustable insulated shutters.

For economic reasons it is desirable to use natural ventilation where possible. An 8 km/h (5 m.p.h.) breeze (fast walking speed) is equivalent to an air flow of about 150 m³/min (5,000 cubic feet per minute) per sow and litter in a two row shed. To provide the same ventilation artificially requires a 60 cm (24 in.) diameter fan driven by a 500 watt motor for every sow and litter.

In winter, an air flow of at least 1.0 m³/min (35 cubic feet per minute) per sow and litter is required. Shutters can be adjusted to try to maintain this rate, but control is difficult. Too much ventilation causes unnecessary heat loss and too little allows moisture and gases to accumulate in the shed. To be sure of getting this correct flow, a fan of the right size should be installed. For example, the fan used in a space heater is often sufficient as long as fresh air is continuously drawn into the building.

Heating

Creep heating

The cheapest method of creep heating is to conserve body heat. This can be achieved effectively by using bag frames, and/or straw bedding in the creep area. However, during the first week of life some artificial heat may be needed, particularly in winter.

Both electric and gas heaters are used as sources of artificial heat. There are three types of electric heaters:

- bar or element heaters,
- infra red heaters, and
- under-floor resistance wires.

Infra red lights are prone to breakage and although their initial cost is cheap, continual replacement may offset this advantage. Under-floor heating has no light associated with it and the piglets may not be attracted to the warm creep area. On the other hand, the tariff may be cheaper than for the other two types.

Gas heating can be used where no electricity is available, and in some areas may be cheaper per unit of heat than electricity. When comparing the relative prices of the two the following conversion can be used:

- 1 kg of gas is equivalent to 14.1 units (kWh) of electricity.
- 1 lb of gas is equivalent to 6.4 units (kWh) of electricity.

Hover boards can be incorporated to cover the creep area if the overall shed temperature is considered below the optimum for piglets. Bag frames are now widely used as they give protection from cold floors and draughts, and so provide a very snug microclimate for the litter. Objections have been raised on the grounds of disease risk, but these can be kept to a minimum.

Space heating

In this system, the temperature of the whole farrowing room is maintained at a constant level by a furnace, usually oil fired. The temperature may be kept at about 27° C (80° F) suitable for the comfort of the litter, and although this may be above the optimum for the sow she does not appear to show signs of heat stress. Alternatively the overall temperature may be maintained at about 21° C (70° F) for the comfort of the sow. Under these circumstances some form of extra creep heating is needed.

Space heated sheds must be insulated to minimise heat losses. However as the whole shed is heated, the heat required may be greater than for individual creep heaters. When comparing oil and gas heaters of the same efficiency (about 75%) the conversion is as follows:

- 1 litre of heating oil is equivalent to 0.7 kg gas.
- 1 gallon of heating oil is equivalent to 7 lb gas.

Water

As mentioned earlier most sows need about 20 litres (4 to 5 gallons) of drinking water per day. This can be supplied by nipples, bowls, or simply by hand watering in the feeding trough. Whichever method of watering is used it is most important to avoid spillage on the floor of the farrowing pen. There are several methods which can effectively reduce spillage.

Lighting

No special requirements have yet been established for lighting, but adequate light should be provided for inspection purposes. It is an advantage to make maximum use of natural light.

PEN DESIGNS

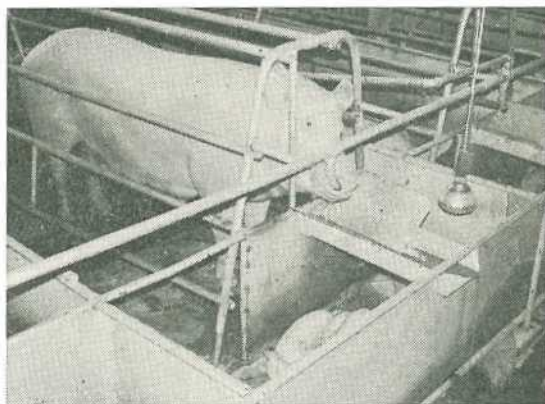
Solid floor farrowing pens

These are the cheapest to construct, and as long as the bedding is kept dry, they provide the most suitable environment for farrowing. However considerable labour is needed to maintain clean dry bedding. Because of this it is desirable to move to a sow and litter pen before the piglets are one week old. A suitable pen would be 215 cm x 150 cm (7 ft. x 5ft.) with a floor slope of 1 in 25 and a 60 cm (2 ft.) wide crate set 38 cm (15 in.) from one side. This allows a 52 cm (21 in.) wide area on the other side of the crate where artificial heat may be provided.

Partly slatted farrowing pens

Pens in which the crate is at right angles to the passage should be 215 cm (7 ft.) long and 150 cm to 185 cm (5 ft. to 6 ft.) wide depending on whether the sow and litter will remain there beyond two weeks of age. In either case the crate should be 38 cm (15 in.) from one side partition.

Minimum width of the slatted floor section is 1 m (39 in.) and this should be of mesh. Slope on the solid floor section should be 1 in 25. The main criticism of partly slatted pens is that it is difficult to design them so that drinker spillage does not wet the floor.



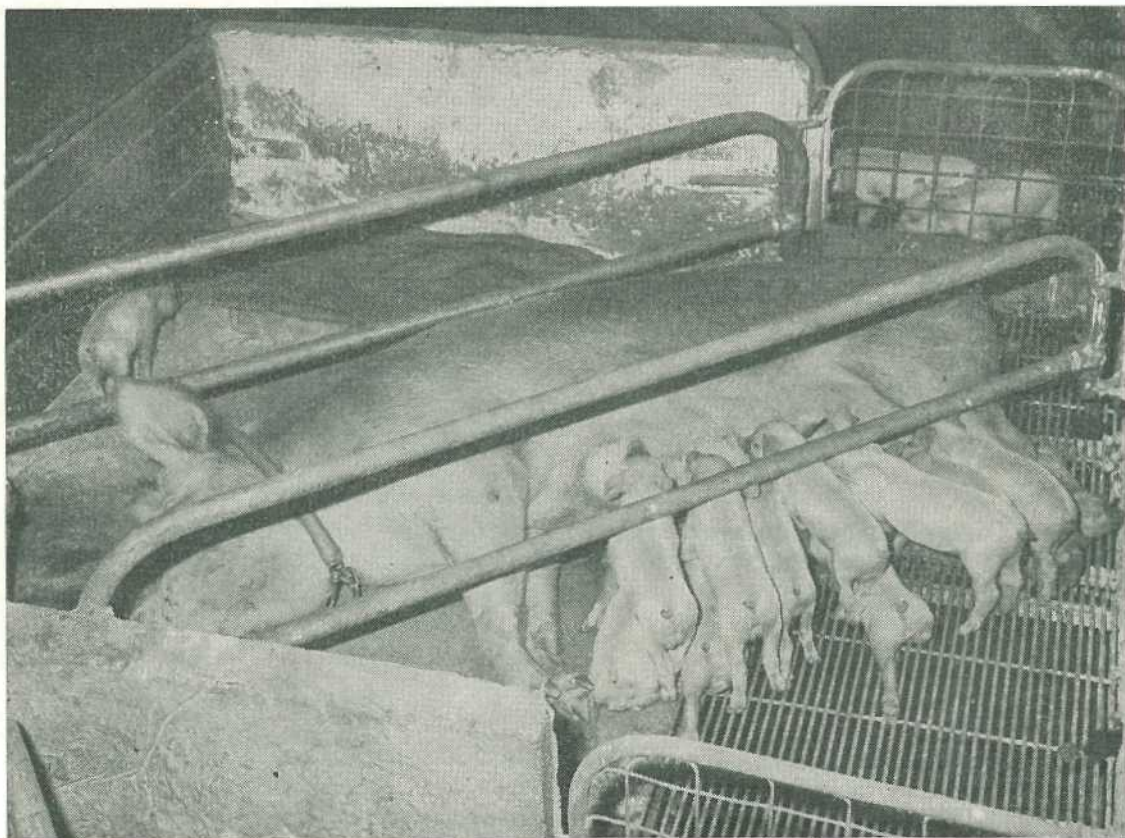
One novel method for preventing drinker spillage from wetting the floor of farrowing pens.

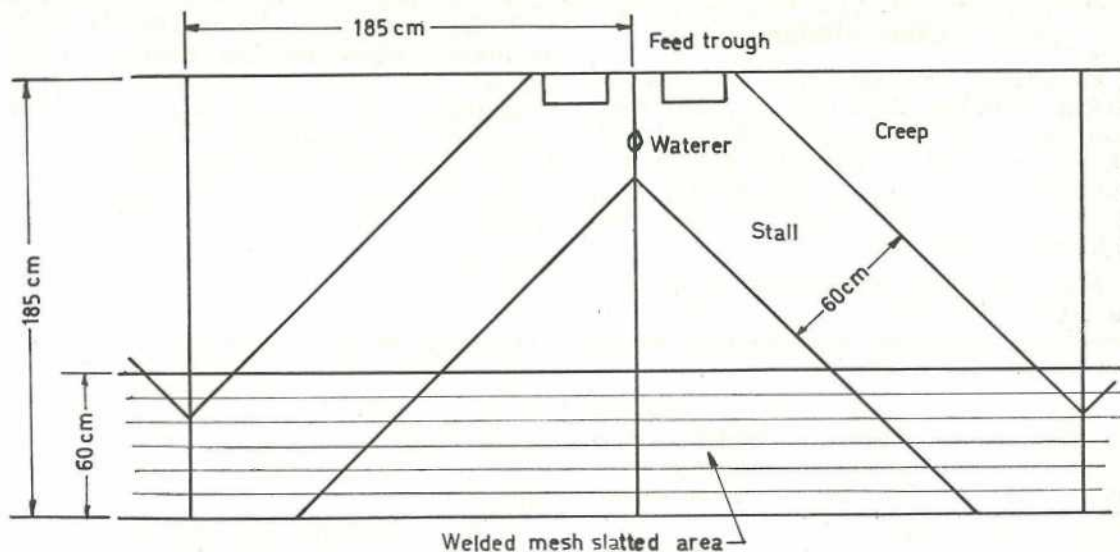
Pens in which the crate is set diagonally across a 185 cm x 185 cm (6 ft. x 6 ft.) partly slatted pen are proving popular. This design is suitable for farrowing and housing the sow and litter for five weeks after farrowing. A 60 cm (2 ft.) wide slatted area is sufficient and should be of mesh. The slope of 1 in 25 in the concrete floor area drains drinker spillage away from the creep area which is the highest corner between sow and feed passage. Piglets may be difficult to catch on the far side of the sow if she is freestanding in a high crate. This problem can be overcome by tethering the sow and using low farrowing rails.

Fully slatted farrowing pens

These have proved quite satisfactory in sheds that have adequate insulation and artificial heat. Size and layout are the same as for partly slatted pens. Drinker spillage is less of a problem. It is desirable to have a minimum of 70 cm (2 ft. 6 in.) of steel mesh flooring at the rear of the pen with the remainder of the floor made of 15 cm x 2.5 cm (6 in x 1 in.) ironbark spaced at 1.0 cm ($\frac{3}{8}$ in.). This type of pen has given excellent results when the whole shed is space heated.

A partly slatted, zig-zag farrowing pen. Note the tethered sow and the low rails and walls.





Zig-zag farrowing pens.

Slippery floors are sometimes a problem for sows and especially for piglets with leg weakness. This may be overcome by 15 cm x 15 cm (6 in. x 6 in.) welded mesh or timber cleats on the floor. Because of the larger trench area there is a greater risk of problems resulting from poor trench design and management.

Suckling pens

These pens are used in conjunction with either specialized farrowing sheds or solid floor pens with straw bedding. Probably the best design is 215 cm x 215 cm (7 ft. x 7 ft.) fully slatted with 10 cm x 2.5 cm (4 in. x 1 in.) ironbark spaced 1.5 cm ($\frac{5}{8}$ in.) apart; a full gate front with trough attached is fitted. 45 cm (18 in.) of the trough is for the sow while the remaining 170 cm (5 ft. 6 in.) is designed for creep feeding. The 215 cm x 185 cm (7 ft. x 6 ft.) partly slatted pens described above can also be used as suckling pens.

Grower pens are sometimes adapted for suckling, e.g. 240 cm x 240 cm (8 ft. x 8 ft.) full slat or 215 cm x 330 cm (7 ft. x 11 ft.) partly slatted facilities. In some instances the larger pens are used for multi-suckling. Two sows and their litters can be housed successfully

in most baconer pens. The difference in age of the litters should be less than one week (preferably no more than a day or so) and the two sows should be placed together in the pen 1 to 2 hours before the litters are put in with them.

A farrowing pen fully slatted with wire mesh and timber. Note the young pigs huddled in the bag frame.



Crate Design

Most crates are 215 cm (7 ft.) long and 60 cm to 68 cm (2 ft. to 2 ft. 3 in.) wide, sometimes with width and height adjustment. Designs which are wider at the bottom than the top appear most satisfactory. Provision should be made to prevent a restless sow climbing out the top.

Minimum height from floor to top of crate is 100 cm (3 ft. 3 in.). In a crate that is not adjustable, the height from floor to bottom rail should be 20 cm (8 in.).

Rear Entry Crates are the most convenient to operate and probably the simplest to construct, but they usually mean a larger floor area for the building and a greater volume of air to heat in winter.

Side Entry Crates are quite satisfactory and widely used. They generally result in a building that is cheaper to construct and also requires a little less to heat.

Tethering of sows for suckling is most satisfactory when they are tethered in the dry sow house as well, although it has been used successfully without this. The chief advantage is a reduction in housing costs due to the simple crate that is required. This also makes both the sow and her litter more readily accessible.

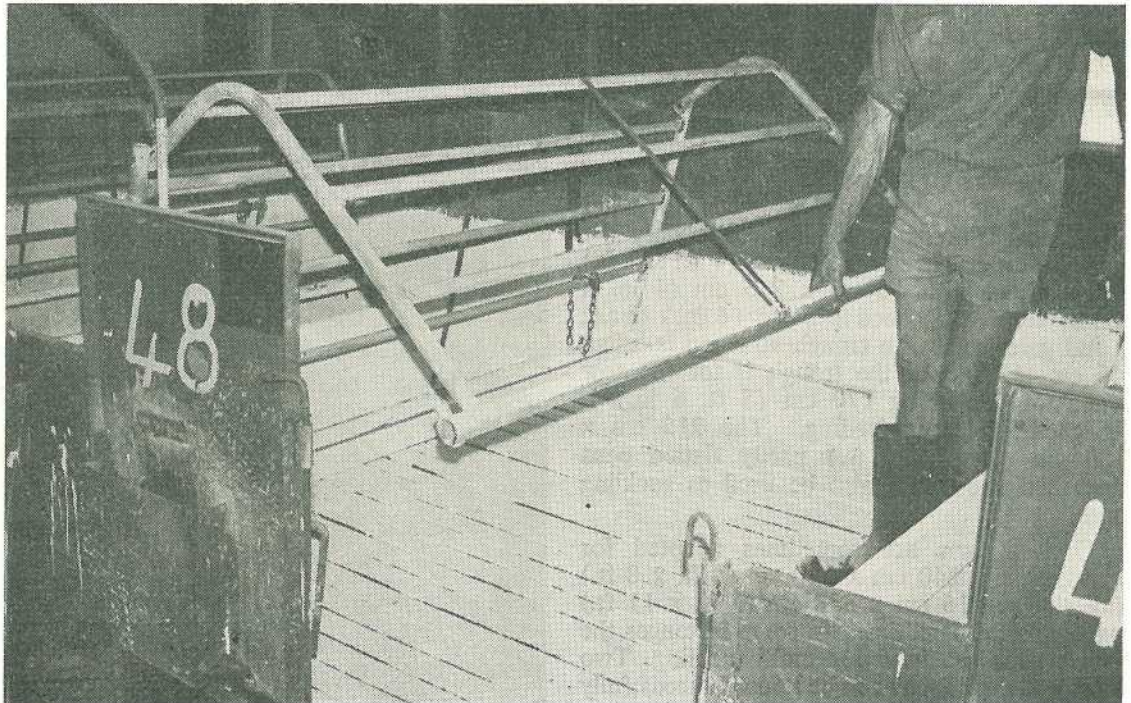
Shed Design

Site.

Probably the most important part of shed design is the site for the farrowing shed. Before selecting a suitable site, proximity to the house, all weather road, suitable water supply, good foundation soil, future expansion, and council by-laws should be considered.

In Queensland the long axis of the shed should run from east to west and ventilation ridges should face north. This takes maximum advantage of warm sunlight and protection from cold winds.

A side-entry fully-slatted farrowing crate: space saving yet easy to work.



In sloping country, it is advisable to select a position that will take maximum advantage of gravity for manure disposal. Trenches can be excavated and still allow gravity flow of effluent away from the shed. However, in flat country, it is more economical to have the bottom of the pit at ground level and build the piggery up from this.

Piggery layout.

The layout of the whole piggery has to be considered. There should be a natural flow from dry sow stalls to farrowing pens and back to mating pens with weaners going to grower pens. This does not necessarily mean separate sheds for each section of the piggery although separate walled off sections are an advantage for such things as disease and environmental control.

Despite this, in the interests of economy, many small to medium sized sheds have been constructed without any real separation of the farrowing area from other accommodation. Excellent results have been achieved where management is of a high standard.

Another aspect that has to be considered is planning the production programme. If the herd is large enough i.e. greater than 35 sows, then a batch farrowing system is recommended. The producer must decide the age of weaning, and whether to rear to weaning in the farrowing pens or move to special suckling pens.

An example of a workable batch farrowing system in a 105 sow herd is set out below. In this system 4-week weaning is practised, with farrowing batches of 5 sows each week.

Weeks		Pens Required
16	gestation	85 dry sow stalls
4	suckling	25 farrowing pens (or 12 farrowing pens and 14 nursery pens)
1	mating	6 boar and 6 sow pens
<hr/>		
21	reproductive cycle	
<hr/>		

When planning a programme extra accommodation has to be provided for sows and gilts that do not fit the cycle perfectly.

Batch farrowing may not be practicable for herds smaller than 35 sows. Minimum farrowing pen requirement would then be calculated using the following formula:

$$\frac{\text{Minimum Number of Farrowing Pens}}{\text{Weaning age in weeks} + 1} = \text{No. of sows} \times \frac{\text{Minimum length of reproductive cycle in weeks.}}{\text{Weaning age in weeks} + 1}$$

Manure trenches.

In all slatted floor farrowing units it is essential that dung and urine be removed before gas can accumulate to harmful levels. All trenches should be completely emptied regularly and the effluent must not come closer than 20 cm (8 in.) from the bottom of slats. To fulfil these requirements, large outlets are essential. Pumping direct from unagitated trenches has proved to be unsatisfactory.

A proven method is that of flat bottom pits with provision for reverse flow. Two or more pits are connected at the end opposite the outlet by a short cross trench of at least the same width as the outlets. The system of operation is that the complete system is emptied through one outlet, and at the next emptying through another. Any sediment left behind is flushed out by flow in the opposite direction at the next emptying.

An extension of this system is to connect the trenches at both ends and to put a paddle wheel in this now continuous pit. This oxygenates the water and keeps the solids in suspension in a continuously flowing stream.

Although not often built in Queensland, the deep "V" drains with side slopes of approximately 60° are reported to clean very effectively. In another system, dung and urine fall into a shallow trench about 20 cm (8 in.) deep with a fall of 1 in 40 to a full width outlet and it is flushed out daily by suddenly releasing a volume of water into the higher end of the pit. This system uses about 50 litres (10 gallons) of water per sow and litter per day.

Floors

Concrete is almost universally used for the solid part of floors. It is essential that a moisture barrier is placed under the concrete to prevent moisture rising from the earth through the concrete. The concrete must be good quality and have sufficient strength to prevent cracking. Cracks are most undesirable as they are impossible to clean and will harbour bacteria. They may also provide pathways for moisture from the earth below.

The surface finish of concrete floors must be strong and durable. The surface must not be rough enough to cause abrasions, but at the same time it should not be slippery. A suitable finish on floors made with concrete containing coarse sand can be obtained with one pass of a steel float. If a topping of very fine sand and cement is used, a wooden float can give an excellent finish. As the surface will inevitably wear under the action of pigs' feet and urine, there may be an advantage in using rounded rather than angular aggregate in the concrete, but this will be at the expense of its strength.

The slope of concrete floors and the size and spacing of wooden slats are dealt with in Section 4 on pen design.

Heavily galvanised mesh is recommended for the area immediately behind the sow in slatted pens. Three different types are used:

- 6.3 mm = (3 gauge) welded mesh with a 1 cm ($\frac{3}{8}$ in.) gap;
- 5 mm = (6 gauge) woven wire with 12 mm ($\frac{1}{2}$ in.) apertures;
- 2 mm = (14 gauge) expanded and rolled metal.

The slots in expanded metal may damage the sows teats.

Walls and Pen Divisions

The walls of a farrowing house may be made of concrete blocks, poured concrete, tilt-up concrete, timber or asbestos cement. The choice of material will depend on the total on-site cost of the completed wall, including any insulation.

It is most important that pen divisions can be easily cleaned. They should not be more than 60 cm (2 ft.) high to allow easy access by the operator. Concrete blocks and poured concrete are satisfactory, but they waste space in the building; 5 cm (2 in.) thick precast concrete is sometimes used. Fully compressed asbestos cement is an excellent but costly material for pen divisions. Steel divisions may corrode, so 15 cm x 2.5 cm (6 in. x 1 in.) hardwood mounted in vertical channels is widely used, simply constructed and effective.

Roofs

As with the rest of the piggery, farrowing house roofs may be clear-span or on supports. They may be gabled, skillion, "cranked over" and, where ridge venting is required, of the californian style. Aluminium, asbestos-cement, and "coolclad" are used for the cladding. With a fully insulated and vapour-sealed ceiling, it should not be necessary to go beyond galvanised steel.

The following officers of the Pig Section contributed to this article: P. J. Brennan, K. C. Gillies, C. R. Grieve, G. J. Hunter, C. D. Macrae and N. E. Reinbott.

TVP—Food from Soybean

CSIRO Division of Food Research, North Ryde (Sydney) is investigating the manufacture of TVP—Textured Vegetable Protein—from soybean and other Australian grown protein crops.

"It's more efficient to convert vegetable protein seeds into human food by a factory process than by feeding an animal and then killing and eating it", CSIRO states.

TVP foods have an indefinite storage life, through either refrigeration or dehydration, and there is no waste in their preparation for cooking.

Extruded TVP comes in small mince-like chunks and successful stews and casseroles are easy to make with it.

However, CSIRO reports that meat analogues (vegetable protein that looks like chicken or steak—sometimes complete with plastic bone) are beyond the scope of the present research.

Once the extruder can be operated to give reproducible results from soy flour, other Australian-grown legumes and oil seed residues can be tried: peanut, sunflower, cotton, chick pea, mung bean, perhaps even subterranean clover and lupins!

Contributed by Near North Coast Extension Services.

Pregnancy toxaemia, often called "twin lamb" disease can be fatal. This article looks at the problem, and some ways of overcoming it.



Ewe suffering from Pregnancy Toxaemia, unaware of surroundings and apparently blind.

Pregnancy Toxaemia

· by C. I. YOUNGER, Sheep and Wool Branch.

PREGNANCY toxaemia occurs in pregnant ewes where seasonal shortage of natural pasture or drought imposes nutritional stress.

The disease occurs where undernourished pregnant ewes are prevented from feeding by cold, inclement weather, or flood.

Moving pregnant ewes to a strange environment can cause outbreaks, such as when ewes are transferred from Mitchell grass downs to

mulga scrublands. Outbreaks have also been recorded where pregnant ewes have been grazing lush pastures. The cause of these outbreaks has been lack of exercise.

Nature of the Disease

The foundations are laid for an outbreak of pregnancy toxaemia as soon as ewes commence to lose body condition during the last stage of pregnancy.

During pregnancy the ewe must:

- Provide for the developing lamb or lambs she is carrying.
- Maintain her own body condition.

The lamb in the ewe's uterus develops quickly during the last two months of pregnancy, when it grows nearly 80 per cent of its birth weight. So the ewe must be fed adequately during this time.

Ewes with large twins are most susceptible and unless extra feed or good quality pasture is available during the last two months of pregnancy every ewe with twins has a chance of developing toxæmia, hence the common term "twin lamb" disease.

Wet, cold weather during late pregnancy interferes with grazing and should ewes be undernourished previously, there is a good chance of a major outbreak occurring, particularly if severe stress such as mustering, yarding, crutching or drenching is imposed.

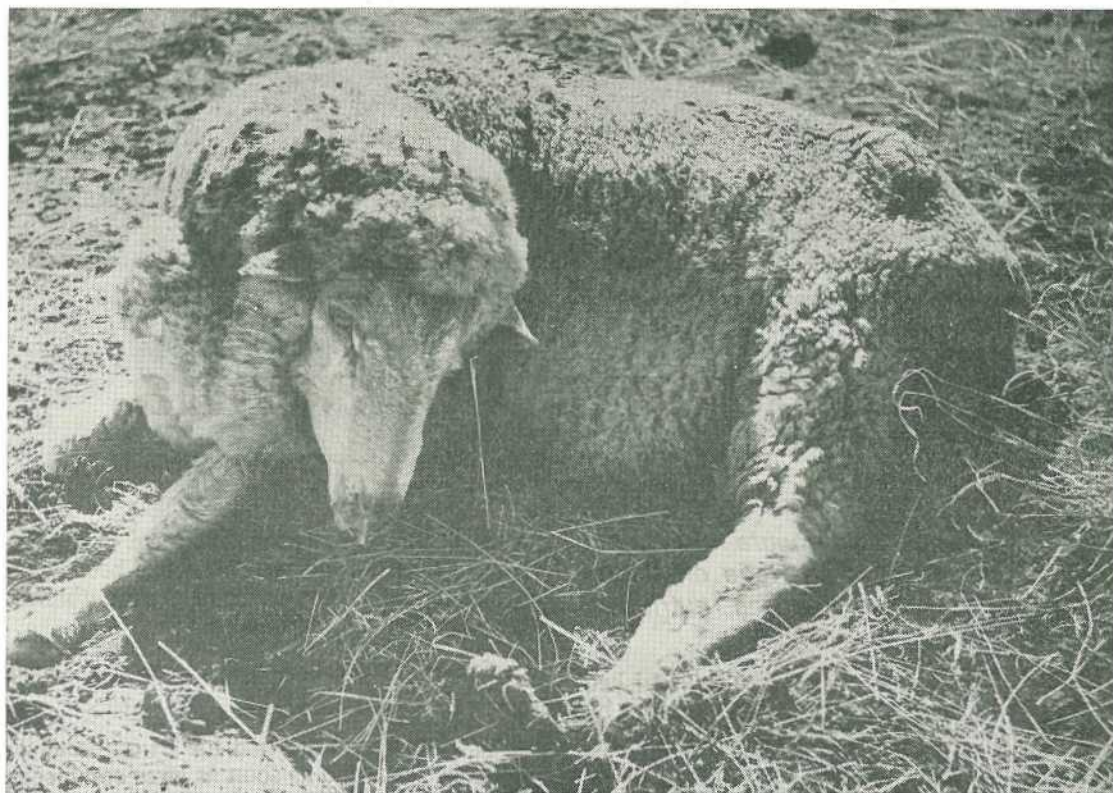
If ewes develop pregnancy toxæmia as a result of poor nutrition alone, such as a low quality Mitchell grass or a sole diet of mulga leaves, they are affected in ones and twos, as each ewe may reach the critical stage at a different time.

Internal parasites may have an important bearing on the general health of the sheep, as heavy burdens of worms affect the appetite. Consequently attention should be paid to ridding the pregnant ewes of their internal parasites during gestation.

Grass seed infestation has been suspected of causing the disease, as sheep are disinclined to move about and their grazing is seriously curtailed.

Causes

If ewes are undernourished during late pregnancy they draw upon their body reserves, and an acute deficiency of glucose or sugar in the bloodstream occurs, owing to the



Ewe showing advanced symptoms of Pregnancy Toxaemia—head beginning to turn towards the flank.

deficiency of food and the demands of twin lambs or a large, rapidly developing lamb.

Because of this fall in blood glucose or sugar, abnormal fat and carbohydrate metabolism results, leading to ketone bodies in the bloodstream. This then causes brain damage and nervous derangement and finally the ewe succumbs to pregnancy toxaemia.

Symptoms

During the early stages of the disease, symptoms are not easily detected. However, if the flock is driven, affected ewes tend to fall behind and have a rather stilted gait, with the head held high and showing slight tremors of the muscles of the face and lips.

Later the symptoms due to brain and nervous tissue damage are much in evidence. The sheep may be apparently blind, they may walk in circles, or stand sleepily in one position, with drooped head oblivious to all about them. Finally they lie down, often with the head resting on the flank. There may be yellow discharge from the nostrils and grinding of the teeth.

After two or three days they become unconscious and die.

Post-mortem Findings

At post-mortem examination, the only striking feature besides the presence of two lambs, or a well developed single lamb, in the uterus is the soft and fatty liver which is yellowish to greyish-red in colour. The carcass may be emaciated, but abdominal fat is fairly plentiful and shows white flaky or chalky patches through it, known as fat necrosis.

Diagnosis

The long course of the disease (four to five days), the presence of nervous symptoms, the fact of late pregnancy, twin lambs, and the nutritional history, all point fairly clearly to pregnancy toxaemia.

However, the disease is easily and frequently confused with milk fever or hypocalcaemia, and many ewes are lost each year because they are thought to be suffering from pregnancy toxaemia, whereas they could be saved by the injection of calcium borogluconate. Ewes suffering from pregnancy toxaemia do not respond to injections of calcium borogluconate.

Treatment

No practical treatment has been devised for ewes that have developed pregnancy toxaemia as a consequence of a long period of under-nutrition.

If a sudden outbreak of the disease occurs following stressful conditions involving a large flock, treatment with glycerine for ewes showing early symptoms is helpful. This is done by an oral dose at dose rates of 110 to 140 ml (4 to 5 oz.) of glycerine diluted with an equal quantity of water and given before brain damage occurs. Once the ewe develops well marked symptoms and later coma, there is little chance of her recovery.

Prevention

The prevention of pregnancy toxaemia is essentially a matter of good sheep husbandry. Therefore every effort should be made to:

- Feed pregnant ewes during the last 6 to eight weeks of gestation so *they gain in body condition*. Pregnant ewes should gain a minimum of 4 kg (9 lb.) during the last two months of pregnancy. Those carrying twins should gain from 7 to 8 kg (15 to 17 lb.).
- Avoid applying any stress to ewes in late pregnancy. This may mean more careful yard work; fewer dogs and greater care during mustering.

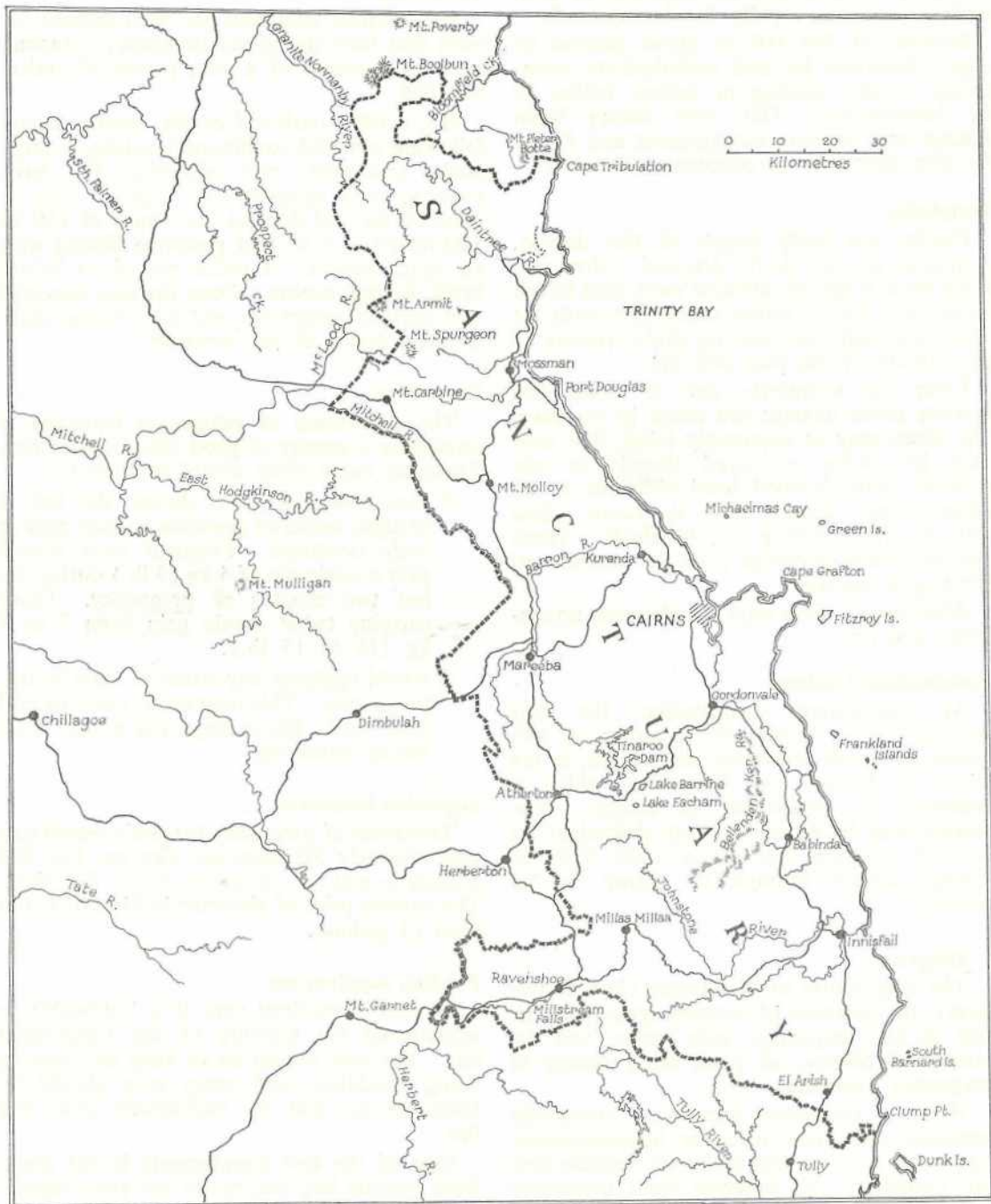
Glycerine treatment

Treatment of pregnancy toxaemia would cost approximately 50 cents per ewe per day and treatment may be necessary for a few days. The current price of glycerine is \$10.00/4.546 litres (1 gallon).

Feeding supplements

Because conditions vary it is impossible to recommend the quantity of any supplement fed. The aim should be to keep the ewes in rising condition, and every care should be taken to see that the supplement does just this.

One of the best supplements is oat grain. Both lucerne hay and maize are good supplements. However, very high levels of grain, up to 0.7 kg (1½ lb.) a day may have to be fed to stop pregnancy toxaemia occurring once it has started.



The North Queensland Coast and Atherton Tableland Fauna Sanctuary

North Queensland Coast and Atherton Tableland

FAUNA SANCTUARY

By C. M. WEAVER, Fauna Ranger

The North Queensland Coast and Atherton Tableland fauna sanctuary includes several national parks and State forest reserves together with many private properties.

The North Queensland Coast and Atherton Tableland is one of the largest and most diverse sanctuaries in Queensland.

This feature provides information on the status of fauna and flora to satisfy an increasing demand about the location of sanctuaries.

During December 1933, the Mossman District Chamber of Commerce submitted a request for the declaration of the Mossman District as a fauna sanctuary. This submission was followed by requests from individual farmers, Local Authorities and other similar organisations, for the constitution of additional areas in the north as fauna sanctuaries.

As a result of these submissions, approaches were made by the State Government to the various graziers' associations, cane growers' associations and Local Authorities in areas from Ingham in the south, to the Douglas Shire in the north. This was undertaken in order to determine from the views of these local organisations, the acceptability of declaring the entire area a fauna sanctuary. The responses were many and varied. Eventually, recommendations were submitted to declare an extensive area of the north Queensland coastal region as a fauna sanctuary.

In January 1936 an Order in Council under "The Animals and Birds Acts 1921 to 1924" proclaimed the North Queensland Coast and Atherton Tableland Fauna Sanctuary. This sanctuary comprised an approximate area of 13,092 square kilometres. Opposition to the magnitude of the proclamation resulted. Emphatic protests against the indiscriminate declaration of sanctuaries in North Queensland was voiced at a monthly meeting of a local Shire Council. Many regional newspapers also headlined the severity of such an extensive declaration and in May 1938 an Order in Council, under an updated Act "The Fauna Protection Act of 1937" was gazetted. This provided for a variation of the boundaries. The Ingham, Cardwell and Tully districts were deleted.

The present sanctuary covers an area of approximately 1,310,175 hectares. It includes the eastern divisions of the Mareeba Shire, the Ravenshoe division of the Herberton Shire together with the Shires of Johnstone, Eacham, Atherton, Douglas and Mulgrave.

The diversity and distribution of fauna is related to the geographical location of the sanctuary and to the habitat types occurring in the area.

Geographical location

Australia has been divided into three zoogeographical sub-regions. These sub-regions may be defined as geographic subdivisions of Australia that are the habitats of a peculiar fauna.

The sanctuary exists in the Torresian sub-region which includes the tropical north and north east, stretching from the Kimberlies in Western Australia to northern Queensland and extending to north eastern New South Wales.

INLAND AUSTRALIAN INFLUENCE: In addition to the geographic locality there are also affinities with inland Australian fauna. Flocks of galahs (*Cacatua roseicapilla* Vieillot), may be encountered near Mareeba and Mt. Molloy while nomadic species such as cuckoo-shrikes, and wood-swallows, may also be observed during the summer wet season.

OCEANIC, SALINE AND FRINGING REEF INFLUENCE: This occurs along the eastern extremities of the sanctuary. A variety of migratory waders such as green-shanks (*Tringa nebularia* (Gunnerus)) and black-tailed godwits (*Limosa limosa* (L.)), are common visitors to tidal flats from September to April of each year. From their major breeding grounds off the coast, such as Michaelmas Cay, sooty terns (*Sterna fuscata* L.), and caspian terns (*Hydroprogne caspia* (Pallas)) may be seen in large numbers feeding and roosting along the mainland shorelines.

NEW GUINEA INFLUENCE: Proximity to New Guinea also affects the area as evidenced by the presence of tree kangaroos and striped possums. The white-tailed kingfisher (*Tanysiptera sylvia* Gould) and the cassowary (*Casuaris casuaris* (L.)) are examples of avifauna having affinities with New Guinea fauna.

Habitat

To a wild animal, habitat means a specific kind of area in which to live, to find food, to dig a burrow or build a nest. Each is dependant on a particular habitat for its survival. Some species, such the platypus (*Ornithorhynchus anatinus* (Shaw and Nodder)), which is common in many streams on the Atherton Tableland, depend exclusively on a specific habitat type.

Others such as the common brush-tailed possum (*Trichosurus vulpecula* (Kerr)) possess abilities to adapt to a range of habitats. The normal habitat of this animal includes the open eucalypt forest; it is also commonly found in roof tops of houses in cities and towns and at night is often seen scavenging for food scraps or raiding fruit trees.

Broadly catagorised, there are seven major habitats within this sanctuary:

- 1. CLOSED FOREST (CF) including rain forests and associated soft wood timberlands.
- 2. OPEN FOREST (OF) including open eucalypt forests and other dry sclerophyll forests.
- 3. GRASSLAND (G) including artificial open grassland areas such as improved pastures. (Natural grasslands are absent from the sanctuary).
- 4. CULTIVATION (C) including crops, gardens and other similarly disturbed land.
- 5. URBAN AREAS (U) including buildings.
- 6. FRESHWATER AREAS (F) including lagoons, rivers, streams and artificial water impoundments.
- 7. SALINE AREAS (S) including salt-pans, estuaries and mangroves.

Fauna

The following list of fauna is a short guide to some mammals and birds which may be encountered in the sanctuary. No attempt is made to include all the species of the area, nor to indicate the relative abundance of each individual species; however, the habitat types in which they may be observed is given.

Most native mammals are shy and secretive by nature, some are nocturnal and therefore considerable effort and patience are required if one wishes to observe these in their natural environment.

MAMMALS

ECHIDNAS

Echidna OF *Tachyglossus aculeatus* (Shaw and Nodder)

MARSUPIAL-CARNIVORES

Brown marsupial-mouse CF .. *Antichinus stuartii* Macleay
 Little northern native-cat OF .. *Dasyurus hallucatus* (Gould)
 Tiger cat CF *Dasyurus maculatus* (Kerr)

BANDICOOTS

Long-nosed bandicoot CF .. *Perameles nasuta* Geoffroy

POSSUMS

Long-tailed pygmy possum CF .. *Cercartetus caudatus* (Milne-Edwards)
 Sugar glider OF *Petaurus breviceps* Waterhouse
 Herbert River ring-tail CF .. *Pseudocheirus herbertensis* (Collett)
 Bushy-tipped ring-tail CF .. *Hemibelideus lemuroides* (Collett)

KANGAROOS

Musk rat-kangaroo CF *Hypsiprymnodon moschatus* Ramsey
 Black-tailed wallaby OF *Wallabia bicolor* (Desmarest)
 Agile wallaby OF, C *Macropus agilis* (Gould)
 Red-legged pademelon CF .. *Thylogale stigmatica* Gould
 Eastern wallaroo OF *Macropus robustus* Gould

FLYING-FOXES

Spectacled flying-fox CF, S, OF .. *Pteropus conspicillatus* Gould
 Little red flying-fox OF *Pteropus scapulatus* Peters

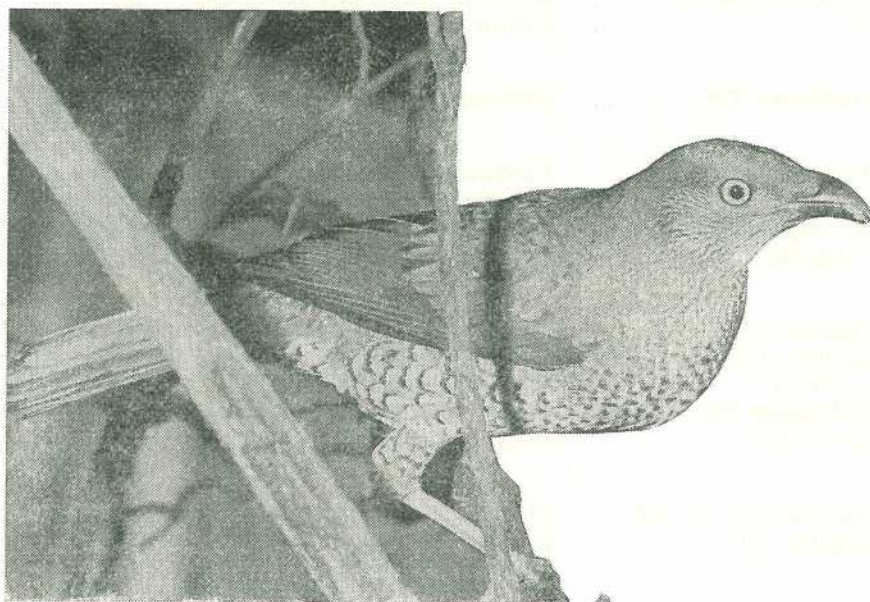
HORSESHOE BATS

Eastern horseshoe bat OF (Caves) *Rhinolophus megaphyllus* (Gray)

Shooting in the Sanctuary . . .



Etty Bay, south of Innisfail.



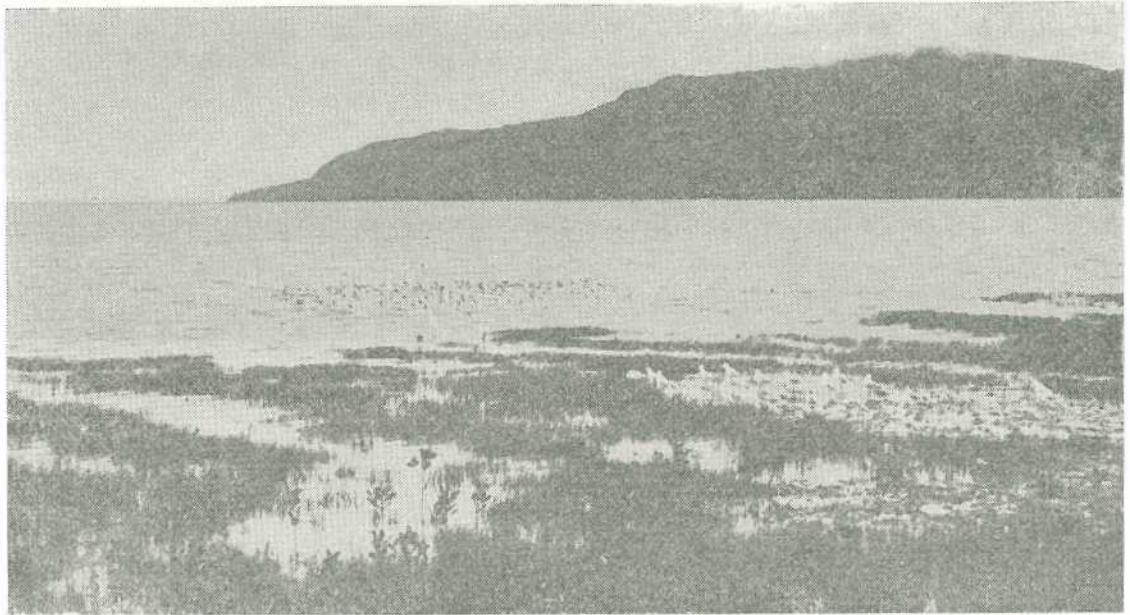
Satin bowerbird

*the
camera
brings
home
the best
trophies*



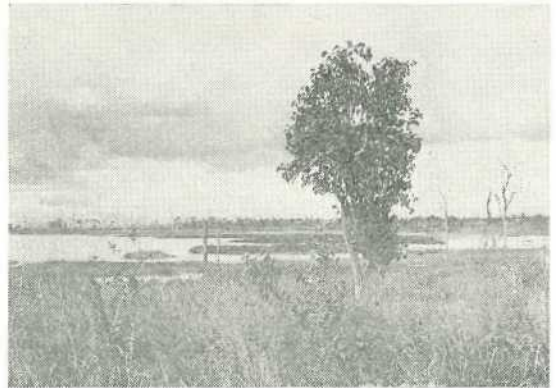
Left—An open forest habitat near Mt. Molloy; providing food and shelter for species such as the grey kangaroo (*Macropus giganteus* Shaw).

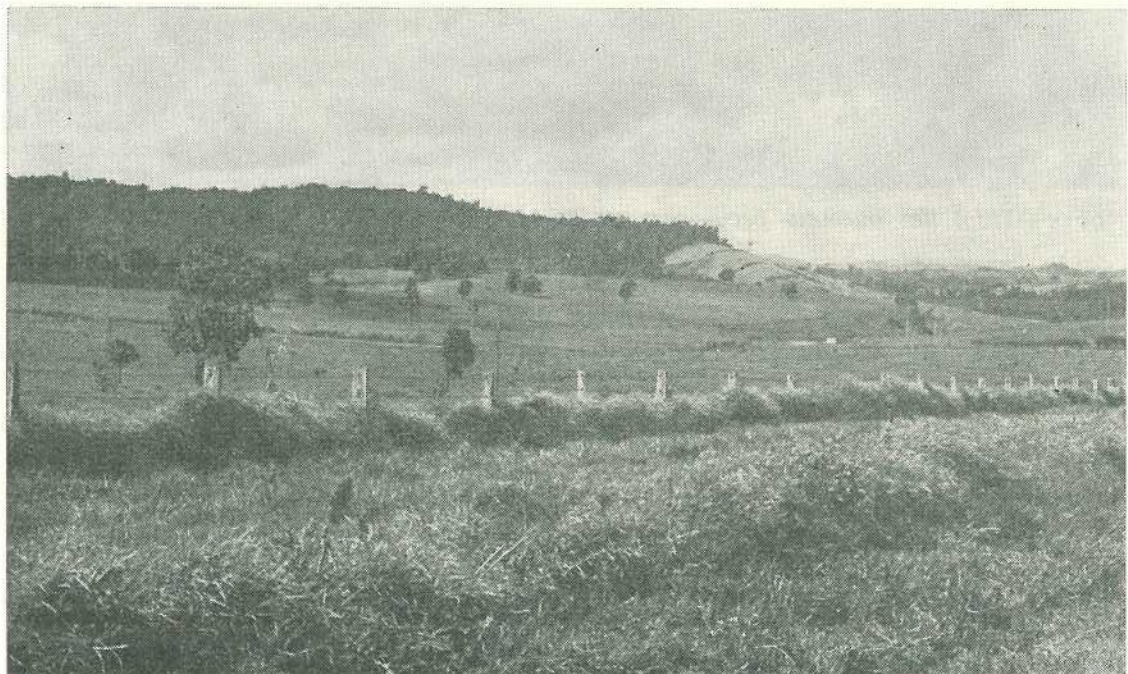
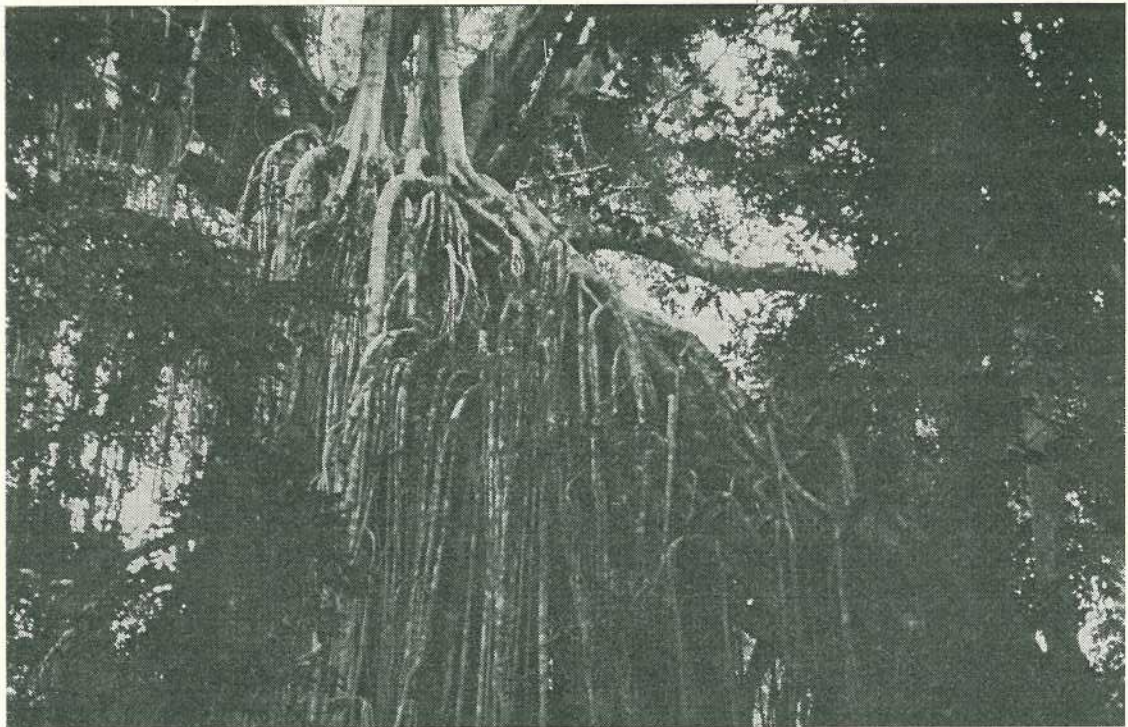
The poplar gum (*Eucalyptus alba*) (right foreground) is a common northern eucalypt.

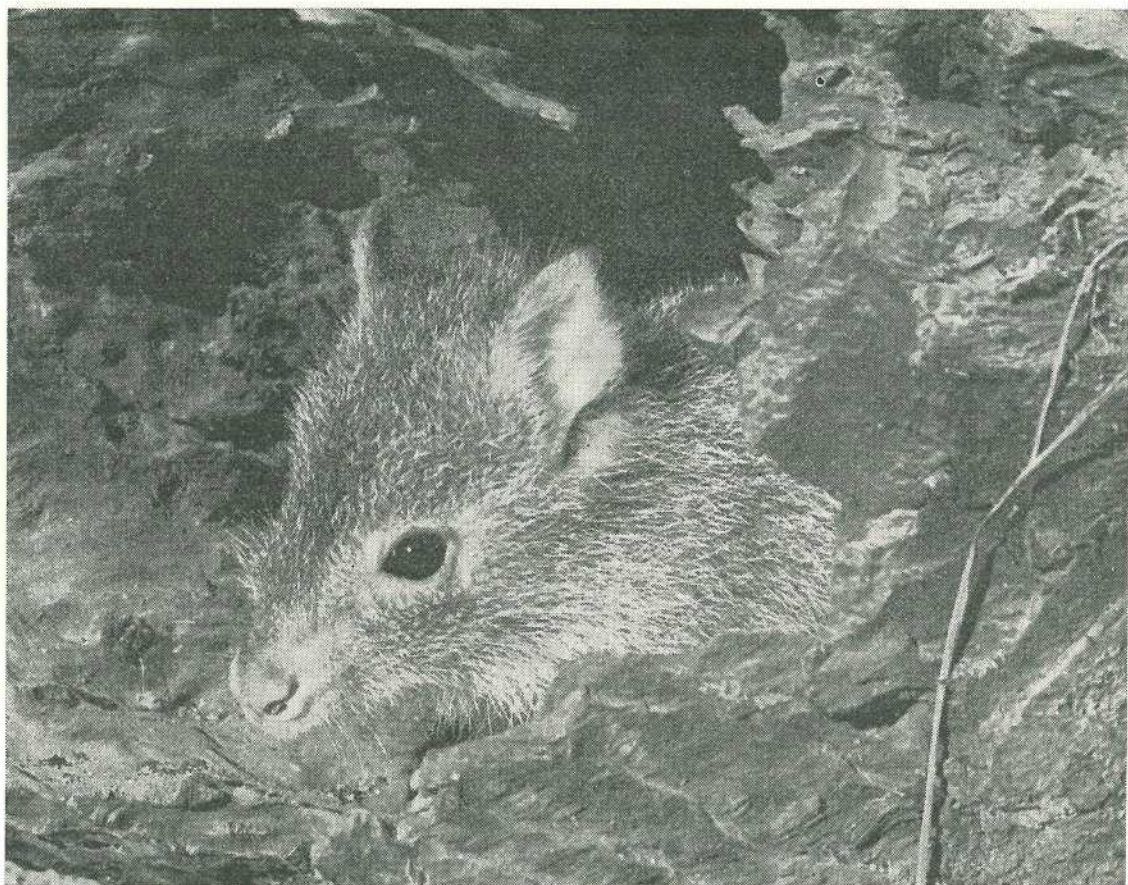


Above—Tidal flat habitats provide a major food source for many migratory waders.

Right—A freshwater swamp along Chewko road near Tolga. The extensive area of grasslands on the periphery of this swamp produces nesting grounds for waterfowl species.





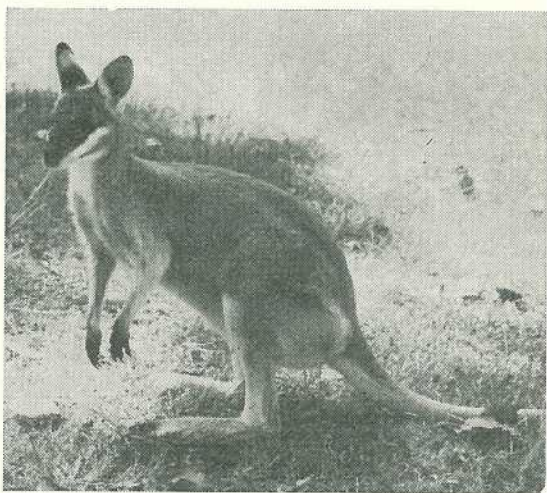


Above—A common marsupial around Ravenshoe, though not often seen, is the rufous rat-kangaroo, (*Aepyprymnus rufescens* (Gray)).

Above left—"Curtain Fig" near Yungaburra; apart from providing an essential habitat for particular species of fauna, closed forest habitat is botanically important as a scientific reference area.

Below left—A typical rural scene on the Atherton Tableland. Extensive areas of cultivation are present, resulting in an artificial habitat. This disturbed habitat does, however, benefit such species as the brown quail, (*Coturnix ypsilophorus* Bosc.)

Right—The whiptail wallaby, (*Macropus parvi* (Bennett)), is a common inhabitant of hilly open forest habitats throughout the western extremities of the sanctuary.





Above—The scrub fowl, (*Megapodius freycinet* Gaimard) of the northern Australian rain forests does not brood its eggs. Instead, the female lays them in a mound of soil and ground litter. Some mounds are of gigantic proportions and are believed to be the largest structures made by birds.

Above—The southern stone curlew, (*Burhinus magnirostris* (Latham)) is a nocturnal bird and its eerie and melancholy mournful whistle, is a familiar sound after dark.

The mound illustrated, measured 2.4 m in height and approximately 8 m in diameter.

Below—Excessive land clearing can seriously affect wildlife. If wildlife is to remain abundant, it must be fitted into our land-use planning programmes. Attitudes are changing, and the presence of wildlife habitats in many instances will increase the value of properties.



MICE/RATS	
Water rat F	<i>Hydromys chrysogaster</i> Geoffroy
Dusky field rat OF, G, C	<i>Rattus conatus</i> Thomas
Giant white-tailed rat CF	<i>Uromys caudimaculatus</i> (Kreffft)
DOGS	
Dingo OF, CF	<i>Canis dingo</i> Meyer
BIRDS	
PELICANS	
Australian pelican F, S	<i>Pelicanus conspicillatus</i> (Temminck)
CORMORANTS	
Little pied cormorant F, S	<i>Phalacrocorax melanoleucos</i> (Viellot)
HERONS/EGRETS/BITTERNS	
Great-billed heron S	<i>Ardea sumatrana</i> Raffles
Reef heron S	<i>Egretta sacra</i> (Gmelin)
STORKS	
Jabiru F	<i>Xenorhynchus asiaticus</i> (Latham)
WATERFOWL	
Maggie goose C, U, F, S	<i>Anaseranas semipalmata</i> (Latham)
Black duck G, C, F, S	<i>Anas superciliosa</i> Gmelin
White-quilled pygmy goose F	<i>Nettapus coromandelianus</i> (Gmelin)
HAWKS	
Black-shouldered kite OF, C, G	<i>Elanus notatus</i> Gould
Red-backed sea eagle OF, S	<i>Haliastur indus</i> (Boddaert)
Wedge-tailed eagle OF	<i>Aquila audax</i> (Latham)
MOUND-BIRDS	
Brush turkey CF, OF	<i>Alecteura lathamii</i> Gray
CRANES	
Sarus crane C, F, OF, G	<i>Grus antigone</i> (Linnaeus)
Brolga, C, F, OF, G, S	<i>Grus rubicundus</i> (Perry)
PIGEONS/DOVES	
Red-crowned pigeon CF, OF	<i>Ptilinopus regina</i> Swainson
Wompoo pigeon CF, OF	<i>Ptilinopus magnificus</i> (Temminck)
Torres Strait pigeon CF, OF	<i>Ducula spilorrhoea</i> (Gray)
PARROTS	
King Parrot CF, OF	<i>Alisterus scapularis</i> (Lichtenstein)
Red-browed fig parrot CF, OF	<i>Oropsitta diophtalma</i> (Hombron and Jacquinot)
BOWERBIRDS	
Tooth-billed bowerbird CF	<i>Scenopoeetes dentirostris</i> (Ramsay)
Golden bowerbird CF	<i>Prionodura newtoniana</i> De Vis

WHAT IS A FAUNA SANCTUARY?

Fauna sanctuaries are any areas of land declared to be such under the relevant provisions of the *Fauna Conservation Act 1974*. All islands that form part of the state of Queensland, all national parks and State forest reserves together with many private properties have been declared sanctuaries.

Native fauna is protected on all lands in Queensland, however, the gazettal of an area of land as a sanctuary provides three additional benefits to the fauna. The first is that open season fauna, for example wild ducks, may not be taken in a sanctuary. The second is that special permits to collect fauna are rarely issued for sanctuary areas. The third is that in the case of private property owners of sanctuaries, they are required to give a written guarantee that they will preserve some habitat for the fauna.

Although limitations do occur, sanctuaries are a valuable feature of rational land use.

Legislation

In Queensland, under the provisions of the *Fauna Conservation Act 1974* all native birds, mammals, reptiles, and two species of butterflies are protected.

The following conditions and restrictions are applicable to fauna sanctuaries.

- It is an offence to kill, capture or disturb fauna within a sanctuary.
- It is an offence to use or attempt to use a firearm or any other appliance for the purpose of taking any fauna within a sanctuary.
- It is an offence to enter a sanctuary for the purpose of committing any act referred to in the above paragraphs.
- If a private holding is located within the boundaries of a sanctuary, only the landholder and his authorised agents are permitted to take prescribed non-protected fauna; e.g. wild pigs.
- If protected fauna is causing serious damage or injury to any private property, including crops or livestock, the landholder may apply for a special permit to control the destructive protected fauna.

Heavy penalties are imposed on offenders to any of the above provisions together with the forfeiture of any appliance such as firearms.

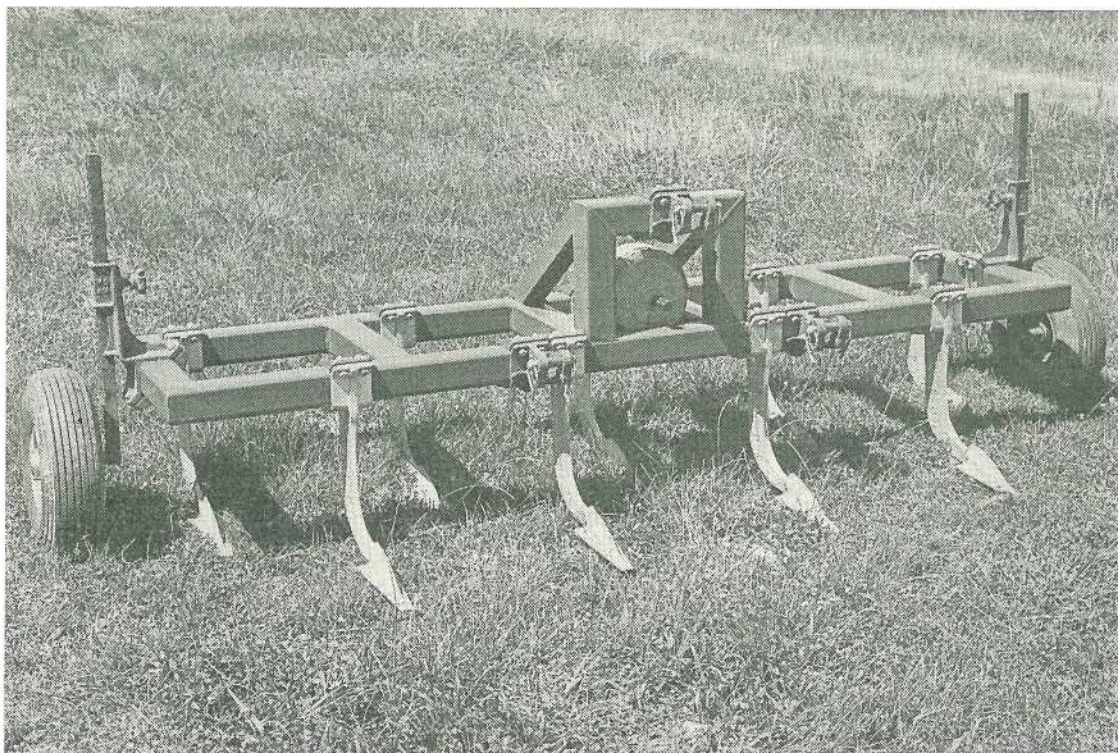
SPACE FLIGHT BONUS

AMERICAN scientists became quite excited when they sent some gypsy moth eggs into outer space aboard a Skylab space station.

The eggs hatched prematurely—almost two months ahead of time—and the scientists feel that it's possible that the zero gravity curtailed the moths' normally long hibernation period.

It has been considered a breakthrough in speeding up the moth's life cycle—it normally takes a year to raise a single generation—and this will help to launch a massive control program using sterile males.

For the past three years, gypsy moths have defoliated almost 2-million acres of forest each year in the north-east of the U.S.A.



The Slipper Imp with Shakaerator.

Slipper Imp wins prize for Australian design

THE machine which won the 1974 Prince Phillip Prize for Australian design could well revolutionize the method of soil care and cultivation throughout the world.

THE Slipper Imp is an agricultural implement for the tillage of soil and pasture which is designed to do the work normally done by the plough, cultivator and ripper.

A simple, welded frame supported on two tyred wheels for transport and penetration limitation, carries a series of knife-edge supporting shanks with replaceable slippers which penetrate the ground, and an out of balance rotor vibrator driven from the tractor power

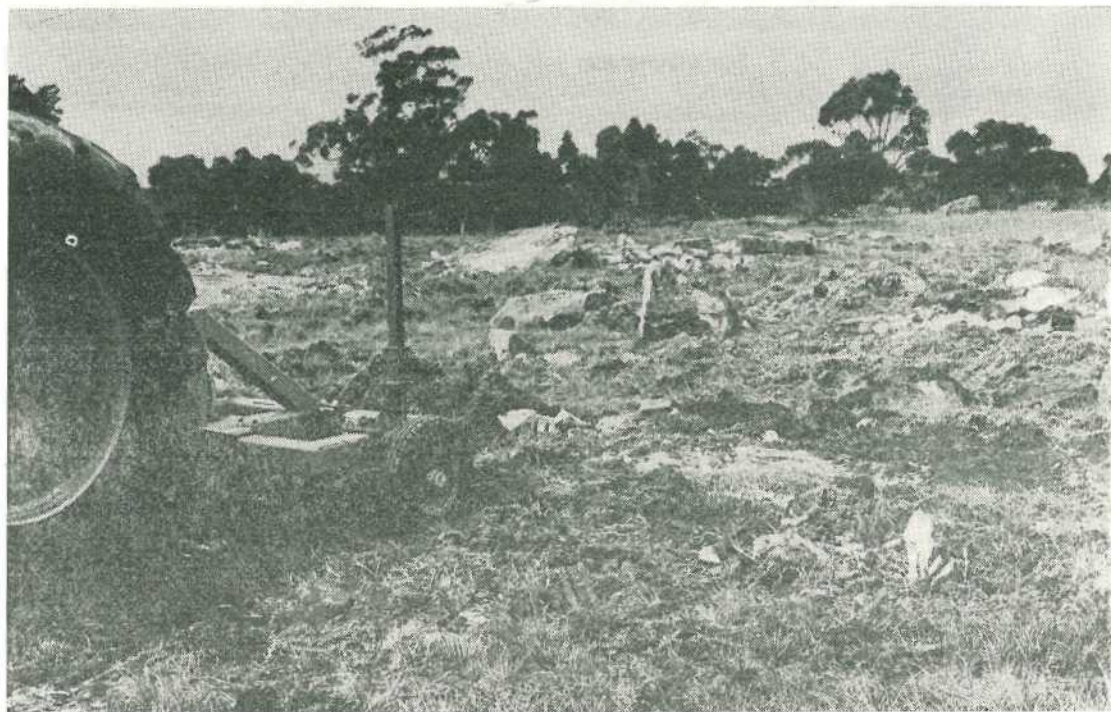
take-off. The vibrator causes the whole frame of the implement, including the slippers, to oscillate with an amplitude of approximately $\frac{1}{4}$ inch and a frequency determined by the speed of the power take-off. The oscillations are predominantly vertical or horizontal according to the width and shape of the slippers used, the soil type and the depth of tillage.

The effect of the combination of vibration with the shape of the slippers is to split and shatter the earth upwards instead of shearing it by the power-absorbing forward tearing action of other tillage implements. As a result, power consumption required from the tractor is reduced by some 40 per cent.

The narrow and wide slippers are readily replaceable using only a hammer. With the appropriate slipper and depth setting, the implement will scarify, mulch, form furrows, do row crop work, plough, cultivate, renovate



Replacing a fail-safe bolt.



Tough rocky ground is no obstacle.

pastures and rip deeply. The implement will open up the roughest and toughest of land and bring it to the pasture or crop stage quickly. Some 150 of the implements are at present in use and the judges were most impressed with the performance of the implement in actual use.

From a design point of view, the implement is particularly elegant. The frame is simple, rugged and cleanly designed. The slipper supports are attached and spaced as required by simple bolting, as are the wheel and all assemblies. The vibrator is completely isolated from the tractor power drive by neoprene bushings.

The whole implement comes to the purchaser in knock-down form and is easily and quickly assembled on the farm.

The judges were impressed by the simplicity of this design and its engineering quality as well as by the unique concept of combining vibration-shatter of the soil with a conventional tillage implement configuration. They regarded it as a very significant contribution to the economics of effective soil preparation, not only in the agricultural field. In that field alone, however, its economic impact worldwide will be very considerable indeed.

FIBRES FOR CLOTHING . . .

the consumers' preferences

WHEN it comes to clothing for informal wear, cotton blend permanent press fabrics emerged as a popular favourite in a recent survey carried out in the United States.

In the survey, more than 2000 men were asked for their opinions of fibres used in a variety of clothing items.

It was designed to help natural fibre producers and manufacturers market their products more effectively, based on consumer preferences.

Although most respondents favoured a blend of synthetic and cotton fibres for dress shirts, light weight sport shirts and slacks, their interest centred on the ease of care which comes from the permanent press finish, rather than on any particular fibre.

The positive features of permanent press included its wrinkle resistance, shape retention, and the need for a minimum of ironing.

But when it came to underclothing, ease of care was replaced by comfort as a matter of prime concern.

Men liked 100% cotton underpants. And while style was the most significant feature they mentioned, the fibre used received the second largest number of mentions.

When discussing fibre content, more than half of the respondents ranked all cotton ahead of all synthetic, all rayon, acetate, or all wool. The reasons given included: feels comfortable, can be worn year round, good values, attractive colors and styles, and durability.

Among other features mentioned were: does not cling, absorbs moisture, and it is washable.

On the other hand, while all synthetic was rated highly because of its resistance to wrinkling, it received low marks for comfort on skin, and moisture absorption.

Wool's image was generally less popular than that of cotton, although it was rated ahead of synthetic materials because of its durability and moisture absorption features.

Regardless of clothing item selected, most respondents mentioned brand name as the least important feature governing purchases of clothing.

CHEMICAL WEED CONTROL GUIDE

WINTER CEREALS 1975

Compiled by S. R. WALSH and J. M. T. MARLEY, Agriculture Branch.

The chart on the following page is a guide to the chemical control of weeds in winter cereal crops.

While chemical weedicides have a valuable part to play in supplementing mechanical weed control, they can never be used to replace sound cultural practices.

Each year the number of chemicals commercially available increases. The successful use of these chemicals depends on a number of factors. These include the choice of the most efficient chemical, the correct timing of the spraying, and the rate and method of application. Careful attention should also be given to applying the chemical at the correct stage of crop growth so that injury to the crop can be kept to a minimum.

It is important that the weed should be identified correctly before selecting the chemical to be used. The weeds listed in the guide are those that occur most frequently in winter cereal crops.

Some basic principles of weed control are given in the notes that accompany this table, and these should be read in conjunction with this guide.

Because chemical costs fluctuate so frequently, it has not been possible to give the cost per litre of the various chemicals.

When applying chemical weedicides, producers should take care to avoid spray drift to adjacent crops that may be susceptible to these chemicals.

Further information on the control of more difficult weeds should be obtained from your local agricultural adviser.

HERBICIDE RATES IN MILLILITRES PER HECTARE (Pints per acre in brackets)

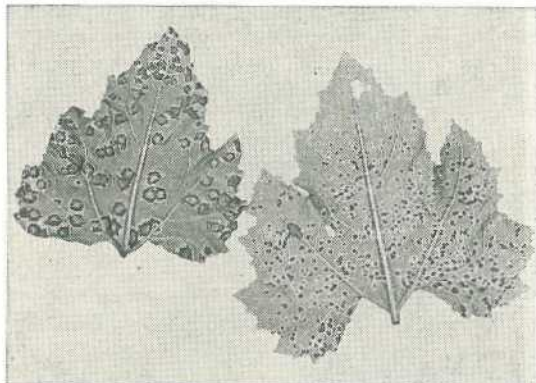
Cereal Weeds	Avadex BW	Treflan	2,4-D Amine 50% W.V.	MCPA 27% W.V.	Tordon 50D	Brominil	Buctril M.A. Brominil M.	Tribunil GRAMS	Banvel 200 Banex
Wild oats	*2100 (1½)	1000 (¾)	..	..	..	..	..	..	..
Paradoxa grass	*1000 (¾)	..	..	..	..	..	..	..
Climbing buckwheat	1100 + W (4/5)	2800 (2)	*350-470 (1/4-1/3)	1400 (1)	1400 (1)	..	700 (¾)
Wire weed	1000 (¾)	*1700 + W (1 1/5)	..	470 + 2,4-D	+ 2,4-D	1400 (1)	..	700 (¾)
Turnip-weed	*700 (¾)	1400 (1)	+ 2,4-D	+ 2,4-D	1400 (1)	..	+ 2,4-D
Radish and mustards	*1100 (4/5)	2100 (1½)	+ 2,4-D	+ 2,4-D	1400 (1)	..	+ 2,4-D
Variegated thistle	*1100 (4/5)	2800 (2)	+ 2,4-D	+ 2,4-D	1400 (1)	..	700 (¾)
Saffron thistle	*1700 (+W) (1 1/5)	..	..	1400 (1)	1400 (1)	..	..

Weed Stage		Annuals	Perennials	Pre-sowing	Pre-sowing	Tillering	Tillering	Tillering	2 leaf to Tillering Young	Tillering	See crop tolerance Up to 6 leaf	Tillering
Weed Stage		Annuals	Perennials	Pre-emerge	Pre-emerge	Young	Young	Young	Young	Young	Young	Young
CROP TOLERANCE		Wheat	Barley	Oats	Canary seed	Lucerne, under-sown in crop	Boom spray	Aircraft	Misting Machines	Boom spray	Aircraft	Misting Machines
Mexican poppy	.. .. .	..	..	..	..	*1700 (1 1/5)	..	..	+ 2,4-D	1400 (1)	..	..
Hexham-scent	.. .. .	..	..	..	..	*1700 (+ W) (1 1/5)	..	+ 2,4-D	+ 2,4-D	1400 (1)	..	700 (½)
New Zealand spinach	.. .. .	..	..	..	..	..	..	*350-470 (1/4-1/3)	+ 2,4-D	1400 (1)	..	..
Spiny emex	.. .. .	..	..	..	..	1700 (+ W) (1 1/5)	..	*470 (1/3)	..	..	..	700 (½)
Deadnettle	.. .. .	..	..	..	..	..	..	..	1400 (1)	1400 (1)	560 grams (½ lb.)	..
Docks	.. .. .	..	..	..	..	1700 (1 1/5)	..	*470 (1/3)	..	..	..	700 (½)
Paterson's curse	.. .. .	..	..	..	..	*1700 (1 1/5)	..	..	..	..	..	..
Bindweed (perennial)	.. .. .	..	..	..	..	*1700 (1 1/5)	..	..	..	..	..	..
Hoary cress (perennial)	.. .. .	..	..	..	..	*1700 (1 1/5)	..	..	..	..	..	..
Sunflower seedlings	.. .. .	..	..	..	..	*1100 (4/5)	..	+ 2,4-D	..	..	..	+ 2,4-D
Crop stage at application	.. .. .	Pre-sowing	Pre-sowing	Tillering	Tillering	Tillering	Tillering	2 leaf to Tillering Young	Tillering	Tillering	See crop tolerance Up to 6 leaf	Tillering
		Pre-emerge	Pre-emerge	Young	Young	Young	Young	Young	Young	Young	Young	Young
		..	..	Bud	Bud	Bud	Bud	Not recomb. Tol.	Not recomb. Tol.	Not recomb. Tol.	Not recomb. Tol.	..
		Wheat	Tol.	Not recomb. Tol.	Tol. to 2240 ml. (1 3/5)	Tol. 5600 ml. (4)	Tol.	Tol.	Tol.	Tol.	Tol. 1 leaf onwards	Tol. to 700 ml. (½)
		Barley	Tol.	Tol.	Tol. 1700 ml. (1 1/5)	Tol. 4200 ml. (3)	Tol.	Tol.	Tol.	Tol.	Tol. 1 leaf onwards	NOT recomb. NA
		Oats	Non-tol.	Non-tol.	Tol. 1100 ml. (4/5)	Tol. 4200 ml. (3)	Tol.	Tol.	Tol.	Tol.	Tol. 3 leaf onwards	NA
		Canary seed	Non-tol.	Non-tol.	Tol. 1100 ml. (4/5)	NA	NA	NA	NA	NA	NA	NA
		Lucerne, under-sown in crop	Tol.	Non-tol.	No	No	No	NA	NA	No	No	No
		Boom spray	.. .. .	..	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Aircraft	.. .. .	..	No	No	Yes	Yes	No	M.A. No M. Yes	No	Yes
		Misting Machines	.. .. .	..	No	No	No	No	No	No	No	No

NOTE:—

1. The treatment marked with an asterisk is the recommendation for cost efficiency.
2. + W indicates to add non-ionic wetting agent at 1 part of 50% to 60% product to 1600 parts of spray mixture.
3. 2,4-D and MCPA vary in their percentage of active ingredient—check the label and adjust the rates accordingly.
4. Bud indicates flower buds.
5. Tol. indicates the crop is normally tolerant at the rates recommended.
6. Not recommended indicates the chemical should NOT be used on this crop. Crop damage may occur.
7. NA indicates crop tolerance data not available.
8. The ester forms of 2,4-D are NOT generally recommended and must NOT be used in declared hazardous areas.
9. Conversion rates to litres per hectare, have been rounded off for ease of use.
10. Sprays should be thoroughly mixed before applying.
11. When 2,4-D is added to Tordon it should be used at the rate of 350 ml. per hectare (¾ pint per acre) of 50% 2,4-D amine.
12. When 2,4-D is added to Brominil or Banvel 200 or Banex it should be used at the rate of 550 ml. per hectare (2/5 pint per acre) of 50% 2,4-D amine.
13. For linseed and safflower, Avadex at the rate of 4200 ml. per hectare (3 pints per acre) is recommended as a presowing application for wild oat control. It is cheaper than Avadex BW but SHOULD NOT Be used on wheat or barley.
14. Mechanical or good by-pass agitation is necessary with Tribunil.
15. REFER TO manufacturer's instructions printed on labels of containers before using chemicals.

A New Disease of Noogoora Burr



Rust pustules on Noogoora burr leaves.

by J. L. ALCORN, Plant Pathology Branch

IN February 1975 a rust disease of Noogoora burr (*Xanthium pungens*) caused by the fungus *Puccinia xanthii* Schw. was recorded for the first time in Queensland.

As far as can be determined this is the first time it has been recorded in Australia. The occurrence of the disease is of interest because it may help to control this serious weed.

Symptoms

Yellow spots, often with reddish to brown centres, are obvious on the upper surface of a diseased leaf. Large, dark brown, raised powdery areas (pustules), often surrounded by a yellow halo, are present on the undersides of these spots. Many pustules may be present on some leaves, while others have only a few. Severely diseased leaves die prematurely.

Life Cycle

Large numbers of spores (teliospores) are borne in each pustule. Given suitable conditions they will germinate while still attached to the leaf to produce another spore stage (the basidiospore) which is dispersed by air currents, and causes new infections in Noogoora burr. Unlike many other rusts, these are the only spore forms produced by this species, and there is no other host essential for the completion of a full life cycle.

Hosts and Distribution

In addition to Noogoora burr the rust is reported to infect other species of *Xanthium*, and *Ambrosia* species (ragweeds). None of these plants has been found infected in Queensland. As no crop plants have been reported as susceptible, the disease is not seen as a threat to useful plants.

The fungus is widespread in the United States, and also occurs in Canada, Mexico, the West Indies, Japan and parts of Europe. Locally it has been found only in south-eastern Queensland but surveys are in progress to determine whether it is more widely distributed.

“What chance of Rain?”

RAINFALL

PROBABILITIES

*how can they help farmers make
management decisions?*

RAINFALL is vital to the welfare of all primary producers. When it comes to predicting rainfall, in advance, many primary producers rely on their experience of an area, while others may be guided by the long range weather forecaster.

In this feature, we examine rainfall probabilities; providing data which primary producers can use to help reinforce their own experience.

THIS MATERIAL has been contributed by I. B. ROBINSON and W. F. Y. MAWSON of the DROUGHT SECRETARIAT of the Queensland Department of Primary Industries. The authors have been helped by many officers of the D.P.I. and acknowledge special assistance from Mr. B. J. WHITE, D.P.I. and Mr S. R. HARRISON (University of Queensland).

The Data shown in Appendix 1 and on the two maps were provided by the Bureau of Meteorology. The assistance of the staff of the Brisbane office is gratefully acknowledged.

THE welfare of many primary producers is directly affected, to a marked extent, by climatic conditions, and in particular, rainfall.

While accurate short term forecasting of weather conditions for the immediate future is very valuable in organising day to day property management there can be little doubt that information over a longer term would further improve property and herd management and decision-making. This is particularly true in the arid and semi-arid pastoral lands which comprise a large proportion of Queensland's land area.

Compared with his pre-space-age counterpart to-day's forecaster has a greater range of information-gathering tools at his command. Generally, short term forecasting for a few days ahead is often available now on a reliable basis.

It is not our purpose here to examine the claims of long term weather forecasters except to observe that long term forecasts must have a high degree of reliability if they are to form a sound basis for major decisions. We are not aware of any published systematic studies which indicate the degree of reliability which is being achieved.

The use of rainfall probabilities derived from past records represents another approach for the primary producer when incorporating likely rainfall patterns into property planning and decision-making. In using probabilities it must be accepted that they are more reliable when related to either a large number of occurrences or over a long period of time. However, their consideration may offer a consistent and "best-available" approach to a particular situation at any one time.

A recent publication of the Bureau of Meteorology indicates that rainfall probability information for more than 2,000 centres in Queensland is now readily available from their Head Office in Melbourne.

The purpose of this article is to provide a sample of these data and to comment briefly on both usefulness and limitations for advisory personnel and primary producers.

Data for selected centres

Appendix 1 contains probability information for 30 Queensland centres located in some of the more important agricultural and pastoral areas. Some changes have been made to the form of presentation used by the Bureau of Meteorology and important points to note about the manner in which the information has been presented are:—

(1) each table gives expected cumulative rainfall for a specified consecutive period from the start of every month of the year. Thus the 1st table in Appendix 1 indicates expected cumulative rainfall for a 1 month period from the start of January, February, March . . . ; the 2nd table indicates expected cumulative rainfall for a 2 month period and so on.

(2) each table in the Appendix shows expected rainfall for 3 levels of probability—20%, 50% and 80%. The original formats provided by the Bureau of Meteorology presented data in terms of "deciles" from which a greater number of probabilities could be inferred. A somewhat simplified format is presented in this article. A probability stated in percentage terms can also be expressed in two other possible forms. Thus if there is a 20% probability that a centre will receive a certain annual rainfall, this is equivalent to saying:

Either that one year in five (or preferably 4 years in 20—larger periods are required for probability information to be valid) this rainfall will be received

or

that in any one year it would be a 4 to 1 "bet" that the specified rainfall will be received.

QUEENSLAND

Data from Bureau of Meteorology, Brisbane.

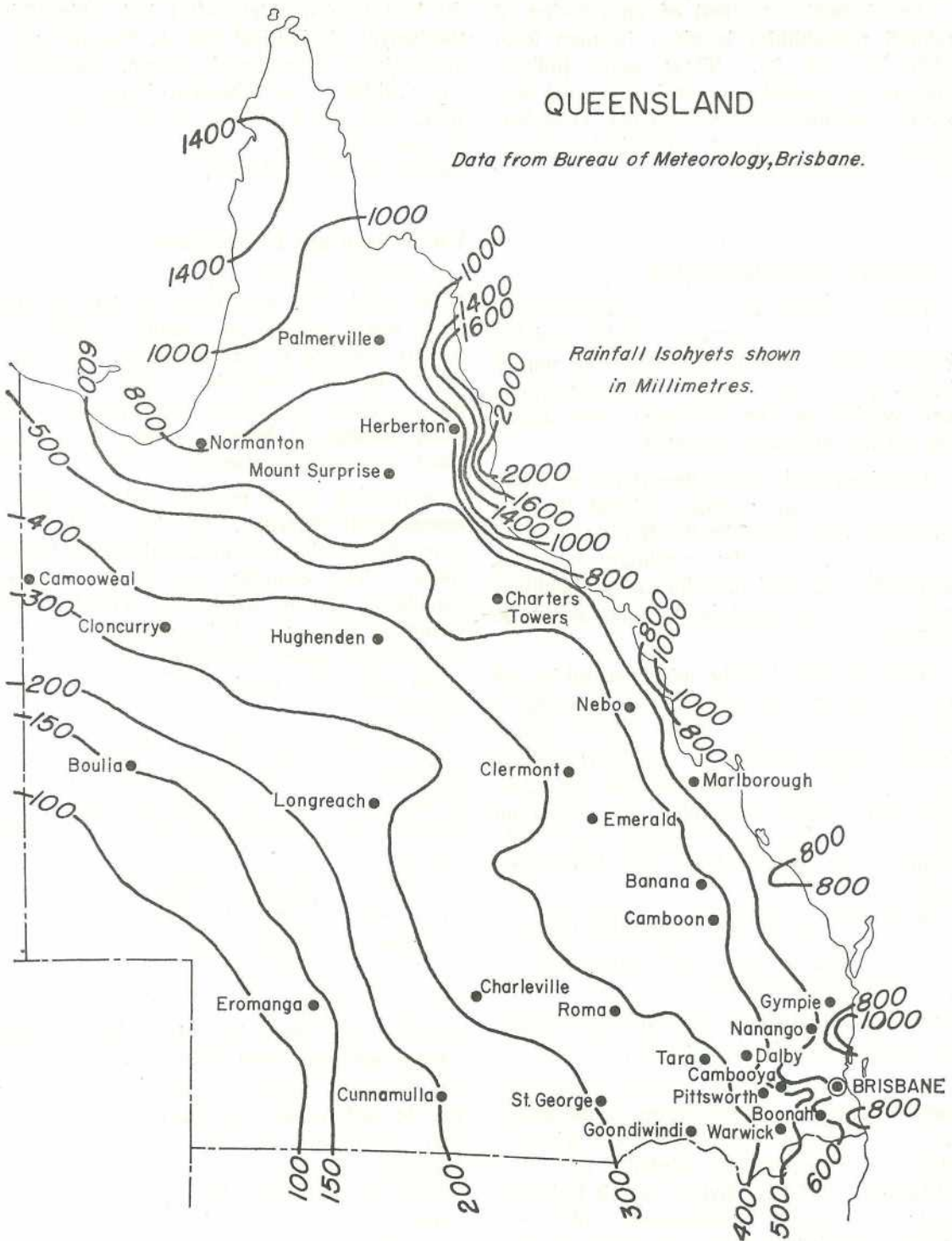


Fig. 1 — Median (50% Probability) Rainfall Isohyets for Summer Period (October — March)

An alternative method of presentation of rainfall probabilities is given in map form (Figs. 1 and 2). These maps indicate amounts of rainfall that can be expected with a 50% probability for the "summer" (October-March) and "winter" (April-September) seasons respectively.

General use of the information

Primary producers in Queensland know only too well that rainfall is highly variable between years. Many remember the run of better than average seasons in the mid fifties and certainly the run of drought years during the sixties and early seventies.

In spite of this, some people are not fully aware of average monthly rainfall in their particular areas or of its distribution throughout the year. Even fewer primary producers would be aware of the different probabilities with which varying rainfall totals might be expected.

This suggests that the main general use of the rainfall probabilities given in Appendix 1 is simply to provide accurate objective information about rainfall so decisions may be made in the light of the best historical data available. Some examples of important property management decisions that could benefit from the use of this type of information are:

- the chances of growing a grain crop;
- the likely onset of new pasture growth after a dry season;
- the likely length of a drought feeding period from a given time.

Men on the land have learnt to operate their farming and pastoral enterprises in the uncertain environment which exists and which is due in part to variable rainfall. In such a situation it is fairly obvious that it is impossible to suggest management rules and decision guidelines that will always produce

the best results. Very often it is only with the benefit of hindsight that the best management action or strategy is known. Nevertheless, decisions have to be made in this environment and the provision of more objective information should result in improving the quality of such decisions.

Use of data: and its limitations

Consider a grazier, say in the Hughenden area, faced with a situation at the end of April where, due to poor summer rainfall, a serious shortage of pasture exists. Suppose that he narrows down his alternative management strategies to a choice between selling and doing nothing, i.e. between selling or allowing stock to take their chance.

Note that there may be other possible management strategies. A simple choice is posed here to better illustrate the point being made. The example was chosen for its simplicity. There would be many other examples where the choice would not be so clear-cut but where knowledge of probabilities could still help graziers in their decision-making.

An examination of the data in Appendix 1 indicates that for Hughenden there is a 50% chance of getting the following rain (mm) from the end of April to the end of the months shown.

May	June	July	Aug.
3	24	36	40
Sept.	Oct.	Nov.	Dec.
56	71	100	163

Consideration of these totals indicate, for example, that there is a 50% chance that 71 mm will have been received between May and October inclusive. However, suppose that in fact no rain has been received during that period then the amount of rain to be expected with a 50% probability in November should be read from Appendix 1 under the amount of rain received in one month beginning with November, namely 24 mm.

QUEENSLAND

Data from Bureau of Meteorology, Brisbane.

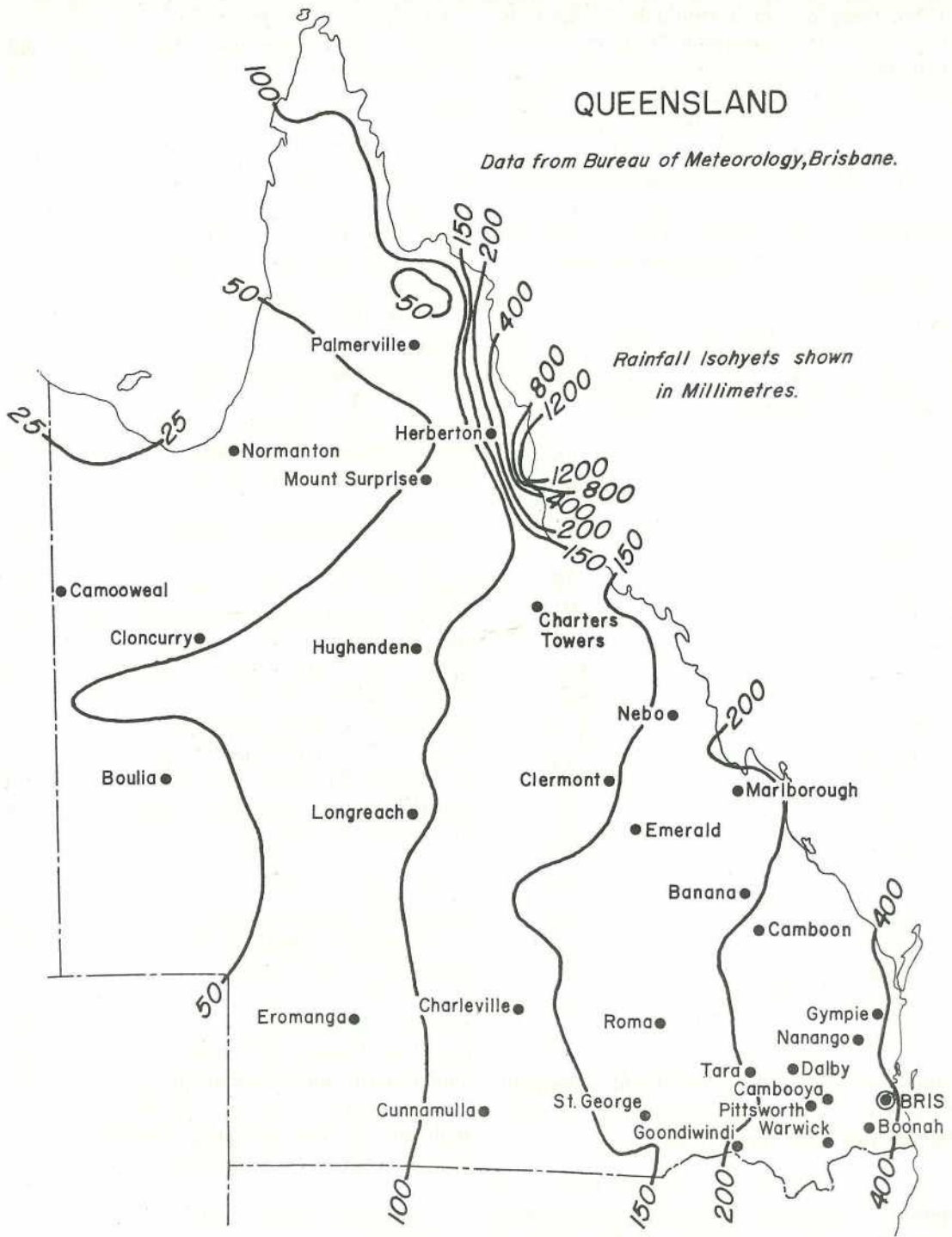


Fig. 2 — Median (50% Probability) Rainfall Isohyets for Winter Period (April — September)

From these figures it would be obvious to the grazier that "substantial" falls could not reasonably be expected before December, i.e. significant relief to the lack of pasture would be unlikely to occur before December/January. In view of this the grazier may well conclude that if stock were not sold they would be unlikely to survive the period May to December. Then, providing it were profitable to do so, a selling programme could be commenced.

To test how useful this approach might have been, actual rainfall (mm) for Hughenden over the period May-November for the 20 years 1947-1966 is given below.

1947	..	..	..	86
1948	..	..	..	66
1949	..	..	..	78
1950	..	..	..	336
1951	..	..	..	56
1952	..	..	..	91
1953	..	..	..	54
1954	..	..	..	161
1955	..	..	..	202
1956	..	..	..	312
1957	..	..	..	93
1958	..	..	..	76
1959	..	..	..	50
1960	..	..	..	111
1961	..	..	..	86
1962	..	..	..	82
1963	..	..	..	43
1964	..	..	..	141
1965	..	..	..	24
1966	..	..	..	98

For the grazier who is faced with a drought at the end of April, an examination of these May to November totals reveals:

(1) That only in 5 of the 20 years was rainfall in the period significantly greater than the total of 100 mm which can be expected with 50% probability.

(2) That in a further 1 of the 20 years, rainfall was greater than 100 mm but not by enough to have ensured the survival of stock.

(3) That in 14 of the 20 years rainfall was below the total of 100 mm that can be expected with 50% probability. It was noted earlier that to state there was a 50% probability of receiving a specified rainfall was equivalent to saying that for a given number of years that rainfall (or more) would be received in half that number of years. In the above example less than the median rainfall was received in 14 of the 20 years considered. This suggests that the particular 20 years analysed (1947-1966) were drier than what could normally be expected.

These conclusions clearly support the grazier's decision about the need to sell if stock were to survive the 7 month period without considerable losses occurring. However, in at least 5 of the years, viz. 1950, 1954, 1955, 1956 and 1964, the strategy would probably have been inferior to the alternative of doing nothing. The important fact remains, however, that considered over the whole 20 years, the strategy of selling would have been the most appropriate one in the simple circumstances outlined.

The general point which can be made in relation to the above simple example is that a probability approach is only valid if a reasonably long period is considered (say 10 years or more). Thus, for a new settler in an area, an adverse run of seasons may prejudice his financial situation. However, in the longer term, and providing he can "weather" the poor early years, a probability approach, such as the one outlined, should serve to improve his overall stability.

It is emphasised that having interpreted the probability information relating to rainfall the next essential step is to estimate the financial

outcome of possible alternative strategies. Often this will not be easy to do. For example, for a grazier who decides to sell stock an important determinant of the final outcome will be the price he will have to pay to replace stock when the drought breaks. This price will, in turn, be related to such factors as the size of the drought affected area.

Another important point about budgeting the financial outcome of a strategy is that many graziers may prefer to accept lower average returns over a period if these are less variable from year to year rather than returns that show high variability but are somewhat higher when averaged over a period. Other important factors to be considered in any budgeting exercise would be whether market outlets existed for drought affected stock and taxation considerations.

Different attitudes to risk

Individual primary producers vary in their attitudes to risk or uncertainty. Some of the factors likely to affect those attitudes are financial situation, age and experience, number of dependants and inherent abilities.

For whatever reasons, some farmers will be prepared to take greater risks than others. Because of these differing preferences it is important to provide rainfall data in an appropriate form. In Appendix 1 the rainfall data that can be expected with probabilities of 20% and 50% would be of greater relevance to producers with a relative preference for risky situations whilst the 50% to 80% probability data would be more relevant to farmers and graziers with a preference for safe or relatively certain situations.

For "average" primary producers whose preferences indicate a use for the 50% probability information, an important point should be noted. It is that there is a less than 50% chance of receiving the "average" rainfall for most Queensland centres. For monthly

rainfall this effect is quite marked. A comparison of 50% probability totals ("median" rainfalls) with average (arithmetic means) rainfall for Cunnamulla for selected months and for a 12 month period illustrates this point.

	Average rainfall mm	*Median rainfall mm
January	40	24
February	55	33
March	40	18
April	25	13
May	27	15
June	28	20
July	22	10
August	16	9
September	20	10
October	25	17
November	27	19
December	38	26
Year	363	347

In the case of median rainfall note that all the monthly and the yearly figures are independent and cannot be combined or grouped. For example, the yearly median total is not the sum of the monthly median totals, in contrast to the yearly average which is the sum of the monthly averages.

The term "median" would be an unfamiliar one except to specialist economists and statisticians. Because of its importance in the use of probability information the following simple example illustrates the differences between it and the more commonly used "average" or arithmetic mean.

continued page 182

*Total that can be expected with 50% probability for each month separately.

Appendix 1

RAINFALL EXPECTATIONS WITH SPECIFIED PROBABILITIES FOR ONE MONTH PERIOD FROM START OF MONTHS SHOWN (mm)

Centre	20% Probability												50% Probability					
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
Banana ..	150	146	120	64	64	69	55	40	49	79	91	135	94	85	58	22	24	32
Boonah ..	177	161	160	67	63	83	70	56	61	106	123	189	100	88	82	36	20	29
Boulia ..	76	85	70	20	20	20	17	9	13	23	27	38	23	28	12	2	2	4
Camboon ..	146	170	102	67	64	75	65	52	64	94	111	135	84	64	51	27	23	36
Cambooya ..	153	114	110	62	65	69	68	56	60	98	103	147	87	63	65	31	29	34
Camowieal ..	144	138	105	24	13	17	6	*	7	21	50	101	55	69	39	3	*	1
Charleville ..	127	108	107	56	58	39	40	37	48	67	73	79	59	62	63	21	21	13
Charters Towers	222	197	176	64	37	47	29	22	21	33	74	136	108	112	86	26	10	12
Clermont ..	197	202	135	67	54	73	48	30	37	62	77	130	101	83	50	30	21	24
Cloncurry ..	130	232	131	37	21	16	12	3	15	28	48	83	67	85	54	7	4	1
Cunnamulla ..	71	92	81	46	56	49	40	27	36	40	45	64	25	31	18	13	15	18
Dalby ..	131	120	111	64	56	62	68	51	65	84	111	138	78	58	56	30	23	29
Emerald ..	175	158	102	66	50	62	48	41	43	70	90	119	88	80	57	17	20	21
Eromanga ..	59	68	48	30	32	29	24	20	23	20	26	47	14	18	8	4	10	9
Goondiwindi ..	130	116	101	61	64	69	67	54	61	74	94	113	64	53	39	26	31	29
Gympie ..	245	264	227	127	104	96	84	57	80	104	133	178	138	120	113	60	51	44
Herberton ..	308	339	329	123	65	54	36	27	27	34	126	196	209	234	170	55	38	24
Hughenden ..	163	150	100	40	29	35	25	11	16	34	58	111	96	77	37	7	3	10
Longreach ..	121	160	154	78	68	40	43	24	22	50	41	103	58	40	53	27	6	5
Marlborough ..	256	280	171	77	65	92	61	38	46	71	102	162	119	131	85	30	29	27
Mount Surprise	305	306	202	53	20	25	11	3	9	32	74	182	183	195	96	15	2	3
Nanango ..	150	152	141	79	67	71	73	61	65	100	129	140	100	86	73	36	34	34
Nebo ..	208	202	175	64	56	79	49	2	33	38	52	89	147	114	100	89	27	22
Normanton ..	394	379	244	56	8	12	2	*	1	15	68	202	247	230	149	16	0	0
Palmerville ..	346	371	276	84	23	25	10	4	15	37	100	226	245	255	155	34	6	4
Pittsworth ..	144	113	104	68	59	64	70	58	62	92	104	144	86	62	54	27	28	31
Roma ..	121	130	93	61	59	62	63	40	62	80	89	108	57	58	47	20	23	24
St. George ..	117	109	94	50	70	61	53	46	44	65	73	87	53	41	34	18	22	23
Tara ..	133	110	88	59	51	59	58	49	49	86	100	134	64	43	49	25	24	29
Warwick ..	142	111	110	67	72	66	68	53	68	92	103	129	86	63	51	28	27	33

* Rainfall between 0.1 and 0.4 mm. Source: Bureau of Meteorology.

RAINFALL EXPECTATIONS WITH SPECIFIED PROBABILITIES FOR TWO MONTH PERIOD FROM START OF MONTHS SHOWN (mm)

Centre	20% Probability												50% Probability					
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
Banana ..	321	304	239	154	161	156	118	113	161	210	268	317	194	155	94	51	64	59
Boonah ..	319	310	203	116	144	119	104	103	151	227	266	338	221	212	116	72	62	79
Boulia ..	135	146	83	59	43	36	29	26	37	64	87	113	73	57	30	9	13	11
Camboon ..	273	244	157	133	141	136	100	112	135	176	223	270	194	139	91	60	72	72
Cambooya ..	247	205	157	117	130	131	113	106	159	194	234	263	166	151	106	69	65	78
Camowieal ..	249	221	120	45	38	32	14	15	32	69	133	221	139	128	58	9	9	3
Charleville ..	219	210	156	97	76	62	77	76	101	128	153	204	126	116	91	51	48	36
Charters Towers	378	345	220	89	87	76	50	50	56	105	209	309	235	206	122	43	32	27
Clermont ..	353	323	181	118	102	101	75	66	94	133	201	311	203	157	105	61	58	51
Cloncurry ..	307	294	135	69	50	35	15	18	38	64	115	238	154	150	77	20	12	4
Cunnamulla ..	144	152	118	85	89	68	63	59	70	83	95	118	76	78	46	38	42	40
Dalby ..	220	203	157	103	120	136	111	97	139	176	227	250	156	132	91	63	62	74
Emerald ..	294	246	179	111	97	108	87	80	100	138	209	263	180	145	83	45	49	46
Eromanga ..	123	101	80	56	68	53	48	35	52	52	67	93	61	38	29	16	27	24
Goondiwindi ..	211	205	143	106	129	128	119	106	134	161	176	208	136	113	74	65	66	70
Gympie ..	469	504	326	246	232	181	123	133	177	227	324	395	318	280	204	119	109	97
Herberton ..	632	623	440	170	109	79	58	51	60	147	284	528	438	410	235	107	68	47
Hughenden ..	303	253	164	73	58	55	40	37	52	86	149	256	190	121	55	19	24	22
Longreach ..	274	321	266	115	70	63	72	49	75	75	125	191	131	110	91	56	42	27
Marlborough ..	501	424	257	141	157	135	106	80	120	165	243	376	291	246	128	64	80	62
Mount Surprise	607	464	256	77	49	37	17	22	44	108	230	434	367	304	126	23	9	7
Nanango ..	290	265	200	128	123	138	113	113	152	201	240	286	190	166	119	75	79	83
Nebo ..	412	377	240	112	117	107	76	73	88	132	223	342	243	205	123	57	61	58
Normanton ..	690	578	278	67	35	18	15	6	20	91	242	535	491	404	182	21	2	1
Palmerville ..	655	602	331	98	47	34	15	20	56	116	298	554	518	422	187	49	19	9
Pittsworth ..	232	197	148	118	125	125	110	105	151	193	227	261	163	132	94	61	63	81
Roma ..	232	224	145	114	111	112	94	97	140	141	177	218	144	109	73	51	60	62
St. George ..	188	176	142	107	103	101	95	81	99	114	145	196	115	92	71	46	54	55
Tara ..	216	192	148	97	119	117	105	85	116	198	233	230	127	118	75	56	55	61
Warwick ..	233	201	163	113	131	126	124	113	148	188	216	254	164	138	87	66	67	82

* Rainfall between 0.1 and 0.4 mm. Source: Bureau of Meteorology.

RAINFALL EXPECTATIONS WITH SPECIFIED PROBABILITIES FOR ONE MONTH PERIOD FROM START OF MONTHS SHOWN (mm)

J	50% Probability						80% Probability										Centre		
	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O		N	D
22	14	18	46	57	84	54	31	18	5	7	4	4	2	3	18	28	45	.. .. Banana
32	29	28	32	65	87	55	47	26	12	11	7	7	7	10	29	32	51	.. .. Boonah
29	1	0	2	6	7	5	4	0	0	0	0	0	0	0	0	1	2	.. .. Boulia
4	29	17	23	45	69	45	24	20	7	9	8	6	5	5	19	27	42	.. .. Camboon
36	36	27	37	60	60	39	31	21	11	6	14	11	9	11	30	30	45	.. .. Cambooya
34	0	0	0	5	15	28	32	7	0	0	0	0	0	0	0	3	15	.. .. Camooweal
1	13	10	12	22	25	23	29	7	1	4	2	1	3	3	8	11	17	.. .. Charleville
13	6	1	4	11	26	45	55	26	3	1	1	0	0	0	1	2	26	.. .. Charters Towers
12	10	7	7	27	41	43	25	16	0	2	3	*	0	0	5	13	32	.. .. Clermont
24	0	0	2	6	17	30	29	9	0	0	0	0	0	0	1	3	23	.. .. Cloncurry
1	11	9	10	17	20	5	6	2	*	1	4	1	*	1	3	3	5	.. .. Cunnamulla
18	35	23	33	50	58	36	26	19	6	7	9	8	8	14	20	23	38	.. .. Dalby
29	14	11	12	30	49	36	29	16	2	1	1	1	1	2	6	18	27	.. .. Emerald
21	4	3	1	4	5	0	0	0	0	0	0	0	0	0	0	0	0	0 Eromanga
9	36	27	34	38	48	61	31	19	10	6	10	10	13	8	10	16	15	28 Goondiwindi
29	38	31	42	63	80	74	63	59	28	18	13	11	12	13	30	36	63	.. .. Gympie
44	15	10	11	20	57	136	95	85	29	16	9	7	3	1	5	18	65	.. .. Herberton
24	1	0	2	10	24	35	32	9	0	0	0	0	0	0	1	5	15	.. .. Hughenden
5	27	0	0	4	21	8	56	10	14	5	0	0	0	0	2	1	24	.. .. Longreach
3	14	10	15	34	49	100	56	45	25	5	5	7	0	0	7	20	47	.. .. Marlborough
34	0	0	0	7	41	88	84	79	29	0	0	0	0	0	0	15	37	.. .. Mount Surprise
29	30	25	35	56	65	94	55	36	28	13	10	11	12	10	14	26	28	49 Nanango
0	11	7	8	18	43	88	55	53	26	8	4	7	1	0	3	10	33	.. .. Nebo
4	0	0	0	1	36	119	121	114	56	0	0	0	0	0	0	12	51	.. .. Normanton
31	0	0	*	11	53	140	160	158	80	11	1	0	0	0	1	15	64	.. .. Palmerville
4	38	23	37	55	63	80	48	28	22	9	6	16	13	9	13	31	29	43 Pittsworth
25	18	18	40	40	57	32	17	14	3	3	6	5	2	5	16	17	27	.. .. Roma
24	26	17	21	27	29	40	22	11	12	4	3	7	4	3	6	8	16	.. .. St. George
32	17	18	47	53	66	29	21	12	6	5	9	10	6	8	17	18	31	.. .. Tara
29	39	29	36	61	80	40	33	19	9	10	12	12	12	16	31	35	43	.. .. Warwick

* Rainfall between 0.1 and 0.4 mm. Source: Bureau of Meteorology.

RAINFALL EXPECTATIONS WITH SPECIFIED PROBABILITIES FOR TWO MONTH PERIOD FROM START OF MONTHS SHOWN (mm)

J	50% Probability						80% Probability										Centre		
	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O		N	D
59	44	46	65	111	142	185	120	86	41	24	28	16	14	37	61	97	129	.. .. Banana	
79	61	67	110	151	204	215	131	102	70	37	33	26	30	52	78	120	150	.. .. Boonah	
11	5	6	12	22	26	40	23	20	3	*	1	0	0	3	6	8	20	.. .. Boulia	
72	53	50	73	118	154	175	92	69	41	28	32	33	26	21	41	65	109	119	.. .. Camboon
78	73	68	93	130	166	185	112	75	51	32	31	38	31	33	59	77	107	119	.. .. Cambooya
3	0	1	9	28	75	121	81	69	12	0	0	0	0	1	8	32	65	.. .. Camooweal	
36	31	28	52	58	81	106	79	53	27	22	15	13	10	12	19	29	43	63	.. .. Charleville
27	15	13	23	47	105	198	149	112	60	12	8	5	3	2	5	11	52	104	.. .. Charters Towers
51	30	29	41	76	124	172	117	71	30	16	19	8	7	4	12	34	63	103	.. .. Clermont
4	4	2	15	26	71	123	100	79	26	*	*	0	0	0	2	9	31	79	.. .. Cloncurry
40	27	27	32	40	49	69	29	24	14	13	21	14	7	11	10	14	25	27	.. .. Cunnamulla
74	61	67	97	110	149	157	99	79	49	28	33	32	27	29	50	70	89	97	.. .. Dalby
46	39	30	50	93	127	160	103	63	36	14	18	7	8	6	18	40	78	107	.. .. Emerald
24	14	13	12	16	32	45	6	7	2	8	9	5	0	0	2	9	10	.. .. Eromanga	
70	67	63	73	100	121	147	78	52	32	28	37	34	31	34	44	48	76	79	.. .. Goondiwindi
97	71	77	110	146	212	289	198	154	106	76	57	39	37	35	67	90	130	192	.. .. Gympie
47	33	26	32	80	194	340	314	267	143	61	39	26	15	9	18	40	118	253	.. .. Herberton
22	8	7	16	42	84	161	111	59	14	0	3	1	0	0	3	15	38	93	.. .. Hughenden
27	20	13	23	37	77	126	37	61	32	10	4	2	3	3	8	13	33	64	.. .. Longreach
62	38	36	55	92	163	258	167	104	53	32	25	12	6	9	20	43	94	137	.. .. Marlborough
7	1	1	17	56	139	299	214	173	39	2	0	0	0	0	1	21	82	176	.. .. Mount Surprise
83	64	73	98	124	176	202	133	111	58	41	34	28	27	35	59	72	107	125	.. .. Nanango
58	32	26	37	64	131	218	147	100	50	25	27	16	6	5	13	24	70	124	.. .. Nebo
1	0	0	4	42	155	358	314	246	77	2	0	0	0	0	17	92	227	.. .. Normanton	
9	3	2	18	67	188	398	345	293	119	18	5	1	0	0	4	24	117	288	.. .. Palmerville
81	70	67	88	115	161	179	111	70	52	28	35	39	35	35	51	81	90	112	.. .. Pittsworth
62	49	41	67	94	114	128	73	63	32	16	22	25	17	17	28	52	58	76	.. .. Roma
55	46	37	51	65	87	107	51	49	28	19	27	22	15	17	26	28	43	58	.. .. St. George
61	56	48	74	93	134	135	86	51	47	28	35	27	21	25	37	54	67	95	.. .. Tara
82	75	67	100	129	151	187	97	71	45	31	33	35	36	44	63	76	103	106	.. .. Warwick

* Rainfall between 0.1 and 0.4 mm. Source: Bureau of Meteorology.

Appendix 1—continued

RAINFALL EXPECTATIONS WITH SPECIFIED PROBABILITIES FOR
THREE MONTH PERIOD FROM START OF MONTHS SHOWN (mm)

Centre	20% Probability												50% Probability						
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J
Banana ..	374	291	231	170	175	153	140	150	205	278	341	379	263	190	122	100	99	85	6
Boonah ..	444	371	258	212	198	161	164	194	276	357	450	475	336	261	169	102	110	112	10
Boulia ..	185	159	103	72	65	49	38	45	72	111	139	164	104	70	42	22	19	18	1
Camboon ..	349	292	205	192	184	166	145	191	227	294	351	384	248	172	142	111	107	98	8
Cambooya ..	351	262	218	185	174	169	165	187	238	320	367	360	229	183	145	99	113	98	9
Camoweal ..	312	224	140	66	55	41	23	35	79	148	254	338	227	147	67	21	15	5	6
Charleville ..	342	303	207	123	102	92	118	126	177	219	229	305	186	167	121	71	67	64	5
Charters Towers	508	406	244	153	113	97	80	79	132	228	353	455	352	250	141	66	50	48	2
Clermont ..	469	373	216	179	157	130	108	120	164	238	359	431	292	194	135	90	82	74	5
Cloncurry ..	433	309	165	89	53	40	32	42	67	146	257	426	258	173	89	28	18	7	9
Cunnamulla ..	204	190	158	129	114	103	94	96	113	126	149	186	116	93	73	70	63	52	5
Dalby ..	278	244	194	166	187	185	155	182	236	298	343	332	220	162	125	97	102	70	5
Emerald ..	387	302	213	150	140	142	125	119	172	253	321	395	242	170	112	80	72	70	9
Eromanga ..	199	109	115	89	89	68	64	69	81	81	112	148	78	64	33	38	34	29	2
Goondiwindi ..	274	229	200	171	181	164	163	173	201	248	279	307	192	149	118	102	108	101	10
Gympie ..	645	607	428	322	293	231	201	226	285	420	500	636	439	348	273	183	167	125	11
Herberton ..	875	768	492	205	128	103	85	82	164	314	596	814	658	497	276	151	93	68	5
Hughenden ..	385	310	183	96	88	63	52	69	97	164	294	392	245	152	73	40	36	29	2
Longreach ..	457	467	309	155	124	89	81	89	102	181	227	329	199	144	104	60	60	39	2
Marlborough ..	683	489	310	234	196	166	139	145	212	323	472	594	417	307	174	117	108	93	6
Mount Surprise	740	499	270	91	54	48	31	58	119	266	502	708	508	338	134	35	18	11	7
Nanango ..	399	332	243	189	198	179	158	209	244	331	382	427	279	222	171	133	112	108	10
Nebo ..	558	425	276	185	166	142	122	114	148	253	390	525	352	256	152	92	91	80	4
Normanton ..	903	614	298	96	36	23	12	23	91	260	604	872	642	428	184	28	6	2	1
Palmerville ..	895	659	352	119	60	36	27	63	127	350	630	887	691	470	210	58	27	14	1
Pittsworth ..	311	231	207	184	169	176	163	174	250	313	336	337	225	184	138	103	111	108	10
Roma ..	311	262	205	152	160	150	164	179	207	234	272	299	187	155	111	88	97	84	7
St. George ..	283	224	192	152	143	137	123	138	168	195	238	268	158	123	108	80	90	77	7
Tara ..	300	245	199	152	157	149	140	162	242	302	334	308	195	149	122	92	99	96	8
Warwick ..	311	337	210	170	180	183	180	188	222	288	323	329	219	167	125	107	112	116	11

* Rainfall between 0.1 and 0.4 mm. Source: Bureau of Meteorology.

RAINFALL EXPECTATIONS WITH SPECIFIED PROBABILITIES FOR
FOUR MONTH PERIOD FROM START OF MONTHS SHOWN (mm)

Centre	20% Probability												50% Probability						
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J
Banana ..	433	337	277	222	190	179	198	236	327	395	456	465	295	229	172	134	122	104	115
Boonah ..	491	427	335	266	241	229	260	307	407	559	567	552	369	280	222	157	154	149	179
Boulia ..	220	194	114	83	74	58	54	83	121	142	192	212	109	82	54	28	29	28	28
Camboon ..	416	339	273	237	216	210	230	262	345	418	491	488	281	213	190	161	136	143	139
Cambooya ..	374	314	271	231	212	217	227	273	353	432	434	455	271	207	194	144	140	149	183
Camoweal ..	348	241	151	81	56	52	46	85	162	291	355	391	246	155	80	28	17	13	15
Charleville ..	412	345	221	139	135	135	143	196	246	379	309	358	220	187	133	84	84	80	91
Charters Towers	565	431	295	169	128	124	107	150	242	379	526	578	396	260	166	79	61	63	49
Clermont ..	511	412	257	210	185	154	149	184	272	393	500	538	322	229	180	111	103	93	87
Cloncurry ..	433	326	170	100	57	44	50	77	149	257	435	500	270	190	116	33	23	18	24
Cunnamulla ..	236	223	166	146	155	127	129	139	158	187	228	247	137	112	105	86	85	74	65
Dalby ..	323	291	246	215	215	225	239	280	345	408	415	406	255	204	169	147	130	136	161
Emerald ..	438	328	268	186	178	179	181	200	289	377	475	503	275	222	145	109	100	87	99
Eromanga ..	229	167	124	102	89	84	89	84	120	134	166	211	96	80	68	47	52	36	34
Goondiwindi ..	317	284	259	218	220	221	211	236	293	346	367	363	224	195	167	148	140	140	153
Gympie ..	777	661	520	408	332	291	310	335	480	624	713	792	533	410	350	246	191	181	187
Herberton ..	1024	808	531	226	150	120	108	188	335	639	894	1052	716	547	305	165	114	79	74
Hughenden ..	415	321	201	120	92	73	79	115	187	309	435	467	264	172	93	52	40	41	42
Longreach ..	542	505	346	210	128	101	102	120	211	256	345	470	235	179	126	69	74	60	61
Marlborough ..	746	526	379	278	215	193	192	238	332	519	714	785	451	336	218	156	137	122	106
Mount Surprise	774	530	285	97	66	53	66	133	271	514	777	826	536	343	152	46	28	23	24
Nanango ..	455	361	305	246	236	228	253	299	380	484	514	506	324	271	220	157	148	144	171
Nebo ..	620	475	313	223	187	169	175	176	286	403	564	641	404	264	191	128	109	101	80
Normanton ..	1059	715	380	122	74	66	54	120	340	735	1115	1192	676	438	196	31	9	7	9
Palmerville ..	943	666	395	124	65	52	68	146	356	637	977	1087	738	500	220	64	29	22	29
Pittsworth ..	350	291	268	233	213	218	240	284	366	417	429	407	268	203	176	134	142	145	171
Roma ..	351	288	252	199	186	204	207	234	296	343	369	394	232	193	154	128	112	113	120
St. George ..	325	269	226	186	177	168	167	183	242	314	324	354	180	159	132	111	116	107	107
Tara ..	355	270	241	202	198	193	208	263	330	414	401	384	224	196	151	139	120	121	134
Warwick ..	345	297	273	229	228	249	243	293	346	418	407	432	252	196	162	156	146	173	195

Source: Bureau of Meteorology.

RAINFALL EXPECTATIONS WITH SPECIFIED PROBABILITIES FOR THREE MONTH PERIOD FROM START OF MONTHS SHOWN (mm)

J	50% Probability						80% Probability										Centre		
	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O		N	D
85	67	96	131	203	256	293	183	117	66	48	45	40	37	51	81	134	176	194	.. .. Banana
112	102	137	181	282	308	343	217	128	95	67	55	58	60	81	111	174	213	256	.. .. Boonah
18	15	21	30	41	57	104	42	28	8	5	4	2	2	6	9	13	27	42	.. .. Boulia
98	86	100	141	211	245	272	161	105	63	52	62	47	41	57	101	152	182	200	.. .. Camboon
117	99	135	173	224	263	260	159	106	76	57	65	62	71	89	103	158	186	192	.. .. Cambooya
5	4	11	34	85	144	201	123	79	16	5	*	0	0	2	12	40	81	117	.. .. Camoowal
64	62	72	72	119	154	194	120	62	45	39	39	30	27	33	49	79	108	119	.. .. Charleville
48	28	32	55	118	242	339	205	147	73	22	14	9	7	10	20	66	132	204	Charters Towers
74	50	64	85	163	216	314	156	105	56	37	31	21	13	23	48	94	149	183	.. .. Clermont
7	7	21	34	75	149	231	149	97	29	5	1	1	1	2	14	55	87	159	.. .. Cloncurry
52	50	50	55	72	95	121	48	44	28	30	37	20	20	21	24	40	46	59	.. .. Cunnamulla
101	98	114	153	197	235	242	167	110	67	55	53	51	64	74	93	143	149	161	.. .. Dalby
70	57	74	110	162	225	256	158	94	54	31	32	22	14	31	58	112	146	162	.. .. Emerald
29	25	22	22	43	57	84	21	19	13	15	12	11	2	6	6	13	21	45	.. .. Eromanga
101	102	106	142	163	205	206	125	84	55	54	62	65	64	65	81	109	119	143	.. .. Goondiwindi
125	116	149	195	278	376	425	313	232	159	117	83	68	69	96	129	191	257	326	.. .. Gympie
68	50	48	101	212	403	550	460	297	180	86	54	38	24	27	56	138	292	409	.. .. Herberton
39	23	28	53	107	191	261	128	79	21	9	5	2	4	22	49	117	151	151	.. .. Hughenden
29	28	33	49	97	142	217	85	82	64	26	17	8	6	13	13	56	70	133	.. .. Longreach
93	65	78	125	198	308	398	258	153	77	51	32	24	18	36	61	123	208	250	.. .. Marlborough
11	7	19	60	161	332	518	333	178	45	6	3	*	0	1	24	87	213	300	Mount Surprise
108	100	127	166	217	272	282	194	145	89	60	60	53	61	78	97	164	192	213	.. .. Nanango
80	49	56	93	165	279	347	212	124	71	55	34	30	15	19	42	93	150	221	.. .. Nebo
2	1	6	46	168	416	626	436	261	79	6	0	0	0	*	19	102	293	434	.. .. Normanton
14	10	23	74	214	455	662	493	319	136	30	6	2	1	5	37	131	321	476	.. .. Palmerville
108	107	127	156	230	254	249	157	92	74	60	67	63	66	78	98	157	164	177	.. .. Pittsworth
84	75	98	122	156	196	205	115	78	58	41	45	37	38	45	68	103	110	133	.. .. Roma
77	75	81	94	123	169	164	99	66	39	46	49	44	38	42	53	73	103	96	.. .. St. George
96	81	104	130	192	195	216	117	76	57	54	49	48	45	56	75	112	124	136	.. .. Tara
116	115	138	167	209	247	246	166	94	75	60	70	62	65	92	122	154	163	165	.. .. Warwick

* Rainfall between 0.1 and 0.4 mm. Source: Bureau of Meteorology.

RAINFALL EXPECTATIONS WITH SPECIFIED PROBABILITIES FOR FOUR MONTH PERIOD FROM START OF MONTHS SHOWN (mm)

J	50% Probability						80% Probability										Centre		
	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O		N	D
104	115	150	237	312	368	356	200	151	105	63	66	61	68	101	151	205	240	264	.. .. Banana
149	179	222	331	413	440	456	255	175	122	97	80	94	114	145	192	260	306	370	.. .. Boonah
28	32	44	84	120	130	48	39	18	10	6	7	10	13	20	34	50	61	61	.. .. Boulia
143	139	180	249	321	357	325	197	139	100	86	79	68	81	117	177	214	257	250	.. .. Camboon
149	183	215	267	337	331	321	206	144	100	95	96	95	115	135	188	220	251	260	.. .. Cambooya
13	15	37	95	155	238	275	126	92	27	6	1	0	2	12	45	96	140	154	.. .. Camoowal
80	91	111	128	178	234	260	141	88	70	58	49	48	43	52	86	119	165	180	.. .. Charleville
63	49	66	135	253	375	457	201	121	77	56	43	35	34	58	103	181	213	225	Charters Towers
93	87	114	174	257	346	377	161	98	33	6	3	3	4	14	55	96	171	207	.. .. Clermont
18	65	71	90	115	144	148	70	61	47	45	38	33	27	33	53	70	77	81	.. .. Cunnamulla
74	161	185	234	298	318	306	200	130	91	77	76	94	101	116	172	199	224	244	.. .. Dalby
136	99	129	190	257	323	319	169	115	79	42	48	39	43	72	118	179	223	212	.. .. Emerald
87	34	31	51	69	93	100	38	25	16	19	18	17	8	13	19	26	47	54	.. .. Eromanga
36	153	164	200	243	271	260	158	114	87	85	82	95	97	101	150	163	186	190	.. .. Goondiwindi
140	187	241	334	442	516	569	365	292	192	137	123	110	121	151	217	305	393	422	.. .. Gympie
181	79	74	116	228	427	611	510	342	208	107	71	48	41	67	155	318	454	561	.. .. Herberton
7	42	57	115	203	286	319	157	87	34	17	9	9	12	26	51	141	173	181	.. .. Hughenden
41	61	60	109	165	234	246	107	89	69	38	28	13	19	23	56	84	139	189	.. .. Longreach
60	106	143	223	364	466	522	280	183	111	68	59	42	43	67	142	217	307	352	.. .. Marlborough
122	24	64	163	346	551	637	335	213	57	9	3	4	3	26	88	229	336	383	Mount Surprise
23	171	209	260	334	361	385	238	172	118	99	94	94	107	121	196	239	265	274	.. .. Nanango
144	80	112	178	302	394	445	227	152	99	65	50	46	33	47	107	186	255	303	.. .. Nebo
101	9	51	178	419	687	774	446	267	83	7	0	0	1	20	105	299	450	591	.. .. Normanton
22	29	79	218	480	693	851	549	332	150	32	9	4	8	37	133	330	538	661	.. .. Palmerville
145	171	190	260	319	318	305	197	118	101	90	93	102	109	133	181	223	227	246	.. .. Pittsworth
113	120	146	198	237	272	257	130	100	75	63	70	64	64	85	113	146	169	169	.. .. Roma
107	107	120	144	183	217	208	116	81	73	67	64	63	61	67	89	112	135	140	.. .. St. George
121	134	149	219	242	291	261	142	89	88	68	65	65	85	92	130	173	168	200	.. .. Tara
121	195	201	263	304	314	306	188	141	101	92	91	103	127	151	187	217	237	233	.. .. Warwick

Source: Bureau of Meteorology.

Appendix 1—continued

RAINFALL EXPECTATIONS WITH SPECIFIED PROBABILITIES FOR FIVE MONTH PERIOD FROM START OF MONTHS SHOWN (mm)

Centre	20% Probability											50% Probability						
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
Banana ..	449	387	308	237	233	240	283	343	437	524	573	530	337	266	207	153	151	166
Boonah ..	520	480	371	292	280	327	358	439	591	673	671	585	422	325	267	199	191	229
Boulia ..	233	208	132	94	78	80	95	125	149	220	244	246	117	92	59	39	37	39
Camboon ..	444	391	302	265	263	284	304	378	462	536	570	522	316	262	212	180	173	183
Cambooya ..	414	365	314	264	254	294	324	389	475	504	518	474	337	252	223	186	188	218
Caroowear ..	355	267	162	83	61	60	90	162	273	362	418	422	253	158	91	35	22	29
Charleville ..	416	353	238	170	146	156	212	264	327	399	429	456	230	215	147	109	114	107
Charters Towers ..	591	465	314	176	148	143	168	251	399	541	644	642	407	298	188	100	79	83
Clermont ..	526	462	314	229	208	198	209	286	416	542	590	608	364	259	196	132	121	115
Cloncurry ..	440	326	187	100	70	66	86	177	258	451	504	571	301	205	117	45	24	37
Cunnamulla ..	255	248	207	164	166	161	164	183	211	262	286	284	176	151	124	105	103	97
Dalby ..	375	325	296	243	252	299	320	388	461	480	482	450	291	247	222	179	172	192
Emerald ..	472	384	299	213	202	217	244	306	412	524	552	538	319	248	177	132	120	127
Eromanga ..	242	183	143	121	105	106	101	127	144	217	216	244	106	101	84	59	58	53
Goondiwindi ..	372	326	294	246	261	276	291	333	397	403	438	418	258	244	193	176	172	186
Gympie ..	854	734	602	445	392	382	402	511	678	818	906	905	598	478	398	275	239	257
Herberton ..	1050	837	546	244	169	154	211	367	652	933	1149	1173	791	556	331	183	125	106
Hughenden ..	441	333	215	128	99	113	138	204	316	453	503	496	284	211	108	61	56	61
Longreach ..	574	522	407	221	143	134	139	211	272	382	494	528	273	179	141	89	74	75
Marlborough ..	758	579	417	299	266	273	272	368	553	748	884	845	478	413	262	171	160	158
Mount Surprise ..	787	546	295	108	71	83	144	280	537	799	887	938	543	354	154	52	35	40
Nanango ..	500	428	340	307	270	312	360	418	516	603	588	551	365	305	283	193	185	208
Nebo ..	659	527	374	258	209	220	236	300	442	581	693	699	415	326	224	147	123	129
Normanton ..	945	634	313	105	46	52	98	262	611	927	1141	1141	691	451	196	32	12	17
Palmerville ..	946	688	398	130	69	88	146	358	652	987	1160	1122	745	526	226	67	37	44
Pittsworth ..	380	353	307	267	254	290	330	390	457	503	492	458	311	249	221	178	185	211
Roma ..	374	332	299	229	235	257	279	324	381	434	456	428	270	227	189	151	144	158
St. George ..	339	310	266	222	215	224	235	247	338	389	376	414	222	203	157	149	141	143
Tara ..	378	312	285	231	226	253	296	370	437	464	484	447	272	234	191	162	157	169
Warwick ..	385	350	318	265	273	312	331	387	475	484	484	462	297	250	220	189	188	230

* Rainfall between 0.1 and 0.4 mm. Source: Bureau of Meteorology.

RAINFALL EXPECTATIONS WITH SPECIFIED PROBABILITIES FOR SIX MONTH PERIOD FROM START OF MONTHS SHOWN (mm)

Centre	20% Probability											50% Probability						
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
Banana ..	495	418	332	273	291	324	390	458	570	624	611	563	368	310	226	183	201	229
Boonah ..	600	512	403	336	373	429	495	625	710	739	698	632	474	378	308	239	262	310
Boulia ..	266	228	141	101	105	119	133	157	220	256	280	263	130	97	65	44	47	53
Camboon ..	500	450	339	300	345	377	422	485	573	622	622	561	365	309	236	223	215	258
Cambooya ..	461	423	340	288	320	380	428	517	547	590	552	518	370	297	261	227	253	296
Caroowear ..	368	284	170	90	85	110	173	280	362	425	434	430	263	173	91	43	46	57
Charleville ..	434	390	263	190	205	233	286	375	409	519	531	467	264	235	169	140	132	133
Charters Towers ..	626	469	322	188	171	194	299	430	562	667	691	655	438	316	207	114	102	119
Clermont ..	565	477	338	263	265	261	315	433	559	627	654	634	410	295	206	149	158	172
Cloncurry ..	477	329	197	118	81	103	192	264	455	504	593	582	304	209	117	49	50	50
Cunnamulla ..	278	272	230	190	191	193	205	231	284	307	307	310	198	165	138	127	125	119
Dalby ..	406	376	327	285	338	373	443	506	529	548	527	472	324	285	252	211	229	280
Emerald ..	516	391	313	247	257	280	336	424	553	610	594	563	337	278	203	167	162	186
Eromanga ..	256	201	166	128	141	118	132	164	224	253	256	268	129	112	88	76	72	66
Goondiwindi ..	409	383	346	295	323	356	366	418	469	511	465	452	308	283	236	204	234	256
Gympie ..	939	779	634	477	476	478	567	714	885	990	1012	975	665	537	435	335	308	349
Herberton ..	1074	842	569	262	195	250	380	664	940	1167	1264	1211	817	583	350	199	145	173
Hughenden ..	476	349	222	140	134	160	731	316	456	519	540	505	306	221	117	72	71	81
Longreach ..	592	547	415	228	163	171	240	295	385	533	545	585	273	179	147	94	98	81
Marlborough ..	821	593	440	322	338	347	414	573	788	933	927	865	553	449	275	193	194	230
Mount Surprise ..	811	546	295	112	98	152	281	538	811	921	1006	965	558	363	155	55	50	85
Nanango ..	553	458	400	345	357	415	507	558	637	691	648	603	412	354	300	237	265	292
Nebo ..	688	546	395	275	253	283	330	454	595	738	784	731	470	341	255	160	157	174
Normanton ..	949	639	313	105	64	112	262	611	930	1153	1182	1148	691	451	196	39	23	60
Palmerville ..	966	688	398	137	102	175	371	658	990	1183	1192	1139	769	528	237	74	61	96
Pittsworth ..	435	401	347	295	317	399	444	497	538	589	560	495	356	288	253	221	252	281
Roma ..	414	376	325	274	298	330	365	439	481	522	496	462	290	272	206	185	207	221
St. George ..	402	344	303	239	270	265	290	342	417	458	416	476	300	225	199	183	177	186
Tara ..	410	349	322	272	290	337	424	463	510	552	511	461	305	282	236	206	211	231
Warwick ..	445	404	354	303	342	383	433	503	566	564	530	502	338	296	250	222	261	314

Source: Bureau of Meteorology.

RAINFALL EXPECTATIONS WITH SPECIFIED PROBABILITIES FOR FIVE MONTH PERIOD FROM START OF MONTHS SHOWN (mm)

I	J	50% Probability						80% Probability										Centre		
		J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O		N	D
51	166	186	247	339	410	410	386	228	180	119	88	91	100	120	172	224	266	313	294	.. .. Banana
91	229	266	364	459	521	529	499	311	197	165	120	115	147	181	243	282	380	438	397	.. .. Boonah
37	39	41	63	88	138	148	132	58	48	23	12	14	20	18	23	41	62	78	79	.. .. Boulia
73	183	223	278	347	404	400	354	238	180	136	107	98	119	138	189	237	289	293	284	.. .. Camboon
88	218	264	295	361	405	404	357	228	170	142	120	122	152	164	231	245	305	317	299	.. .. Cambooya
22	29	44	100	158	244	292	285	136	95	35	9	3	6	19	47	102	161	194	173	.. .. Camooweal
14	107	120	146	204	267	286	302	154	100	86	73	74	78	72	120	142	195	217	188	.. .. Charleville
79	83	85	140	269	390	489	480	244	178	100	43	32	28	33	83	159	232	294	290	Charters Towers
21	115	129	194	281	382	420	407	226	182	104	68	58	69	68	119	186	256	266	266	.. .. Clermont
24	37	44	78	174	265	334	326	162	112	42	10	7	8	18	59	96	193	215	210	.. .. Cloncurry
03	97	99	109	129	174	177	180	83	91	64	58	49	47	46	63	82	100	105	96	.. .. Cunnamulla
72	192	232	260	339	370	383	344	221	174	125	102	111	129	147	205	232	264	305	264	.. .. Dalby
20	127	157	219	285	362	383	352	192	139	105	65	53	72	97	138	190	244	273	247	.. .. Emerald
58	53	51	60	77	108	116	116	45	32	30	26	25	23	14	23	35	51	59	59	.. .. Eromanga
72	186	213	235	281	320	307	287	189	153	112	114	123	124	138	173	193	220	235	222	.. .. Goondiwindi
39	257	278	362	498	595	671	652	447	347	250	170	161	165	189	240	343	438	514	484	.. .. Gympie
25	106	136	233	439	641	890	895	525	373	235	130	82	62	90	171	332	469	607	597	.. .. Herberton
56	61	68	119	215	305	358	334	162	101	47	25	22	24	37	60	141	209	214	208	.. .. Hughenden
74	75	77	110	165	254	255	293	122	95	71	40	30	26	26	60	85	155	191	201	.. .. Longreach
60	158	162	243	378	513	579	565	318	201	133	95	73	78	84	154	254	336	400	397	.. .. Marlborough
35	40	66	167	359	573	687	676	340	229	63	10	8	8	30	94	233	358	448	420	Mount Surprise
85	208	237	305	369	433	467	427	284	220	159	128	125	140	143	220	276	330	342	321	.. .. Nanango
23	129	128	200	334	435	510	500	265	189	121	79	66	59	64	124	195	274	336	324	.. .. Nebo
12	17	56	178	419	692	844	803	447	297	84	8	*	2	22	106	299	455	613	601	.. .. Normanton
37	44	83	224	492	711	884	908	566	337	154	36	13	12	42	135	331	551	718	699	.. .. Palmerville
85	211	251	286	360	392	375	354	221	157	138	118	125	150	152	217	250	280	289	274	.. .. Pittsworth
44	158	183	223	278	317	323	291	164	141	105	89	93	100	107	131	161	210	213	186	.. .. Roma
41	143	150	187	221	243	265	246	153	129	98	79	73	87	91	116	137	152	174	156	.. .. St. George
57	169	186	234	279	319	328	294	155	136	133	89	91	115	118	153	197	228	235	217	.. .. Tara
88	230	260	290	344	380	376	353	217	165	134	120	124	165	172	215	262	284	303	246	.. .. Warwick

* Rainfall between 0.1 and 0.4 mm. Source: Bureau of Meteorology.

RAINFALL EXPECTATIONS WITH SPECIFIED PROBABILITIES FOR SIX MONTH PERIOD FROM START OF MONTHS SHOWN (mm)

I	J	50% Probability						80% Probability										Centre		
		J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O		N	D
101	229	285	359	431	475	446	429	276	204	141	117	128	148	192	241	304	349	351	308	.. .. Banana
162	310	389	479	566	611	564	542	342	260	182	154	175	226	259	312	419	495	485	419	.. .. Boonah
47	53	64	94	141	158	151	146	62	52	25	17	21	30	26	43	76	86	89	87	.. .. Boulia
15	258	322	370	442	481	439	416	279	212	163	125	145	180	219	263	315	336	341	310	.. .. Camboon
53	296	353	413	457	466	430	409	269	208	172	151	185	190	261	294	332	361	350	339	.. .. Cambooya
46	57	101	164	246	312	321	300	141	97	37	10	10	22	48	105	164	221	210	191	.. .. Camooweal
32	133	173	222	301	328	337	305	173	112	112	100	107	99	133	151	199	235	221	196	.. .. Charleville
02	119	152	273	411	516	513	489	265	186	110	56	36	56	91	167	238	315	332	298	Charters Towers
58	172	216	300	399	463	462	443	255	194	117	88	84	99	139	209	274	301	309	285	.. .. Clermont
50	50	90	178	265	340	337	351	176	134	50	17	12	21	59	96	193	221	225	227	.. .. Cloncurry
25	119	126	151	180	201	201	211	113	100	81	74	65	61	76	93	113	125	113	114	.. .. Cunnamulla
129	280	300	362	413	430	425	386	245	205	147	139	158	182	232	256	297	345	321	299	.. .. Dalby
162	186	244	313	372	427	417	383	241	165	125	72	80	116	158	211	262	297	301	281	.. .. Emerald
72	66	76	83	115	131	129	142	63	43	33	27	28	32	39	54	58	61	69	74	.. .. Eromanga
234	256	277	308	348	359	344	332	216	177	143	146	152	172	201	239	259	282	267	255	.. .. Goondiwindi
108	349	415	520	639	741	748	735	503	404	276	217	214	242	284	367	488	573	582	550	.. .. Gympie
145	173	262	456	657	904	983	947	558	403	256	134	104	112	184	346	493	618	652	654	.. .. Herberton
71	81	132	223	318	370	370	351	185	103	47	33	33	48	76	141	214	233	230	230	.. .. Hughenden
98	81	109	174	272	289	319	310	122	97	82	50	49	37	75	103	155	213	218	217	.. .. Longreach
194	230	268	388	532	617	618	604	348	242	150	116	103	131	168	280	348	425	422	417	.. .. Marlborough
50	85	172	369	573	693	714	690	377	229	70	23	16	43	98	233	358	457	459	421	Mount Surprise
265	292	335	414	467	525	509	455	308	256	182	164	172	194	239	303	360	388	395	359	.. .. Nanango
157	174	217	350	451	538	539	529	312	225	125	100	83	92	139	215	297	366	353	346	.. .. Nebo
23	61	182	419	692	845	871	829	460	298	84	8	4	26	106	299	455	614	628	601	.. .. Normanton
61	96	226	495	718	905	973	919	572	353	159	47	17	53	141	331	563	737	577	712	.. .. Palmerville
252	281	330	387	442	446	418	398	249	198	177	153	176	187	252	290	309	345	330	293	.. .. Pittsworth
207	221	251	302	346	359	351	336	206	160	130	114	124	139	148	179	228	257	244	234	.. .. Roma
177	186	206	230	278	305	291	275	174	141	117	106	111	119	136	147	173	202	194	199	.. .. St. George
211	231	263	308	350	388	372	339	206	181	148	116	132	154	180	233	245	285	263	255	.. .. Tara
261	314	340	395	416	463	421	398	255	207	166	148	178	212	243	293	326	340	322	299	.. .. Warwick

Source: Bureau of Meteorology.

Appendix 1—continued

RAINFALL EXPECTATIONS WITH SPECIFIED PROBABILITIES FOR SEVEN MONTH PERIOD FROM START OF MONTHS SHOWN (mm)

Centre	20% Probability												50% Probability					
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
Banana ..	541	437	377	340	360	448	499	587	653	671	652	608	414	336	262	238	277	326
Boonah ..	648	551	458	425	472	564	691	725	819	801	757	689	495	422	340	322	353	437
Boulia ..	281	233	164	118	128	143	165	227	284	289	298	286	132	99	72	56	62	81
Camboon ..	541	457	378	400	421	470	545	602	659	671	641	613	401	325	283	264	284	361
Cambooya ..	499	449	385	375	400	481	564	579	628	624	595	565	418	348	297	292	336	404
Camooewal ..	370	284	174	106	122	182	282	369	438	455	444	440	266	186	91	58	69	117
Charleville ..	472	420	297	257	258	304	407	438	544	549	559	486	265	248	203	169	169	191
Charters Towers ..	629	485	339	232	231	323	454	586	680	721	716	695	453	323	210	133	141	190
Clermont ..	597	489	370	303	320	384	479	578	661	705	673	654	436	302	216	199	206	257
Cloncurry ..	477	282	205	135	141	209	271	457	506	603	599	589	305	209	132	67	76	96
Cunnamulla ..	305	298	258	220	231	241	276	309	315	331	346	329	221	196	155	146	157	160
Dalby ..	463	413	372	360	403	489	552	566	596	581	551	511	373	315	282	261	310	360
Emerald ..	536	422	345	300	314	393	459	564	641	630	616	584	379	300	220	196	211	279
Eromanga ..	268	231	176	157	157	151	177	234	272	273	290	283	132	117	98	88	89	89
Goondiwindi ..	477	431	390	365	413	417	465	497	535	543	495	495	359	322	271	261	293	332
Gympie ..	978	794	657	580	578	640	805	922	1049	1084	1110	1059	723	588	483	438	405	486
Herberton ..	1080	865	575	287	282	415	710	955	1180	1278	1327	1234	832	603	362	219	213	298
Hughenden ..	476	362	238	163	170	251	328	461	552	565	540	524	335	221	124	84	100	142
Longreach ..	779	668	511	316	278	309	419	511	637	716	776	776	273	273	168	116	105	128
Marlborough ..	841	614	467	381	387	488	609	811	966	976	947	932	617	468	304	233	265	329
Mount Surprise ..	812	546	304	131	168	305	540	825	938	1010	1007	966	568	394	329	312	339	378
Nanango ..	589	503	443	404	448	552	614	663	728	751	674	648	451	398	268	197	209	267
Nebo ..	720	565	445	296	318	404	504	618	764	788	823	793	518	452	201	45	63	193
Normanton ..	949	653	315	122	119	263	617	944	1153	1187	1182	1158	704	587	283	131	124	294
Palmerville ..	969	696	408	169	182	376	658	999	1186	1213	1196	1149	842	526	287	300	322	389
Pittsworth ..	486	444	375	360	429	495	552	570	627	622	578	534	407	326	287	300	322	389
Roma ..	465	410	353	332	357	423	495	519	558	569	525	483	336	297	239	230	254	288
St. George ..	440	372	321	297	313	318	390	445	485	497	436	487	265	248	220	219	216	239
Tara ..	449	383	360	313	367	471	509	551	599	586	570	501	356	314	255	252	280	318
Warwick ..	490	433	402	378	423	502	562	583	629	603	556	538	390	326	295	294	338	388

Source: Bureau of Meteorology.

RAINFALL EXPECTATIONS WITH SPECIFIED PROBABILITIES FOR EIGHT MONTH PERIOD FROM START OF MONTHS SHOWN (mm)

Centre	20% Probability												50% Probability					
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
Banana ..	559	491	435	388	481	570	618	684	694	697	680	630	436	366	315	308	358	427
Boonah ..	686	595	541	517	597	757	799	838	860	843	796	732	534	457	414	406	496	558
Boulia ..	287	245	175	143	149	200	245	286	306	309	325	312	143	105	88	69	108	123
Camboon ..	565	514	482	475	527	619	661	702	713	698	693	637	424	365	318	317	391	456
Cambooya ..	539	475	461	453	514	601	641	671	681	675	638	602	447	377	371	366	441	496
Camooewal ..	371	286	184	144	203	292	377	438	467	458	457	441	271	189	110	79	128	186
Charleville ..	509	445	378	318	343	411	470	570	573	563	573	514	298	267	232	191	209	259
Charters Towers ..	636	487	353	283	336	497	589	690	733	738	733	697	469	344	231	170	221	318
Clermont ..	619	521	408	363	448	514	617	665	727	734	700	727	457	332	252	234	288	351
Cloncurry ..	477	405	210	153	214	280	472	506	619	603	617	589	305	209	138	102	126	190
Cunnamulla ..	342	323	285	253	272	295	329	355	347	364	356	364	342	204	178	170	176	200
Dalby ..	511	459	449	441	536	591	626	643	636	622	605	565	398	356	338	354	403	441
Emerald ..	557	471	393	353	446	527	589	646	655	651	641	620	415	329	259	252	298	353
Eromanga ..	272	235	190	186	175	214	239	289	294	306	309	300	155	128	115	95	103	119
Goondiwindi ..	515	482	439	441	463	532	559	577	584	574	542	540	398	349	320	321	387	487
Gympie ..	1042	842	727	690	754	687	1003	1127	1165	1197	1134	1102	764	636	551	513	554	647
Herberton ..	1107	876	619	390	474	742	973	1195	1291	1338	1349	1260	856	617	377	283	336	506
Hughenden ..	482	369	266	231	282	355	476	554	573	576	547	539	338	233	148	114	163	255
Longreach ..	633	567	464	287	289	341	423	548	602	618	625	654	289	246	226	122	161	180
Marlborough ..	859	651	543	445	539	715	871	993	1006	1005	987	966	621	369	183	127	207	389
Mount Surprise ..	824	561	324	209	331	545	831	946	1011	1012	1014	977	497	423	389	389	438	496
Nanango ..	625	546	546	500	587	675	710	776	784	775	715	697	497	376	296	248	300	407
Nebo ..	722	603	469	367	439	550	647	769	801	828	874	807	535	376	296	248	300	407
Normanton ..	952	654	321	171	274	624	961	1153	1187	1189	1191	1161	704	455	217	95	195	434
Palmerville ..	969	704	428	264	387	673	1022	1193	1229	1223	1202	1152	438	363	352	359	412	475
Pittsworth ..	523	475	438	459	528	596	641	672	664	648	632	603	363	325	283	282	325	367
Roma ..	500	451	405	395	445	549	577	600	607	610	559	548	299	276	265	262	269	302
St. George ..	456	389	356	354	355	429	476	507	527	533	503	498	388	338	314	312	359	403
Tara ..	479	401	428	409	509	544	588	632	618	623	586	533	388	338	314	312	359	403
Warwick ..	537	487	461	460	522	603	623	652	677	634	610	598	416	374	365	363	426	495

Source: Bureau of Meteorology.

RAINFALL EXPECTATIONS WITH SPECIFIED PROBABILITIES FOR SEVEN MONTH PERIOD FROM START OF MONTHS SHOWN (mm)

		50% Probability						80% Probability										Centre				
M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O		N	D		
277	326	395	462	499	495	489	463	299	216	171	158	179	215	254	313	379	376	372	360	..	..	Banana
353	437	525	600	651	652	613	588	370	276	222	198	264	322	347	456	529	533	508	467	..	..	Boonah
62	81	106	149	163	163	162	156	74	58	30	25	33	43	49	81	96	98	98	94	..	..	Boullia
284	361	418	478	515	496	481	456	310	240	183	174	214	266	282	343	361	378	373	352	..	..	Camboon
336	404	442	482	525	516	488	457	301	236	205	216	229	309	337	381	393	406	384	376	..	..	Cambooya
69	117	165	246	331	326	334	325	143	98	39	20	27	62	107	167	222	231	224	193	..	..	Camooeal
169	191	246	331	364	365	368	342	180	143	141	122	118	151	171	216	252	235	241	231	..	..	Charleville
141	190	281	413	526	528	531	523	283	192	121	69	78	115	186	242	324	343	343	340	..	..	Charters Towers
206	257	312	421	471	502	502	475	269	202	136	115	118	171	224	296	325	320	346	336	..	..	Clermont
76	96	178	289	340	373	370	358	184	134	51	32	27	69	107	194	221	248	238	230	..	..	Cloncurry
157	160	166	204	220	226	238	234	140	111	91	85	80	90	106	121	136	129	131	148	..	..	Cunnamulla
310	360	402	451	464	461	451	427	285	226	181	174	204	251	283	313	381	382	356	337	..	..	Dalby
211	279	325	406	454	461	430	415	257	194	132	121	143	180	239	281	324	323	342	322	..	..	Emerald
89	89	98	120	135	142	152	151	80	59	38	32	42	48	62	68	69	71	83	89	..	..	Eromanga
293	332	348	384	402	386	401	388	242	191	173	177	200	230	253	293	320	317	311	282	..	..	Goondiwindi
405	486	576	698	794	816	806	794	533	437	324	269	299	345	428	516	588	638	636	598	..	..	Gympie
213	298	485	678	915	991	1018	975	582	427	264	160	156	214	371	499	622	682	690	666	..	..	Herberton
100	142	237	321	381	389	389	382	185	105	56	43	51	85	100	165	218	237	220	217	..	..	Hughenden
105	128	180	277	298	353	341	329	125	98	83	62	65	76	106	165	218	237	220	217	..	..	Longreach
265	329	429	543	629	650	656	668	383	280	171	146	156	201	292	365	447	459	462	451	..	..	Marlborough
99	190	377	579	697	726	732	698	387	229	78	30	46	108	239	367	472	473	465	456	..	..	Mount Surprise
339	378	454	499	562	558	536	528	335	282	234	207	225	298	336	396	436	448	441	405	..	..	Nanango
209	267	361	467	550	572	559	582	339	237	155	113	120	169	228	315	372	394	376	391	..	..	Nebo
63	193	438	692	845	873	873	840	463	298	88	18	34	114	299	455	616	629	640	610	..	..	Normanton
124	294	529	789	1005	1031	1026	984	572	353	164	55	63	146	355	563	746	767	759	725	..	..	Palmerville
322	389	433	457	507	485	452	438	299	217	208	199	231	283	313	342	371	373	371	339	..	..	Pittsworth
254	288	334	373	395	401	401	369	237	189	151	149	170	171	209	243	262	282	279	279	..	..	Roma
216	239	271	302	325	331	330	317	201	164	145	131	136	170	185	204	214	213	211	226	..	..	St. George
280	318	350	379	406	422	401	382	248	196	169	161	173	205	259	273	308	298	295	303	..	..	Tara
338	388	446	444	509	493	466	428	289	224	210	209	239	292	324	357	373	365	360	328	..	..	Warwick

Source: Bureau of Meteorology.

RAINFALL EXPECTATIONS WITH SPECIFIED PROBABILITIES FOR EIGHT MONTH PERIOD FROM START OF MONTHS SHOWN (mm)

		50% Probability						80% Probability										Centre					
M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O		N	D			
358	427	500	509	530	542	529	508	314	246	193	207	258	289	328	400	425	411	416	386	..	..	Banana
496	558	651	685	674	683	648	626	415	333	303	303	361	386	492	554	569	555	556	501	..	..	Boonah
108	123	151	170	170	170	173	165	80	61	40	38	45	59	87	102	115	116	103	100	..	..	Boullia
391	456	528	542	532	542	527	497	328	252	228	247	300	321	361	377	396	410	417	384	..	..	Camboon
441	496	515	550	563	547	522	499	332	267	264	263	336	372	413	421	444	444	430	412	..	..	Cambooya
128	186	248	323	331	340	348	329	147	104	55	36	69	115	169	225	231	241	231	208	..	..	Camooeal
209	259	331	372	376	387	376	358	211	173	153	138	183	203	242	274	253	249	274	231	..	..	Charleville
221	318	433	528	541	568	546	545	292	202	134	104	127	197	249	325	348	356	374	350	..	..	Charters Towers
288	351	441	493	528	533	538	519	298	216	159	149	192	266	315	350	342	358	376	357	..	..	Clermont
126	190	307	351	376	387	378	365	187	134	65	49	77	113	194	221	248	256	238	243	..	..	Cloncurry
176	200	217	242	239	272	270	256	148	130	98	100	107	115	143	139	149	143	157	155	..	..	Cunnamulla
403	441	482	500	496	499	498	468	301	262	244	221	269	317	351	403	423	402	394	366	..	..	Dalby
298	353	424	471	484	485	491	446	275	226	156	169	201	262	294	340	348	352	365	359	..	..	Emerald
103	119	128	136	154	160	163	161	87	68	42	55	65	70	80	76	84	83	98	97	..	..	Eromanga
376	387	416	430	431	438	456	435	288	226	223	229	266	281	321	345	341	338	355	326	..	..	Goondiwindi
554	647	721	826	846	862	874	861	557	474	383	362	415	483	548	624	665	692	668	648	..	..	Gympie
336	506	714	927	1024	1032	1054	1003	613	429	277	220	256	402	517	639	688	700	730	690	..	..	Herberton
163	255	326	396	402	414	413	397	193	107	64	63	94	177	231	259	258	282	274	266	..	..	Hughenden
161	180	270	311	360	357	366	343	131	105	95	74	120	130	162	223	237	242	220	217	..	..	Longreach
207	247	350	467	658	673	713	690	418	288	207	196	239	329	391	460	483	497	492	458	..	..	Marlborough
347	462	587	697	727	750	743	707	287	232	86	52	110	264	367	472	495	495	469	439	..	..	Mount Surprise
300	407	530	607	597	602	603	571	376	326	298	249	329	374	419	472	504	481	421	420	..	..	Nanango
195	434	486	569	588	594	624	614	351	257	184	148	189	255	338	391	423	412	412	400	..	..	Nebo
249	515	692	845	873	874	880	840	463	298	93	47	116	309	455	616	630	642	661	610	..	..	Normanton
412	475	731	909	992	993	997	927	572	361	175	96	153	363	564	750	767	772	767	725	..	..	Palmerville
325	367	402	427	420	441	424	399	254	212	190	198	236	237	270	294	307	315	318	308	..	..	Pittsworth
269	302	334	346	352	374	369	327	224	178	179	165	182	215	224	242	225	241	255	244	..	..	Roma
359	403	422	422	448	456	442	420	260	241	225	185	239	283	307	345	333	342	342	342	..	..	St. George
426	495	521	547	550	536	499	474	325	268	260	262	325	359	402	428	409	410	407	371	..	..	Tara
																					Warwick

Source: Bureau of Meteorology.

Appendix 1—continued

RAINFALL EXPECTATIONS WITH SPECIFIED PROBABILITIES FOR
NINE MONTH PERIOD FROM START OF MONTHS SHOWN (mm)

Centre	20% Probability												50% Probability					
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
Banana ..	592	553	501	504	601	690	734	718	730	741	706	666	465	397	375	388	466	540
Boonah ..	727	691	632	652	795	860	879	880	896	878	845	786	585	529	507	547	627	684
Boulia ..	290	260	199	166	209	267	294	311	324	335	334	319	146	122	115	114	134	157
Camboon ..	614	572	564	570	674	705	746	750	751	763	740	692	463	402	398	419	484	574
Cambooya ..	586	548	529	554	630	716	727	722	723	701	665	625	483	431	441	476	522	573
Camooeal ..	374	305	210	215	299	392	447	471	475	468	457	441	276	191	144	138	199	262
Charleville ..	545	482	432	364	438	470	587	583	588	582	606	535	321	285	246	242	296	350
Charters Towers ..	654	501	405	385	506	617	706	740	756	756	735	721	484	375	301	265	331	461
Clermont ..	680	554	476	476	574	675	718	727	768	746	752	728	464	371	292	314	388	471
Cloncurry ..	477	405	250	236	296	506	518	621	619	630	617	595	313	233	152	141	218	310
Cunnamulla ..	369	357	322	300	322	342	378	364	372	389	382	378	251	223	203	200	224	243
Dalby ..	542	515	540	558	626	650	682	675	669	664	643	612	433	418	410	433	466	527
Emerald ..	587	489	433	454	565	661	699	674	670	694	680	634	433	365	324	320	381	474
Eromanga ..	283	240	213	202	228	261	305	307	309	319	313	310	168	148	134	122	147	147
Goondiwindi ..	552	520	506	504	568	629	635	638	626	620	598	580	416	403	382	406	424	457
Gympie ..	1069	981	874	822	913	1074	1170	1211	1267	1224	1182	1129	821	715	637	650	728	806
Herberton ..	1112	888	701	549	762	1013	1227	1324	1348	1358	1355	1265	882	638	441	403	569	748
Hughenden ..	495	384	317	304	380	509	554	578	589	589	569	542	359	260	176	187	265	361
Longreach ..	636	611	501	345	369	435	580	604	618	644	669	658	303	295	228	201	228	288
Marlborough ..	861	731	619	582	792	918	1056	1033	1056	1093	1019	976	626	526	397	415	506	611
Mount Surprise ..	824	575	383	394	564	846	948	1024	1025	1018	1015	977	581	398	223	225	402	604
Nanango ..	666	647	616	619	711	746	824	821	833	804	778	712	534	487	481	504	545	604
Nebo ..	764	650	531	513	584	687	831	813	840	888	880	829	542	422	332	347	448	547
Normanton ..	959	663	379	326	634	970	1153	1190	1189	1208	1191	1161	720	471	256	234	435	710
Palmerville ..	972	717	488	443	676	1037	1197	1234	1234	1236	1205	1156	784	566	344	318	519	746
Pittsworth ..	557	539	519	588	646	684	712	698	700	705	674	634	460	412	441	463	511	552
Roma ..	537	537	474	489	557	610	636	635	621	633	625	582	393	359	330	344	392	455
St. George ..	494	441	442	410	462	511	543	519	554	557	533	531	329	303	311	313	335	360
Tara ..	507	470	497	548	610	612	680	672	668	661	623	561	417	391	385	391	431	460
Warwick ..	579	549	524	569	651	688	693	703	706	702	685	633	457	442	435	468	513	590

Source: Bureau of Meteorology.

RAINFALL EXPECTATIONS WITH SPECIFIED PROBABILITIES FOR
TEN MONTH PERIOD FROM START OF MONTHS SHOWN (mm)

Centre	20% Probability												50% Probability					
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
Banana ..	647	622	605	624	727	796	761	744	758	769	727	695	534	462	468	505	572	591
Boonah ..	825	754	767	821	883	949	918	920	929	958	874	859	653	616	650	667	739	786
Boulia ..	304	273	225	232	283	318	329	339	343	342	336	323	166	144	141	144	162	189
Camboon ..	682	653	664	721	804	807	779	786	803	794	760	717	533	489	490	520	609	633
Cambooya ..	660	630	656	692	742	765	756	762	751	701	686	554	334	319	318	318	318	318
Camooeal ..	392	333	297	318	407	450	477	480	482	472	457	443	290	219	188	221	279	335
Charleville ..	633	538	485	446	519	622	600	604	603	610	625	562	350	308	305	315	381	400
Charters Towers ..	677	581	530	570	672	745	747	758	807	763	751	722	497	424	370	375	479	601
Clermont ..	712	605	584	617	699	788	767	779	781	786	755	800	491	408	381	420	510	581
Cloncurry ..	504	407	341	333	525	533	622	621	639	637	623	595	330	269	211	225	327	375
Cunnamulla ..	392	402	370	338	369	417	395	395	407	394	416	417	276	260	248	256	276	275
Dalby ..	609	606	643	668	686	736	714	706	712	702	679	645	508	510	497	514	554	588
Emerald ..	627	545	549	590	706	773	746	700	709	700	713	691	455	422	391	413	486	542
Eromanga ..	284	255	214	238	268	326	325	314	328	336	320	319	190	148	155	157	168	163
Goondiwindi ..	601	603	587	627	672	680	650	660	664	666	643	633	480	459	455	468	486	492
Gympie ..	1137	1061	1008	1004	1134	1260	1278	1293	1293	1275	1229	1157	893	784	800	814	870	955
Herberton ..	1123	988	836	846	1056	1312	1350	1356	1372	1365	1362	1281	921	712	593	648	787	983
Hughenden ..	515	430	421	443	533	589	601	594	601	598	571	570	379	300	245	283	374	432
Longreach ..	689	634	561	428	492	586	593	620	657	687	672	686	360	315	302	243	336	310
Marlborough ..	913	801	738	859	1006	1110	1111	1104	1095	1093	1075	995	689	594	517	557	660	749
Mount Surprise ..	844	627	547	590	846	977	1046	1040	1030	1019	1015	977	605	438	327	434	618	713
Nanango ..	762	745	709	748	810	865	843	863	860	853	826	752	601	570	603	604	653	711
Nebo ..	782	713	652	661	729	876	906	857	935	907	898	870	600	473	427	486	578	652
Normanton ..	973	727	543	688	970	1161	1190	1190	1208	1210	1191	1163	721	516	391	479	715	851
Palmerville ..	1016	801	691	757	1045	1202	1239	1239	1247	1237	1212	1156	802	603	495	575	763	925
Pittsworth ..	632	616	639	705	735	761	760	738	734	741	714	668	528	511	547	542	575	610
Roma ..	613	599	564	606	638	657	675	644	643	655	658	611	432	410	419	412	485	502
St. George ..	530	499	490	499	532	595	558	564	568	590	519	574	376	357	353	379	401	411
Tara ..	569	557	604	636	675	716	718	722	718	699	657	577	464	446	472	540	493	516
Warwick ..	643	619	639	693	714	759	755	725	747	764	728	680	526	511	540	550	581	635

Source: Bureau of Meteorology.

RAINFALL EXPECTATIONS WITH SPECIFIED PROBABILITIES FOR NINE MONTH PERIOD FROM START OF MONTHS SHOWN (mm)

J	50% Probability						80% Probability										Centre				
	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O		N	D		
540	538	538	565	589	569	532	354	282	270	281	330	346	424	434	436	458	456	420	..	..	Banana
684	728	725	724	727	709	658	458	392	353	390	431	510	584	599	581	616	584	526	..	..	Boonah
157	184	175	176	187	178	173	87	66	53	54	67	97	102	118	126	125	110	103	..	..	Boulia
574	578	575	572	572	529	338	296	297	329	346	396	398	418	454	471	440	420	..	..	..	Camboon
573	581	587	590	591	572	536	359	336	313	361	395	460	475	469	467	479	466	448	..	..	Cambooya
262	324	331	345	359	348	331	151	124	69	75	135	170	231	231	241	258	239	210	..	..	Camooeal
350	392	395	408	400	382	372	233	196	188	202	227	265	298	289	289	289	278	251	..	..	Charleville
461	548	571	581	579	592	545	301	221	166	148	216	285	334	356	357	389	401	375	..	..	Charters Towers
471	539	538	552	575	554	533	303	244	183	217	291	331	354	360	365	385	384	361	..	..	Clermont
310	372	379	387	399	391	374	190	139	85	81	132	208	226	249	265	256	246	245	..	..	Cloncurry
243	261	253	290	295	289	280	157	147	116	142	137	153	157	156	160	180	168	162	..	..	Cunnamulla
527	546	540	532	539	544	492	338	307	294	304	350	400	438	432	437	443	433	392	..	..	Dalby
474	494	520	501	522	518	479	302	261	214	251	284	319	361	358	383	391	404	372	..	..	Emerald
147	144	154	176	178	178	176	89	79	65	71	84	96	90	84	86	98	108	109	..	..	Eromanga
457	472	463	475	484	479	458	323	258	267	282	321	348	365	379	370	383	385	353	..	..	Goondiwindi
806	887	884	901	943	933	888	618	533	474	472	555	606	664	695	720	740	732	667	..	..	Gympie
748	939	1059	1060	1073	1077	1003	645	480	339	325	440	531	657	700	723	742	750	718	..	..	Herberton
361	404	414	415	423	434	402	204	111	83	113	185	245	260	274	288	296	289	266	..	..	Hughenden
288	304	368	366	394	380	356	131	123	98	133	145	168	217	240	243	242	220	223	..	..	Longreach
611	671	665	701	738	763	697	456	308	256	280	361	431	480	498	507	553	529	498	..	..	Marlborough
604	712	727	751	768	752	710	390	260	137	126	270	388	483	498	507	519	509	458	..	..	Mount Surprise
604	644	644	620	658	647	602	415	375	340	368	419	451	496	529	532	528	522	476	..	..	Nebo
547	584	596	620	651	651	631	363	290	217	223	284	378	423	442	435	448	465	425	..	..	Nanango
710	845	874	874	884	880	840	476	300	139	133	312	487	617	630	642	662	661	610	..	..	Normanton
746	912	1000	993	1011	1003	937	572	379	228	191	371	568	756	767	773	785	772	725	..	..	Palmerville
552	573	563	587	574	541	511	358	325	317	340	418	411	438	449	451	455	442	420	..	..	Pittsworth
455	454	451	461	465	456	424	276	242	236	259	291	305	316	324	349	355	347	313	..	..	Roma
360	372	368	395	414	381	357	250	214	198	216	275	258	265	264	269	277	270	254	..	..	St. George
460	462	464	472	497	471	452	302	279	256	256	310	331	358	363	366	387	389	362	..	..	Tara
590	581	571	575	570	546	523	352	311	329	362	387	431	457	451	459	450	440	404	..	..	Warwick

Source: Bureau of Meteorology.

RAINFALL EXPECTATIONS WITH SPECIFIED PROBABILITIES FOR TEN MONTH PERIOD FROM START OF MONTHS SHOWN (mm)

J	50% Probability						80% Probability										Centre				
	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O		N	D		
591	568	582	622	636	591	550	390	353	358	358	402	442	470	443	473	479	470	444	..	..	Banana
786	763	758	770	778	736	697	502	488	446	474	570	624	643	615	646	648	627	573	..	..	Boonah
189	188	189	195	188	187	174	94	81	66	70	117	124	122	133	133	125	116	114	..	..	Boulia
633	617	597	614	609	579	566	375	355	378	379	428	430	448	470	500	519	464	433	..	..	Camboon
644	623	629	633	634	608	584	430	380	412	440	506	510	523	521	521	527	506	478	..	..	Cambooya
335	337	345	364	359	351	336	172	139	118	141	183	231	238	241	258	263	250	215	..	..	Camooeal
400	411	414	435	427	410	392	242	221	225	235	278	310	313	302	298	293	301	267	..	..	Charleville
601	583	595	590	600	599	574	340	239	207	237	311	341	363	362	400	428	414	375	..	..	Charters Towers
581	569	571	599	600	585	553	328	290	278	314	352	374	371	377	392	412	411	380	..	..	Clermont
375	383	387	399	412	396	380	203	173	135	182	232	255	252	272	269	261	251	252	..	..	Cloncurry
275	286	315	321	321	307	299	176	158	153	167	186	169	177	176	201	194	185	176	..	..	Cunnamulla
588	581	568	578	602	562	529	383	360	362	374	423	464	467	456	480	486	442	421	..	..	Dalby
542	539	545	545	542	529	497	332	314	292	302	351	376	373	383	408	422	420	387	..	..	Emerald
163	155	187	184	191	189	192	97	91	92	92	104	110	108	94	107	108	115	113	..	..	Eromanga
492	501	498	517	514	516	499	344	312	337	354	389	390	397	407	425	426	413	381	..	..	Goondiwindi
955	956	939	1004	982	973	947	687	605	591	611	676	700	726	742	766	790	753	726	..	..	Gympie
983	1068	1087	1087	1087	1089	1024	732	588	516	534	655	776	797	815	836	850	842	827	..	..	Herberton
432	419	416	428	448	434	406	225	150	135	187	255	274	281	291	303	304	299	269	..	..	Hughenden
310	369	372	399	407	386	368	164	140	167	162	192	221	231	254	248	242	227	229	..	..	Longreach
749	709	722	756	794	786	704	490	382	360	407	466	506	522	530	575	577	542	536	..	..	Marlborough
713	731	751	772	774	756	724	412	286	222	287	402	484	524	510	524	524	509	458	..	..	Mount Surprise
711	690	665	685	691	677	642	478	421	435	459	492	528	545	543	593	575	562	520	..	..	Nanango
652	612	633	663	676	666	654	477	422	341	427	575	756	771	773	786	789	772	725	..	..	Normanton
851	874	875	884	888	880	840	396	319	319	306	416	462	455	462	470	481	481	434	..	..	Palmerville
925	1000	1003	1019	1021	1005	948	573	328	248	334	488	617	631	642	663	662	661	630	..	..	Pittsworth
610	606	614	619	601	576	547	430	373	407	426	457	480	480	472	493	505	484	465	..	..	Roma
502	483	480	492	499	473	453	316	301	313	317	354	345	350	378	399	383	366	346	..	..	St. George
411	406	417	429	434	417	380	267	235	258	271	286	291	292	284	291	300	296	281	..	..	Tara
516	520	490	510	536	514	475	323	330	349	329	354	387	385	379	413	430	417	393	..	..	Warwick
635	618	623	622	603	584	553	403	384	434	427	463	496	503	480	492	492	461	438	..	..	Warwick

Source: Bureau of Meteorology.

Appendix 1—continued

RAINFALL EXPECTATIONS WITH SPECIFIED PROBABILITIES FOR ELEVEN MONTH PERIOD FROM START OF MONTHS SHOWN (mm)

Centre	20% Probability												50% Probability					
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
Banana ..	722	756	736	751	807	845	795	799	792	792	764	748	590	570	567	591	633	629
Boonah ..	882	894	921	923	999	987	950	952	980	990	928	933	731	751	779	780	834	806
Boulia ..	341	320	276	294	335	355	346	349	353	342	346	345	175	164	168	174	197	196
Camboon ..	764	755	760	835	836	839	819	850	837	808	808	807	594	580	576	637	677	678
Cambooya ..	731	732	764	765	796	826	783	800	794	773	759	755	633	630	640	630	666	667
Camooewal ..	438	408	402	412	461	483	483	483	485	472	460	471	314	272	267	320	349	354
Charleville ..	703	602	583	561	655	632	621	631	635	628	666	695	365	354	371	392	427	440
Charters Towers	706	675	699	699	778	774	769	812	809	765	761	762	547	500	475	511	624	625
Clermont ..	758	734	709	734	838	849	808	799	821	788	848	837	557	491	498	557	599	612
Cloncurry ..	544	507	434	525	553	622	640	640	639	638	623	598	353	323	313	341	383	394
Cunnamulla ..	426	446	414	407	444	450	446	433	417	442	450	443	306	287	278	297	323	305
Dalby ..	609	606	613	668	686	736	714	706	712	702	679	645	508	510	497	514	554	588
Emerald ..	676	690	673	730	801	816	754	725	746	742	738	761	514	496	466	525	575	561
Eromanga ..	316	262	291	298	328	342	332	340	356	345	329	323	190	181	190	191	175	171
Goondiwindi ..	688	693	687	696	707	709	710	703	719	703	673	680	542	531	527	520	532	537
Gympie ..	1251	1236	1181	1231	1289	1307	1329	1334	1338	1307	1284	1246	992	963	999	1001	997	1023
Herberton ..	1233	1129	1098	1142	1358	1395	1409	1379	1378	1369	1364	1304	966	836	846	846	1039	1107
Hughenden ..	537	498	512	586	607	634	605	607	613	606	617	609	412	364	342	391	441	441
Longreach ..	712	675	641	594	660	612	611	659	694	690	700	740	371	420	288	336	340	375
Marlborough ..	968	935	968	1090	1156	1155	1137	1130	1119	1151	1104	1060	755	708	652	705	780	789
Mount Surprise	893	772	748	861	977	1052	1053	1060	1033	1019	1016	988	659	562	565	654	738	749
Nanango ..	848	853	835	836	887	907	900	893	899	881	854	873	674	665	720	706	737	736
Nebo ..	865	808	809	881	906	945	928	937	935	920	932	893	643	577	560	609	674	681
Normanton ..	1015	873	876	1011	1162	1194	1197	1211	1210	1211	1195	1169	770	666	625	721	856	888
Palmerville ..	1110	973	961	1079	1236	1246	1247	1250	1247	1237	1217	1187	866	741	729	817	966	1024
Pittsworth ..	734	731	751	788	786	803	797	758	775	776	756	740	602	618	620	601	636	650
Roma ..	661	640	696	674	695	708	691	677	695	700	697	662	486	498	491	498	547	528
St. George ..	597	559	594	596	592	599	584	595	596	626	597	605	436	385	401	427	434	443
Tara ..	656	655	681	700	735	735	761	748	746	738	684	657	525	533	536	530	553	562
Warwick ..	742	724	754	794	787	810	779	737	796	797	747	778	596	608	617	629	651	658

Source: Bureau of Meteorology.

RAINFALL EXPECTATIONS WITH SPECIFIED PROBABILITIES FOR TWELVE MONTH PERIOD FROM START OF MONTHS SHOWN (mm)

Source	20% Probability												50% Probability					
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
Banana ..	850	878	873	863	879	875	830	825	809	826	809	823	684	649	657	675	666	671
Boonah ..	1018	1063	1029	1035	1052	1025	1007	1010	1025	1033	1010	1005	884	908	916	875	861	864
Boulia ..	356	349	352	358	376	376	371	356	361	352	367	359	200	190	203	209	205	208
Camboon ..	850	861	899	879	885	865	870	872	864	854	894	862	700	684	696	711	702	705
Cambooya ..	848	867	841	813	846	839	840	839	833	831	811	836	708	716	702	710	701	708
Camooewal ..	495	495	477	472	490	490	488	485	485	475	484	505	362	345	362	369	357	369
Charleville ..	733	693	684	685	666	651	651	641	651	681	727	717	410	434	474	447	465	483
Charters Towers	836	865	826	818	805	826	827	817	809	791	782	785	634	627	640	633	640	651
Clermont ..	868	871	879	879	880	899	862	835	838	858	912	900	621	608	630	636	631	635
Cloncurry ..	603	602	659	571	633	640	640	640	646	638	639	608	443	401	402	415	410	412
Cunnamulla ..	455	477	478	456	457	473	459	439	456	458	464	458	346	356	333	341	347	336
Dalby ..	812	823	805	790	777	799	783	781	775	795	773	797	675	666	650	659	651	650
Emerald ..	800	767	815	840	844	839	785	760	755	792	817	793	603	594	578	608	604	598
Eromanga ..	335	325	335	345	353	373	352	360	374	352	331	347	208	231	232	204	204	194
Goondiwindi ..	774	775	765	740	749	746	728	743	749	742	729	734	606	598	597	577	583	569
Gympie ..	1372	1429	1405	1398	1363	1383	1392	1369	1354	1325	1352	1370	1130	1133	1144	1086	1078	1074
Herberton ..	1360	1411	1373	1420	1417	1436	1433	1385	1382	1374	1380	1398	1138	1083	1112	1101	1136	1128
Hughenden ..	638	645	646	633	641	641	626	619	638	641	636	642	488	467	456	454	441	443
Longreach ..	748	791	678	775	667	630	643	696	698	718	747	775	461	413	425	372	394	375
Marlborough ..	1114	1134	1196	1212	1209	1198	1219	1143	1160	1183	1151	1117	888	863	859	829	828	815
Mount Surprise	1007	1010	949	1008	1060	1055	1068	1060	1033	1020	1054	1066	815	733	785	751	766	767
Nanango ..	970	1017	933	947	945	951	939	941	930	913	931	965	766	777	796	789	782	786
Nebo ..	981	967	1004	933	1008	989	979	941	942	935	951	958	730	705	716	720	705	697
Normanton ..	1165	1205	1168	1189	1201	1200	1212	1211	1211	1211	1206	1200	941	873	926	882	894	893
Palmerville ..	1240	1264	1241	1291	1263	1254	1254	1250	1251	1237	1245	1259	985	1041	1028	987	1035	1035
Pittsworth ..	813	837	830	846	843	847	847	810	812	825	815	821	703	704	698	688	685	685
Roma ..	734	750	752	733	728	721	727	719	744	740	762	750	556	550	571	566	557	543
St. George ..	685	672	670	650	631	650	609	632	630	611	646	640	469	468	470	461	471	476
Tara ..	751	819	791	767	787	787	796	776	758	769	754	749	616	590	606	584	584	578
Warwick ..	806	846	844	841	814	834	824	839	830	823	827	839	691	722	680	682	677	731

Source: Bureau of Meteorology.

**RAINFALL EXPECTATIONS WITH SPECIFIED PROBABILITIES FOR
ELEVEN MONTH PERIOD FROM START OF MONTHS SHOWN (mm)**

J	50% Probability						80% Probability										Centre		
	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O		N	D
629	623	650	676	659	615	600	440	422	408	427	480	484	496	484	507	507	500	493	.. .. Banana
806	814	816	821	816	751	771	600	529	567	602	655	680	672	687	679	677	665	642	.. .. Boonah
196	195	199	196	193	189	185	104	102	93	119	129	134	133	138	134	139	119	123	.. .. Boulia
678	646	649	651	632	614	614	441	446	440	452	455	473	497	514	544	550	494	482	.. .. Camboon
667	661	650	661	665	643	636	509	498	508	540	540	564	559	565	563	554	532	537	.. .. Cambooya
354	357	372	372	361	364	339	193	181	181	191	242	239	248	261	263	265	253	218	.. .. Camooweal
440	450	444	443	433	431	439	279	259	270	305	334	323	324	309	304	313	308	287	.. .. Charleville
625	616	615	619	620	607	596	355	290	317	356	375	374	378	400	433	433	423	396	.. .. Charters Towers
394	395	616	620	606	597	581	377	358	361	369	392	388	385	431	423	423	415	407	.. .. Clermont
391	391	399	412	417	397	387	238	207	206	249	261	262	276	272	270	262	259	255	.. .. Cloncurry
588	323	343	342	340	323	318	185	196	191	209	204	196	201	211	219	202	196	201	.. .. Cunnamulla
561	581	568	578	602	562	529	383	360	362	374	423	464	467	456	480	486	442	421	.. .. Dalby
171	540	567	562	554	559	541	398	374	372	385	397	386	396	410	451	466	433	426	.. .. Emerald
537	187	192	205	210	211	199	109	105	109	122	122	122	108	110	109	118	118	116	.. .. Eromanga
1023	540	547	547	570	553	543	403	394	398	413	422	426	442	466	466	460	448	440	.. .. Goondiwindi
1107	1027	1025	1041	1033	1030	1021	746	734	715	720	798	789	778	819	815	820	807	801	.. .. Gympie
441	1103	1094	1099	1117	1115	1073	715	654	666	663	719	730	748	768	769	782	785	773	.. .. Herberton
375	432	441	452	448	434	435	252	191	227	268	289	298	298	307	309	314	300	276	.. .. Hughenden
789	375	410	422	424	397	404	198	208	236	261	256	233	237	259	256	249	232	258	.. .. Longreach
749	740	773	823	813	805	774	550	456	498	500	552	541	546	587	590	581	564	562	.. .. Marlborough
736	757	772	777	777	770	738	446	378	357	421	508	524	524	525	524	524	510	487	.. .. Mount Surprise
681	710	724	733	718	723	713	546	499	510	521	558	590	566	612	615	611	594	574	.. .. Nanango
888	657	671	690	700	687	671	437	393	404	447	481	482	473	485	502	500	493	476	.. .. Nebo
1024	880	884	888	891	880	847	507	423	475	528	626	631	643	663	663	662	665	632	.. .. Normanton
650	1004	1019	1021	1022	1005	968	666	558	609	634	768	771	783	786	794	789	772	729	.. .. Palmerville
528	643	651	661	652	614	602	486	442	485	476	520	535	507	524	540	529	512	499	.. .. Pittsworth
443	522	513	533	519	494	492	361	370	360	379	387	368	402	408	425	410	401	395	.. .. Roma
562	434	452	455	456	445	438	298	305	313	306	311	314	316	310	321	313	300	310	.. .. St. George
658	535	531	547	556	525	535	365	418	443	389	414	417	409	430	450	453	442	442	.. .. Tara
	664	601	656	654	612	628	486	489	506	468	518	524	527	536	529	511	522	504	.. .. Warwick

Source: Bureau of Meteorology.

**RAINFALL EXPECTATIONS WITH SPECIFIED PROBABILITIES FOR
TWELVE MONTH PERIOD FROM START OF MONTHS SHOWN (mm)**

J	50% Probability						80% Probability										Centre		
	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O		N	D
671	665	681	692	675	686	666	517	490	501	511	514	518	518	518	527	549	552	541	.. .. Banana
864	855	850	864	856	848	860	680	641	687	683	706	699	728	716	715	698	739	739	.. .. Boonah
208	206	203	200	199	198	201	133	124	146	135	148	140	145	138	147	139	138	137	.. .. Boulia
705	691	679	669	669	695	676	553	513	494	486	495	513	626	562	566	571	530	556	.. .. Camboon
708	710	686	690	701	721	713	592	564	602	582	605	588	600	590	591	596	604	617	.. .. Cambooya
369	374	372	372	374	364	365	240	236	240	257	262	251	263	263	265	276	267	234	.. .. Camooweal
483	462	459	472	461	455	464	305	303	361	374	349	333	327	322	328	331	331	313	.. .. Charleville
651	636	633	629	638	628	632	422	408	456	415	394	390	400	437	442	441	426	430	.. .. Charters Towers
412	627	631	632	641	638	624	454	423	440	414	420	405	464	451	444	444	444	442	.. .. Clermont
336	402	412	417	419	409	420	272	289	294	277	271	277	276	272	275	267	291	282	.. .. Cloncurry
650	348	355	355	345	341	348	223	227	221	230	219	224	236	224	230	221	223	206	.. .. Cunnamulla
598	651	662	668	674	665	658	516	506	512	531	529	530	539	533	538	544	544	526	.. .. Dalby
194	595	591	585	598	598	617	464	446	455	429	401	409	429	465	473	472	470	480	.. .. Emerald
569	192	214	215	233	229	200	125	140	138	132	135	128	137	123	119	119	119	129	.. .. Eromanga
1074	586	592	592	605	612	608	468	451	467	467	476	469	482	488	499	472	483	464	.. .. Goondiwindi
1128	1095	1067	1095	1094	1083	1106	897	867	898	871	879	863	849	840	853	882	867	855	.. .. Gympie
443	1135	1122	1123	1142	1162	1114	860	844	804	786	771	761	775	784	792	794	800	836	.. .. Herberton
375	455	457	458	448	450	449	301	311	293	308	310	312	314	314	318	318	308	309	.. .. Hughenden
815	417	445	437	436	429	432	245	284	273	314	260	266	240	261	261	254	259	271	.. .. Longreach
767	805	835	844	856	859	867	593	618	574	597	599	566	591	609	599	597	636	647	.. .. Marlborough
686	772	777	783	783	782	780	503	567	527	542	527	525	525	525	525	525	524	517	.. .. Mount Surprise
797	750	773	765	782	775	767	629	606	619	617	313	603	637	647	646	651	652	637	.. .. Nanango
893	684	708	719	728	717	720	544	527	494	508	511	502	508	523	528	512	517	530	.. .. Nebo
1035	884	888	891	891	896	912	642	596	617	636	637	643	664	663	663	667	665	663	.. .. Normanton
685	1035	1021	1022	1028	1030	1025	781	823	823	794	785	784	796	794	799	789	782	763	.. .. Palmerville
543	682	685	684	681	697	690	567	528	539	541	569	563	566	567	553	570	564	559	.. .. Pittsworth
476	559	548	549	542	549	549	425	410	424	430	414	423	428	449	448	434	442	432	.. .. Roma
578	487	483	479	463	496	481	346	343	348	337	329	336	334	353	339	324	328	332	.. .. St. George
731	569	567	580	574	603	593	473	496	467	450	446	440	446	467	468	484	493	474	.. .. Tara
	677	694	679	698	671	675	561	565	563	505	544	592	546	567	551	576	594	567	.. .. Warwick

Source: Bureau of Meteorology.

Rainfall records indicate the following March totals (mm) for Hughenden for the period 1947-1957.

1947 ..	183	1953 ..	0
1948 ..	21	1954 ..	127
1949 ..	100	1955 ..	312
1950 ..	258	1956 ..	40
1951 ..	0	1957 ..	22
1952 ..	0.6		

To obtain the average or arithmetic mean rainfall for March the procedure is simply to total the 11 separate March rainfalls and divide by the number of years—as follows:—

$$\text{Average (arithmetic mean)} = \frac{1064}{11} = 97\text{mm}$$

The rule for obtaining the median March rainfall is to select the one in the "middle" of all the figures—that is to select the one with as many figures above it as below. To facilitate this selection, the rainfall figures should be arranged in either ascending or descending order—as follows:—

March Rainfall in Descending Order	mm
	312
	258
	183
	127
	100
	40
	22
	21
	0.6
	0
	0

From these figures the median March rainfall is 40 mm for it is the one in the "middle" of the figures in the sense that it has as many figures above it as below. If the median had to be calculated from 10 rainfall figures the "middle two" are selected and averaged.

The median is a very useful concept in situations where unusually high or low, but also

rare values, may considerably distort the average figure. In the example given it is evident that the two falls of 312 and 258 mm have a strong influence in raising the average to more than double the median.

Research into farming and grazing systems

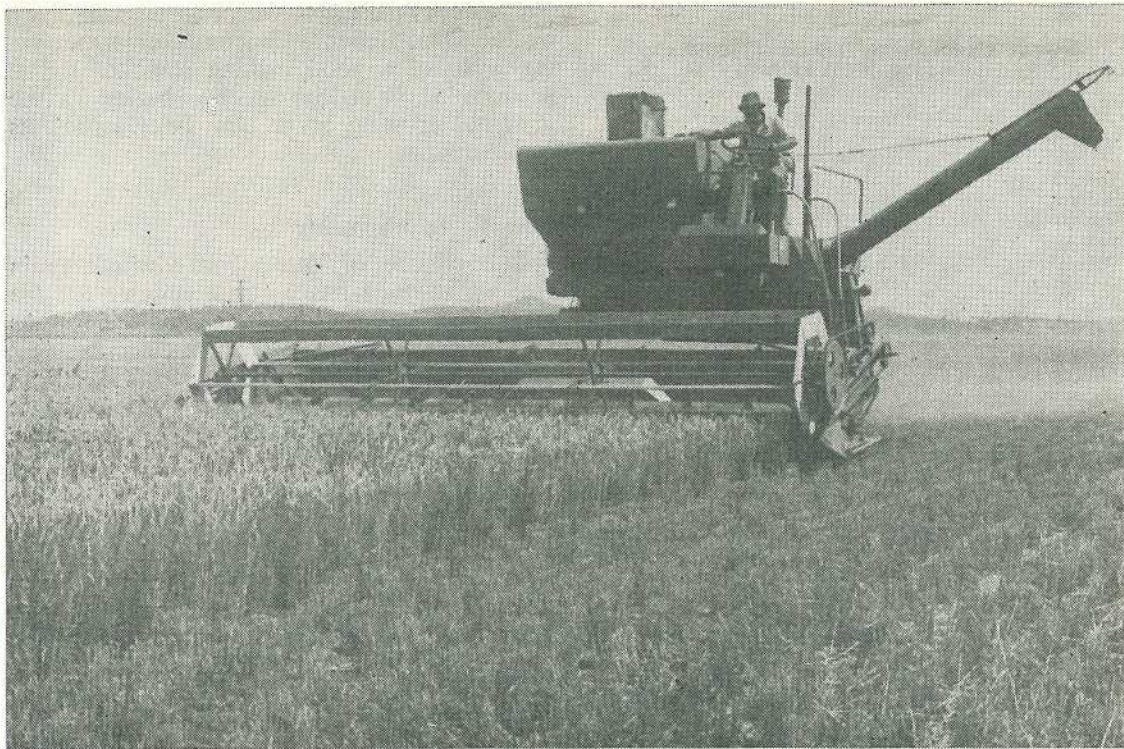
It has been suggested that while there are serious limitations to the use of rainfall probability data, it may nevertheless result in some improvement in farm management.

In the longer-term, it appears that further improvement is likely to result from the efforts of research workers who are constructing "models" of different farming and grazing systems. These models attempt to predict crop and livestock growth from different rainfall and climatic occurrences. Not only the amount of rain is considered important but also its intensity; how much is absorbed by the soil, how much evaporates, and so on.

As more research results become available from different parts of Queensland, it is hoped that it will become possible to build models that can predict stock turnoff and crop yields within a reasonable degree of accuracy. An important component part of these models would be the inclusion of rainfall probability data of the type described.

A very early example of a model for the different pastoral areas of Queensland is the one constructed by the late G. R. Moule and published in his article "Supplementary Feeding of Sheep" which appeared in this Journal in May-November, 1955. At present more complex models are being developed for specific agricultural and pastoral areas including the Darling Downs, the Brigalow, the Mulga country and the Northern Mitchell grass country.

Note:— All rainfall data have been expressed in metric units—viz. millimetres (mm). To convert imperial units to millimetres, inches should be multiplied by 25.4 and points should be multiplied by 0.254.



Harvesting barley on the Darling Downs.

Barley Growing in Queensland

by G. H. MALCOLMSON
District Adviser in Agriculture

While wheat continues as our main grain crop, barley is still of great importance to the Queensland grain industry.

Barley is grown for fodder and grain production. While the bulk of the grain produced is consumed on the home market, a varying portion in amount reaches the export market.

The export barley grain began in 1947. Exports reached a peak of 153 000 tonnes in 1958/59. Since then, export sales of barley have fluctuated because of the inconsistency of supply, demand and prices from overseas buyers.

TABLE 1
BARLEY GRAIN PRODUCTION IN QUEENSLAND
1964-65 TO 1973-74

Season	Area	Production	Yield
	Hectares	Tonnes	kg/ha
1964-65	91 173	161 285	1 769
1965-66	136 859	207 234	1 514
1966-67	155 292	299 243	1 927
1967-68	138 592	203 316	1 467
1968-69	172 782	291 875	1 689
1969-70	168 681	172 064	1 020
1970-71	91 273	61 329	672
1971-72	158 162	248 719	1 568
1972-73	77 922	79 933	1 026
1973-74 .. ..	..	..	..

Table II shows the quantity and value of barley grain exported since the 1964/65 crop.

TABLE 2
EXPORT SALES—1964-65 TO 1973-74

Season	Tonnes	Total Value	Value
		\$	\$/tonne
1964-65	14 020	746 950	52.3
1965-66	8 218	400 587	48.7
1966-67	23 840	1 321 618	55.4
1967-68	43 133	2 121 379	49.2
1968-69	30 477	1 121 346	36.8
1969-70	12 801	489 968	38.3
1970-71	4 172	219 847	52.7
1971-72	15 267	530 020	34.7
1972-73	Nil	Nil	Nil
1973-74	60 854	5 144 143	84.5

The Darling Downs, the principal barley growing region in Queensland, produced 82 per cent. of the 1972-73 crop, the Burnett region produced 8 per cent. and the rest of the crop was grown in the Moreton, Near South West and Capricornia regions.

Barley received by the Barley Marketing Board is graded as suitable for malting I and malting II, milling, stock feed or seed.

Most malting barley is produced on the south-eastern Downs. Barley for grazing can be grown in most Queensland environments except the tropical coast.

Growers in districts with hot, crop-finishing weather find difficulty in consistently marketing grain of a good malting standard. The production of malting quality barley in the marginal growing areas may be regarded as opportunistic.

Climatic requirements

The climate of Queensland's winter grain growing districts has a range suitable for the production of the various types of barley. As with wheat, crop success is largely dependent on soil moisture reserves at planting. Both crops have somewhat similar soil moisture requirements and respond in much the same way to the local climatic patterns.

Climatic conditions for malting barley are more exacting than those required for the production of barley to be used for food. Hot dry weather during ripening forces maturity and favours the development of thin, coarse-skinned, vitreous grains instead of the plump, mellow type of grain sought by the maltsters.

Soil requirements

Soil requirements vary with the purpose for which the crop is grown. Good yields of high protein grain are obtained on fertile soils of good depth and moisture holding capacity. The plains of the Darling Downs and the brigalow soils all meet these requirements. To secure the low protein grain used by maltsters, soils with less available nitrogen are needed. These soils are generally associated with the older cultivations of the eastern Downs.

Barley is hardier than wheat and has a place in those areas which return only average or below average wheat yields. On low fertility soils, barley is more dependable than either wheat or oats.

Land preparation

A disc cultivator, scarifier or chisel plough, combine drill and harrows are normally used in preparing land for barley.

The first cultivation should rarely exceed 12 cm with later workings aimed at establishing a firm seedbed 5 to 7 cm. from the surface.

After the first cultivation, the soil surface is allowed to lie in a rough state. All subsequent tillage operations are then directed towards moisture conservation by the elimination of weeds and the provision of loose, rough surface mulch.

The breaking of surface crusts encourages infiltration and increases soil moisture reserves. The mulch provides insulation for the moist, subsurface soil and minimizes evaporation. This protection is particularly important in clay soils which tend to crack during hot, dry periods and so lose further moisture from the deeper layers.

Tined implements are preferable for these workings as they have the advantage of cultivating weeds without unnecessary soil inversion and undue loss of moisture. At the same time, the tines prepare an even seedbed and maintain a stubble layer to minimise erosion.

During the normal, heavy rains of January, February and March, it is essential to maintain a rough land surface to promote water infiltration and conserve soil moisture.

Varieties

Since 1971 the South Australian bred variety Clipper has been the only two-row malting type accepted by the Barley Board for malting and milling purposes.

The Queensland Barley Marketing Board replaced the previous variety Prior because of the higher malt extract and superior yielding qualities found in Clipper.

Clipper, an early/mid season maturing variety, has an erect habit of growth, with a firm bright coloured strong straw.

It is less subject to lodging than Prior. It has a medium-dense head and is semi-erect during the growing period. Because of the semi-erect characteristic of the head, it is less susceptible to head snapping than Prior.

Apart from its higher malt extract and superior yielding ability, the main distinguishing feature between Clipper and Prior is the grain. The grain of Clipper is slightly smaller than that of Prior, but can be positively identified by the presence of long rachilla hairs.

Of the six-row types used for feed grain and grazing, Cape is still the principal variety grown. Skinless, an awnless variety which resembles wheat when threshed, is popular in some areas as a stock feed, as the grain yield is good and there is no problem with broken awns. Black barley is sown for grazing.

Time and rate of sowing

Barley planted for grain purposes is generally sown from May–August. The optimum time for malting quality barley is May; these crops mature in the cooler spring months and hot, dry conditions during ripening are avoided. Late sown crops generally produce grain more suitable for human consumption or livestock feeding.

Grazing crops of barley can be sown from early March to late August, with the best performance being provided from the early sown crops. Barley will produce quicker feed than other winter grazing crops and can be sown late in the season to provide spring feed.

The rate of sowing varies with the soil type and the locality. In the principal barley growing areas, the sowing rates vary from 45–55 kg per hectare, while in the more marginal areas rates of 25–30 kg per hectare are more common. In late plantings, sowing rates should be increased to offset lower stooling.

Seed quality and treatment

As in all crops, the quality of the seed sown is very important. If the crop is sown for malting grain, it is necessary to avoid mixtures of seed of various varieties as such mixtures cause quality control difficulties in the malt-house.

Until recently the Barley Marketing Board provided selected seed of Clipper which had been treated with a fungicidal dressing for protection against covered smut. Seed barley for the 1974 sowing was not treated, due to the ban on the use of mercury, and the absence of a suitable replacement fungicide.

Investigations are continuing for a suitable replacement and the Board envisages this will be available for the 1975 season.

Weed control

With all weeds, cultural methods of control supported by adequate farm hygiene are the most effective.

A range of broad-leaf weeds may be controlled with 2,4-D Amine 50% concentrate spray, at a rate of 1 100 ml/ha applied when the crop is in the tillering stage.

Damage and loss of yield may occur if the crop is sprayed in the later stages of growth.

The more difficult weed species such as climbing buckwheat and New Zealand spinach can be controlled by the use of Tordon 50D (regd. trade mark) (Picloram) plus 2,4-D. Rates of application will vary according to the stage of growth of the weeds present. Weeds at the three-leaf stage can be controlled at a rate of 350–450 ml/ha of Tordon 50D (regd. trade mark), plus 350–450 ml/ha of 2,4-D Amine 50%.

Buctril MA or Brominil M applied at 1 400 ml/ha are alternative herbicides to the Tordon 2,4-D mixture where crops which are susceptible to herbicide residues are to be double cropped into barley stubble.

Black oats in barley can be controlled with Avadex BW, applied at the rate of 2100 ml/ha, prior to planting.

Harvesting

A clean grain sample is essential so the crop requires considerable care in harvesting. Barley, especially a heavy crop, is more difficult to handle than wheat and often needs slow ground speeds to avoid threshing losses.

Mature barley does not stand as well as wheat, and harvesting must be undertaken promptly when the crop reaches maturity (October–December). Large sowings of barley should be made only when adequate harvesting machinery is available. The Barley Marketing Board will receive bulk barley of 12½% moisture content and bagged grain of 13½% moisture content.

Careful harvesting is particularly important in the production of malting barley. In the production of malt, barley is steeped in water, germinated under controlled temperatures, moisture and time conditions, and finally dried.



A maturing crop of Clipper barley.

The malting process is thus based on germination of the grain. Germination of 95–100% is necessary to produce high quality malt and the germination must be vigorous and uniform.

Germination is impaired in many ways, including harvesting damage, excess moisture, heat damage, weathering, sprouting and frosting. The avoidance of harvesting damage is in the grower's hands. Properly threshed kernels should have the base of the beard attached. Skinned, cracked or broken kernels, the result of close threshing, are unacceptable.

If malting grade is to be obtained barley growers must pay adequate attention to the setting of their harvesters, each of which varies somewhat. The harvester must be adjusted during and between days of varying temperatures and moisture conditions.

Marketing

The Barley Marketing Board in Queensland is a statutory body which receives and disposes of the State's crop. Grain is received in bulk or in bags, but most of the crop is handled in bulk. Installation of facilities by maltsters has accelerated the trend towards bulk handling.

TABLE III
BARLEY MARKETING BOARD RECEIVALS AND GRADINGS FOR RESPECTIVE PRODUCTION AREAS

	1967-68	1968-69	1969-70	1970-71	1971-72	1972-73
	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes
Northern Downs—						
Malting	16 335	17 610	248	324	5 710	2 772
Milling	6 049	10 392	1 969	799	18 421	2 756
Feed	85	276	373	68	410	..
Seed .. .. .	..	..	42	..	..	..
	22 469	28 278	2 632	1 191	24 541	5 528
Central Downs—						
Malting	37 904	55 194	22 868	3 872	38 151	4 233
Milling	13 395	25 700	24 485	9 474	46 662	1 605
Feed	210	1 081	1 004	1 314	243	..
Seed	2 819	2 785	1 674	..	..	..
	54 328	83 760	54 155	17 768	85 056	5 838
Southern Downs—						
Malting	6 262	15 047	5 204	434	11 953	308
Milling	767	1 463	4 075	1 191	6 678	190
Feed	48	247	262	462	48	..
Seed .. .. .	..	..	..	..	..	..
	7 077	16 757	9 541	2 087	18 679	498
Near South-West—						
Malting	104	1 257	524	..	668	5
Milling	348	4 569	3 472	930	10 843	219
Feed	254	768	457	280	663	..
Seed .. .. .	..	..	..	..	..	..
	706	6 614	4 453	1 210	12 174	224
Burnett—						
Malting	308	1 196	28	15	101	219
Milling	895	784	683	78	1 422	336
Feed	41	153	388	32	8	..
Seed	130	301	252	15	275	164
	1 374	2 434	1 351	140	1 806	619
Biloela-Central Highlands—						
Malting .. .. .	..	121	..	..	..	..
Milling	258	386	..	..	..	..
Feed	76	21	..	..	..	..
Seed .. .. .	..	..	..	..	..	..
	334	528	..	..	..	..
Other—						
Malting	360	263	19	19	463	..
Milling	207	827	389	996	5 993	45
Feed	207	309	271	155	13	..
Seed	174	..	..	..	..	..
	948	1 399	679	1 170	10 146	45
TOTAL	87 236	139 770	72 811	23 566	152 402	12 752



Baling barley stubble on a Darling Downs dairy farm.

The State Wheat Board handles the intake, initial classification and country storage of barley on behalf of the Barley Marketing Board. This arrangement has avoided duplication of handling facilities and has proved quite satisfactory because a substantial proportion of the barley is normally delivered before the main wheat harvest.

Barley is classified into malting, milling and seed grades. The standard requirements set by the Board for malting barley are:—

- Malting I up to 1.84% Nitrogen content
- Malting II 1.85–1.95% Nitrogen content.

There is a nil tolerance of cracked grain and a maximum of 5% screenings.

Grain must also be free from other seeds and weather damage such as frosted grain.

The same standards apply for barley kept for seed.

Payment to growers is made according to grade, and premiums are paid for the higher grades of grain. Seed grain is accorded malting status or above for payment purposes.

Prices for the 1972-73 crop were \$56.09 for Malting, \$51.69 for Milling and \$60.52 for Seed per bulk tonne respectively. Returns to growers from the Board for several years are listed in Table IV.

TABLE IV

Year	Average (all grades) Returns from Barley Board
	\$/tonne
1969-70	44.21
1970-71	45.15
1971-72	39.37
1972-73	54.96

Barley diseases

Loose and covered smut together with powdery mildew are the main diseases occurring in Queensland barley crops. Unlike wheat, barley is rarely severely attacked by the rust fungus.

Heads of barley infected with covered smut generally appear a little later than healthy heads, and they are readily recognized by the smut balls which replace the seeds. At first, a grey membrane covers the smut balls, but this membrane breaks open before or during harvesting to liberate a mass of black spores. Spores are distributed in healthy seed where they are carried on or beneath the glumes. When such infected seed is sown the following season, the fungus germinates with the seed, infects the plant and re-appears at heading.

Covered smut can be effectively controlled by seed dressings. Until recently, organic mercurial fungicides were used, but these have now been banned. Two replacement chemicals, Mancozeb and Carboxin, are available as commercial seed dressings.

These are sold as 75 per cent. strength preparations. Carboxin has the added advantage of controlling loose smut; however, the cost of the chemical may preclude its use as a general seed treatment. Treatments are applied as a dust. Application rate is 100 grms. per kilogram seed (2 oz. per bushel). Any unused treated seed should not be fed to stock. Further investigations are in progress and other materials may become available in the near future.

The loose smut disease of barley produces a dark powdery mass of spores in place of the floral organs of the plant, and this spore mass is blown and washed from the infected plant by wind and rain, so that at the time of harvesting only the empty stalk remains.

Loose smut infection occurs only at flowering time. Under conditions of high humidity, spores may germinate within a flower if inoculum is present within a crop, sending an infection thread into the developing seed. The plant developing from this seed will be "smutted".

Control measures for loose smut rely largely on the elimination of the disease from areas to be used for seed. Where infection is suspect in seed lines, stocks have been treated

with hot water, to eradicate the infection. A chemical, Carboxin, has recently been registered as a barley seed dressing and controls loose smut. This product can be recommended for seed areas in place of the more laborious hot water treatment.

Powdery mildew disease produces small, greyish-white powdery patches over the leaves. These patches develop to cover a large portion of the plant, particularly of the lower leaves. When the attack is severe, the lower leaves yellow and die off. While the disease is readily controlled by sulphur fungicides, this is not an economic measure.

Clipper was initially resistant to powdery mildew, but over the past three seasons its resistance has broken down and now it is as equally susceptible to this disease as Prior.

In addition to providing seed and handling the crop, the Board also operates a compulsory hail insurance scheme for growers.

Insect pests

In common with other cereal crops, barley is subject to a number of general feeding pests which can cause widespread losses, particularly when effective and prompt control measures are not taken.

The most common and serious pests are cutworms, armyworms and locusts. Other pests which are occasionally encountered are: blue oat mite, petrobia or brown wheat mite, false wireworms and ants.

Cutworms can cause serious reductions in plant stands by chewing through the stems of seedlings, while armyworms may attack the crop at any stage of growth and consume all of the above ground parts. The more serious losses occur in ripening crops, when the armyworm caterpillars cut through the stems and heads fall.

Locusts are occasionally encountered as pests, particularly in the more western districts. Swarms of the immature stages of hoppers can menace the crop by consuming all above ground parts.

Control measures

Chemical control is the most effective means of controlling these pests.

Cutworms and armyworms

Chemical control measures in the past have been based upon the hydrocarbon insecticides such as D.D.T.

On barley crops, where stubble is to be utilized for stock, or in straight grazing crops, trichlorophon ("Dipterex S.P. 80", "Klorfon") at the rate of 650 g a.i./ha, should be used.

D.D.T. is unacceptable for use in barley crops, except for cutworm control. D.D.T., applied at the rate of 550 g a.i./ha (1 gallon 25%–5 acres), will give satisfactory control of cutworms but is only to be used on crops not intended for grazing.

Locusts

Locust invasion may be checked by spraying over and around the swarms with insecticides.

Insecticides gaining some measure of control on these pests, are as follows:—

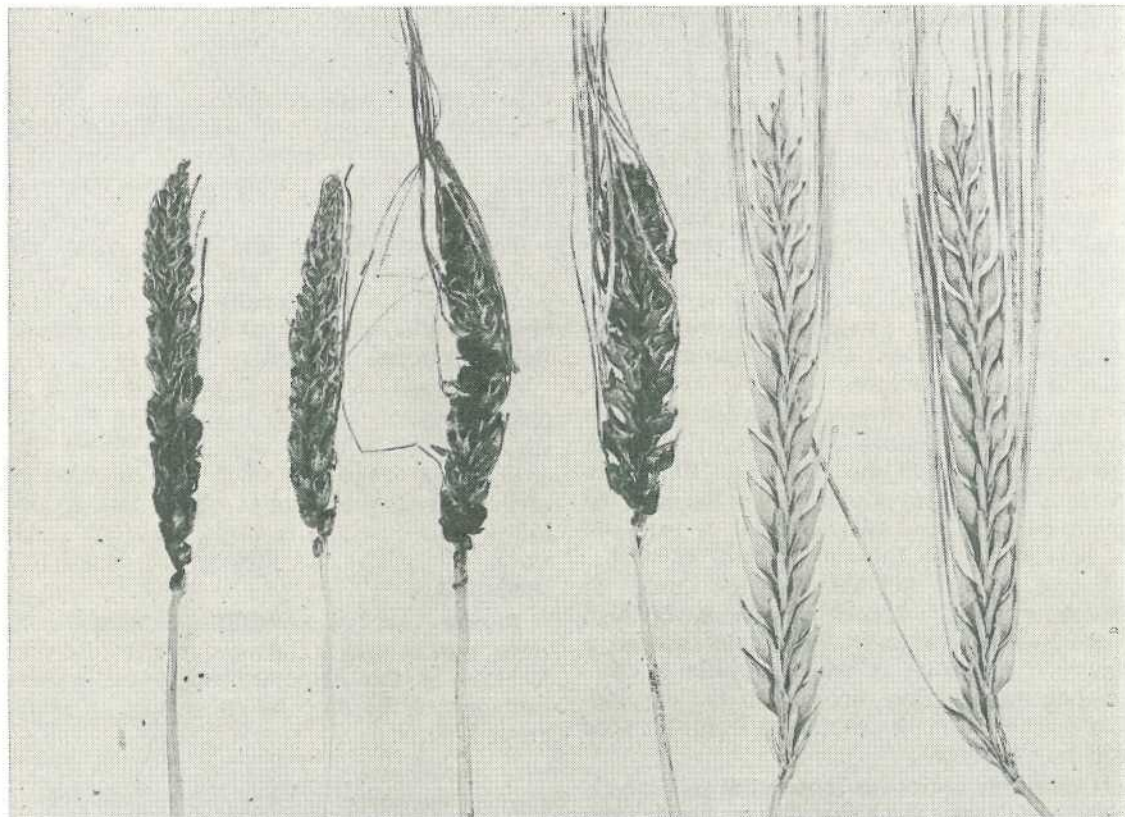
Australian Plague and Migratory Locusts

Fenitrothion	..	325 g/ha
Carbaryl	.. ..	600–700 g/ha
Maldison	.. ..	500–700 g/ha
Naled	.. ..	300–450 g/ha

Spur-throated Locust

Monocrotophos	..	275–550 g/ha
Diazinon	.. ..	550–700 g/ha
Naled	.. ..	400–600 g/ha

Stock should be withheld from crops after application of these chemicals. The length of the withholding period varies with the chemical



*Covered smut—potentially an important disease of barley in Queensland.
Left: smutted heads; Right: healthy heads.*

used. Those given in Table V should be used as a guide:—

TABLE V

Chemical	Recommended withholding Period
Maldison	7 days
Carbaryl	7 days
Naled	1 day
Monocrotophos	at least 21 days
Fenitrothion	7 days
Trichlorphon	2 days

Marsupials, Wild Pigs and Mice can also affect barley production, but their occurrence is generally sporadic.

Economics of barley production

The following is an example of Gross Margins using costs typical of barley growing on the Darling Downs. The assumptions are arbitrary, so where possible a Gross Margin relative to a property or district should be worked out using the practices and costs for that property or district. Yields and recommended practices can be obtained from the text.

NOTES:—

1. Seed:

Cost of seed for the 1974/75 season is:

Toowoomba Depot—

	c/kg
Reserve seed	9.39
Selected seed	9.61

Dalby, Brookstead, Kingaroy, Clifton—

Reserve seed	10.41
Selected seed	10.63

2. Plant Operating Costs:

Includes 4 cultivations, planting and harvesting.

3. Aerial Spraying:

Cost of ground spraying of weeds is less than for aerial spraying.

4. Price:

As a guide to price, estimated total payments to growers for the 1973/74 season (only Board administration costs have been deducted) were:

	\$ per tonne
Selected Seed	74.00
Reserve Seed	70.70
Malting 1	68.50
Malting 2	64.50
Milling	62.00

(For the grades of barley usually grown in different areas, see Table III).

The nett farm gate price used in the Gross Margins table is gross price less:

- Board administration costs,
- Hail levy,
- Cartage to railhead (average \$2 per tonne),
- Rail freight.

No individual rail freight is deducted from growers within approximately 80 kilometres from Toowoomba. However, a differential freight has been in use since 1973-74 season and is paid by growers outside that area as follows:—

	\$/tonne		\$/tonne
Chinchilla ..	2.07	Magee ..	3.21
Gulera ..	1.27	Marnhull ..	1.27
Inglewood ..	2.51	Mocatta's Cnr.	0.39
Jandowae ..	1.41	Pirrinuan ..	0.48
Jimbour ..	0.92	Texas ..	3.26
Kaimkillenbun	0.70	Warra ..	1.36
Kupunn ..	0.49	Waranga ..	1.67
Kuyura ..	1.19	Yelarbon ..	3.00
Macalister ..	0.79		

VARIABLE COSTS PER HECTARE—RAINGROWN BARLEY

	\$
Seed—40 kg at 9.59 cents/kg	3.83
Fertilizer—40 kg N at 18.9 cents/kg	7.56
Weedicide—0.33 litre Tordon +0.331 litre 2,4-D (50%)	1.83
Insecticide	
Plant Operating Costs	9.00
Aerial Spraying of Weedicides	2.60
	<u>\$24.82</u>

GROSS MARGINS PER HECTARE

Yield Tonne/ha	Net farm gate price (\$/tonne)							
	40	45	50	55	60	65	70	75
1.0	15	20	25	30	35	40	45	50
1.5	35	43	50	58	65	73	80	88
2.0	55	65	75	85	95	105	115	125
2.5	75	88	100	113	125	138	150	163
3.0	95	110	125	140	155	170	185	200
3.5	115	133	150	168	185	203	220	238
4.0	135	155	175	195	215	235	255	275

Grazing

Barley is sometimes grazed once or twice before the crop is taken off. If grazing is practised, some estimate of the income from live-weight gain of livestock on the crop should be included in the gross margin.

Acknowledgement

The assistance of the Barley Marketing Board, Toowoomba in the preparation of this article is gratefully acknowledged.

“HEN QUOTAS ACT 1973”

ALL appeals which were made under Section 47 of this Act by persons aggrieved by any decision of the Hen Quota Committee (with respect to the initial allocation of an egg producer's basic hen quota) have now been heard and finalised by the Hen Quota Appeals Tribunal. The closing date for appeals was 5 p.m. on December 9, 1974.

The Tribunal sat at Toowoomba, Rockhampton, Mackay, Townsville, Cairns and Brisbane for a total of fifteen sittings. These were held wherever sufficient appeals were received to warrant the Tribunal going to that centre.

A summary of the Tribunal's findings is as hereunder:

	Total Number of Appeals	Appeals Upheld	Appeals Dismissed
District 1	45	12	33
District 2	4	1	3
District 3	10	4	6

Adjustments to successful appellant's quotas will be published in the *Government Gazette* in due course.

A number of appeals were upheld, due mainly to the fact that the Tribunal had the benefit of evidence given at first hand by legal, accounting, taxation and other technical experts and was able to cross-examine on the various points put forward and to call for documentation where necessary.

The attention of the Tribunal has been brought to the apparent misunderstanding in some sections of the Industry insofar as it is not fully realised that the egg producer's basic hen quota attaches to both the person to whom it is allocated and to the land specified in such allocation, and that before any sale of the land or quota is contemplated or made the consent of the Hen Quota Committee to the transfer of the egg producer's basic hen quota should be obtained.

It became fairly obvious during the Tribunal's sessions that when the original quotas were being allocated by The Hen Quota Committee a lot of information presented to the Tribunal had not been available to the Committee, and that they had performed a very difficult task in a very fair and impartial way on the facts known to it.

H. P. Ryan (Chairman)

Hen Quota Appeal Tribunal

Three leaf and stem diseases of lucerne

Downy mildew

DOWNY mildew (*Peronospora trifoliorum*) is seen mostly during the cooler months of the year. Thick, or excessively weedy stands are usually affected.

It may also be severer in lower sections of paddocks where mists lie during the early hours of the morning.

Symptoms are usually more obvious on the young tips of plants. Leaflets are distorted, with the margins curled downwards, and the upper surfaces of affected leaves at first show a much lighter green colour than usual.

As the disease develops, the leaves yellow and may appear scorched. On the lower surfaces of these affected leaves, a light purple to grey, downy growth is visible. This growth is characteristic of the disease and is the reason for the common name of 'downy mildew'. Young stems may also be affected, resulting in a wilting and death of shoots.

The fungus causing the disease produces masses of spores on the diseased leaves, and these permit rapid spread of the fungus if rainy conditions are frequent.

Downy mildew causes little permanent damage to older stands of lucerne. They may sometimes appear unattractive, but recovery is rapid when the weather becomes warm and dry. On the other hand, it may kill seedling plants. Spraying to control this disease is not considered economical.

Common leaf spot

COMMON leaf spot (*Pseudopeziza medicaginis*) is the most common disease of lucerne in Queensland and may be found in almost every crop.

It attacks the plants at all times of the year, but is more common during winter months.

The disease is recognized by small, dark-brown to black leaf spots about the size of pin-heads. Leaflets may be almost completely covered by these spots. Such leaves frequently yellow and fall prematurely, reducing both the quality and quantity of the hay.

Leaf stalks and stems may also be affected where the disease is severe. Spots appear first on the lower leaves and progress up the plant.

With rainy weather, masses of spores of the fungus are produced on the leaf spots. This permits a rapid build-up and spread of the disease. Fallen leaves may remain a source of the fungus for a considerable time.

Stands which are growing vigorously and are cut regularly are less likely to be affected by common leaf spot. If excessive leaf fall is likely, cutting is recommended.

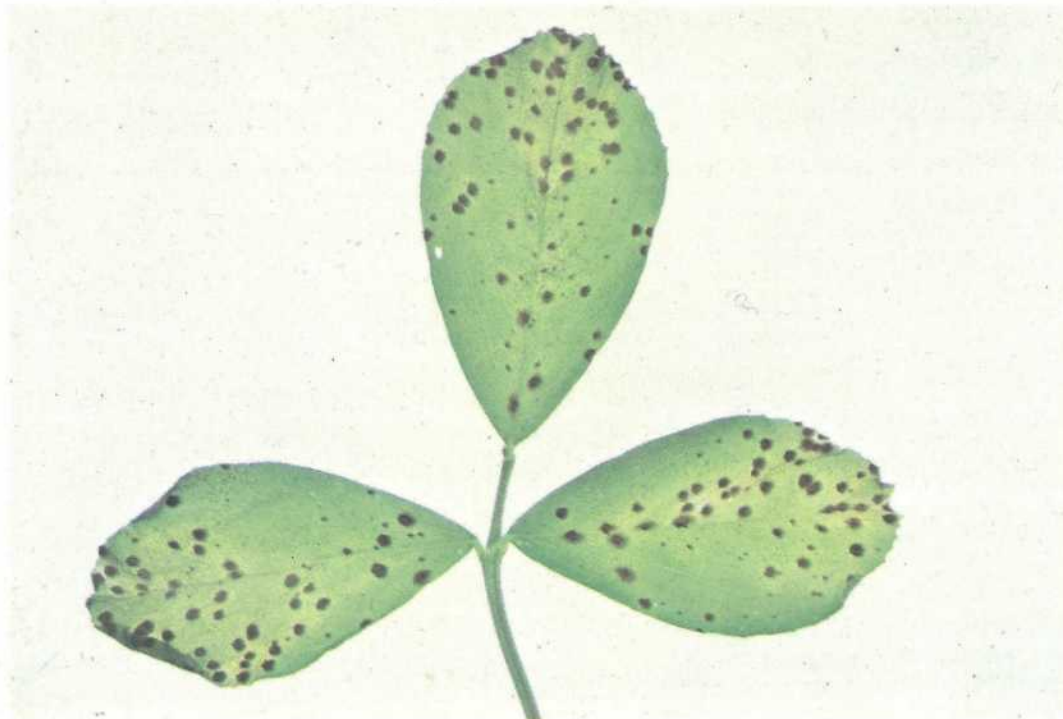
Compiled by N.T. Vock, Plant Pathologist

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

Diseases of lucerne - 4

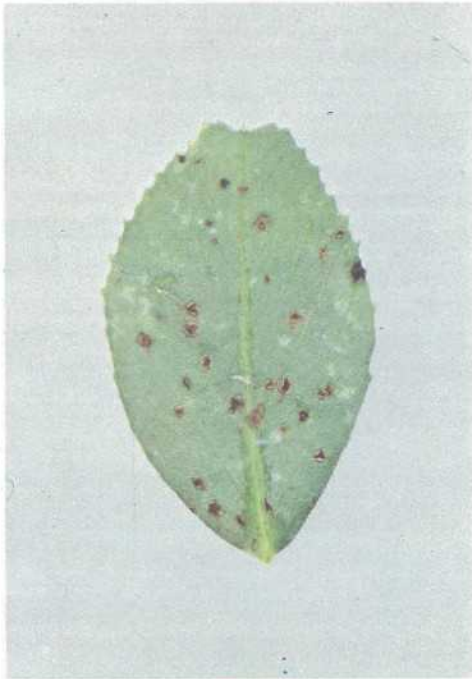


Downy mildew. Left: upper surface of leaf. Right: lower surface of leaflet showing downy growth

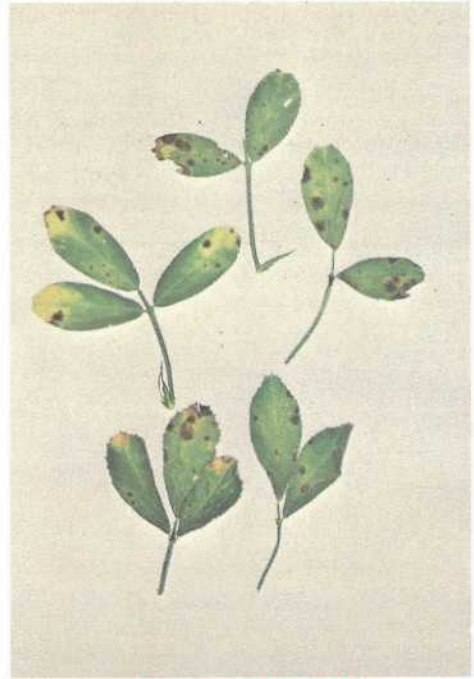


Common leaf spot

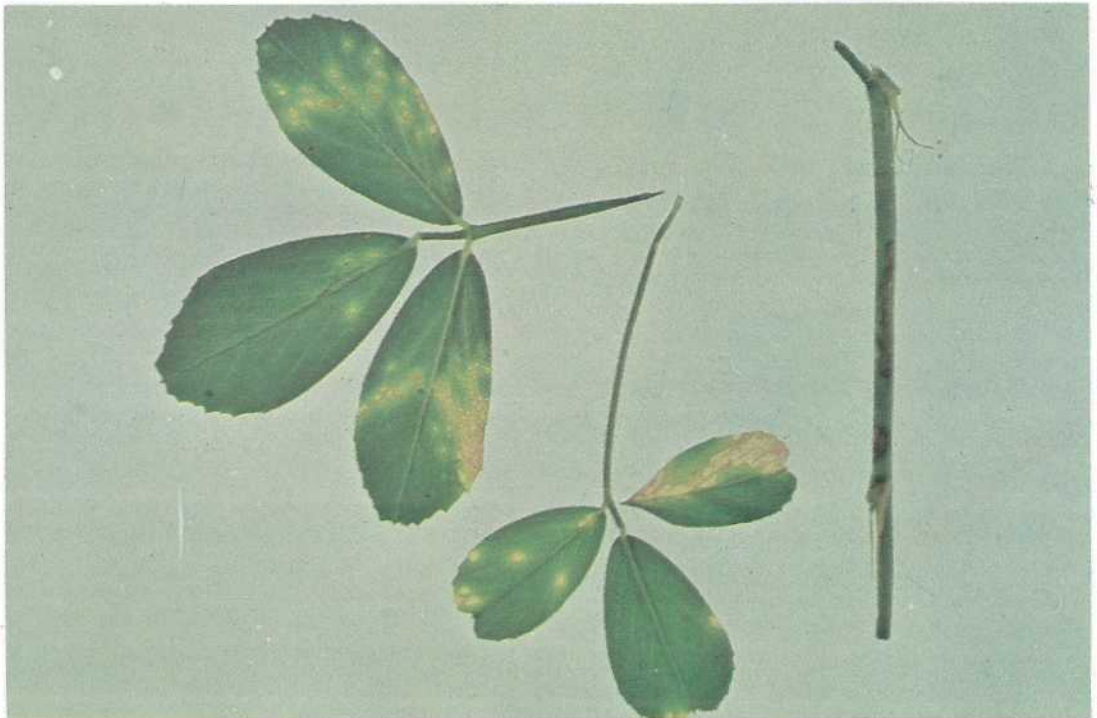
Diseases of lucerne - 5



Rust



Cercospora leaf spot



Bacterial leaf and stem spot

Two leaf diseases of lucerne

Rust

RUST (*Uromyces striatus*) may be found throughout the year in lucerne stands but is generally more severe during the moist and warm months.

Rust is recognized by the reddish-brown spots or pustules formed on the lower surfaces of the leaves. The spots are often surrounded by yellow haloes. Stem spots may also be seen, particularly in thick stands or where the interval between cutting has been extended.

Spores are produced in large numbers in the pustules thus causing a rapid build-up and spread of the fungus during moist weather.

Although young stands may sometimes be severely affected, symptoms generally pass quickly once the weather becomes drier. Timely cutting will also prevent serious leaf loss.

Cercospora leaf spot

CERCOSPORA leaf spot (*Cercospora zebrina*) is not a very important disease in Queensland but occurs occasionally during the warmer months of the year.

Leaf spots are usually about 5 mm across, irregular in shape, and a light-brown colour. Stem spots may also form, but these are generally darker in colour. Severely affected leaves yellow and fall prematurely.

The larger leaf spots distinguish this disease from common leaf spot caused by *Pseudopeziza medicaginis* for which the spots are rarely larger than pin-heads.

Bacterial leaf and stem spot

BACTERIAL leaf and stem spot (*Xanthomonas alfalfae*) is favoured by wet, humid conditions and may be serious on young plants during the summer.

Leaf symptoms begin as small, circular, water-soaked spots within a general chlorotic area. These spots enlarge and become tan with a yellow central area and chlorotic margin. The spots eventually become bleached and papery and leaf fall may result.

Stem spots are water-soaked or greasy and roughly circular. Adjacent spots often coalesce to form large, diseased areas extending from node to node. Eventually this area develops a dark-purple margin.

The economic importance of this disease has not yet been estimated.

Compiled by N.T. Vock, Plant Pathologist

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

Bitter peas add a touch of yellow

by BERYL A. LEBLER, Senior Botanist.

IN springtime, wildflowers of many colours brighten sandy wallum stretches along the coast and the hillsides in open eucalyptus forests.

Among the wild pea-flowers contributing different tones of yellow and gold to this colourful display are various species of *Daviesia*. The foliage and, in some cases, the whole plant has a very bitter taste, hence the common name of bitter-pea applied to these plants.

The name *Daviesia* was given to this genus in 1798 by Sir James Edward Smith, a British botanist, in honour of 'Reverend Hugh Davies, a Welsh botanist celebrated for his knowledge of the British flora'. Bitter-peas are found only in Australia, and it is virtually certain that the Rev. Mr. Davies, after whom the genus was named, never saw them growing wild!

They are shrubs or undershrubs, with simple, entire, alternate leaves. These can be flat and horizontal, flat and vertical, terete and spine-like, or reduced to short spines. In some Western Australian species, the stems are flattened and bear no leaves at all.

In the Queensland species, the flowers are usually golden yellow, or partly orange-yellow and partly reddish-brown, or a wine colour. In some other Australian species, the colour can be apricot, flame, wine-red or purple.

Individual flowers are usually small. Normally they are grouped in racemes or in umbels in the leaf axils. Very rarely they may be terminal or solitary. The flowers of bitter-peas, like wedge peas and dogwoods, have five sepals, five petals, and ten free stamens.

The sepals are joined to form a tube in which the two upper calyx lobes are often united almost to the end, to form a truncated upper lip. The prominent reflexed standard is usually entire and not notched at the tip. The ovary has a short stalk and contains two ovules.

The flattened triangular pod, with its nearly straight upper edge and its lower edge curved almost into a right angle, is peculiar to bitter-peas.

Five bitter-peas are common in south-eastern Queensland: *Daviesia umbellulata*, *D. ulicifolia*, *D. squarrosa*, *D. wyattiana* and *D. arborea*. Another species, *D. genistifolia*, does grow in the area, but has been collected near Helidon only once (in 1930). By comparison with other native 'pea-flowers' the blossoms of bitter-peas are small and relatively insignificant.

Daviesia umbellulata. This species has no common name. The specific epithet for this plant is derived from the Latin word *umbellula*, the diminutive form of *umbella*. It means a little sunshade or parasol and refers to the inflorescence.

DISTINGUISHING FEATURES. The leaves, which are rigid, pungent-pointed and horizontally flattened, together with the appearance of the inflorescence, distinguish this bitter-pea from the others found in south-eastern Queensland.

DESCRIPTION. It is a slender, much branched shrub up to 2.5 m high, often with long, arching branches. It can be glabrous, but more often the branches are covered by spreading hairs. These can be either sparse and short, or dense and long.



A *Daviesia umbellulata*.

The leaves are sessile and project straight out from the stem in a horizontal plane. They are 1.25 to 1.9 cm long and 0.2 to 0.7 cm wide. A single vein runs down the centre of the leaf and each leaf ends in a rigid, pungent point.

On plants with hairy stems, usually the leaves are also hairy, particularly on the margin and along the vein on the lower surface of the leaf.

The inflorescences arise from the axils of the leaves and often far exceed them in length. Although, in the strict botanical sense, the inflorescence is a form of raceme, the axis is so short that at first glance it appears to be an umbel.

As many as seven flowers, each on a slender stalk 0.6 cm long, form the inflorescence. Individual flowers are 0.5 cm long.

The calyx tube is half the length of the flower. It is not uniformly green in colour but, in places, is tinged with dark reddish brown. The short triangular calyx lobes have blunt tips. The reflexed standard is twice as wide as it is long, dark reddish brown at the base, with a broad margin of rich golden-yellow.

The almost rectangular wings are 0.25 cm wide and twice as long as wide. They are usually the same colour as the base of the standard, with a golden-yellow tip. Between the wings, the reddish-brown keel can be seen. A characteristic of the inflorescence is that all the flowers tend to face in the same direction.

The pod is 0.6 cm long and, as in other species of *Daviesia*, splits along the lower edge into two valves, each rolling in on itself to form a cone. Inside there is usually only a single smooth, reddish-brown, kidney-shaped seed.

FLOWERING TIME. Spring.

HABITAT. It is found in the coastal wallum areas, growing in sandy soil, sometimes in swampy areas. It also grows on hillsides in open eucalytus forests, in stony, gravelly soil.

DISTRIBUTION. It is found from as far south as Port Jackson in New South Wales to as far north as Howard in Queensland.

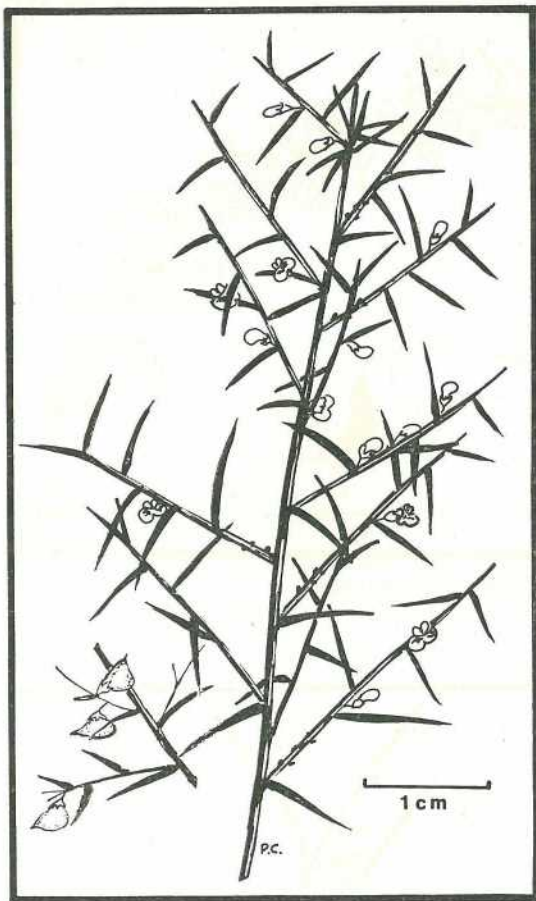
GENERAL REMARKS. Although this is a very prickly plant, it is most attractive, both in flower and in fruit. It blooms in such profusion that the weight of blossom often bends the slender branches.

Native gorse

NATIVE GORSE (*Daviesia ulicifolia*). *Ulex* is the botanical name for gorse, a spiny shrub once cultivated in Europe for its fragrant blossom and now a common weed in many temperate regions.

Its leaves are reduced to a thorn-like leaf stalk. Native gorse has leaves of a similar appearance, and this is the reason for the choice of the specific epithet.

DISTINGUISHING FEATURES. The spinescent branches, the horizontally flattened, rigid leaves and the small number of flowers in the inflorescence are sufficient to distinguish this bitter-pea.



B Native gorse (*Daviesia ulicifolia*).

DESCRIPTION. This is an intricately branched shrub about 1 m high, with many thin, woody branches, each usually ending in a spine. The lateral branches are arranged in a loose spiral, slanting upwards at an angle of about 45 degrees. As they are spaced at intervals of about 1 inch, this makes the plant very prickly to handle.

The branches can be glabrous or covered with spreading hairs. The green leaves are firm in texture and closely arranged along the twigs, projecting out at right angles to them. They are usually 1.25 cm long and less than 0.25 cm wide. Because they are horizontally flattened, they look like flattened thorns.

Usually there is only one flower on a very short stalk in a leaf axil, but sometimes three or four flowers form a short raceme. The flowers are less than 0.6 cm long, with a green calyx about 0.25 cm long, in which the free calyx lobes are as long as the tube. The three lower lobes are green, and the two upper lobes are flushed with red. These two upper lobes are a little longer and broader than the others.

From a distance, the overall appearance of the flowers is an apricot colour. The reflexed portion of the standard is less than 0.6 cm across. Its base is wine-coloured, and in older flowers, the margins and tips fade to a golden colour. The narrow wings are wine-coloured with a golden tip, and the narrow keel is the same colour as the wings.

Mature fruits are golden-brown and 0.5 cm long and slightly less in width. They contain a single light greenish-brown, kidney-shaped seed flecked with black. It is 0.2 cm long and half as wide as it is long.

FLOWERING TIME. Spring.

HABITAT. It grows in open eucalyptus forests, in soils ranging from sands, through poor gravelly clay, to stony gravelly slopes on sandstone ridges.

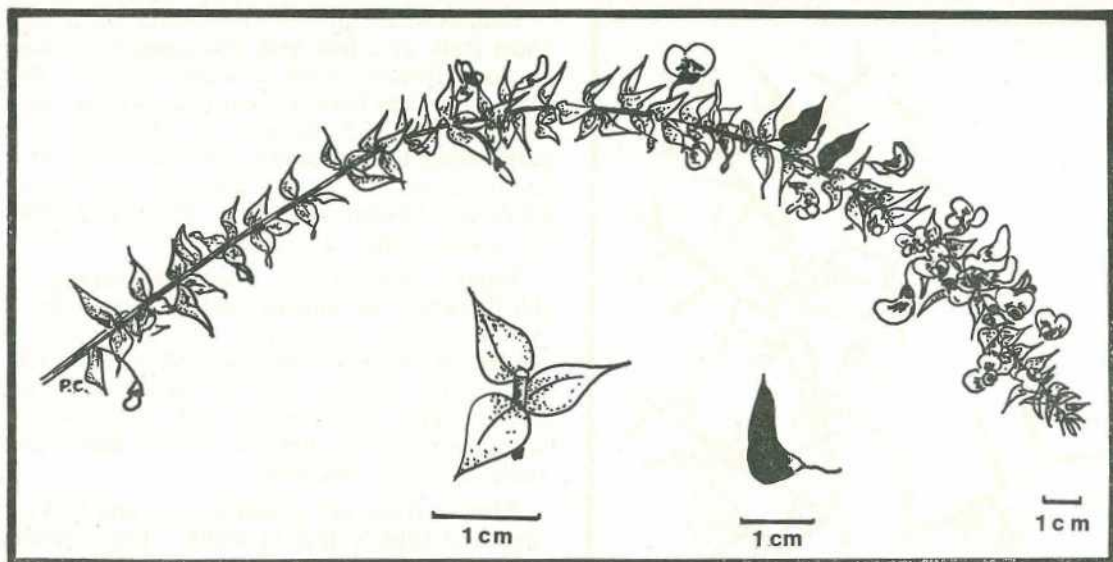
DISTRIBUTION. It is found in South Australia and in all the eastern States to as far north as Mt. Garnet in Queensland.

Daviesia genistifoli. This species has no common name. This plant is very similar to *D. ulicifolia*.

DISTINGUISHING FEATURES. The leaves are twice as long as those of native gorse and are either terete or very slightly laterally flattened.

DISTRIBUTION. In south-western Queensland, it has been collected only once in 1930 near Helidon. In Queensland, it has been found most frequently west of the Great Dividing Range on the Darling Downs and in the Carnarvon Ranges. It also grows in South Australia, Victoria and New South Wales.

Daviesia squarrosa. This species has no common name. The Latin adjective *squarrosus*, from which the specific epithet for this plant is derived, means rough with scales or



C *Daviesia squarrosa*.

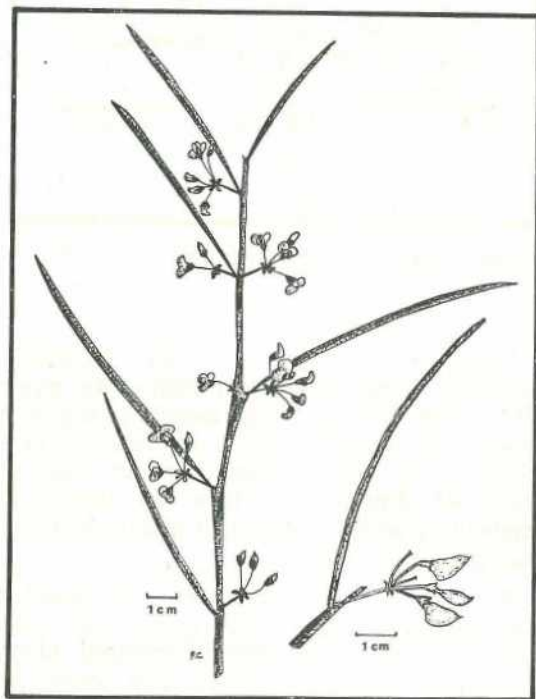
other parts projecting outwards, usually at about 90 degrees. This describes the leaves and the way they are arranged on the stems.

DISTINGUISHING FEATURES. The shape of the horizontal, squarrose leaves, and the thread-like pedicels carrying the flowers are all that is necessary to separate this bitter-pea from the others.

DESCRIPTION. This is a prickly shrub, often with hairy stems and leaves. The hairs are usually long, fine and spreading. Often, numbers of stout, woody stems are developed close to ground level, forming a bush 1 m high and as wide. Some plants grow to twice this height. Many short laterals are developed along the main branches which have a tendency to arch downwards at the end.

The horizontally spreading leaves have cordate bases and are just over 0.5 cm long and slightly narrower. Each leaf is drawn out into a long point ending in a reddish or brown rigid spine. Immediately behind this terminal point, the leaf is folded downwards on either side of the midrib and, at the base of the leaf, the cordate auricles are folded downwards.

This gives the leaf a very characteristic appearance which enables the plant to be identified even when not in flower. The



D *Daviesia wyattiana*.

leaves are arranged along the stems in such a tight spiral that sometimes some of them appear to be opposite.

Most of the flowers are solitary, on slender stalks, just under 1.25 cm long, but two flowers are sometimes found in the axils of the upper leaves. Usually the stalks are twisted so that the standards point backwards along the stem rather than upwards.

The reflexed standard is just over 0.5 cm wide and not quite as long. It has a shallow notch at the tip and is a deep golden colour, with a blotch at the base of the standard on each side of the centre. These blotches are either brown or purple-red. Both wings and keel are purplish-brown in colour and they project about 0.3 cm beyond the standard.

Lower down on the stems, on the older parts of the plant, fruits can often be found. Young fruits are tinged with red, and the pale ripe seed pods are 1.25 cm long. Their widest part, near their base, is about 0.6 cm. The seeds are smooth, kidney-shaped and reddish-brown.

FLOWERING TIME. From late winter to the beginning of summer.

HABITAT. Usually it is found growing in sandy soil over sandstone, on dry stony hills or on rocky slopes in open eucalyptus forest.

DISTRIBUTION. It grows in coastal areas from as far south as Bateman's Bay in New South Wales to the northern outskirts of Brisbane. In Queensland it has been found as far west as the slopes of the Great Dividing Range east of Toowoomba and has also been found south-west of Springsure.

Daviesia wyattiana. This species has no common name. In 1880, F. M. Bailey who, in the following year, became Colonial Botanist, named this plant 'in honour of Dr. William Wyatt, a great promoter of botany and horticulture in South Australia'.

DISTINGUISHING FEATURES. The triangular stems and the long, narrow leaves (which usually do not end in a pungent point) are sufficient to distinguish this bitter-pea.

DESCRIPTION. It is a slender, glabrous shrub which can grow to a height of about 2 m. Usually it has only a single thick, pale green stem from which several lateral branches curve outwards in graceful arcs. These branches are triangular in cross section. The pale green leaves are spaced at intervals of about 3.75 cm and make an angle of about 30 degrees with the stem, pointing towards its tip. They are 15 to 20 cm long, never more than 0.6 cm wide and taper gradually towards the tip.

The midrib can be seen on both sides as a paler green line. Usually two umbels of flowers are found in each leaf axil, one pointing to each side of the stem. In each umbel, there are three to five flowers. The common pedicel is 1.25 cm long and as many as five small, reddish, scale-like bracts are scattered along it. Five much larger bracts form a flat star beneath the pedicels which are slender and green, sometimes flushed with red.

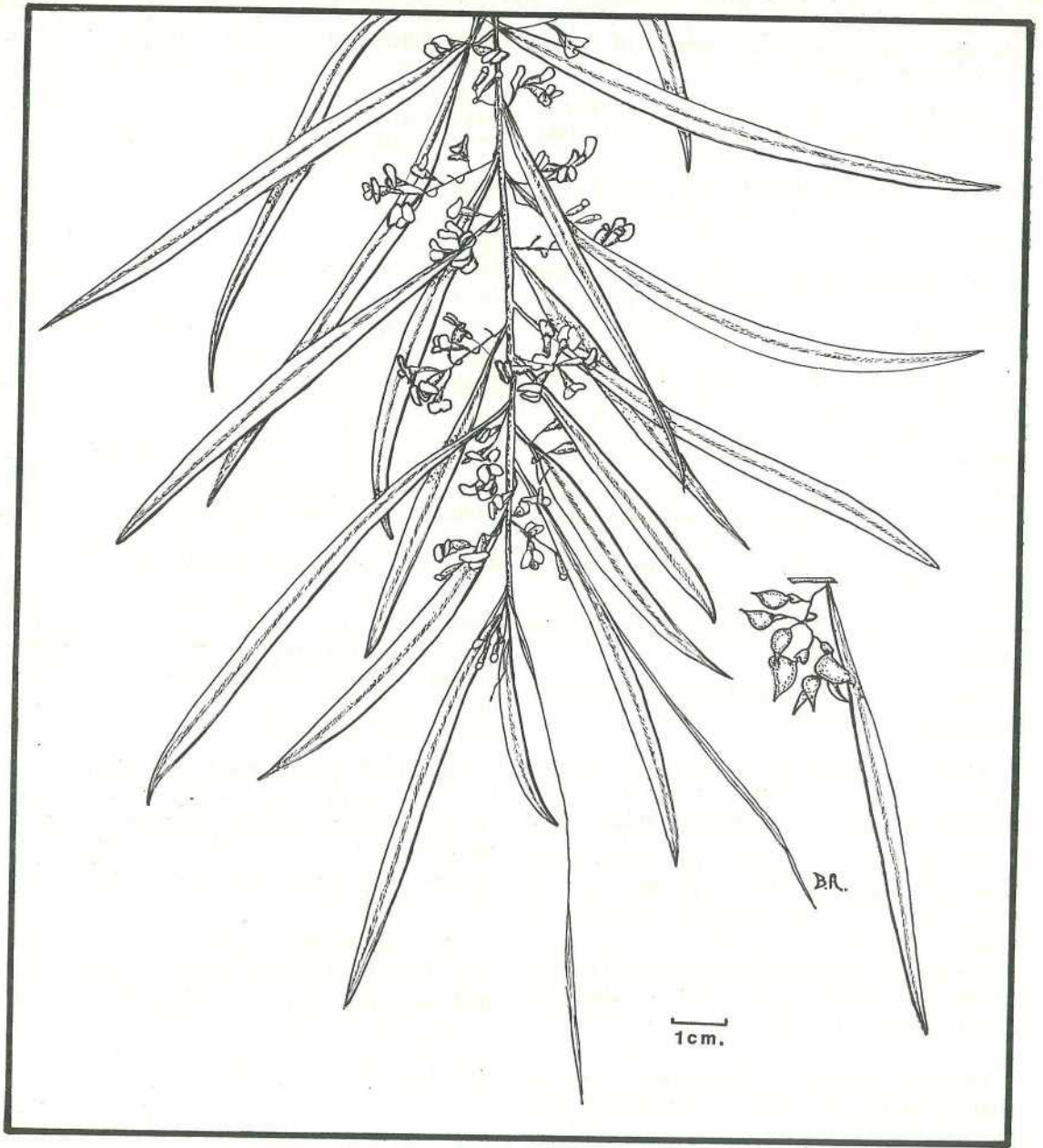
The green calyx tube about 0.3 cm long ends in five, short, pointed teeth. Each flower is less than 0.6 cm long. It has a prominent upward curving standard less than 0.6 cm long and the same in width. This is a golden colour with a brown arc at the base.

The short narrow wings are deep apricot to orange, each wing curving outwards from the narrow keel and then inwards to overlap at the tips. The keel is a slightly darker colour. The wings and keel project beyond the standard about 0.15 cm.

The golden-brown pods are almost 1 cm long, and near the base are half as wide. Each pod contains only one kidney-shaped seed less than 0.6 cm long and about 0.2 cm wide. It is olive green in colour and is speckled with black flecks.

FLOWERING TIME. In most seasons it flowers from midwinter through to the end of spring.

HABITAT. Usually it is found in open eucalyptus forest, in sandy or gravelly soil, on rocky ridges or mountain slopes or in soil pockets on granite outcrops.



E Golden pea (*Daviesia arborea*).

DISTRIBUTION. From as far south as Green Cape, just north of the border between Victoria and New South Wales, to as far north as Crow's Nest in Queensland.

GENERAL REMARKS. F. M. Bailey found the first plant at Eight Mile Plains about 16 km south-east of Brisbane and it can still be found on the Griffith University site at Mt. Gravatt.

Golden pea

GOLDEN PEA (*Daviesia arborea*). The specific epithet of this plant is derived from the Latin word *arbor* meaning a tree. It was chosen because this is the only bitter-pea which reaches tree proportions.

DISTINGUISHING FEATURES. The size and the habit of the plant alone would be sufficient to distinguish this bitter-pea, but these characters, together with the shape of the leaves and the large racemes of flowers, are a combination found in no other bitter-pea.

DESCRIPTION. It is a tree, which, growing as an understorey plant in open eucalyptus forest, can reach a height of 8 to 10 m. It has an erect trunk which branches in the upper half. In some plants, the branches are not straight, but have a gnarled appearance.

This seems to highlight the beauty of the flowers and of the drooping, willow-like leaves. When the plant is not flowering there is a superficial resemblance to some of the narrow-leaved wattles.

The bark is dark and deeply furrowed, the furrows close together and forming parallel lines down the trunk. The twigs are slender and green with sessile leaves arranged in a loose spiral. The light green leaves spread out around the stem. They are thin in texture, up to 10 cm long and just under 1 cm broad, with the midrib prominent as a slightly raised ridge on the upper surface.

When the leaf is held against the light, a network of smaller veins can be seen as lighter green lines, more or less parallel to the midrib, but anastomosing with one another, that is, connected together like the meshes of a net.

Racemes of flowers are found in the axils of the leaves, often two in each axil. Since there can be as many as 12 flowers in each raceme, and the flowering twigs can be more than 30 cm long, this is one of the most attractive of our native plants when in full bloom.

Each raceme is almost 2.5 cm long, with the individual flowers on very slender peduncles up to 0.6 cm long.

The light green calyx tube is 0.3 cm long with the two upper lobes joined almost to the end. These are only slightly longer than the three lower, short triangular lobes. Under magnification, it is possible to see a fringe of minute, white hairs along the edges of the calyx lobes.

The light golden-yellow flowers have a spreading, reflexed standard which is as broad as it is long. At its base is a dark crescent-shaped marking. In the bud stage, this coloration is very clear on the outside of the standard. A fainter marking of the same colour can also be seen along the middle of each wing, but the overall colour of the flower, seen from a distance, is yellow.

A striking characteristic of this plant is the way in which all the flowers are held with the standard curving back towards the stem.

FLOWERING TIME. Spring.

HABITAT. It grows best in moist, shaded places in open eucalyptus forest on stony hill-sides, but it can also be found on the edges of rain forest.

DISTRIBUTION. It is restricted to the coastal lowlands from as far south as the Whian Whian State Forest, north-east of Lismore, to Mt. Glorious, on the north-western outskirts of Brisbane in Queensland.

GENERAL REMARKS. This particular species grows into such a shapely small tree and is so attractive in full bloom, with weeping branches on which the yellow blossoms are massed among the spreading, light green leaves, that I feel it would be an asset to any garden.

I have been informed that some of the nurseries specializing in Australian native plants are now attempting to bring it into cultivation.

It is also interesting to note that the wood of this tree is hard, close-grained and beautifully-mottled, with numerous reddish streaked lines and a peculiarly agreeable fragrance. It is described as a useful cabinet wood which takes a beautiful polish.

Daviesia mimosoides. This species has no common name. This plant is closely related to *D. arborea*, and has been found in south-eastern Queensland. The specific epithet is a combination of the name *Mimosa* and the Greek suffix *oides* which indicates resemblance.

When Robert Brown described this plant in 1811 in the catalogue of plants cultivated at the Royal Botanical Gardens at Kew, he referred to it as *Mimosa-leaved Daviesia*.

DISTINGUISHING FEATURES. It can readily be distinguished from *D. arborea* as it is a shrub which seldom exceeds 1.5 m. It has

shorter, blunter leaves. Their texture is firmer than those of *D. arborea* and the pinnate venation is more pronounced.

The flowers are more or less at the same level in the inflorescence since the lower pedicels are longer than the upper ones. The inflorescences are shorter than those of *D. arborea*.

DISTRIBUTION. In south-eastern Queensland, it has been found only in four widely distributed localities—at Crow's Nest, Elimbah, Ernest Junction and Mudgeeraba. It is more common west of the Great Dividing Range in the Stanthorpe-Warwick area. It also grows in South Australia, Victoria and New South Wales.

HABITAT. In south-eastern Queensland it grows in open eucalyptus forest country and it may be significant that, at both Elimbah and Mudgeeraba, the plants were found on railway embankments.

On the Darling Downs it is often found on roadsides in granite soil or among granite outcrops.

Supersonic flight a problem?

SUPERSONIC flight could affect future crop production by increasing the amount of ultraviolet (UV) light that reaches the earth, according to scientists from the United States Department of Agriculture.

Such light increases when the exhaust from supersonic transports reacts with ozone in the air.

Crops respond differently to UV light. Peanuts and wheat are more tolerant to high levels of UV than are tomatoes, lettuce, coleus, millet and green peppers.

Experiments show UV light can reduce green pepper production by almost one-third.

For chrysanthemums, however, it is possible to create a positive reaction to extra UV light. At a particular point, exposure of the chrysanthemums to such light inhibits growth of the terminal bud and causes branching. This could be a useful tool for flower producers who must now rely on chemical or mechanical methods to encourage the desired branching.

“Mixed Ripe” . . .

a problem for the banana industry

by B. C. PEACOCK (Senior Psychologist) of the Sandy Trout Food Preservation Research Laboratory.

THE term “mixed ripe” is used when some coloured or “sprung” bananas are mixed with hard green fruit in the same box or carton on arrival at its destination and before commercial ripening.

It is also used to describe a bunch which, in the field, contains some ripe or “sprung” fruit while the remainder are still hard and green.

There are two reasons why “mixed-ripe” is a problem to the banana industry. Firstly, if mixed fruit are held for a period in a ripening room, those fruit which were ripe or ripening before they were put in become over-ripe and unsaleable by the time the cartons are removed. This not only results in a loss of fruit but also spoils the appearance of a package.

Secondly, Queensland fruit fly may attack ripening bananas, so southern States have quarantine regulations which protect the import of ripening fruit. Because of the danger of fruit fly being brought into those States, their regulations require that any cartons of bananas which contain ripening fruit on arrival in these States are subjected to one hundred per cent inspection or are fumigated.

“Mixed ripe” is mainly a result of some of the fruit being too mature when they are packed. In other words their green-life (the time that elapses between harvest and when ripening commences) is too short to enable them to survive the conditions they have to experience during transport. All the fruit in a carton may be too mature and all may ripen before they reach a market, or only some of the fruit may be too mature, thus producing the classical “mixed ripe” carton as shown in the picture.

The problem cannot be prevented entirely. However, many factors which contribute to the problem are known and various steps can be taken to reduce its occurrence. Stage of

maturation, temperature, ethylene concentration, mechanical injury and fungal infections are some of the factors involved.

Stage of maturation

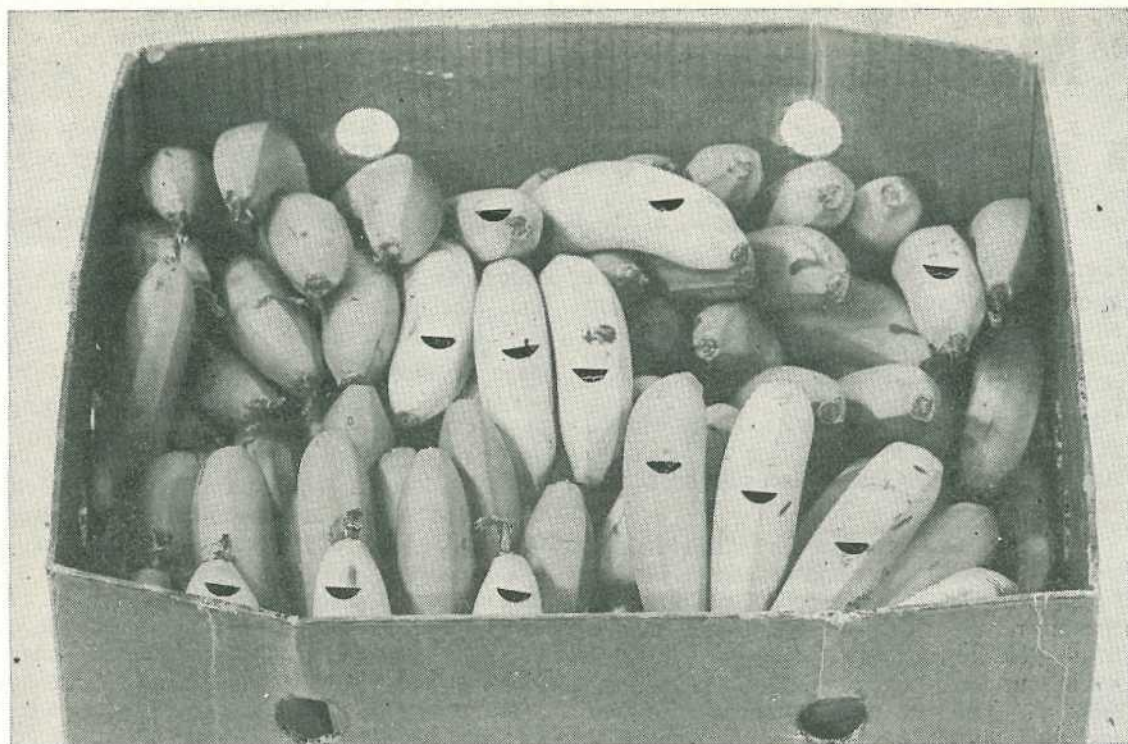
Two sets of processes occur in a growing banana: growth processes and maturation processes. Growth processes result in the fruit becoming larger. Maturation processes result in a fruit having a shorter green-life once harvested. Generally these two processes progress together. As a fruit enlarges its green-life becomes shorter. However, all fruit of about the same size do not necessarily have the same green-life; in fact green-life may differ greatly. This means certain growing conditions must affect these two processes by different amounts.

If the vigour of a crop could be maintained, it is believed these two processes would continue at about the same rate so the size of a fruit may better reflect its actual green-life.

To maintain vigour in a crop, stress conditions such as lack of fertilizer or water should be avoided if possible. Since it is possible to have large and small fruits with the same green-life, size of fruit is therefore not a satisfactory measure of maturation. Taking size as a measure could lead to errors.

Very little is known about the maturation process. So far no chemical or physical index of stage of maturation has been devised, so there is no way of telling just what the green-life of fruit on a bunch may be. Therefore, a grower relies on his experience when he decides whether or not to cut a bunch. He has to decide whether the fruit will have sufficient green-life to get to market without beginning to ripen on the way.

Should he misjudge and send fruit to market which turns “mixed ripe”, he can only harvest his next shipment at an earlier stage of maturation. Recent experimental work has given some measure of how effective



IN the above picture of a carton of "mixed ripe" bananas, the already ripe fruit have been marked with a half-moon shaped dot.

"cutting back" to get longer green-life may be. "Cutting back" one week results in a green-life increase of about 3 to 5 days, but a loss in yield of about 9% will occur.

Should a grower be doubtful as to whether or not a bunch will get to a particular market without ripening, for example, the bunch may have been missed when cutting the previous week, then the bunch should be discarded or consigned to a closer market. If it is not, then, during the packing process, fruit from that bunch may end up in five or six cartons all of which may then become "mixed ripe".

Temperature

Green-life of harvested bananas is shortened by exposing them to high temperatures. A reduction in temperature of 5° C, applied throughout a fruit's life will increase its green-life about 1.7 times. So a fruit which

has a green-life of four days when it is transported at, say 24° C, will be ripening before it reaches a market which is 6 days journey away. However, if that fruit were transported at 18° C it would then have a green-life of 7 days and so would reach the market in a hard green condition.

This is one obvious way of reducing the degree of mixed ripe that occurs. However, it cannot completely overcome the problem. For example, suppose the fruit described above only had a green-life of 1 day at 24° C, then even if it were transported at 13° C, (the lowest temperature bananas can be held without risking chilling injury), it would only last three days and so would not reach a market 6 days away still in a hard green condition.

The effectiveness of lowering the transport temperature in reducing "mixed ripe", must be judged in terms of the quantity of fruit which can be saved by this practice. It must be stressed that such a practice will not necessarily stop all fruit from starting to ripen during transport.

Ethylene

Ethylene gas is a natural product of bananas. It is produced in very small quantities by green fruit and in much greater quantities by ripening fruit. If green fruit are exposed to a sufficient quantity of ethylene they will begin to ripen immediately. Even if there is not enough ethylene to initiate ripening, it can still cause a shortening of green-life. However, the amount of green-life that will be lost depends on a number of factors:

- the concentration of ethylene to which they are exposed,
- the time for which fruit are in contact with gas, and
- the amount of green-life initially possessed by the fruit, that is, their stage of maturation.

Depending on these factors, the presence of ethylene during transport could be harmful and contribute to the "mixed-ripe" problem. Detrimental levels of ethylene may originate from the fruit themselves, particularly ripening fruit, or from some other source such as smoke, leakage from ripening rooms, or car exhaust fumes.

Experimental results have shown that it is unlikely that ethylene produced by the fruit will have any appreciable effect on the occurrence of "mixed-ripe".

Using cartons containing ventilation holes and choosing any stacking pattern which will allow air circulation within a load should prevent an ethylene build up which could bring on the "mixed-ripe" condition.

Where fruit are being held in a packing shed before transport, the most likely source of ethylene contamination is probably from nearby ripening rooms. Stacking the fruit so that air from outside the shed can circulate freely around them can reduce this danger. Forced ventilation using fans should only be necessary where the stacked fruit are being held in a closed shed.

Ethylene contamination becomes really important only where fruit are being stored for long periods. Even very low levels, say 0.1 parts per million, can then be quite important. Commercially, low temperature storage is employed when bananas are to be stored for long periods, and generally the fruit are then being held under conditions

of restricted ventilation. In these circumstances any ethylene contamination cannot be readily removed, regardless of whether the accumulation is due to natural production from the fruit or to contamination from an external source.

Should the ethylene originate from an external source, the most effective action to take is removal of the source. Accumulation from the fruit itself can be overcome to some extent by periodically ventilating the room with fresh air, for example, by leaving the door open for a quarter of an hour twice a day. Technically it is feasible to remove ethylene contamination by various types of air scrubbing devices or chemical absorbents, but these are not commonly used in commercial practice.

Recent experiments by Mr. K. Scott of the New South Wales Department of Agriculture have shown that removing ethylene by using ultra-violet lights may be a cheap, commercially feasible proposition.

Anthracnose disease

Recent work at the Sandy Trout Food Preservation Research Laboratory has shown that anthracnose infection severely reduces green-life and that it may be a most important factor contributing to the occurrence of "mixed ripe". The fungus that causes this disease, *Colletotrichum musae*, can attack the fruit through wounds, or through unbroken skin. In the latter case, the infection can occur at anytime and remain latent until the fruit begins to ripen. Latent infection occurs in the field. There is no evidence that latent infections affect the green-life of fruit.

Wound infections are a different matter, however. With wound infections, the organism enters the fruit through a cut or abrasion on the skin or through the stem end, which is wounded when a finger is removed from a hand. With fruit that are kept in hands, the organism can enter the cushion portion of the hand where this is damaged by removing the hand from the stalk.

Once the fungus gains entry through a wound it keeps growing even while the fruit remains green. It has been shown that these infections can cause drastic shortening of the green-life of a fruit, even within the space of a few days. This effect on green-life can be quite marked even though the infection has not

spread sufficiently to have an adverse effect on appearance. Shortening of green-life by this disease could well be related to the fact that the fungus itself produces ethylene gas.

As mentioned previously, it is believed that this factor is probably vitally involved in the production of "mixed-ripe" fruit. The use of fungicidal dips, as recommended by the Plant Pathology Branch in their advisory pamphlets, will reduce this problem to a minimum.

Mechanical injury

Overseas and local investigations have shown that mechanical injury of a banana will reduce its green-life. Injuries such as cuts, abrasions or bumps produce this effect. As far as contributing to "mixed-ripe" in commercial practice however, mechanical injuries are probably not very important. To obtain a loss in green-life that would be commercially significant, injuries must be so severe that, through the resultant loss in appearance, the fruit is made unmarketable anyhow. But mechanical injuries should still be avoided through careful handling practices in order to market blemish-free fruit.

Leaf diseases

Two fungal leaf diseases are important in bananas. The occurrence of either or both can affect the incidence of "mixed ripe". These diseases are leaf spot caused by the fungus *Mycosphaerella musicola* and speckle caused by the fungus *Mycosphaerella musae*. These fungi attack the leaves of the banana plant, and spots of dead tissue appear. The spots may get bigger, join together and finally destroy quite large portions of a leaf.

Fruit from severely affected plants are generally undersized and somewhat angular since their growth processes have been slowed down. Maturation processes continue however, with the result that the fruit have a shorter greenlife than what would be expected from their external appearance. The fruits will still ripen quite normally.

If the disease is severe, the fruit is often too small to send to the market. This disease can be controlled, and growers are advised to refer to Plant Pathology Branch advisory pamphlets for details of treatment.

Other factors

There may be other factors which influence the incidence of "mixed ripe". Recent investigations have demonstrated that exposing harvested fruit to light can reduce its green-life. The effect can be quite marked and precautions should be taken to shield harvested fruit from sunlight as much as possible. Moisture loss from fruit reduces green-life also, but probably does not play a major part in the incidence of the condition in commercial practice.

There is no one cause of "mixed ripe". Its occurrence is influenced to varying extents by a variety of factors, many of which can be controlled. Of these factors, temperature is considered to be the most important.

Undoubtedly precooling of harvested fruit and their subsequent transport to market under refrigerated conditions would virtually eliminate the problem. However, such a treatment would add a significant cost to the marketing of bananas and any decision to use such a procedure must be based on the economic returns likely to be achieved. Precise details of economic returns have not been determined, yet the procedure is already being implemented in some sections of the industry.

Maturity at harvest is probably the second most important factor of those that have been discussed. Growers should be particularly careful not to despatch to distant markets any fruit which they suspect may have insufficient green-life to reach those markets.

Anthrax disease is also possibly making a significant contribution to the "mixed ripe" problem. Actually the costs involved in controlling anthracnose are relatively minor and since control of this disease will improve fruit appearance, it is worth implementing regardless of its effectiveness in reducing "mixed ripe".

Leaf disease must also be considered a major contributing factor, but again is one that can be controlled.

Care in the control of these four major factors will not completely eliminate the "mixed-ripe" problem, but it will go a long way towards doing so.

Tobacco diseases and their control--2

Mosaic

Tobacco mosaic is a virus disease which occurs in all tobacco growing districts of Queensland. In north Queensland, the disease seldom causes serious losses. In south Queensland it is generally present.

Symptoms

The characteristic symptom of mosaic is a light-green and dark-green pattern on the foliage of affected plants. It is this feature of the disease that gives rise to the name mosaic.

This mottle is obvious on plants in the field but may be overlooked in the seedbed where plants are crowded and a diseased seedling may be hidden by adjacent healthy ones.

The dark-green areas, which stand out in contrast to the normal green of the leaf, may be scattered over the leaf or may be present as bands along the veins and are often blistered or ballooned.

Plants affected early in their life are generally stunted and leaves are often malformed as well as mottled. Some small, brown, irregularly circular spots or brown flecks may develop on the middle and lower leaves. These spots or flecks sometimes follow the veins to give a vein banding effect.

Plants affected in the later stages of growth show the symptoms only in the tip leaves or in young suckers.

Sources of infection

The virus particles are present in the sap of infected plants or their remnants. At the beginning of a tobacco season, the most usual source of infection is provided by manufactured tobacco products since the virus is not eradicated during the manufacturing process.



Tobacco mosaic.

by R. G. O'BRIEN, *Plant Pathologist.*

Plants related to tobacco, such as tomato, capsicum, cape gooseberry, petunia, blackberry, nightshade and wild hops, may also carry the disease and provide a source of infection for tobacco plants.

Method of spread

Transmission of the disease occurs when sap from infected plants comes into contact with healthy plants. Sap may be carried by cultivating and spraying equipment or by hands and clothing which have been in brief contact with a mosaic infected plant.

Tobacco plants may become infected at any stage of their development. Infection of plants in seedbeds or during the early stages of growth in the field results in losses of yield and quality.

Infection of mature plants during the topping, suckering and harvesting operations does not have a serious effect on the crop but provides, in the form of diseased plant debris, a possible source of inoculum for following crops.

Control

Mosaic can be avoided if growers recognize the ways by which it is transmitted and take the following appropriate action—

1. Seedbed soil must be sterilized and sown with clean seed.
2. Seedbeds should be fenced and isolated from other plants such as tomato, capsicum, cape gooseberry or petunia which may harbour the disease.
3. Tobacco workers, especially those who smoke, should take care to wash their hands well with soap and water before handling tobacco plants. This is especially important during the seedling pulling and transplanting operations.
4. When the plants are established in the field, they should be inspected closely so that any diseased plants can be removed and destroyed and the sites replanted before the field is cultivated for the first time.
5. A crop rotation will ensure that the virus is not carried over in the soil on the remains of a previous tobacco crop.



Tobacco vein banding. Note the darkened midrib and veins.

Tobacco vein banding

Tobacco vein banding is caused by an insect-transmitted virus, Potato Virus Y. It has been recorded in tobacco from both north Queensland and south Queensland, but it is much more common and severe in south Queensland.

Symptoms

The severity of the symptoms of this disease depends on the tobacco cultivar, the age of the plant when infected and the environmental conditions. It is also likely that different strains of the virus exist which produce different symptoms.

The mildest symptoms of the disease are a faint mottling on the expanding leaves and slight bleaching of the green colour between

small veins on large leaves. A band of dark-green tissue may remain along each side of the vein.

Bronzing of leaves is a common symptom in south Queensland crops which is seldom seen in northern areas. Affected leaves are generally in the upper half of the plant and have a distinct bronze colour. These leaves ripen prematurely.

The most severe symptom is produced on the veins of the leaves. The veins and, later, the midribs of leaves turn dark brown to black, although the leaf tissue often remains alive for some time. Leaves with necrotic midribs are usually smaller than normal and puckered.

Plants with necrotic midribs will often show the same brown-black discoloration in the stem tissues. Such plants die prematurely.

The variety N.C. 95 is considered to be more susceptible and shows more severe symptoms than other cultivars at present available in Queensland. Symptoms are likely to be more severe during relatively cool growing conditions.

Method of spread

The causal virus is carried by aphids (*Myzus persicae*) and is spread from plant to plant by their feeding.

The aphids may initially acquire the virus from other species of plants which can be carriers of the virus. These include cultivated plants such as tomato, potato, capsicum, petunia and weeds such as apple-of-Peru, wild gooseberry and cape gooseberry.

Control

The control of tobacco vein banding depends primarily on eliminating the weed hosts and growing tobacco in as much isolation as possible from the cultivated host plants. If capsicums are grown near by, a cultivar resistant to Potato Virus Y, for example, Yolo Y should be used.

Big bud

Big bud disease is similar to diseases of other hosts which are caused by mycoplasma-like organisms. Big bud usually occurs on isolated plants in a tobacco paddock and is of no economic importance.



Big Bud. A plant affected during the early part of the growing period.

Symptoms

The characteristic symptom of the disease is the development of green, leaf-like structures in place of the flowers. Diseased plants are noticeable because they are stunted and the leaves are draped around the stem. The sucker leaves are small and numerous, and the proliferation of leaves and abnormal floral parts gives the apex of an infected plant a tufted or bunched appearance often referred to as 'bunchy top'.

Method of spread and control

The disease is spread by a small, sap-sucking insect known as a leaf-hopper. It is unlikely that big bud will become important in crops which are sprayed regularly with insecticides to control other tobacco pests.

Spraying specifically to control leaf hoppers is not warranted.

Root and stalk diseases

Seedling damping-off

Damping-off is a disease of seedlings which is caused by fungi living in the soil (*Rhizoctonia solani*, *Pythium aphanidermatum*, and *P. myriotylum*).

Symptoms

The disease shows up quickly and spreads rapidly. The first indication of its presence in a seedbed is the collapse of a patch of plants.

The seedlings will show either a dark lesion on the stem at ground level or discoloured and rotted roots. The area of diseased seedlings rapidly increases unless steps are taken to check the spread of the trouble. Tender seedlings are naturally more prone to damping-off.

Control

Crowding in the beds predisposes plants to attack, so care should be taken that the seed is sown at the recommended rate. If crowding does occur, the stand should be thinned early.

Since the damping-off fungi are carried in the soil, sterilization of seedbed soil will greatly reduce the chance of the disease occurring. The beds may be sterilized by heat or by fumigation with methyl bromide. The procedure is described at the end of this section. Only seed treated with silver nitrate should be planted in sterilized soil.

It is possible to contaminate sterilized seedbed soil with unsterilized soil from outside the treated area and, if damping-off starts in a sterilized bed, losses may be more severe than in the original unsterilized soil.

Special care should be taken therefore, with all implements to be used on the beds. They should be cleaned of soil and should be swabbed with 2% formalin before being used on the sterile area. Weekly watering with Cheshunt compound can be used as a preventative treatment, but is usually not necessary if seedbeds have been sterilized. The preparation of this fungicide is described later.

If damping-off does appear in a seedbed, prompt action must be taken to prevent its spread. Drenching the affected area with thiram or captan is recommended.

Thiram drench is prepared at the rate of 30 g in 20 litres of water, and captan drench at 40 g in 20 litres. The drenches should be applied at 3 to 5 litres per square metre of seedbed.

Both these organic fungicides may damage young tobacco seedlings under certain conditions and it is not advisable to use either drench as a repeated treatment.

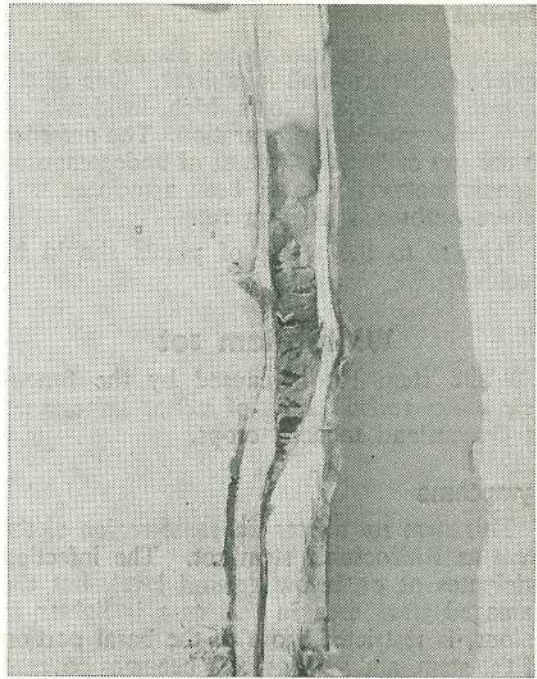
Rather, the fungicide should be applied at the recommended dilution only to an area of seedbed which includes the affected patch and a narrow buffer area of healthy seedlings around it.

Rhizoctonia stem rot

Rhizoctonia stem rot is a common disease in young crops in all districts. It is caused by the fungus *Rhizoctonia solani*.



Rhizoctonia stem rot. The final result is a complete collapse of the plant.



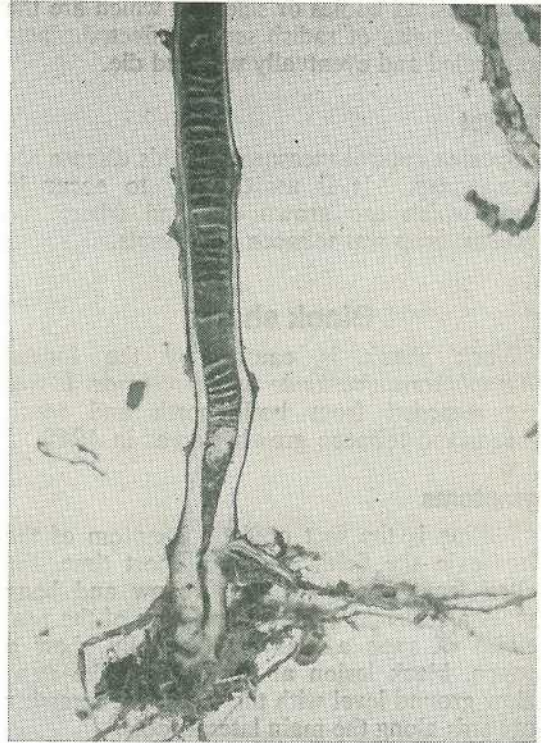
Black shank. Wilting is the first indication of the disease (above). Early decay of the pith inside the stem (right top). Advanced root and stem decay showing 'discing' of the pith (right bottom).

Symptoms

Most losses from this disease occur within 3 weeks of transplanting. The fungus enters the plant at or below ground level and a dark-brown or black sunken lesion develops at the base of the stalk. As the disease progresses, this cankerous area extends up the stem and may reach a point several centimetres above ground level.

In advanced stages of the disease, the internal tissues of the stem become rotted and a hollow, central cavity is formed. Plants with stem rot easily lodge. The root system remains healthy and breaks down only in the last stages of the disease.

The fungus is not able to attack large plants except through wounds. Such wounds can occur during cultivation or hilling operations when lower leaves may be snapped off.



Control

The fungus that causes the disease is a very widely distributed soil inhabitant. One of the factors contributing to a high incidence of stem rot is late land preparation. The presence in the soil of large quantities of undecomposed organic matter has often been associated with severe outbreaks of stem rot.

Injuries to the stems of plants should be avoided.

White stem rot

White stem rot is caused by the fungus *Sclerotium rolfsii*. It is of minor importance in Queensland tobacco crops.

Symptoms

This stem rot affects the same region of the stem as *Rhizoctonia* stem rot. The infection originates at or below ground level, but the damaged stem area in this case is lighter in colour, is restricted more to the basal portion of the stem, and very quickly becomes covered with the white cottony wefts of the fungus.

These strands in turn give rise to the light-brown resting bodies or sclerotia which are the shape and size of radish seed. Affected plants are girdled and eventually wilt and die.

Control

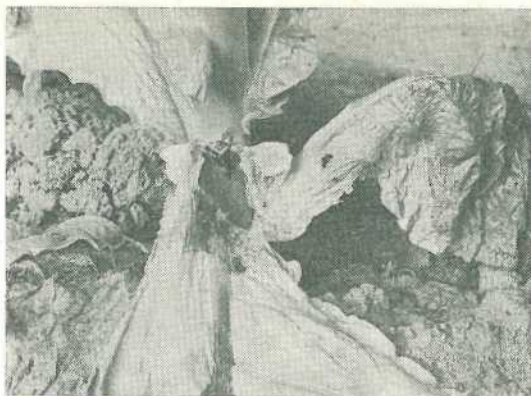
Specific control measures for this disease are unnecessary. It is most likely to occur in crops which are grown on land where the previous crop was tobacco or peanuts.

Black shank

Black shank is caused by the fungus *Phytophthora nicotianae* var. *nicotianae*. It was first recorded from both north and south Queensland tobacco growing areas in 1969.

Symptoms

Wilting is the first obvious symptom of the disease in the field. After a short time, the wilted leaves begin to turn yellow and hang limply around the plant. Inspection of the root system of such a plant will usually show a sunken, black lesion at the base of the stem below ground level with the disease progressing outwards along the main lateral roots.



Hollow stalk. Basal infection of the stem (above).
Section of an affected stem (right).

At a more advanced stage, more of the root system becomes affected and the internal tissues of the stalk begin to break down.

In the final stage of the disease, all the roots are destroyed, the stalk shows a black discoloration for several centimetres above ground level and the internal tissues of the stalk are reduced to a series of discs.

The first sign of black shank may appear as early as 3 weeks after the crop is transplanted into the field or at any time thereafter.

Control

The fungus that causes black shank lives in the soil and can survive for several years. It is readily transported with soil carried on shoes, wheels or farm implements. Running water will also disperse the fungus.

On farms where the disease has appeared, unnecessary movement of implements from affected paddocks to clean areas should be avoided. A grass rotation of at least 3 years is recommended for paddocks where black shank has occurred.

Tobacco cultivars differ considerably in their resistance to this disease. Sirone is particularly susceptible and most losses have occurred in plantings of this cultivar. N.C. 95 is highly resistant. The disease has been recorded in crops of Hicks and C.S.I.R.O.-40T but losses have generally been slight.



High populations of nematodes will increase the severity of the disease. Careful attention should, therefore, be paid to nematode control measures.

Bacterial wilt

This disease is caused by the bacterium *Pseudomonas solanacearum*. It is most severe in the Ingham district but is also commonly found in the Mareeba-Dimbulah area. It has not been recorded in tobacco crops in south Queensland.

Symptoms

The symptoms of bacterial wilt may occur at any stage of growth but, in Queensland, they are most commonly noticed at or shortly before the budding stage. Leaves on affected plants wilt and turn yellow prematurely. In some cases, the leaves on only one side of the plant may show these symptoms.

In many diseased plants, one half of a leaf turns yellow while the other half remains green. When plants are affected during early stages of growth, stunting may result.

If the root system of a plant showing the first foliar symptoms of bacterial wilt is examined, it will be seen that one or more of the larger lateral roots is dark, brown-black in colour and decayed. Other lateral roots and smaller rootlets will show signs of infection. In these, the decay begins at the root tips and progresses towards the basal part of the stem below ground level.

In a plant where the disease is well advanced, narrow, dark, brown-black streaks can be seen in the woody tissues of the stem, below the bark. These may run from ground level to almost the top of the plant.

Bacterial wilt generally occurs in patches through a crop. With cultivation, these patches enlarge in each succeeding crop.

Control

The bacteria causing the disease survive in the soil in undecomposed, infected roots and stalks. Measures should be taken to ensure the rapid decomposition of plant trash remaining in the soil.

Although crop rotation may reduce the bacterial population, it is unlikely that it will eliminate the disease from future crops of tobacco. The causal organism has a wide host range which includes many Solanaceous crop plants and weeds.

The cultivar N.C. 95 has a high level of resistance to bacterial wilt. Other cultivars (Hicks, Sirone, C.S.I.R.O.-40T) at present available in Queensland are all susceptible. High populations of nematodes may increase the severity of the disease.

As with black shank the causal organism is transported in soil and water from affected areas to clean areas. Traffic through areas where the disease is known to occur should be kept to a minimum.

Leaves harvested from plants affected with bacterial wilt are difficult to cure. In fields where patches of such plants occur, it is frequently beneficial to harvest and cure these

separately. The colouring period required for these leaves is shorter than for leaves from healthy plants.

Hollow stalk

Hollow stalk is a bacterial disease caused by *Erwinia aroideae*. Although it is generally of minor importance, the incidence may be high in wet seasons.

Symptoms

The disease becomes established at stem wounds. Most commonly, the sites of these wounds are at the top of the stalk where the flower head is broken off and at leaf axils or at the base of the plant following chemical desuckering.

After gaining entrance to the plant, the bacteria rapidly become established in the central pith section of the stalk. Invaded sections of the pith turn brown and collapse. In advanced stages, the pith cavity is hollow.

The leaves on affected plants may wilt, although this is not always so. Sometimes the midribs may show a dark, brown-black rot at the points of attachment to the stem. If harvested, the soft rot develops rapidly during curing and this phase of the disease is known as bacterial barn rot.

Control

For this disease to be severe, two factors are generally necessary: wounded plants and high humidity. For this reason, topping and suckering should not be carried out during wet conditions if possible.

It is important to adhere to the recommended rates of application of desuckering chemicals. Applying these at concentrations above those recommended or in excessive quantities will result in burnt leaf bases and girdled stems which are suitable wounds for the causal bacteria to enter.

Barn diseases

Fungal barn rot

Fungal barn rot is an important disease of harvested tobacco in Queensland. It is caused by the fungus *Rhizopus oryzae*.

Symptoms

Fungal barn rot spreads most rapidly during the colouring stage of curing. The first symptom is usually a spreading, soft, brown decay which begins at the butt end of the harvested leaves and extends down the midrib and into the adjoining laminar tissue. A short time later, thick wefts of grey, fungal growth cover the decayed areas.

The disease may also be found in the bulks, especially under humid conditions.

Control

Hygiene is a fundamental measure in preventing barn rot. Fragments of leaf and trash should not be allowed to accumulate in and around the barns and sheds. This refuse should be regularly removed to a safe distance or burnt.

If the disease does occur, the sticks, racks and shed should be treated with 2% formalin or 0.2% dichloran to reduce contamination. If formalin is used, the fumes must be dissipated before further curing is carried out.

The curing barn should be correctly loaded and ventilated and temperatures controlled so that they reach the appropriate levels. Leaf must not be left to hang in the barn before applying heat. Rotted leaf should be rejected after curing and not be included in the bulks. The bulks should be turned regularly and any decaying leaf removed.

Sometimes barn rot is a recurring problem on a farm despite these precautions. Then, it is recommended that the butts of leaves be thoroughly sprayed with 0.2% dichloran before being placed in the barn.

Bacterial barn rot

Bacterial barn rot has become more prevalent in north Queensland in the last few years. It is a continuation in the barn of the field disease hollow stalk. The organism involved is the bacterium *Erwinia aroideae*.

Symptoms

The disease is characterised by a very soft, wet rot of the midrib of harvested leaves during the colouring phase of curing. Leaves commonly are so decayed that they fall to the floor of the barn. There is an odour of decaying vegetable matter in a barn where the disease is present.

The growth of the bacteria that cause the rot is favoured by warm, humid conditions. When leaves are wet, the bacteria can spread rapidly from one leaf to another.

Control

Since the initial sources of infection in a barn are usually leaves harvested from plants affected with hollow stalk, precautions should be taken to prevent hollow stalk from occurring in the field. If it is known that hollow stalk is present, affected plants should not be harvested.

Harvesting during wet conditions and overloading the barns should be avoided.

If the disease is noticed in a barn, the temperature should be raised to the range 40 to 42°C as soon as practicable.

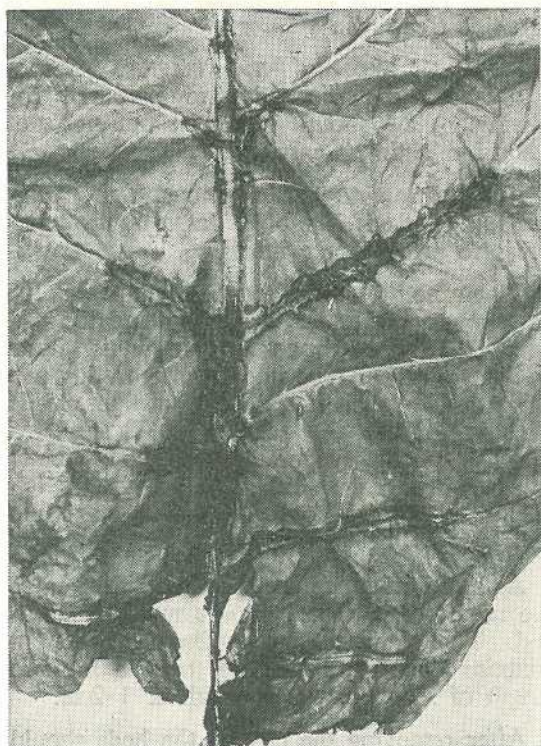
Miscellaneous disorders

Frenching

Frenching is a non-parasitic disorder that occurs only rarely.

Symptoms

The first signs of the disorder are noted in the young leaves of affected plants. These develop a yellow appearance; the veins, however, retain their colour and stand out as a green network.



Bacterial barn rot. The midrib breaks down with a soft, wet rot.



Lightning damage. Discoloration and dehydration of the stem and petioles is evident.

In severe cases, these leaves fail to develop to a normal size and shape and the leaf blade is often reduced to the merest strip of tissue on each side of the midrib. Such leaves are thicker than normal and are brittle in texture.

Frenching symptoms may appear soon after transplanting. Plants affected at this early stage remain stunted and have a rosetted appearance because they produce numerous abnormal leaves.

In milder cases, leaf yellowing is the most prominent symptom and leaf distortion may be slight. Often plants are not affected until after they have flowered; then the sucker leaves are abnormal.

Control

Frenching is caused by a disturbance to the nitrogen metabolism of the tobacco plant which results in the accumulation in the leaf of large amounts of certain amino-acids. It is believed that the agent responsible for this upset in the physiology of the plant is a toxin produced by a common soil inhabiting non-pathogenic bacterium.

The trouble is more prevalent on poorly-drained soils and tobacco should not be grown on such unsuitable soil types. Adequate fertilizer goes a long way towards controlling frenching and the fertilizers recommended for the particular soil type in use should be used.

Lightning injury

Damage caused by lightning strikes is sometimes mistakenly thought to be caused by an infectious disease.

Symptoms

The affected area in a field is usually circular with plants most severely affected in the centre. The area involved can be up to 20 m in diameter.

The midribs and sections of stems of plants in the zone are usually discoloured dark-brown or black. They have a dried-out appearance and, if the stalk is split open, the pith tissue is commonly separated into discs.

The subsequent growth of plants affected by a lightning strike will result in bent plants and puckered leaves.

Sterilization

Seed sterilization

The seed is placed in a muslin or cheese-cloth bag and immersed in a silver nitrate solution made up at 1 gram to the litre. The seed is left in the solution for 15 minutes stirring from time to time to remove air bubbles. After the period of immersion, it is rinsed well with clean water and dried in the shade.

Seedbed sterilization

Although heat is an effective way of sterilizing seedbeds, this method is rarely used today because of the scarcity of combustible ant-bed and the convenience of the methyl bromide treatment.

METHYL BROMIDE TREATMENT. Before fumigation, the seedbeds are prepared for sowing. They should be moist but not wet when fumigation is carried out.

Methyl bromide is a poisonous, highly volatile fumigant. It is supplied as a liquid under pressure in cans or cylinders.

When the pressure is reduced by opening the valve on the cylinder or by piercing the can with a special dispenser, the liquid flows through a rubber tube into an evaporating pan or bottle previously placed under airtight plastic sheets covering the seedbed. The methyl bromide quickly evaporates from the container and penetrates the soil. The covers are left on for 24 to 36 hours to ensure maximum penetration.

As a general guide, 100 g of methyl bromide are required to treat 1 square metre of seedbed. The standard can available at present contains 680 g and this will treat a 6-metre length of seedbed with a width of 1.2 m.

After removing the covers, the beds should be aired for at least 3 days before the seed is sown.

It is very important to pay careful attention to the manufacturers' instructions for applying methyl bromide and to take extreme precautions against inhaling the very poisonous vapour. Most formulations now contain 2% chloropicrin which has a pungent smell.

Before beginning to use methyl bromide, the operator should be quite certain he is familiar with the full procedure involved and the precautions necessary.

CHESHUNT MIXTURE. The cheshunt mixture formula is 2 parts of powdered bluestone (copper sulphate) and 11 parts of fresh powdered rock ammonia (ammonium carbonate). If necessary, the bluestone and rock ammonia should be crushed to a fine powder.

The two are thoroughly mixed together in the correct proportions and kept in a tightly-stoppered glass or earthenware vessel for at least 24 hours before using.

For use, the dry mixture is dissolved in water at 3 g to the litre and this solution is watered on the soil until it is well wetted. Five litres per square metre is usually sufficient to ensure this.

Commercially-available fungicides are made up of a proportion of active ingredient combined with inert products. The percentage of active ingredient is always stated on the label.

In this article, dosages and spray concentrations are based on the quantities of commercially available fungicides and should contain the percentages of active ingredient shown in the table below.

If a different formulation is used it will be necessary to adjust the dosage so that the quantity of active ingredient used per hectare remains the same.

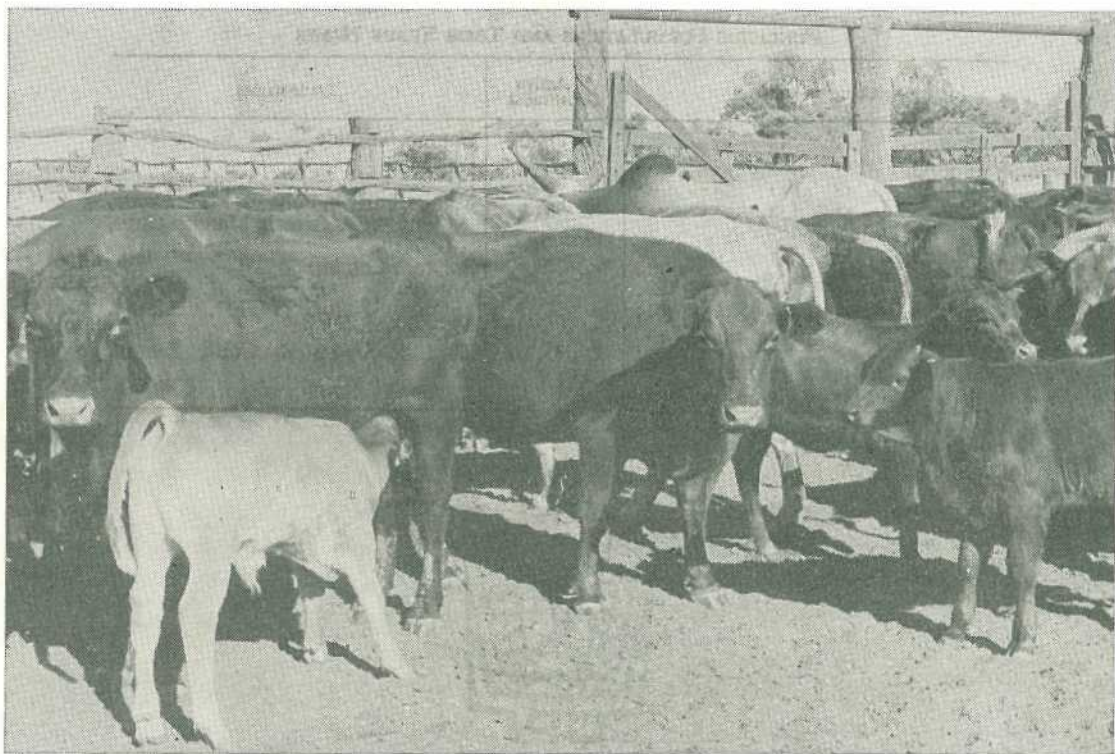
TABLE 2
FUNGICIDE FORMULATIONS AND THEIR TRADE NAMES

Common name	% Active Constituent	Trade names
Captan	50, 80, 83	Captan, Trimide
Dichloran	50	Allisan
Mancozeb	80	Dithane M45, Manzion, Manzate 200
Maneb	80	Maneb, Parneb, Polyram M, Manzate, Manzate D, Triman, Mangan Curit, Le-Neb
Metiram	80	Polyram Combi
Mezineb	70	Antracol
Thiram	80	Thiram, Lantox, TMTD, Thiotox, Tritem
Zineb	65, 75, 80	Zineb, Polyram Z, Curit, Zebtox, Trizinc



More beef through early weaning

by B. A. ARTHUR and B. G. MAYER, formerly Beef Cattle Husbandry Branch.



These trial cows were run as one mob in a 15 sq.km paddock carrying Mitchell and Flinders grasses with areas of gravelly gidgee country. Half of the calves were weaned early in the year (May to July) and the remainder late in the year (September to November).

3. Cows weaned in May-June each year conceived earlier the following season than those weaned from September to November. By July 1973, the early weaned cows had a 14.3% better conception rate.
4. Because of their better body condition, cows weaned early each year tended to have better total pregnancy rates.
5. Early weaned cows had shorter intercalving intervals than late weaned cows.

Trial paddock

'Fort Constantine' covers 10 600 sq. km, 29 km north of Cloncurry. Trial cattle were run in the 1 500 ha Courtney Creek paddock at the Fort. This paddock consists of areas of open, grey heavy-textured grasslands carrying bull, curly and hoop Mitchell grass (*Astrelba* spp), brown top (*Eulalia fulva*), Flinders grass (*Iseilma* spp) and golden beard grass (*Chrysopogon fallax*). The country is interspersed by gravelly ridges carrying predominantly gidyea (*Acacia cambagei*) with some whitewood (*Atalaya hemiglauca*), beefwood (*Grevillea striata*) and bauhinia (*Bauhinia cunninghamii*), with associated kerosene grass and wire grasses (*Aristida* spp). Channels of the Williams River run through the paddock.

Trial herds

In May 1970, 206 mixed age, wet, Shorthorn breeders were selected for the trial. In order to follow the same cows through over a number of years (that is, no cows were culled for age), the original trial herd was substituted with 235 first and second calf, wet Shorthorn cows in June 1971. They were run in the same paddock under the same conditions as the original group.

Half the cows were weaned early in the year (May-July) and half were weaned late in the year (September-November). These groups were maintained in the one mob from 1971-1973.

All cows and calves were mothered up and weighed at each observation, and cows were pregnancy tested twice a year. They were vaccinated for vibriosis, were brucellosis free and had a very low incidence of leptospirosis.

Brahman bulls (6%) were used under an uncontrolled mating system. All cattle were unsupplemented.

WEANING practices vary greatly from one herd to another in North-western Queensland. These range from either no weaning at all, weaning heifers only or steers only, or weaning all calves either early or late in life.

In May 1970 on the Stanbroke Pastoral Company property 'Fort Constantine', Cloncurry, the Queensland Department of Primary Industries began a trial to investigate the effect that weaning all calves over 5 months of age had on the cows' liveweight and reproductive rate. More than 200 breeders were involved in this trial, which ran until September 1973.

The following is a summary of the results of this trial—

1. Cows that were weaned late in the year lost an average of 39 kg more during winter-spring than cows which were weaned early in the year.
2. During the course of the trial calves were weaned down to 114 kg at 4 months of age with negligible losses. These calves survived on fresh paddocks of Mitchell-Flinders grass without supplementation through the dry season.

RAINFALL MILLIMETRES

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1970	10	88	90	16	..	..	..	..	15	..	8	17	244
1971	19	34	422	116	6	11	..	..	..	54	5	14	682
1972	66	12	133	..	..	..	..	..	..	..	76	..	287
1973	74	150	239	3	..	..	..	..	..	..	..	..	..

The 43-year average for the property is 370 mm. During the course of the trial there were two good seasons (1971 and 1973), one fair season (1972) and one bad year (1970).

COW LIVEWEIGHTS

Liveweight changes of cows weaned at different times of the year were recorded over the winter/spring period:—

1970	L/WT. CHANGE/Hd. 25-6-70-27-10-70 (124 days)
Cows Weaned May ..	-23.4 kg.
Cows Weaned Aug. ..	-43.4 kg.
Cows not Weaned ..	-66.9 kg.

1971	L/WT. CHANGE/Hd. 22-7-71-30-11-71 (131 days)
Cows Weaned June ..	+29.1 kg.
Cows Weaned July ..	+44.8 kg.
Cows Weaned Sept. ..	+45.8 kg.
Cows Weaned Nov. ..	-10.4 kg.

1972	L/WT. CHANGE/Hd. 30-5-72-18-10-72 (141 days)
Cows Weaned May ..	-34.0 kg.
Cows Weaned July ..	-53.5 kg.
Cows Weaned Oct. ..	-76.4 kg.

1973	L/WT. CHANGE/Hd. 29-5-73-3-9-73 (127 days)
Cows Weaned May ..	- 0.5 kg.
Cows Weaned Sept. ..	-32.0 kg.

Cows not weaned or cows weaned late, lost significantly more weight over winter-spring than the earliest weaned cows. The differences between the two are—

1970	43.5 kg.	1972	42.4 kg.
1971	39.5 kg.	1973	31.5 kg.

Cow conception rates

No pregnancy testing was carried out during 1970, but all cows were pregnancy tested twice a year during 1971, 1972 and 1973. Therefore, the following figures refer only to the second group of wet cows which were introduced into the trial in May 1971. As can be seen from the above tables, weaning of these cows did not begin until June 1971.

Total conception rates were:—

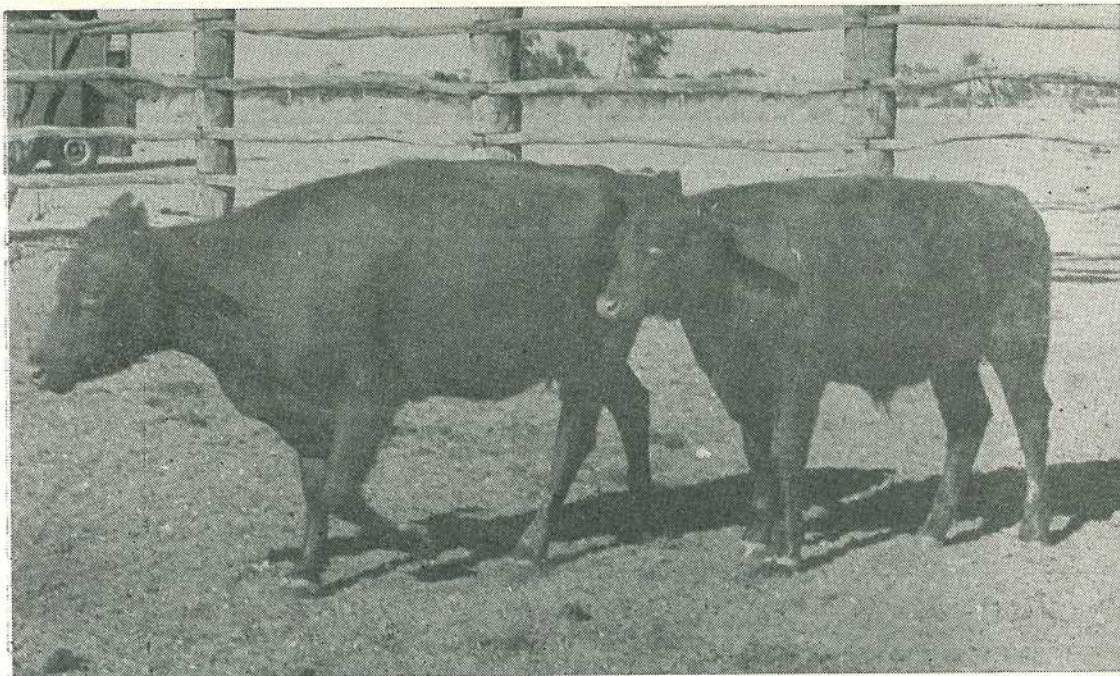
Group	12-month Period Dec. '70- Nov. '71	12-month Period Dec. '71- Nov. '72	8-month Period Dec. '72- July '73
	%	%	%
Early Weaned Group	86.2	80.7	76.6
Late Weaned Group	90.9	78.0	62.7

It should be borne in mind that weaning from June to November can affect conception rates only in the following year. Thus, the two different weaning periods in this trial can affect the conception rates only from 1972 onwards. Although the totals do not vary greatly, as the trial progressed it became evident that the early weaned cows were conceiving earlier the following season because of their better body condition—

CONCEPTIONS: DECEMBER-JULY

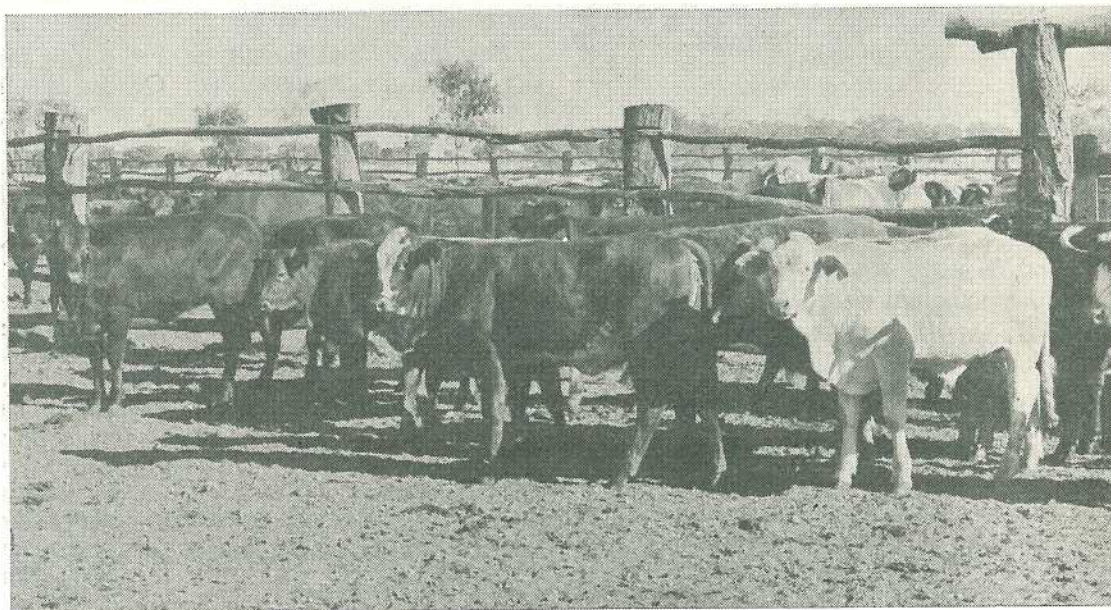
Group	1970-71 (%)	1971-72 (%)	1972-73 (%)
Early Weaned Group ..	75.3	65.8	76.7
Late Weaned Group ..	78.3	63.4	62.4

The table shows that 14.3% more of the early weaned cows conceived between December 1972 and July 1973. It is interesting to note that, over the 3 years, conception during this period of the year dropped 15.9% in the late weaning group.



▲ This picture was taken in May. A weaner this size, if left on the cow during the dry, will seriously deplete her body reserves and may even kill her.

▼ During the trial, calves from the early-weaned group were as small as 114 kg while some from the late-weaned group weighed as much as 255 kg. The early-weaned calves caught up during the next wet season.



Conceptions in the early weaned group dropped 9.5% during the second year but during the third year rose 1.4% above the first year's level. Early weaning also put more calves on the ground before March. This would allow more calves to be weaned early during the winter under an uncontrolled mating system.

Conception data was calculated by using a combination of two to three pregnancy tests (depending upon the month when cows were tested). This was necessary to ascertain conception per month over a whole year in this uncontrolled mating situation.

Intervals Between calvings

As the trial proceeded, the intervals between calving of early weaned cows became progressively shorter—

Group	1971-72 (months)	1972-73 (months)
Early Weaned Group	13.9	12.6
Late Weaned Group	13.7	13.6

Cow condition

Each cow was scored for condition visually at each observation. Cows weaned early were invariably in better condition and ranged from store to forward store at the end of the dry, compared with backward store to store for late weaned cows.

Weaner weights

In the early weaning group, all calves over 4 months of age were weaned during the May-July period each year. Cows in the late weaned group were not weaned until September-November when weaners ranging from 7 to 10 months old were taken off.

Early weaners were as light as 114 kg while some late weaners weighed 254 kg at 10 months. During 1972 and 1973, calves left on the cows over the winter gained approximately 0.5 kg a head a day while their dams lost about 0.5 kg a head a day.

It was not possible to follow these calves after weaning. However, trial work on similar country at 'Melinda Downs', Cloncurry, indicates that although the young

weaner taken off his mother does not fare as well during the winter, he gains weight faster the following wet season.

'MELINDA DOWNS', CLONCURRY STEERS BORN DEC.-JAN. 1971-72

	Weaned June, 1972	Weaned Sept., 1972
Number	23	16
Age at Weaning	5-6 months	8-9 months
Weaning Weight (kg.) ..	166.5 (June '72)	192.8 (Sept. '72)
Liveweight Gain June-Dec. 1972 (kg.)	47.5	60.1
Liveweight Gain Dec. '72- July '73 (kg.)	122.6	115.4
Total Gain June '72-July '73 (kg.)	170.1	175.4

Results from 'Swan's Lagoon' Cattle Field Research Station at Millaroo, North Queensland, and other research in Queensland, also indicate similar performance of early weaners.

Stanbroke Pastoral Company reports that early weaners from this trial have made just as good bullocks as weaners taken off the cow later in life, and the company has adopted an early weaning strategy, where possible, for all their North-west breeding properties.

Supplementary feeding of early weaners has not been necessary at Fort Constantine, but would be advisable on poorer country farther north.

Low quality and quantity of feed during the dry season in North-western Queensland is the major cause of low branding percentages and high breeder deaths.

Herd losses

A survey of 53 Gulf country cattle properties carried out by Mr. K. F. Howard, of the Department of Primary Industries, during the years 1962-64 indicated that average annual herd losses in the area were 10.8%. The average number of cattle lost annually was 1 259 head per property. An observation at 'Kamilaroi', Cloncurry, carried out by Mr. J. J. Daly, of the D.P.I., during the years 1963-66 showed that 26% of first calf heifers died as a result of producing and raising their first calf. Most of these heifers died as a result of poverty during the July-November period.

Under these annual adverse seasonal conditions, it is most important to conserve a cow's body condition so that she will survive the dry, calve in reasonable condition, and conceive promptly thereafter. One of the best methods of conserving cow condition is to wean her calf. A dry cow needs—

30% less dry matter

64% less digestible protein

40% less energy than a wet cow.

Therefore if a cow is not rearing a calf during the dry season, her feed requirements are substantially reduced. Early weaned cows at 'Fort Constantine' lost 39 kg *less* liveweight during the dry season than cows weaned late in the year.

In an area where supplementary feeding costs are very high, an invaluable fodder reserve is the condition on a cow's back and this needs careful husbanding. In the Gulf country, the average property is 2 200 sq. km., carrying 9 000 head of cattle. Because of the extensive nature of operations, as a rule only two musters a year are possible. A calf not weaned on the first round in April-June will not be seen until the second round in September-November. The 'Fort Constantine' trial, and results from other properties, have shown that total herd production can be substantially increased if all calves over 5 months of age are weaned on the first mustering round.

Generally, feed quality deteriorates as we move north from Cloncurry. The benefits of early weaning demonstrated on good quality country at 'Fort Constantine' should be even greater farther north.

Although not yet widely practised in the North-west, several properties have now adopted early weaning with good results. One property in the Burketown area has increased brandings by 25% in the last 4 years by using a combination of early weaning, heifer segregation, supplementary feeding, infertility disease control and improved subdivision. Some properties in poor quality forest country in northern parts of the Richmond Shire have adopted a 'one suck and they are gone' approach with calves. Some of these properties have increased brandings by 20% using a combination of early weaning and phosphorus supplementation.

It is difficult to pinpoint the economics of early weaning unless one studies an actual property situation. However, costs are small and returns substantial. Any capital outlay on extra fencing required for weaner paddocks would soon be recouped in increased herd production and fewer deaths, while reduced growth rate of the early weaners in their first year of life is compensated for by a higher growth rate in subsequent season.

Research by the Department of Primary Industries at 'Fort Constantine', and observations by owners and managers of better developed properties in North-west Queensland have shown that weaning all calves over 5 months of age on the first mustering round can give a considerable boost to herd production.

Beef Cattle Husbandry Branch of the D.P.I., would like to thank Stanbroke Pastoral Company, and Mr. Bill Hughes, of 'Fort Constantine' and his staff for their patience and co-operation in the running of this trial.

ELECTRONIC HARVEST

HARVESTING a crop such as lettuce has always involved a large labour force, but this could be reduced considerably in the future if electronic harvesters can be brought into use.

In the U.S.A., an experimental lettuce harvester has incorporated an X-ray selector which gives each head what might be termed an electronic "squeeze" and automatically cuts off those that are mature.

Under ideal conditions, the mechanical harvester and a trained 15-man crew can harvest about 400 cartons of lettuce an hour. Picking by hand, the same 15 men could turn out only about 180 to 225 cartons.

Limited role for Archer axillaris

by T. H. McCOSKER and C. H. MIDDLETON, Agriculture Branch.



A vigorous pasture of Archer axillaris and green panic (*Panicum maximum* var. *trichoglume* cv. Petrie) at Mt. Mee in south-eastern Queensland.

ALTHOUGH not widely used as a pasture legume, *Macrotyloma axillare* cv. Archer, formerly known as *Dolichos axillaris*, has some important attributes.

It possesses above average drought tolerance and good early spring growth. It is a valuable addition to the suite of legumes suitable for coastal and sub-coastal districts of south-eastern Queensland.

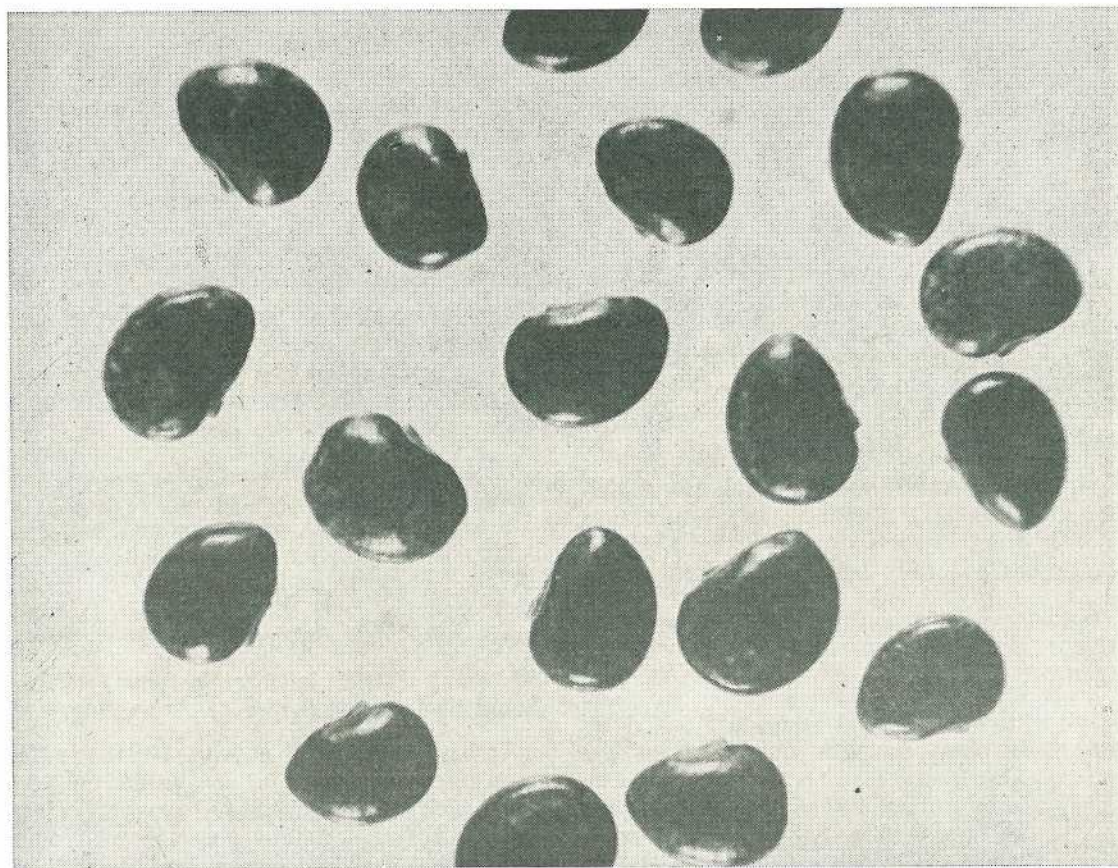
What is Archer?

Archer is a hardy, perennial, tropical legume with a vigorous twining and climbing growth habit and a deep root system. Its growth habit gives it the ability to suppress weeds and combine well with tall tropical grasses.

The trifoliolate leaves are slightly hairy and have a smooth, shiny appearance. The stems are thick and firm. Groups of two to three yellowish-green pea-shaped flowers are found in the leaf axils. The seed pods are slightly hairy, being broad and flat and 3 to 5 cm long. Each pod usually contains seven or eight oval, flat, dark brown seeds. There are 90 000 to 120 000 seeds per kg.

Where is it from?

Macrotyloma axillare is native to many parts of Africa and Sri Lanka (Ceylon). Archer was originally introduced into Australia from Kitale, Kenya, in 1953.



Seeds of Archer, magnified seven times.



Archer's twining growth can smother weeds such as *stinking Roger*.

It was tested in the sub-tropics and tropics of Australia and released for commercial use in September 1966. Some 3 000 hectares have now been sown to mixtures containing Archer.

Where to grow Archer

Archer is best adapted to a frost free sub-tropical environment receiving above 1 000 mm rainfall a year. Experiments and commercial experience have shown that it prefers the sub-coastal and coastal areas east of the Great Dividing Range in south-east Queensland.

Although Archer shows a relatively high degree of drought tolerance, its performance in the drier districts west of the Dividing Range has generally been disappointing.

Similarly its growth in the humid wet tropics is inferior to that of many other legumes.

While the leaves and stems are killed by frost, the plant recovers quickly from the crown. On frost-free sites, it will produce some growth throughout winter. Archer will survive in areas with a dry winter-spring period and will withstand heat wave conditions.

Archer will grow on a wide range of soil types and has performed admirably on soils of extremely poor structure such as old cultivations. However, it will not tolerate water-logging or saline soil conditions.

Establishment

Like most pasture legumes, Archer should be planted into a moist, firm, weed-free seed-bed where possible. The normal planting rate is 2 to 4 kg per ha, the lower rate being used where other legumes are included.

While Archer nodulates readily with native 'cowpea' *Rhizobium* present in the soil, it is wise to ensure good nodulation and nitrogen fixation by inoculation with *Rhizobium* strain CB756. This strain is also used for many other legumes such as Siratro, phasey bean, puero, stylo and cowpea.

Normal district fertilizer recommendations should be followed before or at planting.

Archer is compatible with all the tufted grasses recommended for use in its environment, such as the panics and setarias. However, it does not readily combine with other tropical legumes like Siratro and desmodium and should not be planted with them.

Seed production

Most of the State's seed is now produced in the Mareeba area of north Queensland where irrigation is available and climatic conditions are best suited to seed harvesting. However, a limited amount is still produced in the near north coastal area of southern Queensland.

Archer seed is a difficult crop to harvest. The seed pods are interspersed with the leaves and stems, and the trailing stems tend to wrap up on the moving parts of the header-harvester. This may be reduced by replacing the retracting fingers on the feed auger with a sweeper pad.

The seed is harvested with a header. This is sometimes followed by a suction harvester to collect any seed shed by premature ripening or lost in the harvesting process. While total yields of 100 to 150 kg per ha are about average in north Queensland, yields of over 200 kg per ha are possible. Yields are generally slightly lower in south-eastern Queensland.

Since the seed does not ripen evenly, some experience is essential in determining when to harvest. Suction harvesting reduces losses associated with lengthy ripening periods and pod shattering. Where irrigation is available (as in north Queensland) pre-harvest irrigation is recommended 1 week before harvest, first to reduce seed shattering and secondly to lessen the tendency of the vines to wrap on the harvester. Dry vines tend to be ropy and irrigation softens them and makes them break easier.

Harvest time varies with climate. In south-eastern Queensland the peak flowering is generally in late autumn-early winter and the seed is harvested from late May. Harvesting is often delayed until frost occurs about July. In north Queensland, seed is generally harvested in June-July.

Weed prevention and control

The cardinal rule of pasture establishment is to reduce the potential weed problem by

ensuring good seedbed preparation, proper planting rates and methods, and ample fertilizer.

Where weeds have become a problem, however, several control measures can be adopted.

Firstly, if grazing is withheld, Archer has the ability to climb over weeds and smother them. This is the best method with tall weeds such as stinking Roger (*Tagetes minuta*).

Secondly, where withholding grazing is impractical, or where weed growth is very dense, mechanical means such as slashing or mowing can be adopted, taking care not to defoliate below about 10 cm.

Thirdly, there is chemical weed control, but this is expensive and should only be used as a last resort. Archer will tolerate 2,4-DB as a post emergence spray at rates of up to 2.5 kg per ha of active constituent (a.c.) but is susceptible to 2,4-D at rates as low as 0.6 kg a.c. per ha.

For chemical weed control in seed production areas, trifluralin (Treflan)* or benfluralin (Balan)* may be used for grass control, and propachlor (Ramrod 65)* for non-leguminous broadleaved weeds.

Pests and diseases

Archer is relatively free from serious pests or diseases. The chief disease is 'little leaf' virus which has been identified in many areas, usually on isolated plants. This disease has been a major limitation to its use in the more humid tropical coast of north Queensland (above 2 000 mm rainfall).

Nematodes have also been found on Archer but do not appear to restrict its vigour to any great extent.

Archer is not affected by amnemus weevil which can seriously affect desmodium, clover and glycine. Bean fly can, at times, badly damage young seedlings.

* These are the only trade names under which these weedicides are marketed in Australia.

Management

During establishment, grazing should be lenient and aimed at preventing shading of the legume by the grass. Short, intermittent, light grazing suits the purpose, since Archer is relatively unpalatable in its young growth stage. Once established, a rotational grazing system is preferred.

In frost free areas, Archer is very useful as standover feed. By withdrawal of animals towards the end of March, a large bulk of quality pasture will accumulate for winter usage. The mature Archer, which is well accepted by stock, can be grazed during early and mid-winter when other rain-grown pastures are normally in short supply.

The standover feed practice also allows self seeding of Archer which is useful in thin

stands. So long as plant material is available, Archer can be grazed throughout the winter and in the early spring when growth begins again.

In most situations where Archer grows, Siratro is a much more productive legume. For this reason, Archer is unlikely to become a major pasture legume in Queensland and should be considered as a supplement to, rather than a replacement for, other tropical legumes.

The ability of Archer to provide high protein feed at the critical periods of early winter and early spring makes it a valuable component of pastures in south-eastern Queensland. Consideration could be given to planting a small area of Archer with a grass for intensive use at these periods.

Siphoning Petrol

MANY drivers have experienced the annoying situation where they run out of petrol "miles from anywhere". Often times the only way to get moving again is to borrow petrol from a passing car. Usually the only way to do this is by siphoning fuel from one petrol tank to the other.

But, if you value your health, you will do this with a self priming siphoning device, NOT by drawing vacuum with your mouth. Petrol (especially the high octane gas most modern cars use) swallowed or inhaled can cause severe health problems.

In extreme cases death can even result where a person consumes a large amount of fuel.

The greatest danger in swallowing a significant amount of petrol is that the fuel may reach the lungs, whether by inhalation or via the blood stream. The effect will be a form of pneumonia, and possible permanent lung damage.

First-aid is limited when petrol is inhaled or swallowed. Oxygen may help relieve breathing distress, but drinking large quantities of water and inducing vomiting should be

avoided. If breathing problems develop, medical help should be sought immediately.

The best defence against injury from petrol siphoning is, of course, never to run out of petrol. If you plan fuel stops in advance for your trip you will probably never be caught in the situation where you have to siphon petrol.

But, if for some unforeseen circumstance you are caught, and need to siphon fuel, use a self-priming siphoning device. Usually they are a length of tube with an attached squeeze bulb and they are available at most motor accessories retailers and are quite inexpensive.

If you have to siphon petrol from a large container, such as a 44 gallon drum, you can often get the liquid flowing by moving a hose up and down in the drum quickly.

But, remember, even if it means a delay to your schedule DO NOT siphon fuel by using your mouth to make a vacuum.

The Queensland Health Education Council.



RICE GROWING

by M. FINLAY, Agriculture Branch.

IN QUEENSLAND rice is grown in the Burdekin Delta area in the Ayr Shire.

Commercial rice growing was first demonstrated on the Millaroo Research Station in 1965. Following this, the lead was taken up by a few interested growers.

By the end of 1967, twenty growers had planted an area of 140 ha. Yields averaged three tonnes per hectare. Plantings increased until in 1973, 3 600 ha were grown in two plantings. At present, yields of four t/ha can be expected in an "average" season.

The advent of cyclones and lengthy wet spells results in high individual yield losses and severely restricted plantings of the summer crops.

These heavy wet periods have shown us the effects of variable climatic conditions over a few years and some re-thinking of our timing of operations may be warranted.

Climatic Conditions

Although rice is primarily a tropical and sub-tropical crop, high grain yields are obtained in temperate areas such as the M.I.A. in southern New South Wales.

Rainfall, temperature, light and day length are all important in determining high yields. Rice yields are generally higher in dry sunny seasons than in rainy seasons.

It has been claimed that cloudy weather reduces light intensity with a consequent yield reduction. Also, in a dry sunny season a greater response from nitrogen applications is obtained.

Low temperatures during certain stages of growth such as panicle development just before emergence can reduce grain yields through sterile florets. High air temperature results in increased absorption of nitrogen, phosphorous and potassium, and affects the growth pattern.

In summer-planted crops, a high nutrient level results in excessive vegetative growth which ultimately results in lodging. Root temperatures affect uptake of nutrients and water.

Soils

Rice needs a heavy soil through which irrigation water will not easily seep. For this reason the heavy textured low fertility flood plain soils are well suited to the crop.

The flood plain soils of the Lower Burdekin Valley represent the largest area likely to be commanded by an irrigation scheme based on the Burdekin River.

Land use

Crop rotation is not practised at the moment. A continuous cropping schedule is adopted by many growers with two crops a year being produced. This has its disadvantages in that little time is available between crops for releveling and check-bank maintenance, and in fact wet weather at harvest time tends to put the next crop back. Many growers are now adopting some form of cropping management whereby portion of the area is fallowed for one crop.

The continuous cropping practices in use do not appear to have had any upsetting influence on soil structure. If anything the soil is showing physical improvement, although fertilizer usage per crop has increased. This can be expected with the plant residue incorporated after each crop.

Land preparation

It is most important to have bays well levelled to ensure uniform irrigation and proper drainage.

Bay check-banks are normally spaced at 75 mm vertical intervals. Water depths on rice of 75 to 100 mm are preferable and bays should be levelled so that water is no deeper than 150 mm or shallower than 75 mm.

In a farm layout for rice, adequate drainage ditches should be established from the outset.

Seedbed

In seedbed preparation the aim is to have a firm, fairly fine soil for planting. This can be accomplished with a disc plough, offset discs, chiselling, rotary hoeing and peg tooth harrowing.

Should seeding into water be considered, the seedbed may be left in a coarser or more cloddy condition.

Planting information

A study of long-term average climatic conditions within the area suggested two crop plantings a year—December/early January and mid June/early July. These have worked out reasonably well, although with the cyclones expected from December onwards it may be better to aim at having all planting done by the end of June.

Examinations of harvest results suggest that a July planting can yield slightly better than a June, as there is less likelihood of low temperatures during panicle development. However, effort should be made to have harvesting complete by the first week in December because there can be problems in harvesting these later crops. A cool spring could still upset a late June planting by increasing the number of sterile florets and delaying plant maturity.

In the summer, crop plantings should be made in December if possible. The later planting occurs in January the greater is the incidence of "dead heads" (sterile florets). The summer crop is ready for harvest in approximately 130 days.

The winter crop is ready in 150 to 160 days but can take as much as 180 days depending on temperatures from planting to early October. Low temperatures slow growth—particularly in the vegetative stage.

Planting is normally carried out with a seed drill with drills spaced 150 to 175 mm apart. On our heavy soils, seeding depths should be around 12 mm, certainly no more than 25 mm. It can be left for a week or so in the hope of sufficient rain to germinate seed. Alternatively bays are flushed (covered with water for only 3 to 6 hours).

Stands of plants containing 15 to 30 seedlings per 0.1 m² (1 sq. ft.) are adequate for optimum yields. Yields do not appear to vary when plant numbers are within this range. A seeding rate of 100 to 110 kg/ha of seed above 85% germination should produce this result.

Variety

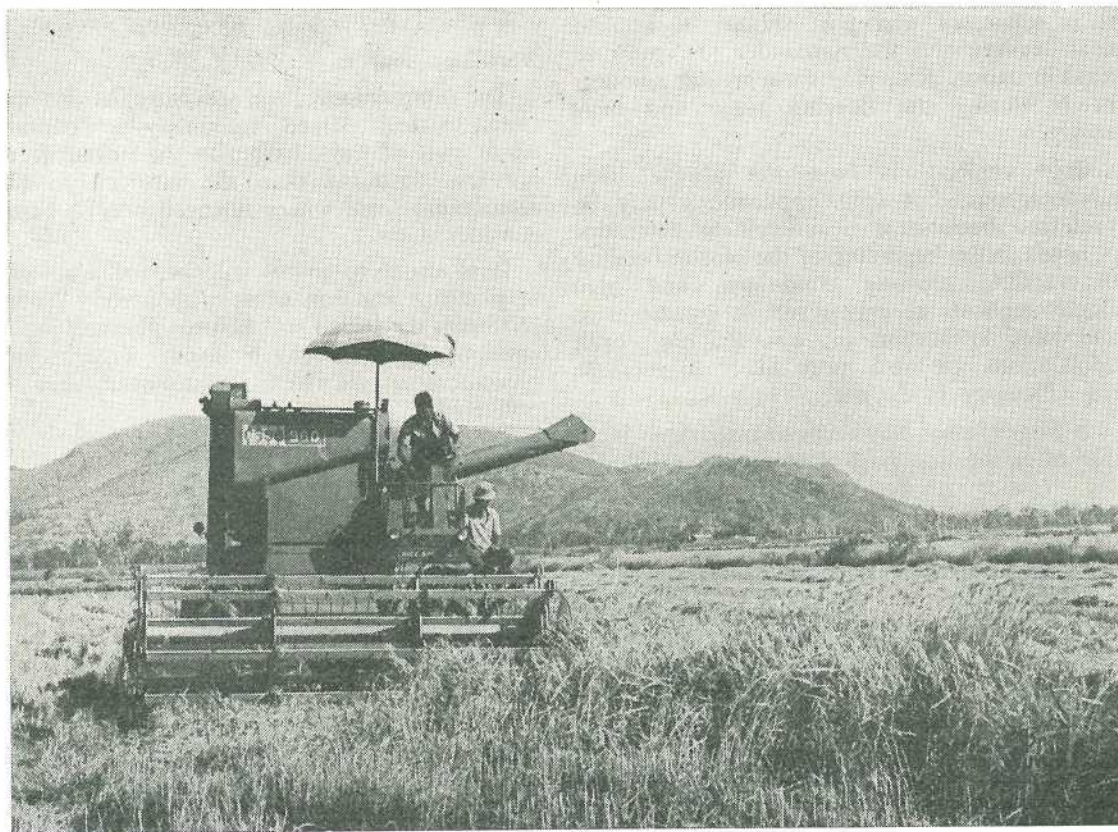
Blue Bonnett 50 is the only variety in use. It is a long grain high quality rice. Yield ability in comparison to newer IRRI rices is not high, but its quality is higher. It is also prone to lodging, particularly if excessive N is used. The rice produced is finding ample markets.

Fertilizer

The proper amounts can best be determined by using all available information concerning a paddy. This could include past cropping results, soil tests, length of fallow, past fertilizer responses and observations during crop growth.

Nitrogen (N) is the most important element needed for production. A summer plant on new ground requires about 90 kg N/ha. With continuous cropping N applications are now as much as 135 kg/ha while the winter crops often receive higher still.

Although soils are low in available phosphorus (P), early experimental work did not indicate responses to applied phosphorus in summer plantings. Even after 3 or 4 crops the response may be not obvious although the winter plantings are certainly reacting to an application of P. Work carried out on the Millaroo Research Station and on farmers' crops show that 11 to 16 kg/ha should be applied to winter plantings.



Harvesting rice.

The use of P on the summer crops is still indefinite and growers would be wise to try some experimentation on their own properties. With continued rice growing it is likely both plantings will, in time, require phosphorus.

The soils have fair levels of Potash (K) and so far no response to applied K has occurred.

Timing and application

The plant needs adequate supplies of N, P and K for early root and seedling growth as well as for grain formation and development. So it is necessary that these elements should be available early.

Phosphorus is used efficiently when applied broadcast or in bands as with the seed drill. It may be applied before or during seeding, whichever is the more convenient. All crop requirements of P should be applied in the first application.

The timing of N applications is important. It is suggested that part should be applied near seeding and the remainder just prior to head initiation. Rice plants use greater amounts of N during the tillering stage and head emergence.

Split applications have not always been advantageous, but split applications may be preferred because it is difficult to determine N needs at the beginning of the season because of variable growing conditions, and high single applications may result in greater grass and weed infestation and also lodging. Split applications are also more likely to increase the efficiency of N use.

Nitrogen losses may occur through denitrification after the first post-plant emergence flooding. Losses can be decreased by placing the ammonium form of nitrogen 100-120 mm in the soil. This will generally mean an increase in application costs besides disturbing good seedbed conditions.

Placing nitrogen directly with the seed when drilling rice has been known to cause germination problems. Losses increase with the rate of N application. However, with the amount of seed commonly sown by growers and the moderate levels of nitrogen used at planting, seedling losses are unlikely to cause any significant reduction in plant numbers.



Leaf hopper damage in rice.

Nitrogen application through irrigation water has been tried with some success but management difficulties are the main reason for the practice not being widely adopted. To obtain some uniformity of application, bays must be drained of water prior to commencement.

Fertilizer sources

The ammonium form of nitrogen is best suited to rice. Mixed materials which contain all or part of the nitrogen in the nitrate form are less desirable than the nitrogen in the ammonium form where nitrogen only is being considered.

It is usual to apply sulphate of ammonia at planting and top dress with urea. Where fertilizer is drilled in before planting aqua ammonia or urea may be used. Where deep placement of nitrogen is employed urea is preferred.

Water management

Deep and early flooding can damage young rice seedlings. The depth of water should be no more than 100 to 150 mm if the land is level enough. Water at these depths, if maintained for a period of about 3 weeks, can smother young grassy weeds.

After planting, if rain does not fall, bays are flushed to promote germination.

Rice seedlings generally appear in 4 to 5 days in summer, and slightly longer in winter. In winter bays may need a second or even a third flushing (if crusting occurs) to promote seedling emergence.

Permanent water is introduced about 12 to 15 days after emergence in summer and a week or so longer in winter. Water levels should be maintained from here on until draining 2 to 3 weeks before harvest.

The crop is ready for draining when about half of the head grains have changed from green to brown. Well levelled and drained bays will dry out fast and cause few problems during harvest. Fields will normally dry out quickly in November-December.

Salts in water

Overseas work and our observations here suggest that irrigation water containing more than 800 p.p.m. total soluble salts is not suitable for rice production. If water containing more than this amount is used, management practices that will minimize salt injury should be employed. Growing the crop in the summer months when

- under-ground water levels are more likely to be high and contain less salt,
- rainfall will supplement irrigation, and
- shallow creeks with running water can be used as better sources of irrigation water, will assist.

Continual use of saline or sodic water means the concentrations of soluble salts within the bays increase and so worsen the problem. Water to be used for irrigation from under-ground sources should be checked prior to the installation of pumps.

Pests

By far the biggest pest problem in the area to date has been wild fowl, broilgas and moor hens.

Ducks and geese caused considerable damage to young seedlings and mature crops here in 1972-73. Conditions then were very favourable, in that most of the north was dry and the paddies were an ideal habitat. We can expect further invasions when similar conditions occur.

Broilgas are always present but here also their feeding is largely dependent on seasonal conditions and availability of other feed. Moor hens, swamp hens, or water hens as they are more commonly known, similarly are in greater numbers and cause more damage when dry seasons occur. Finches also damage developing grain.

Insect pests generally have not been considered a real problem. Leaf hoppers and armyworms have caused most concern.

Leaf hoppers appeared in the 1972 summer crop causing some damage. The damage appeared in patches, the plants showing leaf death and in more advanced crops, lodging. They were readily controlled with Diazinon or DDT at $\frac{1}{2}$ to 1 kg/ha. They are probably present in lighter numbers in odd crops each planting but have only once had conditions favourable enough to permit build-up in numbers.

The day-feeding armyworm is often present in a few summer-planted crops. In infested areas it is usual that bays on which the water level had previously been low carried large numbers. Maintaining water levels deters the pest and minimizes damage.

The stem borer so far has not been recorded here but other insect pests such as the skipper butterfly, the paddy case borer, grasshoppers, a paddy bug, and various beetles have been noted on rice areas but damage has been insignificant. Stem borers have been recorded in the Ingham area where infestations are at times heavy enough to warrant a control schedule.

Diseases

Diseases have been of little importance in the area to date, although several have been identified and some investigational work carried out.

Rice blast (*Pyricularia oryzae*) which is one of the most destructive rice diseases in the world shows up occasionally on some summer planted crops. The disease appears as spindle-shaped spots with a reddish-brown margin and a grey centre, and so far has been confined to a mild leaf spotting. The strain here is apparently only mildly virulent.

A somewhat similar condition known as narrow brown leaf spot (*Cercospora oryzae*) has been more common in both crops. It appears as linear brown marginal spots with the centre of the narrow spots grey also. The narrow brown leaf spot is usually present late in the plants' life and does not seem to be of any significance at the moment.



Aerial spraying of weeds in rice.

Rice smut (*Tilletia barclayana*) was recorded on grain from the 1973 winter harvested crop. The disease was present in trace proportions in a large number of crops in the area. No deterioration in the quality of the milled product was noted due to smut infection and it is thought that the disease will prove to be a very minor problem.

Various stem and root rots have been noted occasionally, and investigational work on their economic importance is being carried out.

Harvesting

Irrigation water should be removed from the field when rice heads are well turned down and in sufficient time for the soil to become firm for harvester operations. The rice heads at this stage should on an average be showing nearly half brown florets. When the grain moisture of a crop is between 18 and 22% it is ready for harvest.

Grain cracking can increase significantly if the moisture drops below 16% prior to harvest.

Good husbandry before harvest can in part be wasted if harvester adjustments at heading are not fully understood by the operator. Losses can occur from shattering at the front, from partially threshed heads, or from threshed grains being discarded with the straw. Each problem requires independent adjustment and operators' manuals should be carefully read for high efficiency. Grain on the ground or in straw behind the machine will tell the story of losses. Approximately 90 seeds every square metre is equivalent to 1 bushel per hectare.

Ratoon cropping

The history of ratoon cropping here has not been bright, although there are occasional crops which yield in excess of four tonnes per hectare. A number of approaches are possible.

Weeds Controlled	Herbicide	Rate/ha Active Ingredient	Spray Volume ha	Time to Apply	Remarks
Most grasses in rice fields and annual broadleaves in young stages e.g. <i>Sesbania</i> <i>Aeschynomene</i> <i>Cyperus</i> spp.	Stam. (Propanil)	10 to 14 l	200 to 400 l/ha by boom spray 90 l/ha by air	When grasses have 3 and 4 leaves and are not stressed	Fields should be flooded within 2 days of treatment. Apply flood water 12 hours after application. Preferably spray in cool early morning hours. Do not spray if rain is expected within 6 hours.
Broadleaved ..	2, 4-D Amine	1 to 1½ kg/ha	200 to 400 l/ha by boom spray 60-90 l/ha by air	When rice is in late tillering and before panicle initiation	The field should be lightly flooded at treatment. Yield reductions likely if herbicide applied at early seedling. Panicle development, flowering and early heading stages.
Broadleaved ..	2, 4, 5-T Amine	1 to 1½ kg/ha	200 to 400 l/ha by boom spray 60-90 l/ha by air	When rice is in late tillering and before panicle initiation In summer 6-8 weeks Later in winter	The field should be lightly flooded at treatment. 2, 4, 5-T is less damaging to young seedlings and can be applied slightly earlier than 2, 4-D. Prefer when treatment is being done at completion of tillering.

P.N. Use herbicides at recommended rates. Refer to label for restrictions on use.

Provided harvesting damage is not excessive and the straw from harvest is spread uniformly the crop can be given a light flood irrigation and then fertilized. About 60 to 80 kg N is suggested and the operations carried out as close to harvesting as possible.

The area might then be left for about 2 weeks to allow the nitrogen to be absorbed and tillering to progress. At the end of this time tillers are about 4 inches and a shallow flooding can now be applied and water levels maintained until harvest time. This method is not suitable after a winter harvest. There is too much likelihood of head sterility from low temperatures. Burning of straw following slashing can reduce stands and is not recommended.

The ratoon method more common to the area is to slash the crop after harvesting, and then apply water and fertilizer. Otherwise farmers delay for a few weeks and slash again

to even up the stands of seedlings and ratoon plants. A shallow flooding is then applied followed by fertilizing. For best results it seems that levels 110 kg/ha N should be applied. Further nitrogen will probably be necessary at head initiation.

Yields from this method are invariably better than those of non-slashed crop as 3 t/ha are obtained while the former produces around 1 t/ha. The quality of the grain with its irregular maturity is not up to planted rice grain quality and ratooning is not a practice to be used unless adverse weather conditions prevail.

These crops are comparatively cheap to grow as land preparation, planting, and weed control measures are not necessary, although it is sometimes advisable to control broad-leaf weeds with 2,4-D.

Economics of Rice Production

by N. SING, Agriculture Economist

Rice production practices, such as fertilizer use, water use, weed control, insect or disease control and harvesting, have an influence on the profitability of the crop.

Although all practices are important, some will have a greater effect on costs and these should receive more attention and consideration.

Simple records and accounts of each practice will pin-point costs and aid decisions to make changes in management.

Gross Margin	\$/ha Harvested
Gross Receipts	
5 t/ha @ \$81.50/t	408.00
Total Gross Income	408.00

Less

Growing Costs	\$
Land preparation including Bank Maintenance	26.18
Planting and Fertilizing (Contract)	8.64
Seed—2.5 bags/ha @ \$4/bag	10.00

Weedicide—	
11.24 l Stam/ha @ \$2.64/l flown on @	\$
77c/l (2 out of 3 crops)	25.27
Cartage 5 tonnes @ \$2.94/t	14.70
Harvesting 5 t/ha @ \$7.35/t	36.76
Water Winter Harvest 10.62 MI @	
\$6.50/MI (for a Summer Harvest	
\$13.67/MI)	79.66

Fertilizer—

Basal—	
250 kg sulphate of ammonia @	
\$2.79/50 kg	13.95
125 kg super @ \$2.35/50 kg	5.88
Topdressing—	
160 kg Urea @ \$4.54/50 kg	14.53
Flown on @ \$3.20/50 kg	10.24

\$245.81

Gross Margin/ha Harvested \$162.19

Effect of Varying Yields—

Yield	Tonnes per Hectare		
	4	5	6
Crop			
Summer Harvest	\$82	\$153	\$224
Winter Harvest	\$91	\$162	\$233

Gross Margin/MI of Water

Summer Harvest	5 tonne crop
Winter Harvest	\$11.19 per MI
	\$15.27 per MI
1 acre foot = 1.2 MI (megalitres)	

(January, 1974)



Bulk bins are used to transport rice.

Four spring-flowering native vines

DURING spring, four vines with pea flowers can be seen blooming either in open eucalyptus forests or on the margins of light rain-forests.

Both native sarsaparilla, which has bluish-purple flowers, and red-flowered Kennedy pea are slender, wiry vines that sprawl over the ground or on supporting vegetation, twine about themselves to form a tangled mass, or twine up and around shrubs and tree trunks.

Blood vine, which has small port-wine coloured flowers, and derris, with larger flowers flushed with lavender, are both vigorous woody vines. At the end of spring, their flowers festoon the canopies of trees over which the vines climb.

These four plants have typical pea flowers with five sepals united into a calyx tube, five petals, and 10 stamens, nine of which have their filaments joined to form a sheath which is split along the upper edge. The tenth stamen is either quite free, as in native sarsaparilla and Kennedy pea, or is free at the base and connate with the others at the middle, as in blood vine and derris.

Native sarsaparilla

NATIVE SARSAPARILLA (*Hardenbergia violacea*). The first specimen of *Hardenbergia* was collected in 1837 by Baron Huegel, an Austrian statesman and well-known traveller. His sister, the countess of Hardenberg, cared for the plants he took back 'with the greatest solicitude' and the genus was named in her honour.

by BERYL A. LEBLER, Senior Botanist.

Hardenbergias are always glabrous, twining plants or undershrubs. They have alternate leaves which are compound, with one, three, or five entire leaflets. The small flowers arranged in racemes can be purple, white or pinkish. They always have a yellow or pale green blotch at the base of the reflexed portion of the spreading standard.

These plants are found only in Australia and this is the only species found growing naturally in south-eastern Queensland.

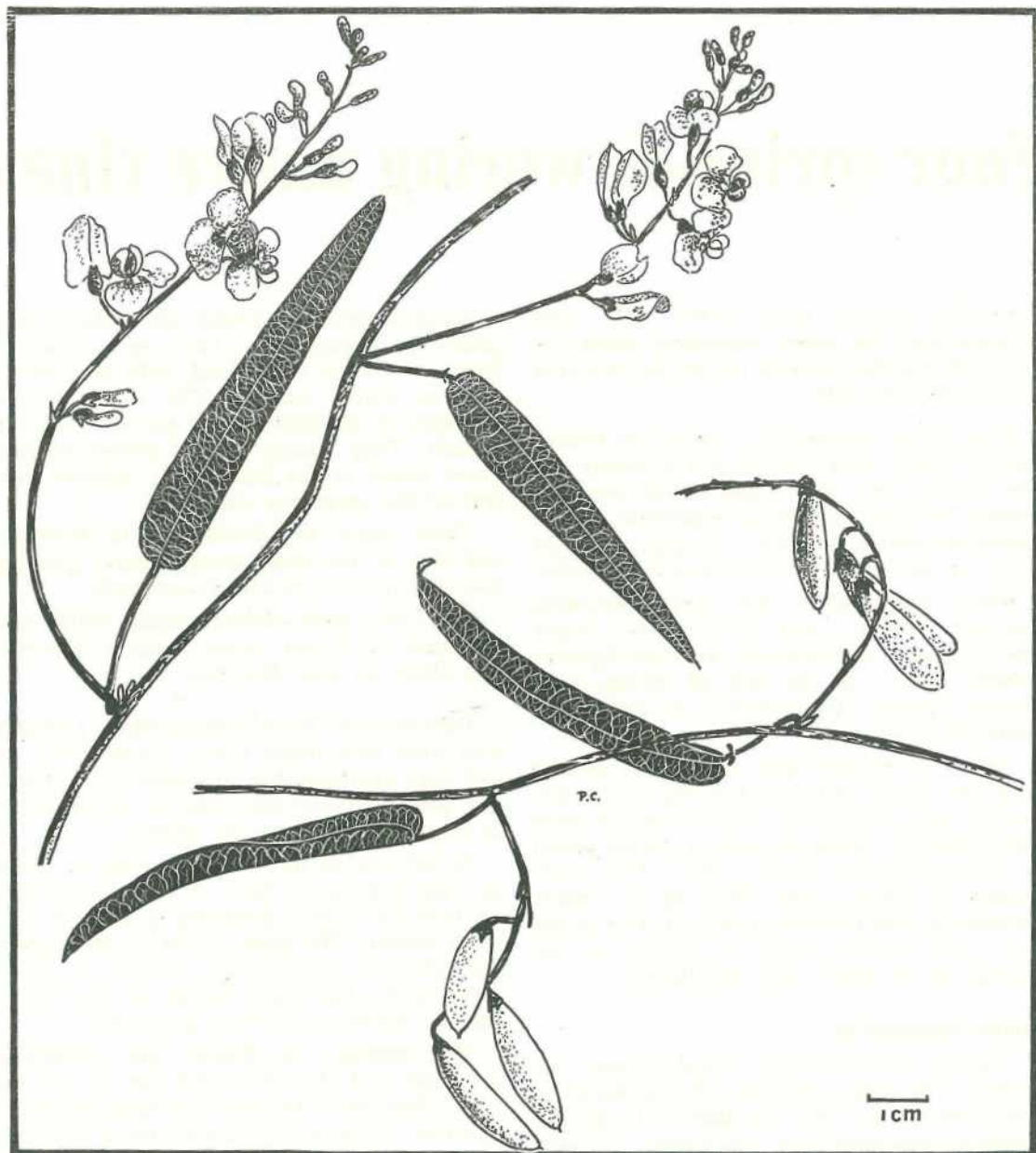
The Latin word *violacea* means violet, and describes the flower colour. This is blue-red, and closer to blue than red.

DESCRIPTION. Native sarsaparilla is a slender wiry vine with tough stems. These twine up and over anything that will support the plant. The leaves are alternate, and the single leaflet is ovate to lanceolate in shape.

A leaf can be up to 11 cm long, as much as 5 cm wide at the base. It tapers to a blunt tip with the midrib produced to form a very short mucro. The upper surface is dark green and shows a conspicuous network of paler, green veins. The lower surface is much paler and the leaves are leathery in texture.

The racemes of flowers are sometimes luxuriant and branched and can be 17 cm long. They stand out from the stem and curve upwards. Deep, violet flowers are at the ends of red stalks up to 0.8 cm long. The green calyx tube, 0.25 cm long, ends in five short, pointed teeth which are flushed with purple. The two upper teeth are joined together almost to the ends.

Individual flowers are almost 1 cm long, and have a spreading, reflexed, emarginate standard almost 1 cm wide. The claw at the base of the standard is white. This colour extends up



Native sarsaparilla (*Hardenbergia violacea*).

into the standard and then widens into a pale green two-lobed batch. Darker purple veins on each side of this area give a deeper tone to this part of the standard.

The fruit is a smooth, brown flattened pod about 4 cm long and 0.5 cm wide. It splits along both the upper and lower edges to

expose small, dark brown, oblong seeds placed obliquely across the pod and separated from each other by pithy pulp.

FLOWERING TIME. Spring.

HABITAT. The habitat of native sarsaparilla is in sandy soil on coastal lowlands, in mixed eucalyptus forests, wattle and tea-tree forests, and on the slopes behind wallum flats. Further inland, it is found on soil derived from granite, often on steep slopes among boulders.

DISTRIBUTION. This plant grows in all the mainland States except Western Australia. In Queensland, on the coastal areas, it grows as far north as Dalrymple Heights west of Mackay, and as far west as Pentland, west of Charters Towers, and the Blackdown Tableland, west of Rockhampton.

GENERAL REMARKS. The long, loose racemes of vividly coloured flowers make this one of the most conspicuous flowering plants in early spring. This climber has been brought into cultivation.

Kennedy Peas

In 1804, Lewis Kennedy, an important nurseryman of the latter part of the eighteenth century, was commemorated when the first Kennedy pea was described as *Kennedia rubicunda*.

These plants are perennials with trailing or twining stems. They are usually covered with hairs, either short and stiff, or long and shaggy. The leaves are alternate and compound, usually consisting of three leaflets. A pair of persistent, striate stipules is at the base of each petiole.

The flowers are some shade of red, so dark in some species they are almost black. They grow up the axils of the leaves either singly, in pairs, or grouped in umbels or racemes. The pods are long and cylindrical, either flattened or swollen, and are more or less divided by a pithy substance between the seeds. Kennedy Peas grow only in Australia.

Red Kennedy pea

RED KENNEDY PEA. (*Kennedia rubicunda*). This is the only Kennedy pea growing naturally in south-eastern Queensland. The Latin adjective *rubicundus* means red or ruddy and describes the colour of the flower.

DESCRIPTION. This is a large vine which sprawls over vegetation, or twines about itself to form a tangled mass. The stems are firm

and sparsely covered with hairs. In the young flowering stems the covering is much denser.

The trifoliate leaves are widely spaced on the stems. Young leaves are bronze green and older leaves are dark green, firm and almost leathery in texture. The lower surface is lighter in colour. Both surfaces feel smooth to the touch but under magnification a sparse covering of short fine appressed hairs can be seen.

The petiole is up to 5 cm long and is swollen at the base. There are also swellings beneath each leaflet. At the base of each petiole is a pair of brown, reflexed, striate stipules which are triangular in shape and 0.6 cm long. The terminal leaflet can be up to 12 cm long and half as wide. It is rounded at the base and narrowed to a blunt point with the midrib produced to form a short mucro.

The lateral leaflets are up to 11 cm long and 7 cm wide and are asymmetrical, with blunt tips and rounded bases.

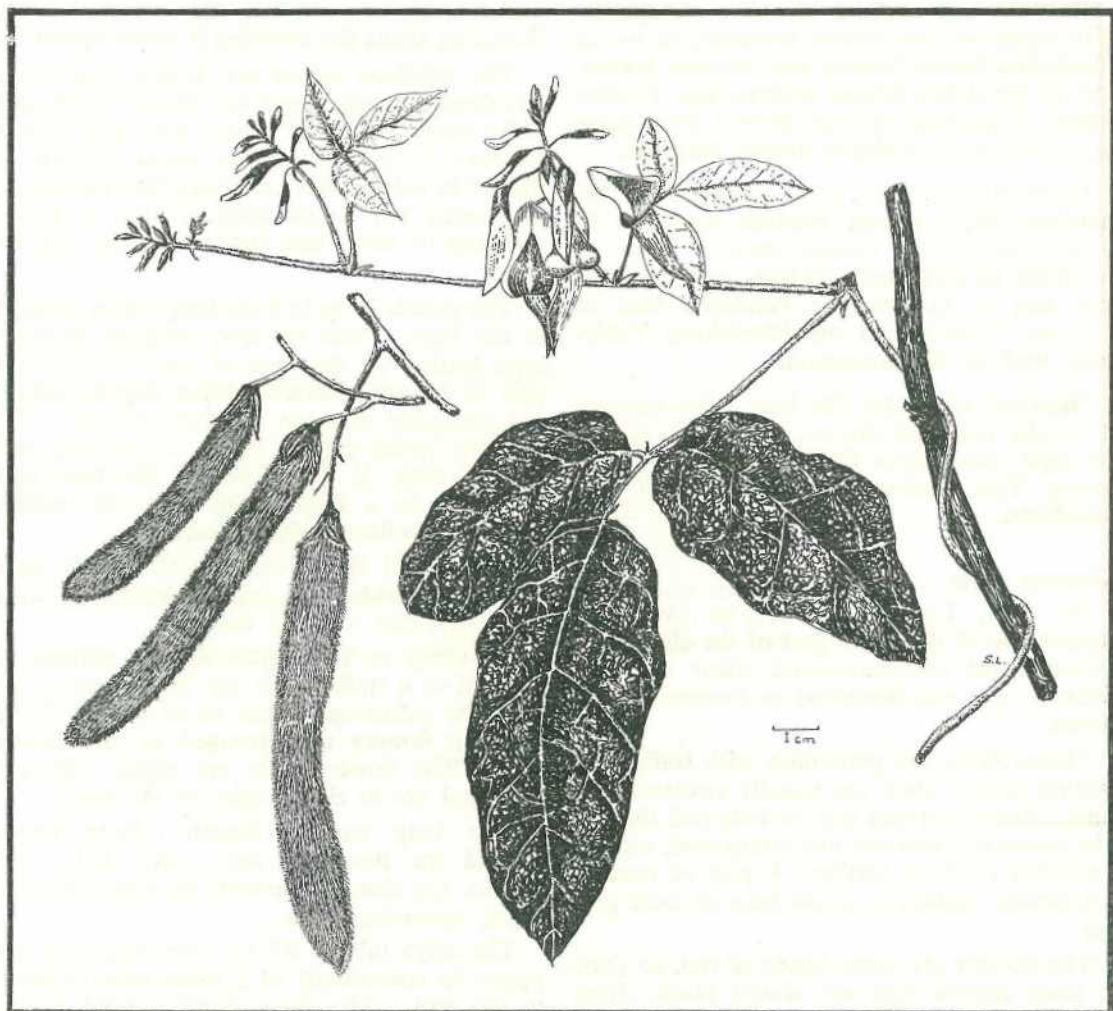
As many as 20 flowers form a raceme at the end of a stalk which can be as long as 12 cm. The inflorescence can be as long as 7 cm and the flowers are arranged in an uneven spiral. The flower stalks are about 1.25 cm long and are at right angles to the stem.

The long narrow flowers hang down around the flowering stem. The stalks and calyces are densely covered by rust-coloured, short, spreading hairs.

The calyx tube is 0.5 to 1 cm long with the upper lip consistently of 2 lobes joined almost to the end. The three finely-pointed, lower lobes are spreading and are almost as long as the tube. When the flowers open, the most noticeable feature is the manner in which the standard is abruptly reflexed at the end of the calyx and lies back along the flower stalk.

At this point the petal bulges outward and is covered by a contrasting colour which, in Queensland plants, looks like a purple-red thumb print on the bright red petal.

The standard is almost 4 cm long, half as wide and has a blunt tip. The keel and wings are darker red, flushed with blood red along the upper edges of the wings. The tip of the keel curves out in a point between the rounded ends of the wings. These are as long as the standard.



Red Kennedy pea (*Kennedia rubicunda*).

DISTRIBUTION. This plant grows in the eastern Australian States to as far north in Queensland as Mt. Spurgeon in the Great Dividing Range, north west of Mossman.

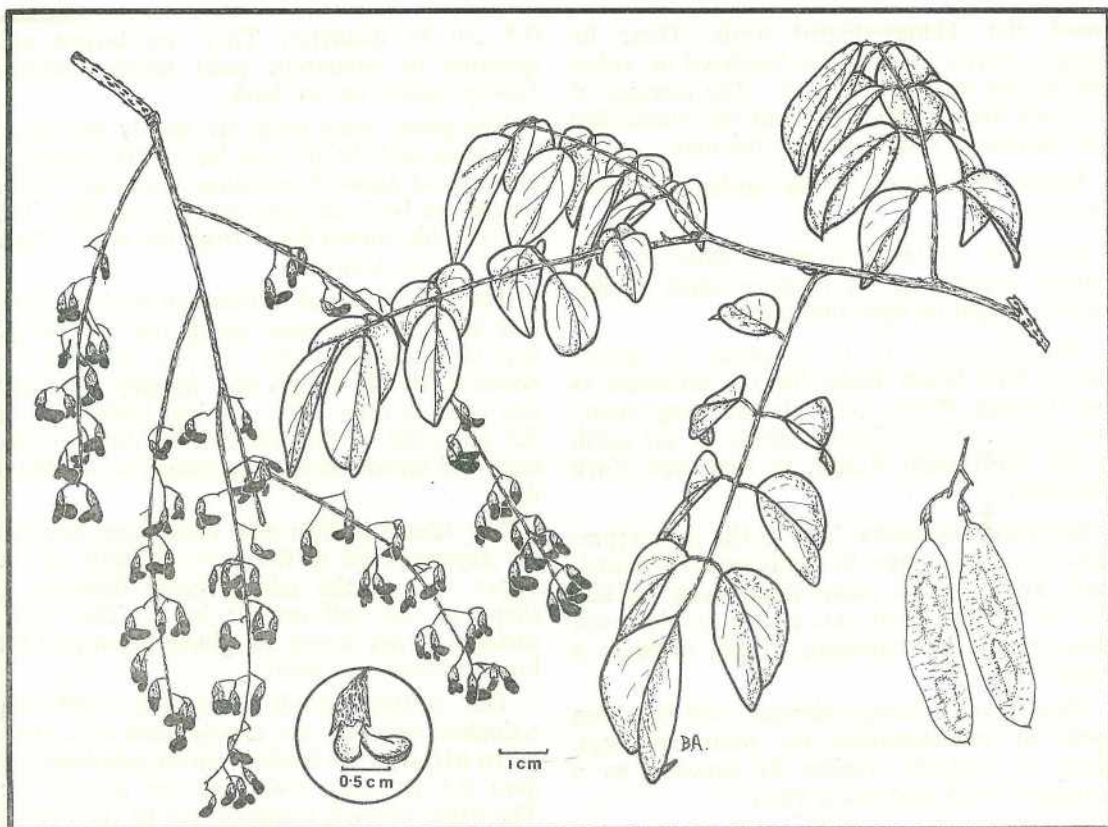
GENERAL NOTES. This plant is also being cultivated in home gardens.

Blood vine

BLOOD VINE. (*Lonchocarpus blackii*). Two Greek words, *lonche* meaning a lance and *Karpos* meaning a fruit are combined to form the generic epithet which describes the shape of the fruit. This plant was named in honour

of Allan Black, who was curator of Kew Herbarium from 1853 to 1863 and who first determined the generic relationship of this plant.

DESCRIPTION. This is a woody vine with many branches. Minute, rusty hairs cover the stems, leaf rachis, and midribs of the pinnate leaves. These can be seen only under magnification. The leaves are glabrous and dark green and shiny on the upper surfaces. The lower surfaces are covered with minute rusty hairs.



Blood vine (*Lonchocarpus blackii*).

The leaves can be 9.5 cm long and 5.5 cm wide. Individual leaflets are ovate in shape, with rounded bases and tips drawn out into a short, blunt point. They can be 4 cm long and 2.5 cm wide, and are at the ends of petiolules almost 0.5 cm long.

A single hair-like secondary stipule (stipella) is at the base of each petiolule. The terminal leaflet is often larger than the others. The rachis arches downwards and the leaflets curve downwards in each side.

Deep port-wine coloured flowers are scattered on long, loose racemes which together form a large terminal panicle. Usually two flowers, each on a pedicel 0.4 cm long are together at the end of a short common peduncle 0.25 cm long. The standards point back towards the rachis of the raceme. Minute, appressed golden hairs are lightly sprinkled on the pale green petiolules and calyces.

The calyx tube is about as long as the petiolule and ends in fine, short, triangular pointed lobes. The standard is folded down on each side of the flower and does not spread widely like native sarsapailla or red Kennedy pea. Short appressed hairs are sprinkled on the outside, at the end of the standard.

Each flower is about 0.6 cm long. In old flowers the tip of the hairy, green style protrudes from the end of the keel. The weight of the flowers is such that the panicle droops from the stem. This plant is a semi-deciduous vine and blooms when the new foliage is just appearing.

The pods are almost papery in texture, brown in colour, 5 to 12.5 cm long, 1.25 to 2 cm wide, and contain from two to five

broad, flat, kidney-shaped seeds. These lie along a central line and are bordered on either side by the walls of the pod. The margins of the pods are usually wavy and the thread-like style remnants can be seen at the end.

FLOWERING TIME. Late spring to early summer.

HABITAT. Usually, it grows close to permanent waterways, on river or creek banks, on the margin of light rain forests.

DISTRIBUTION. It is common in north-eastern New South Wales from as far south as the Hastings River, and extends along nearly the whole coast of Queensland to as far north as the McIlwraith Range, in the Cape York Peninsula.

GENERAL REMARKS. This is the only representative of the genus in south-eastern Queensland. The common name arises from the fact that the plant, when cut, exudes a blood-red juice, which, on exposure to air, dries to a brown gum.

Blood vine is being cultivated and has been used on embankments on some freeways. Here, it controls erosion by growing as a scandent shrub and not a vine.

In the Yarraman district, a cerise-pink flowered form of this plant has been found.

Derris

DERRIS (*Derris involuta*). In 1904, an Australian climber flowered for the first time after cultivation in London at Kew Gardens for about 20 years. The plant was given the name *Wistaria involuta*. It had been collected from the Richmond River district of New South Wales. When the fruits developed and matured, it was obvious the plant had been placed in the wrong genus. In 1905 the name was amended to *Derris involuta*.

Derris is a Greek word meaning a leather covering, and describes the tough seed pods of these woody climbers. A Latin word meaning rolled inwards forms the specific epithet and describes the margins of the bell-shaped calyx tube.

DESCRIPTION. It is a vigorous, woody vine with the main stems about as thick as a man's wrist and the leafy flowering stems are about

0.5 cm in diameter. They are brown and speckled by numerous paler brown lenticels (corky spots) on the bark.

The green, leafy twigs are widely spaced on the stems and the pinnate leaves are spaced at intervals of about 3 cm along the twigs. These leaves can be 2 cm long and 10 cm wide. The leaf rhachis curves down from the stem. There are 9 to 13 leaflets.

The lowest pair of leaflets can be 4 cm long, and the size increases along the rhachis so that the terminal leaflet and the top pair are about twice the length and roughly the same size as each other. The terminal leaflet can be 3.5 cm wide at the middle, narrowed to the base and narrowed more gradually to the blunt tip.

The lateral leaflets also have blunt tips but are asymmetrical at the base, the half on the upper side of the midrib being different in shape to the half on the lower. The upper surfaces of the leaves are glossy green and the lower surfaces are paler.

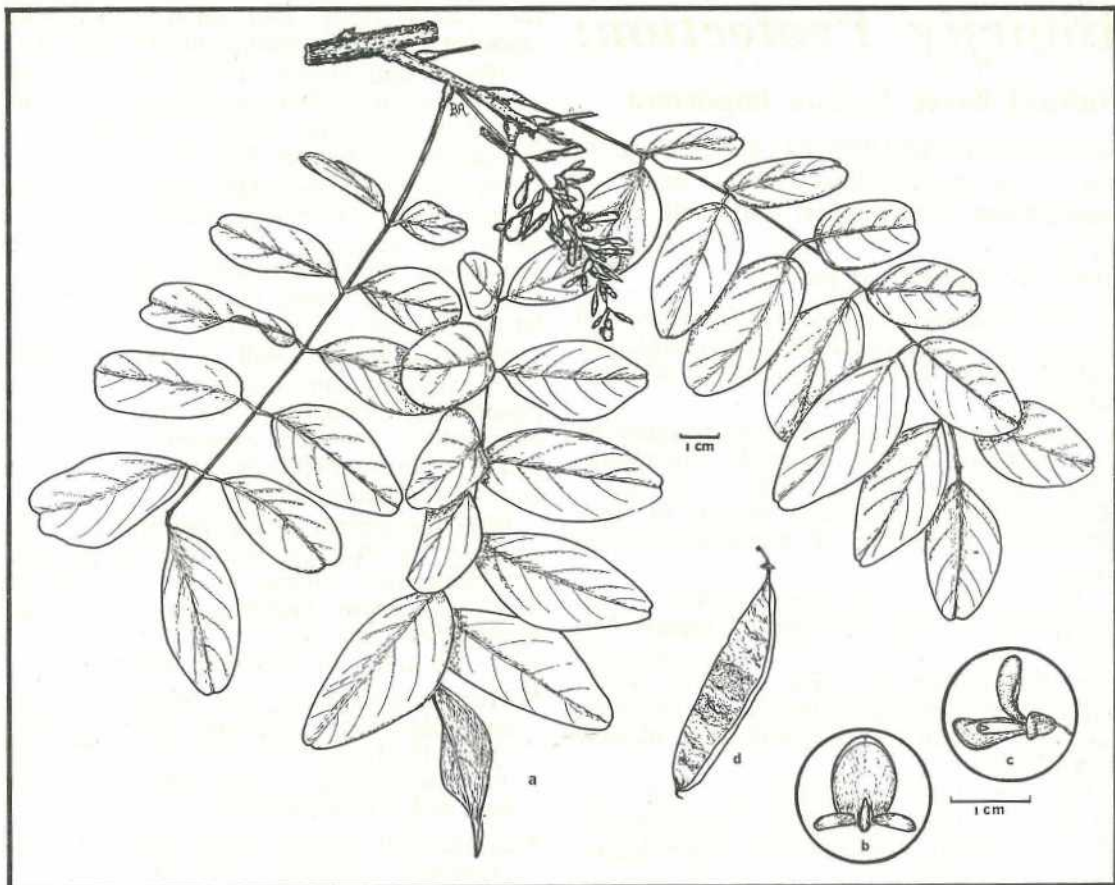
The midrib, lateral veins and connecting reticulate venation are clearly seen as a paler green network. All leaflets are on petiolules less than 0.5 cm long and there are no stipelae. The bases of each petiolule and of the rhachis itself are conspicuously swollen and a different colour.

The upper surfaces of the leaves are glabrous, but short, rusty hairs are scattered on the lower surfaces particularly on the veins.

The flowers are in axillary racemes of up to 50 flowers scattered in clusters of three, four or five along the rhachis. Each flower is white, flushed with lavender, and is about 1.25 cm long. The slender pedicel is 0.5 cm long.

Under magnification, appressed rusty hairs can be seen on both the pedicel and cup-shaped pale green calyx tube which is about 0.3 cm long. The spreading standard curves back over the calyx tube. The wings and keel project more than 0.6 cm beyond the standard. In the bud, the only part of the flower visible is the standard, with its white tip and the basal part flushed with lavender.

As the flower opens, the impression of a lavender-pink flower increases, since the colour on the inner surface of the standard is more vivid and the wings and keel are the same



Derris (Derris involuta).

colour. If all the petals are removed, the arrangement of the stamens is seen, with the filaments of nine of the stamens united in a tube which is open on the upper side. The tenth stamen is free from the rest at the base and sometimes united to the others at the middle.

The pod is flat, thin, but leathery in texture. Usually it is about 4 cm long and one-seeded, but it can be 7 cm long and contain two seeds. These are red-brown, kidney-shaped, about 0.5 cm long and are enclosed in rounded, domed swellings.

The pods are rounded at the end, and narrowed at the base. A conspicuous wing about 0.2 cm wide runs along the upper edge with a raised ridge separating it from the rest of the pod.

FLOWERING TIME. Late spring to midsummer.

HABITAT. In south-eastern Queensland, it is often found in the rain-forest remnants or the thickets along creek banks.

DISTRIBUTION. The plant is found from as far south as the Clarence River in northern New South Wales to as far north in Queensland as Maryborough, and as far west as the Bunya Mountains.

GENERAL REMARKS. Like blood vine, this is being used on embankments to control soil erosion.

Blowfly Protection:

Natural fleece factors important

NATURALLY-OCCURRING substances in the fleece can interfere with the action of insecticides used against the sheep blowfly, and reduce the period of protection given by dipping or jetting.

These findings have emerged from research centred on the Glenfield Veterinary Research Station of the N.S.W. Department of Agriculture.

In this project, one of a series financed by the Australian Meat Research Committee, Senior Veterinary Research Officer Mr. C. A. Hall has been investigating reasons for lack of effective persistence of insecticides in the fleece.

"The length of protection given against the blowfly is still diminishing," reports Mr. Hall. "Our continuing field investigations show that during the spring of 1974, breakdowns after thorough jetting did occur within 12 to 18 days in widely spread areas of New South Wales.

"It is generally recognised that resistance by the fly to the insecticide is a major feature of this problem, but there are other factors involved as well".

Mr. Hall explains that in the laboratory, young maggots can be killed by insecticidal concentrations as low as one or two parts per million.

Yet in fleece wool which has ceased to kill the maggots, chemical extraction methods have shown insecticidal concentrations of more than fifty times this still remaining.

This strongly suggests that when the insecticide is applied to the fleece—by jetting or dipping—something interferes with its action and prevents it from doing the job it should be doing.

According to Mr. Hall, it appears that when the insecticide is applied, there is a certain amount of emulsification or softening of the wool wax, which allows some of the insecticide to penetrate the wax layer and become trapped.

When maggots hatch from the eggs and move to the skin surface to start the strike,

they don't come into contact with any insecticide which is masked in this way.

"We've also looked at other factors commonly present in fleece and which were suspected of interfering with the persistence of the insecticide," states Mr. Hall.

"We've found that dust and dung in the fleece can interfere with persistence by as much as 30 per cent, cutting down the period of protection. This is probably a physical effect, with insecticide being trapped or forming a barrier against effective action.

"Urine—even in small amounts—is found to be extremely damaging to the persistence of insecticides, probably by breaking them down chemically. In our experiments, even a couple of teaspoonfuls have reduced persistence to less than seven days."

With the already severe problem of resistance by the fly, it's vital that we give the insecticide every chance to do its job to the best of its ability, and Mr. Hall advises that management can play an important role in this. He gives the following hints:—

- More emphasis on the Mules operation and mid-season crutching. This not only makes the breech less attractive to flies, but cuts down fleece pollution which can interfere with the insecticide.
- Correct tail docking, which helps to divert urine and dung away from the fleece.
- Avoidance of scouring, which can be done by drenching if worms are the problem, or by supplementary feeding and paddock management if feed is the problem.

"Dust, of course, is harder to control," Mr. Hall points out. "Yet you'll often hear graziers warn against yarding sheep or taking them along dusty roads during a fly wave. They've probably learned by experience that this cuts down their protection."

As far as interference with insecticide by wool wax is concerned, the research work indicates that the situation might perhaps be improved by changes in methods of formulation and application of the insecticide, so that it could be applied as a layer on top of the wax rather than mixing in with it.

This is all part of the overall research project, which is aimed at reversing the current trends and giving the grazier longer periods of protection against the blowfly.

Place of annual medics in the near south-west

by P. B. WYLIE and J. F. BOURNE,
Agriculture Branch.

INTEREST in sown pastures for beef and wool production in the near south-west has increased considerably in recent years.

The area sown in the Miles-Roma-St. George-Goondiwindi region now exceeds 250 000 hectares. Buffel (*Cenchrus ciliaris*) and green panic (*Panicum maximum* var. *trichoglume*) are the common grasses.

Annual medics (*Medicago* spp.), when sown with these grasses, can give the following benefits by

- supplying a high quality winter feed supplement;
- adding nitrogen to the soil which summer growing grasses can use;
- providing a basic pasture during spelling of land from continuous cropping.

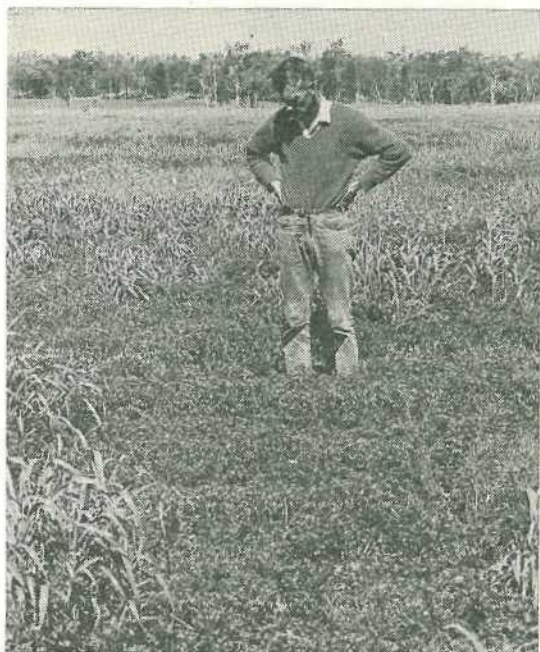
What are annual medics?

Annual medics are winter-growing legumes that regenerate naturally each year from self-sown seed. They are natives of the Mediterranean region and are similar in feed value to lucerne (*Medicago sativa*). Since growth is confined to the cooler months they do not have to compete with grasses during summer.



Close up of a buffel grass-Cyprus barrel medic pasture near Roma.

Annual medics are similar in growth pattern to subterranean clover which is widely grown in pastures in southern Australia. However, the medics are more suited to Queensland than subterranean clover because they grow and set seed better under the drier conditions.



Dense growth of Harbinger (strand) medic with volunteer wheat plants on river flats south-west of Condamine after good winter rains.

As well, medics will produce more 'hard' seed than subterranean clover. This hard seed can remain dormant for many years thus ensuring that some viable seed will remain in the soil after several dry winters. The mechanism is such that, in a good medic year, both the seed yield and the proportion of hard seed are increased.

Quality feed from medics

Feed production of medics is determined by cool season rainfall. Small amounts will be produced in most years with large amounts in good winter-spring seasons. On the average, a good medic season can be expected one year in three.

Even small amounts of medic growth can be valuable to stock. Because of its protein content, it will supplement the dry grass which is the main component of winter feed. Annual medic is particularly valuable for sheep as seed pods provide an additional bonus in a dry spell.

Where cattle graze medics, the bloat problem must be kept in mind particularly in good seasons. Bloat is not usually a problem with sheep. However, cases have been recorded in hungry sheep grazing flush growth of burr medic.

Nitrogen and grass growth

Without any compensation for soil nitrogen losses, the yield of a sown grass pasture will decline. Where soils have high initial levels of nitrogen, such as in brigalow country, this decline may not occur for many years. However, on poorer soils or on those which have been cropped for many years, a considerable decline may be evident after 2 or 3 years.

When a grass is sown on a cultivated seed-bed enough nitrogen becomes available through breakdown of organic matter to give good growth for the first year or two. After this, pasture growth depends on nitrogen returned to the soil from dung, urine and organic matter.



Dense medic growth among native grass during the pasture phase of a rotation.



Jemalong barrel medic sown with wheat near Glenmorgan. Note the purple-brown splash in the centre of the leaflets, which is characteristic of Jemalong.

Renovation produces a temporary increase in grass growth as the result of increased release of nitrogen from organic matter. This is quickly used and the pasture once more depends on the normally slow recycling of nitrogen.

The point to be realized is that renovation does not add nitrogen to the soil-plant system.

It can give other benefits, however, such as improved moisture penetration and seed germination on hard-setting soils.

Nitrogen is lost from the system when animals are removed for sale and by leaching during heavy rain. The main loss, however,

is from urine. Under hot, dry conditions, much of the nitrogen in urine is lost to the atmosphere as ammonia gas. For the 500 to 625 mm rainfall zone, the annual loss of nitrogen is likely to be around 15 kg per ha.

The addition of 15 kg per ha of nitrogen to a pasture would require 30 kg per ha of nitrogen applied as fertilizer. This is because less than half of the nitrogen applied as fertilizer will be recovered in the feed available to stock. To provide 30 kg of nitrogen would require 65 kg of urea (46%) at an approximate cost of \$7 per ha. This is not economical.

Although the yields vary greatly from year to year, medics provide a small but definite contribution to soil nitrogen over a period of years. In a good winter, they may add more than 50 kg per ha of nitrogen to the soil. Thus, on a long-term basis medics will gradually raise soil fertility.

Species and cultivars

The following species and cultivars of annual medic have been used successfully in the near south-west:—

Species	Cultivars
Burr medic (<i>Medicago polymorpha</i>)	No named cultivars
Small woolly burr medic (<i>M. minima</i>)	No named cultivars
Barrel medic (<i>M. truncatula</i>)	Jemalong, Cyprus
Strand medic (<i>M. littoralis</i>)	Harbinger
Snail medic (<i>M. scutellata</i>)	No named cultivars

Burr medic and small woolly burr medic are naturalised in the region. Their seedpods have hooked spines that lodge in fleeces and reduce the value of the wool.

The sown species of medic are less troublesome in this way. The burr or barrel medic has straight spines which can be readily combed from wool. The pods of snail medic have no spines.

Medics will grow on all soil types found in the region from the cypress pine/bull-oak sands to the melonhole brigalow clays. However, snail medic is less suited to the sandy soils than the other cultivars.

It is a common practice to sow a mixture of two or three cultivars. This is based on the observation that cultivars respond differently to varying seasonal conditions.

Time of sowing

New sowings should be made early enough in the season to allow the plants to complete their life cycle and set seed for next year's crop.

February–March is the recommended sowing period for grass–medic pasture mixtures. This allows the grass to become established before the frosts begin.

Medics can be successfully oversown into established grass pasture, either sown or native, during a renovation. This operation should be carried out during autumn when soil is moist.



Snail medic establishment on a heavy clay soil. Note the large coiled seed-pods.

They can be added to a winter-cropping system by sowing with the last crop before spelling. The most favourable sowing time is April–May. However, this period can be extended to the end of July to fit in with cereal sowing dates. The sowing rate for the crop should be reduced by 20 to 30%.

If medics are sown with a forage crop such as oats, the grazing pressure should be light enough to allow the medic seedlings to develop and set seed.

Rate and depth of sowing

Sowing rate recommended in the region is 1.5 to 2 kg per ha of total seed. If a mixture of two cultivars is sown, 0.75 to 1 kg per ha of each is planted.

Depth of sowing should be 1 to 2 cm, usually obtained by allowing seed to drop directly onto the ground and covering with trailing harrows.

When sowing with a cereal crop, seed should be added from a small seeds box and again dropped directly on the surface.

Under favourable conditions for early cereal sowings, medic seed can be safely sown at up to 5 cm, mixed with the crop seed. Sowing at this depth is not recommended in late plantings as germination is slower in the colder weather and seedlings are less likely to emerge from depth.

Inoculation and lime pelleting

The seed should be inoculated with the appropriate inoculant (bacterial culture) before sowing.

Acidity, sunlight and dry conditions are harmful to the bacteria. The harmful effect can be counteracted by lime pelleting the seed. Situations that require lime pelleting are—

- Acid soils such as cypress pine sands.
- Sowing in close contact with acidic fertilizers such as superphosphate.
- Sowing with perennial grasses treated with dust to prevent attack by seed-harvesting ants. Seed dusts used will kill the bacterial culture.
- Surface sowing into an ash seed-bed.
- Sowing into dry soil.

Fertilizers

On the cypress pine/bull-oak sands, an establishment fertilizer of superphosphate plus molybdenum, copper and zinc is recommended. It is possible that superphosphate would give a response on some other soil types but it is not commonly used. Medics could also benefit from residual superphosphate applied to previous crops.

Summing up

Annual medics have been observed to persist for more than 10 years where the average April to September rainfall exceeds 175 mm.

As the vigour of sown grass pastures declines, the opportunity for introducing medics is improved. The nitrogen provided by the legumes can play an important role in restoring the fertility of grass pastures.

Establishment of medics requires no specialized techniques or expensive machinery. Property owners who have grown lucerne will already be familiar with the concept of planting a legume and the benefits which result.

Following a good seed-set in the first 2 years, medics will build-up a seed-bank in the soil. This will enable them to regenerate each year without further sowings.

Observation suggests that heavy grazing of dense pasture growth in early autumn assists germination and growth of medics.

SAVE ON FUEL COSTS

ACCORDING to surveys carried out by the United States Department of Agriculture, farmers can make use of some very simple strategies to make considerable savings on their fuel needs.

The following, reprinted from the publication *Agricultural Situation* will be of interest to many Queensland farmers.

Maintenance: Careful adjustment of the air ratio, correct timing, good plugs and a clean cooling system are essential for farm machinery to operate at maximum efficiency. A survey of farm tractors in Illinois several years ago showed that nearly three-quarters were capable of developing only 75 per cent. of their rated power because of neglected maintenance.

Paint the Tank: As much as 3% of fuel stored above ground in dark coloured, unshaded tanks can evaporate. Evaporation losses can be cut to less than 1% however, if the tank is painted white and capped with a pressure vent. Shading the tank can substitute for painting.

Break Fuel Wasting Habits: Whenever equipment is likely to be inactive for some time, it pays to shut off the engine. Restarting the motor will often use considerably less fuel than idling.

Notes from all over . . .

QUICKER PREGNANCY TESTING is being looked at in Britain, where Wickham Laboratories in Hampshire have launched a new scheme to provide an early pregnancy diagnosis in cattle. The test is based on the measurement of the amount of progesterone in the milk. Significantly higher levels of this hormone are usually detectable 21 days after mating.

ELECTRIC FENCES on a mini-scale are being used in France for a new type of farming venture. Near Landes, an enterprising Frenchman has started a snail farm, to meet a growing demand from the world's gourmets. During the two years it's been in operation, the owner has had to solve the problem of keeping his livestock from wandering away. And so, like the owners of more conventional type livestock, he's resorted to the use of an electric wire, charged with a low alternating current.

PIG AND POULTRY producers in Europe can take little heart from a recently conducted survey of London hotels, and the breakfast habits of the passing public. Rising costs have meant that the traditional breakfast of bacon and eggs has been well and truly replaced by rolls and coffee. Now, only 20 per cent. of hotels make any attempt to serve a cooked breakfast to their guests. In Australia, however, perhaps, with the fall in beef prices, we'll see a return to our traditional breakfast menu—steak and eggs.

EGG SALES were the subject of a recent report from West Germany. As far as most customers were concerned, a rich yolk colour was equated with 'farm freshness'. Even though the customer can't see inside the egg before she breaks it, the German housewife wants to feel confident that she's going to be pleased with the yolk colour before she buys her eggs. As a result, German producers are prepared

to pay extra for feeds that will produce eggs that are going to be more attractive to their customers.

WILD OATS are being used by scientists at the Iowa State University, U.S.A., in an attempt to develop new high-protein, high-yielding varieties. They are using several wild and weedy oat types (the ancestors of our present commercial varieties) that have new and desirable genes for increased protein content, disease resistance and grain yield. They are hoping they can successfully extend the "Green Revolution" from wheat and rice to oats as well.

FUEL from organic matter such as manure and crop residues captured the imagination of the popular press during the height of the recent world energy crisis. Metropolitan editors had a lot of fun with stories of cars running on cow manure, and such like. At the University of Wisconsin, U.S.A., work done on producing methane or bio-gas from organic matter has indicated that the process is neither easy nor practical. The advice given to farmers who have been tinkering with machinery to try to produce methane has been that, unless fuel costs rise much higher, they'd be spending their time more economically doing field work, milking, or other income-producing activities.

GOVERNMENT WASTE PAPER could help solve some of the sheep man's feed problems. Scientists in Britain have found that pellet supplements containing 65% Government waste paper resulted in mature wethers gaining 117 g per day. Not surprisingly, perhaps, newspaper does not have the same effect as this highpower roughage. Now, perhaps someone will get busy and find a practical use for red tape.

THE FARM FAMILY

Spinning...



new interest in an ancient skill

A D.P.I. officer at Warwick is helping to develop interest in a skill that promises excellent promotion for the wool industry.

*J. G. NATION,
Sheep Husbandry Branch;*

*R. B. PORTER,
Information and Extension Training Branch.*

SPINNING, an ancient skill, is becoming increasingly popular in Australia. There are more spinning wheels in use in Australia now than at any other time in the country's history.

More than 2,000 years ago shepherds used twigs for spinning wool, primitive tribesmen rolled fibre between hand and thigh, while spun fibre has been found in the pyramids. Today



housewives (and some men) are learning the skill through Adult Education classes, groups, from books, or from friends.

It seems appropriate that one of the first provincial towns in Queensland to experience a revival of interest in spinning was Warwick, a centre for one of Queensland's major wool producing areas. John Nation, Sheep Husbandry Branch Officer at Warwick, demonstrated the skill to a group of housewives in Warwick in 1965.

Warwick has an informal spinners' group—so informal that the group does not have a name of office bearers. The spinners meet once a month, and the meeting becomes a social as well as a productive event. Satellite spinners' groups have developed in the townships of Dalveen and Leyburn and there are also enthusiasts in Stanthorpe, Inglewood and Texas.

A seminar held at Warwick was so popular with spinners and weavers in southern Queensland that more of these types of events are planned.



ABOVE: A single loom of the type used by schoolchildren.

LEFT: A crocheted shawl produced from hand-spun wool.

BELOW: Four shaft, upright loom. Can be used for more complex types of weaving.



Most women say they spin because it is relaxing and creative. For others, spinning is becoming a profitable cottage industry. There is a continuing demand for hand-made clothing—the most common end product of spinning. Outlets for these goods are craft centres in Toowoomba and Warwick, as well as personal contacts.

Spinning is the twisting together for strength of a selected number of fibres. When spinning with a wheel, the number of twists is regulated according to the way the yarn will be used.

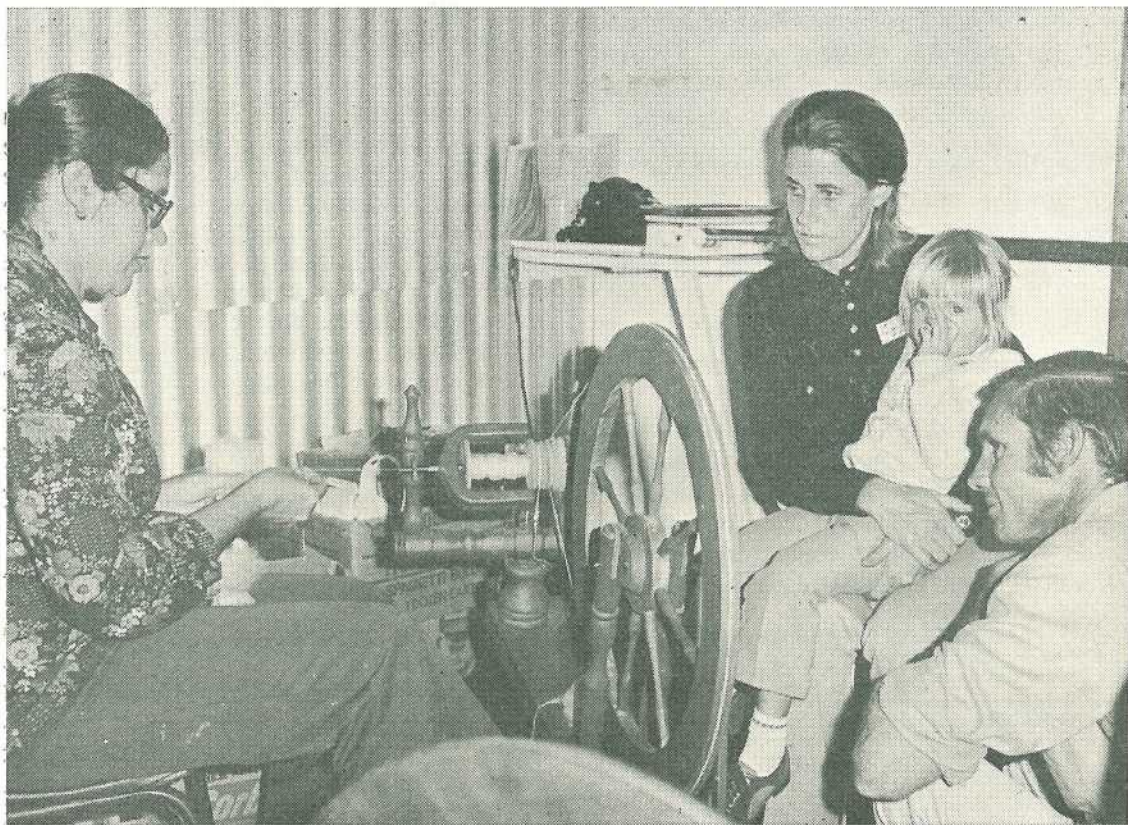
After obtaining the yarn, some spinners weave, while others knit or crochet. The variety of articles which can be made appears to be limited only by the imagination—anything from a potholder to a women's evening ensemble.

Getting the right type of wool for spinning can be a problem in towns and cities remote from sheep areas, although more hobby shops are stocking an increasing range of wool. It is easiest for the beginner to start out using the coarser wool of British or cross-breed sheep and then to move to the finer wool of the Merino or Polwarth.

In the past sheep producing coloured wool were destined for the station cooking pot because their fleeces had no commercial value. Now, as a result of demand, there are small flocks of sheep with fleeces coloured from blue-grey to black. For spinners these sheep provide a source of natural coloured wool.

Because raw wool contains wax, grease and other matter, between 10 per cent. and 50 per cent. of the fleece weight can be lost

BELOW: Using a home made spinning wheel.



during spinning. As a rough guide, a fleece (2 kg) of clean, scoured wool is enough to make a woman's pullover and two large shawls. On present prices, wool costs between \$2 and \$4 a kg.

Most spinners start off with a spindle, costing less than \$2, to see whether they like the hobby. They may graduate to wheels which are priced from \$45 to \$300.

In terms of wool consumed, home spinning means little to the wool industry. But as a public relations vehicle, it can be a great success. Townspeople taking up spinning are more aware of the problems of the wool industry. They can quote wool quality in terms of fleece characteristics such as handle.

Spinning, as a minor cottage industry, is helping to promote the wool industry and tourism. A tourist attracted to an article because it is hand made may later be impressed with the attributes of pure wool. The purchaser of a hand-spun wool product associates it with an area, which can help tourism.

For the spinner, it is a relaxing, creative and possibly profitable hobby.

REFRIGERATORS, ice chests and similar articles can be a real danger to children if not disposed of properly. Before dumping such articles, remove all doors and lids that could trap a child who climbed in while playing.

The Queensland Health Education Council.

Blame virus for warts

IF you avoided frogs in childhood because of tales that you would develop warts, then you worried unnecessarily; warts are a viral infection of the skin.

Warts may appear at any age, but are more common in children. There is, however, a tremendous variation in susceptibility. The lesions usually appear on exposed parts of the body, particularly on the face, soles, hands and fingers, but again, this varies greatly. Any part of the body, including the mucous membranes, may be affected.

Warts begin as minute, smooth-surfaced, skin-coloured lesions. They enlarge for a while, but remain stationary after reaching a certain size. Repeated irritation, such as rubbing, promotes growth, and the surface assumes a roughened, 'bubbly' appearance. Some individual warts may remain unchanged for months, then suddenly develop satellite lesions. Others may grow or appear at a steady rate.

Characteristics of warts depend chiefly on their site. For example, plantar warts are found on weight-bearing surfaces of the sole of the foot. Most of the wart lies beneath the skin surface and the callous area is usually tender. A special type of wart which appears on the nail fold is the periungual wart; flat warts which appear on the face and backs of the hands are smooth, flat, yellow-brown lesions and are more common in children and young adults. Filiform or thread warts are thin elevations, seen usually on the eyelids, face, neck, or lips. Moist, or 'venereal' warts appear on the mucous membrane, or skin of the genital organs and in the anal region.

Treatment varies greatly, and this is one field where some of the old wives' remedies actually work. However, a degree of local immunity may explain the sudden disappearance of some warts. Warts can be removed by the application of certain chemical preparations, or surgically, but treatment is best decided by a doctor.

—Queensland Health Education Council.



Anne COOK'S farm home

Item from America that caught my eye this month, and made the stomach turn at the same time, concerns the current 'in' topic, the world wide food shortage.

Dr Ronald Taylor from the University of California advocates that we drop our prejudices against eating insects, and make use of this buzzing, crawling, hopping source of protein.

He says that insects provide one of the best remaining sources of protein for the human diet, that they're tasty, and much cleaner than modern sea foods.

The good doctor spends a lot of time collecting insect recipes, and after considerable research, declared that grasshoppers are the favourite insect delicacy. They can be served raw, toasted, fried, broiled, curried, chocolate-covered, or baked into cakes.

As I write this, much of Queensland is being plagued by locusts. So it would seem that any hostess who wanted to spring something new into the menu would need only to approach the current plague with plenty of culinary imagination—and guests with strong stomachs.

Level crossing accidents occur all too frequently; many of them in country areas. So I was interested in a study by Canadian road safety experts who believe that many of these accidents are caused because the car driver misjudges the speed of an oncoming train.

They believe that, in many cases, the drivers have seen the train, but think they have plenty of time to cross the tracks before it reaches the crossing.

This misjudgment is often the explanation for a car slamming into the side of a train, well back from the engine.

In other cases, the driver realises too late that he will not cross the tracks in time, and the car and train reach the crossing together.

They came to a very definite conclusion that, if you can see or hear a train coming as you approach a level crossing, stop until it goes past. Considering the results if you lose, the race just isn't worth the running.

Superstitions are always fascinating, particularly when they concern an everyday food, such as bread.

Down through the ages, many beliefs have grown up about bread and its uses. Even today, some Dutch mothers place a piece of stale bread in the baby's cradle to ward off disgrace.

In Labrador it is considered bad luck to pass a neighbour's house without stopping for some bread and tea, while in Morocco, stale bread is believed to be an excellent cure for indigestion.

Still on the subject of bread, here's an excellent way to dress it up if you have visitors drop in for drinks. Spread the slices with Mama Horvath's Special Beer Cheese Spread.

To make it, take about 250 g ($\frac{1}{2}$ lb) cream cheese, mix into it a tablespoon of red Paprika powder, add a heaped tablespoon of capers, chopped fine, a teaspoon of French mustard, four anchovies finely chopped, and a pinch each of salt, pepper and caraway seed.

Mix it all well, and then spread it on the top of brown or white buttered bread, crusty rolls, or dry biscuits.

Browsing through old copies of the Queensland Agricultural Journal, was interested by the following recipes for preserving meat.

To salt meat, rub in a mixture of 500 g (1 lb) salt to 250 g ($\frac{1}{2}$ lb) brown sugar and $\frac{1}{2}$ oz saltpetre. Take care to rub this mixture well into the meat, then place it in a barrel or wooden tub, turning the meat each day in the brine that is formed.

A large enamel dish would serve instead of the wooden barrel. Just remember not to use anything that the salt will corrode.

Spiced meat can be made by rubbing in a mixture of saltpetre, salt, and adding pepper and pimento in small quantities to replace the brown sugar.

Now, to finish, some hints you may find helpful:

- Keep an old pair of long socks, with the feet cut out, in the car for those times when the engine needs attention, and everybody's dressed in their best. The socks will protect cuffs of long sleeves from grease, or keep the arms clean if the sleeves have been rolled up.
- If you have trouble trying to find the end of a roll of cellotape, put a small button at the end of the tape after each use. This keeps the end free, it's easy to find and none of the tape is wasted as the button is easily removed.
- Next time you're trying to remove the dust from under a heavy chest of drawers, forget about the lady wrestler act, and simply take out the bottom drawer. It's then quite easy to clean the floor with the vacuum cleaner.
- If you have several quantities of dripping in which you've cooked different meats, save the lot until next time you cook corned meat. Then put the whole lot in the water, and boil hard for 20 minutes. You'll end up with clarified dripping, free from all odours.

Vegetable intrigue

LEEKs, zucchini, eggplants, mushrooms, peppers and tomatoes—an intriguing basketful of vegetables which, when cooked imaginatively, become colourful plattery.

Saucy sauces, custards and stuffings complement piquant Blue Vein, fast melting Mozzarella, robust Parmesan, salty Feta, and bland sweetish Ricotta in the role of vegetable casseroles, pancakes and a savoury flan.

There is a little intrigue in these combinations. Being unusual, they immediately become the perfect complete dish.

In all recipes, a standard 8-oz measuring cup is used and all spoon measurements are level.

Salami Peppers Mozzarella

- 2 large well shaped peppers, cut lengthwise, with sufficient depth for stuffing
- $\frac{1}{2}$ cup long grain rice, cooked and drained well
- $\frac{1}{2}$ cup salami, finely chopped
- 3 cloves garlic, crushed
- 1 teaspoon freshly grated nutmeg
- salt and freshly ground black pepper to taste
- 5 oz. ($1\frac{1}{4}$ cups) grated Australian Mozzarella cheese
- 2 tablespoons butter.

Remove seeds and any thick membrane from pepper halves. Bring large saucepan of water to the boil. Add peppers. Cook until water returns to a rolling boil. Quickly strain and run through cold water. If peppers become too limp they will not support filling. Combine rice, salami, garlic and nutmeg. Season with salt and pepper. Spoon filling into halves. Lightly butter a shallow ovenproof dish. Arrange peppers in dish to fit firmly. Dot with remaining butter and sprinkle over cheese thickly. Bake in hot oven (400° F) for 20 minutes. Serves 4.



Mushroom and blue cheese flan

Eggplant Cheese Casserole

- 2 large eggplants
- 2 oz. clarified butter
- 3 cloves garlic, crushed
- 1 lb. Australian Ricotta cheese
- 2 eggs.

Mix together:

- $\frac{1}{2}$ cup chopped parsley
- grated rind of 1 lemon
- $\frac{1}{4}$ teaspoon ground oregano.

Wash eggplants. Slice thinly and place on absorbent paper. Sprinkle over salt and allow to stand for 30 minutes. Dry thoroughly. Melt butter, add garlic. Brush flat baking trays with butter mixture. Arrange eggplant slices on trays slightly overlapping each other. Brush over remaining butter mixture. Bake in very hot oven (450° F) for 10 minutes. Beat Ricotta cheese well, gradually adding the eggs. Arrange half the eggplant slices in bottom of a buttered shallow 6 cup ovenproof dish. Sprinkle over half the parsley mixture and half the Ricotta mixture. Repeat layers in similar manner using remaining ingredients. Bake in slow oven (300° F) for 20-30 minutes till set. Serves 6.

Crusty Chicken Parmesan

- 1, 1 lb. 14 oz. chicken
- 3 medium leeks, rinsed well to remove grit
- 2 oz. butter
- 2 tablespoons flour
- 1 lb. tomatoes, cut into thick slices
- 1 cup cream
- 3 oz. ($\frac{3}{4}$ cup) Australian Parmesan cheese
- $\frac{1}{8}$ teaspoon cayenne
- salt and pepper to taste
- $\frac{1}{2}$ cup fresh breadcrumbs.

Place chicken in large heavy based saucepan. Pour in sufficient water to cover. Add piece of carrot, celery, onion, peppercorns, bayleaf, salt and pepper. Bring to the boil then simmer for 1 hour till juices run clear when flesh is pierced with a skewer. Remove and allow to cool. Remove all chicken meat from bones. Slice leeks thinly. Melt butter in saucepan. Saute leeks gently for 5-10 minutes. Remove from heat. Stir in flour. Mix cream, Parmesan and cayenne together. Butter an 8-cup ovenproof casserole. Arrange half leeks on base, top with tomatoes, chicken pieces and remaining leeks, seasoning each layer with salt and pepper. Pour over cream mixture. Top with breadcrumbs. Bake in moderate oven (350° F) for 30 minutes. Serves 4-6.

Mushroom and Blue Cheese Flan

THE PASTRY

- 1 $\frac{1}{2}$ cups flour
- 4 oz. butter
- 1 teaspoon castor sugar
- 1 egg yolk, mixed with 2 teaspoons cold water.

Rub butter very lightly into flour until it resembles fine breadcrumbs. Add sugar. Mix in yolk and water to form dough. Knead lightly on floured board. Set aside for approximately 30 minutes.

THE FILLING

- 8 oz. cultivated mushrooms, approximately 1" in diameter
- 2 tablespoons butter
- juice of $\frac{1}{2}$ lemon

- salt and ground black pepper to taste
- $\frac{3}{4}$ cup crumbled Australian Blue Vein cheese
- $\frac{3}{4}$ cup cream
- 2 eggs.

Roll out pastry. Line an 8" fluted flan ring ensuring a good edge. Place on flat baking tray. Prick base. Load with greaseproof paper and rice or beans. Bake in hot oven (425° F) for 10 minutes. Remove from oven and lift out loading. Reduce temperature to moderate (350° F). Melt butter in pan. Saute mushrooms until butter coated then scatter over base of pastry. Season with lemon juice, salt and pepper. Sprinkle over cheese. Beat together eggs and cream lightly. Pour over mushrooms and cheese. Return to oven for further 25 minutes or till custard is set. Serves 4-6.

Zucchini and Feta Crepes

THE BATTER

- $\frac{3}{4}$ cup milk
- 1 egg
- $\frac{1}{4}$ cup flour.

Beat milk and egg together. Sift flour over liquid. Stir in, till batter becomes lumpy. Cover, set aside for at least 1 hour. Beat batter until smooth. In a butter brushed 6" pan pour in sufficient batter to cover base thinly. Cook till bubbles disappear, turn and brown other side lightly. Make 5 more pancakes in similar manner.

THE FILLING

- 1 large zucchini, thinly sliced
- 3 oz. Australian Feta cheese, cut into 6 slices
- 1 $\frac{1}{2}$ teaspoons dried mint
- 1 teaspoon brown sugar
- 2 tablespoons butter.

Cook zucchini in boiling salted water till tender. Drain, rinse in cold water. Mix mint and sugar together. Divide zucchini between pancakes. Top each with Feta and sprinkle over mint mixture. Fold up pancakes neatly. Place in a buttered shallow ovenproof casserole. Bake in a hot oven (400° F) for 20 minutes. Serves 6.

Black spot (scab) of apples

BLACK SPOT (or scab), caused by the fungus *Venturia inaequalis* is the most serious disease of apples in Queensland.

The cultivars Granny Smith and Delicious are the most susceptible. Jonathan, Gravenstein and other cultivars may occasionally be affected when orchards are neglected. The disease necessitates an expensive control programme in the orchard, involving regular spraying with fungicides.

Symptoms

Leaves and fruit are commonly affected by the disease, flower stalks occasionally and twigs rarely.

Leaf spots are generally the first symptom seen. These are light, olive-green in colour and about 3 mm in diameter. Very young leaves characteristically show these spots on the lower surfaces together with a diffuse, irregular, velvety growth.

The spots are more readily observed on the upper surface of older leaves and darken with age, eventually becoming black and may coalesce to cover almost the entire leaf area. When the disease is severe, leaves are distorted, reduced in size and some defoliation occurs.

Fruit symptoms begin as small, dark spots on the skin. These enlarge and become brown and corky in the centre with black, broken margins. Fruit is lowered in quality and often becomes unmarketable.

Spread

During winter, the fungus grows within old, infected apple leaves on the ground beneath the trees. Here, the fungus forms microscopic fruiting bodies known as perithecia. By early spring, enormous numbers of primary spores have been produced within these bodies.

With the onset of the spring rains, these spores are forcibly ejected into the air and carried by wind currents to developing apple leaves and flowers. If these remain wet for at least 9 hours at temperatures not less than 16.5°C, or for 14 hours at 10°C, infection may take place. These conditions are known as apple scab infection periods.

Six or seven such periods can normally be expected between late September and mid-December in the Stanthorpe district. By mid-summer, almost all primary spores have been released.

Two weeks after infection, spots appear on the leaves and fruit. On the surface of these spots, secondary spores are produced which spread to adjacent leaves and fruit by raindrop splash. Showery weather, common during January and February, favours new infections.

Secondary spores continue to be produced until harvest and autumn leaf fall.

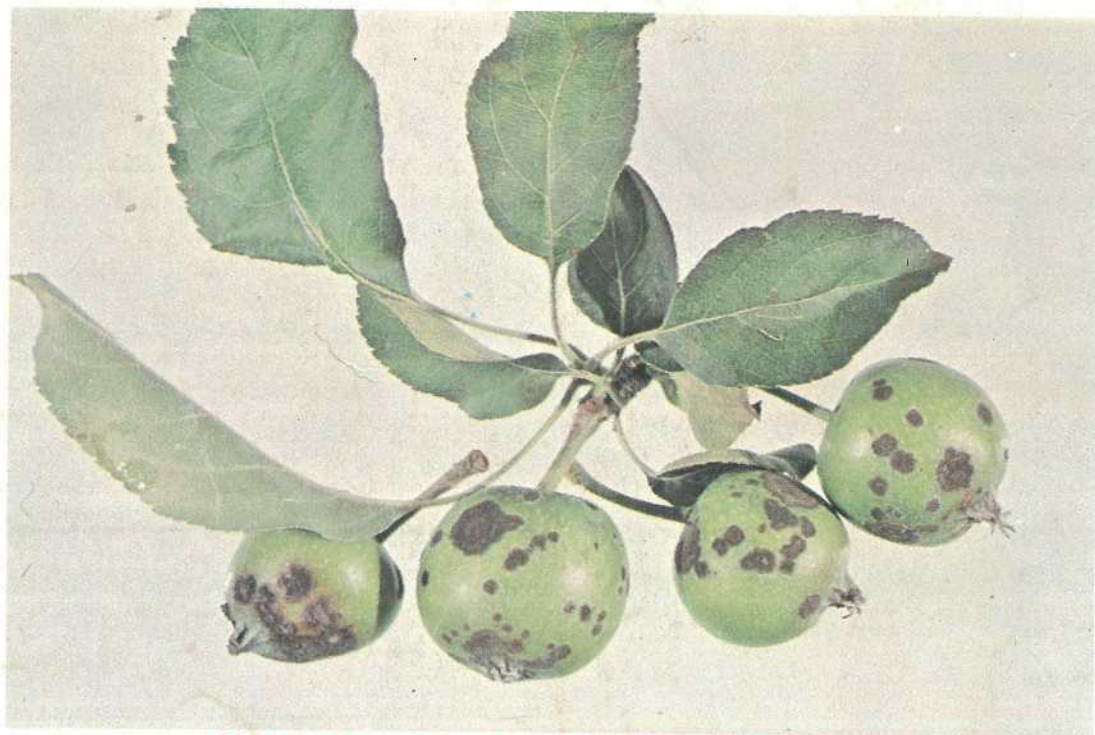
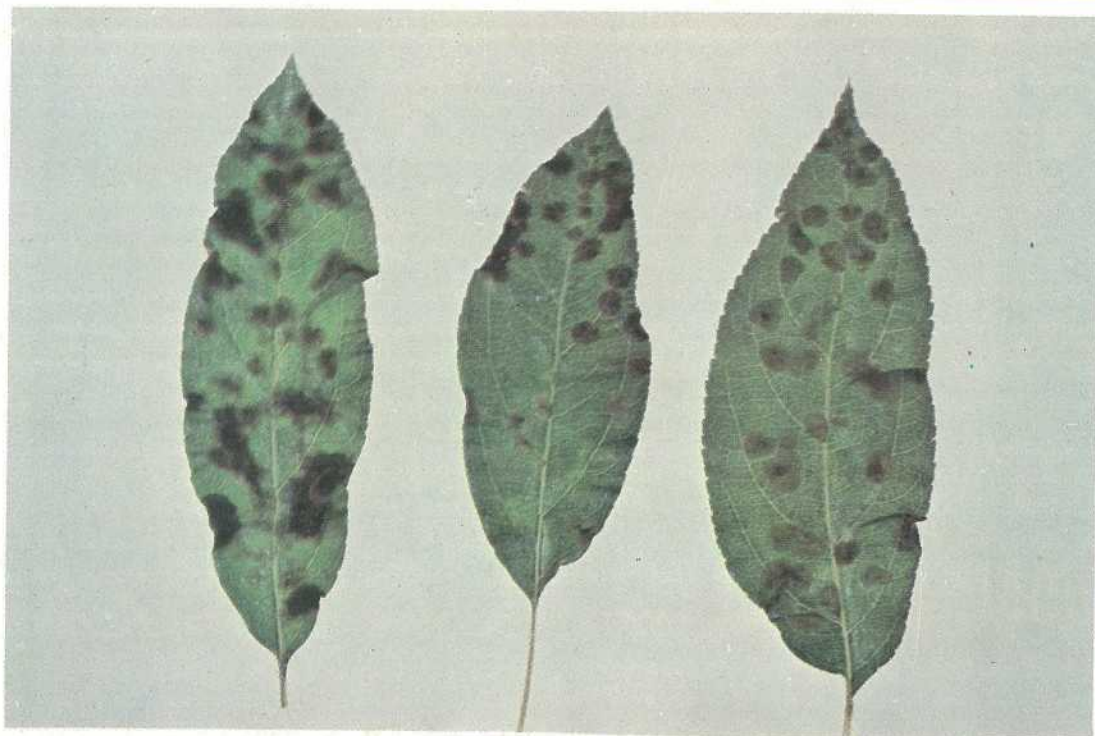
Control

Satisfactory control is possible with regular applications of protectant fungicides throughout the season according to the control schedule. Eradicant fungicides will also give satisfactory control provided they are applied soon after infection periods.

Compiled by N.T. VOCK, Plant Pathology Branch

(Further information including recommended fungicides may be obtained from either the Plant Pathology Branch office at the Granite Belt Horticultural Research Station, Applethorpe, Q., 4378, or the Director, Plant Pathology Branch, Department of Primary Industries, Meiers Road, Indooroopilly, Q., 4068).

Diseases of apples - 1



BLACK SPOT. Upper: leaf spots. Lower: spots on young fruit.