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Cover: Dressage horses on kikuyu pasture at N. and A. Payne's property, Maleny. See 'Pastures and fodder crops for horses in southern coastal Queensland' in this issue. Photograph by B. J. Rogers.

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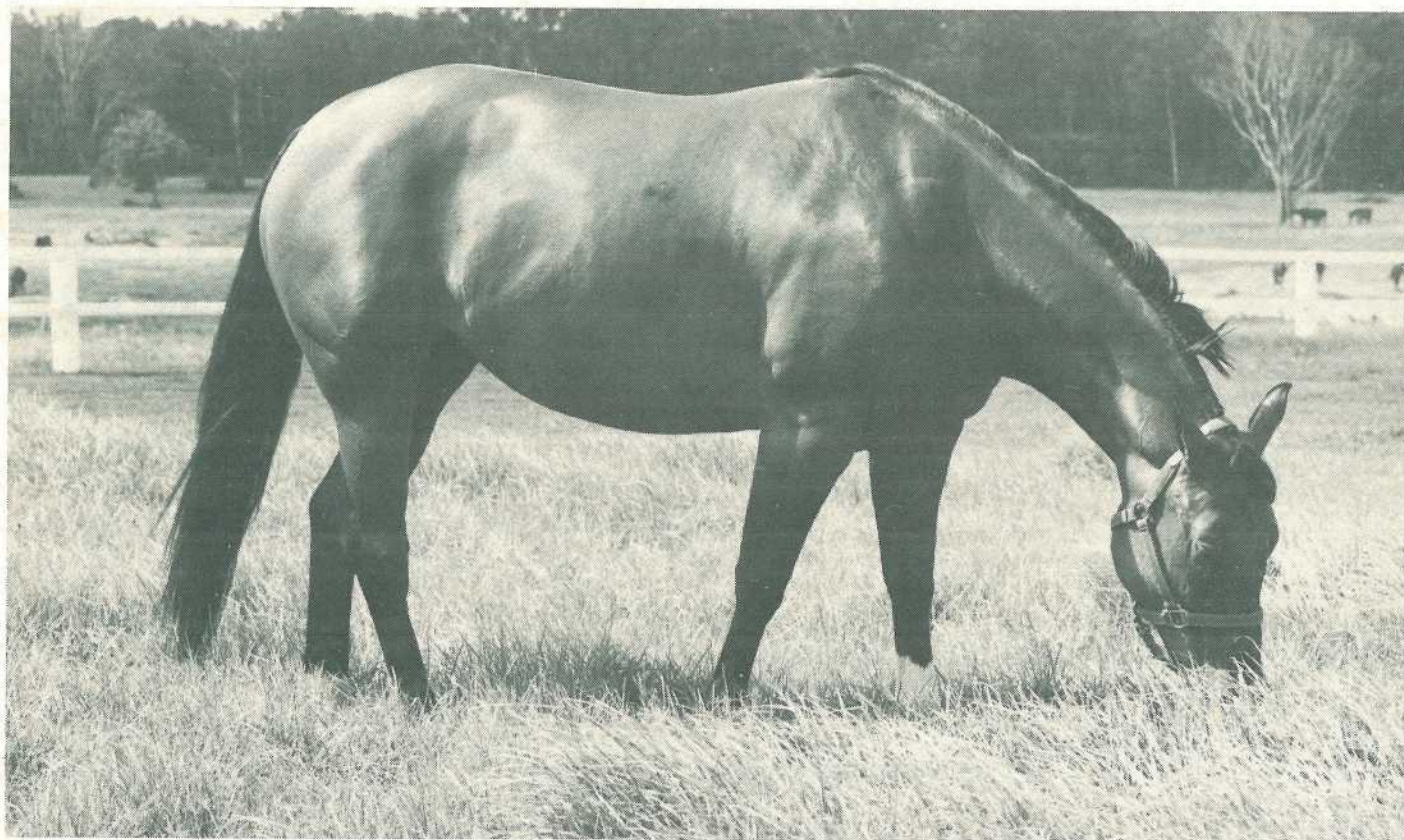
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Pastures and fodder crops for horses in southern coastal Queensland

by G. D. Elphinstone, Agriculture Branch

There are some 8 500 horses on 1 400 commercial holdings on the coastal strip from Gympie to the New South Wales border.

In addition, there are a large number of non-commercial hobby farms and small holdings. A recent survey in the Nambour area showed that 50% of these holdings carry an average of three horses.

These horse enterprises have been established to service the sport and leisure activities of this densely populated area and because the coastal environment is appealing to property owners. Race horse spelling, studs, riding schools, trail rides and pony clubs have all grown dramatically over the past 10 to 15 years. Most of the properties are small, and usually overstocked.

This region traditionally has not been favoured for horse breeding or spelling. Even draught animals used on farms prior to the 1940s were mainly bred in sub-coastal areas or on the Darling Downs and brought to the coast to work. It was claimed that

horses born and bred on the coast did not grow well.

This reputation arose mainly through sub-standard nutrition. It is a consequence of poor pasture quality particularly during the dormant winter/spring period, mineral deficiency or imbalance, and the high incidence of internal parasites.

This nutritional situation is a function of the lower fertility of coastal soils in conjunction with the high rainfall of about 1 000 mm. Consequently, feed supplementation is necessary for satisfactory growth and performance from horses grazed on pasture.

Very few coastal properties have an adequate area of improved pasture to cater for the feed requirements of their present stock numbers.

Horses prefer a shorter pasture which they can graze closer to the ground than cattle. They cannot handle large amounts of fibre in their diet, they prefer to eat little and often, and they cannot synthesize

protein. However, they do require some protein especially if not working or mothering a foal.

Pasture criteria

There are four important criteria in the specialized use of improved pastures for horses—low-growing species, grazing selection, role of supplements, and the oxalate problem.

Low-growing species

This refers to the height and maturity of pasture on offer and takes account of their preference for a short, green pick. The most attractive are stoloniferous or running grasses such as kikuyu (*Pennisetum clandestinum*) blue and green couch grasses (*Digitaria didactyla* and *Cynodon dactylon*) and pangola (*D. decumbens*). Rhodes grass (*Chloris gayana*)

Photograph above. The imported American quarterhorse mare 'Winn O Peg' grazing kikuyu pasture on J. and D. Hoffmann's property at Noosa.



Quarterhorse brood mares and foals grazing a new pasture comprised of Callide Rhodes/Narok setaria/siratro/lotononis/Cook stylo on J. L. and J. D. Mawhinney's property at Curra.

cultivars are an example of a stoloniferous grass with a higher growth.

Grasses with a tussock growth habit are not unsuitable, as most horses in Queensland graze these grasses. The tall, stalky forage which

usually results from uneaten tussock grasses quickly declines in feed value and increases in fibre content after flowering. Management of these grasses should aim at delaying maturity by slashing to maintain young, leafy regrowth.

Grazing selection

Horses with access to a wide pasture choice rarely have any grazing problems. The palatability of forage plants varies with plant maturity and seasonal growth pattern. This variability is the key to selective grazing.

Horses appear to graze grasses to which they are accustomed. While they prefer access to some unimproved native or natural pasture which may not be very productive or high in feed value, some horses in southern coastal Queensland have access only to a sown species such as kikuyu and thrive.

Reports of horses not eating kikuyu are received from time to time. This situation most likely arises when the pasture or fodder crop has recently been heavily fertilized with nitrogen. Similar reports have arisen when horses have grazed lush stands of clover (*Trifolium* spp.). The quality of the forage may be high, but the palatability to horses is low.

Horses will often select the seed-heads of mature, stalky grasses and ignore the remainder of the plant. Grass seed constitutes a highly nutritious 'mini-grain' ration which is also high in phosphorus, thus providing a valuable grazing supplement.

Role of supplements

About 1 ha of improved rain-grown pasture in this region is normally capable of providing the energy, protein and vitamin requirements of a non-working mature horse without significant supplementary feeding. However, supplementation may be necessary in the winter/spring period when pastures are mature and dormant.

Working horses, growing horses and brood mares will not perform satisfactorily during this period when grazing pasture alone. Some supplementation through winter fodder crops or hand feeding is required.

Calcium and phosphorus are two very important mineral requirements. The balance is also important. The ratio of calcium to phosphorus in the diet should be within the limits of 2:1 and 1:1, with the former value considered optimum. The calcium and phosphorus ratio in pastures can range from 1.5:1 in early summer regrowth down to 0.2:1 when the pasture is mature in autumn and winter. Hence, it is important that a mineral supplement be fed during autumn, winter and spring, and also during droughts and other periods of poor pasture growth.



Quarterhorses grazing a pangola grass/lotononis/white clover pasture on J. and D. Hoffmann's property at Noosa.

Copper is sometimes deficient in coastal areas, particularly on wallum country. Salt should be available in licks, especially when grazing low sodium pastures such as kikuyu.

Many horse owners find it more convenient to feed a complete proprietary mix and these are readily available.

The oxalate problem

Many grasses used in sown pastures in this region produce oxalic acid. In certain circumstances, this can induce a secondary calcium deficiency in horses by preventing calcium absorption over an extended period. The disorder is called *Osteodystrophia fibrosa* (ODF) or Big Head Disease.

Signs of ODF are

- Affected gait and performance
- Ill-thrift
- Swellings of bones of the head.

These signs can occur individually or in any combination. There is no firm pattern or progression from one syndrome to another.

The cause is thought to be that much of the plant calcium is bound by the oxalic acid to form insoluble calcium oxalate, which cannot be absorbed from the intestine. If this low calcium diet continues for some months, ODF may result. Although horses of both sexes and all ages are susceptible, the risk with lactating mares and foals is greater.

Laboratory analyses of well-fertilized young leaf blades have shown that the setaria grass (*Setaria anceps*) cultivars contain the highest levels of oxalate (3 to 5%) followed by kikuyu, pangola and green/Gatton panic (*Panicum maximum* var. *trichoglume*) with less than 1%.

The Rhodes grass cultivars, paspalum (*Paspalum dilatatum*), and couch grasses all have a low oxalate content and are well accepted by horses. Pasture legumes and native grasses contain negligible levels of oxalate.

All three cultivars of setaria (Narok, Nandi, Kazungula) have been widely sown as pasture grasses for beef and dairy production in the region. Kazungula contains the highest oxalate levels and Nandi the lowest. Kazungula has mainly been used in the wallum country, while Narok is the favoured cultivar now being sown.

Nearly all confirmed cases of ODF in southern coastal Queensland have been associated with Kazungula setaria, although there have been isolated instances attributed to kikuyu and green panic.

Over 50% of the horse population in southern coastal Queensland has continuous access to some setaria and/or kikuyu. In some localities in the Sunshine Coast hinterland, up to 75% of the horses have access to setaria-based pastures. This includes numerous situations where horses have grazed pastures dominated by these grasses for many years without showing any ill effects.

ODF is far more prevalent where horses are restricted to pastures containing almost exclusively these suspect grasses. Where horses have access to areas of unimproved pasture, ODF prevalence is markedly reduced.

The incidence of Big Head Disease is far lower than one would expect with all the hazardous grasses grown.

Pasture management

As horses are selective in their grazing habits and prefer a short pick, an uneven grazing pattern results. Some patches are grazed very short and adjacent patches are left tall and rank. If this pattern is unchecked, significant areas of pasture are not utilized, and woody weeds and blady grass often invade the pasture.

Slashing

Cattle can be grazed simultaneously with horses to obtain more uniform forage utilization.

However, a regular slashing programme during summer will maintain grasses in the leafy stage, delay the onset of flowering, and

control weeds. Selective slashing will also reduce the late summer and autumn incidence of ergot fungus on paspalum seedheads which can cause dermatitis in horses.

A summer slashing programme will be detrimental to the twining tropical legumes. Tropical legumes are also intolerant of the continuous heavy grazing by horses in their chosen areas of close-cropped pasture.

Furthermore, the twining tropical legumes do not combine well with stoloniferous grasses because of the latter's dense competitive sward and the resultant close grazing. These factors limit the role of tropical legumes as alternate oxalate-free forage for horses although they are good sources of calcium.

On the other hand, the low-growing legumes such as clovers (*Trifolium* spp.) are adapted to summer slashing and close grazing. Horses appear to graze Safari Kenya white clover more readily than other clovers.

The regrowth from slashed setaria dominant pastures may be more acceptable to the horses, but this may compound the oxalate risk.

Fertilizer

Well-fertilized sown pastures in this region contain adequate levels of calcium and phosphorus which are in balance. Most coastal soils are naturally low in phosphorus and marginal in calcium. Superphosphate (9.2% P, 10% S and 20% Ca) is the major fertilizer used in pasture



Paint geldings grazing a Kazungula setaria-dominant pasture on J. Kelleher's property at Eumundi. Horses with continuous access to these pastures should be fed with a calcium/phosphorus mineral supplement

establishment and annual topdressing. This fertilizer would have little or no effect on soil pH and plant growth as tropical pastures are very tolerant of acid soil conditions.

A general fertilizer recommendation for the establishment of grass-legume pastures in the region is 400 kg per ha of molybdenized superphosphate. Poorer forest soils and 'wallum' country may require rates up to 700 kg per ha, while more fertile basaltic soils in upper river valleys may also require 250 kg per ha. Equal quantities of lime or dolomite are recommended with the superphosphate.

The phosphorus and calcium levels in the pasture should be maintained to compensate for animal utilization and soil losses. Annual topdressing with superphosphate and lime or dolomite at rates between 100 and 300 kg per ha, depending on soil type and stocking rate, should maintain pasture productivity.

ODF control

If symptoms of ODF appear while grazing hazardous tropical pastures, the most effective counter is to move the horses to a native pasture paddock, or to one containing lower oxalate sown grasses and to feed a calcium/phosphorus supplement.

Horses grazing setaria have been observed not to be eating the setaria, but selectively grazing the natural grasses and herbage around the base of the setaria clumps. There are similar reports of horses rejecting kikuyu in favour of other grasses. This is usually attributed to a lower palatability of lush stands, but it could also be a selective rejection by horses.

An area of native pasture should be left undeveloped in all sown pasture paddocks to enable horses to adjust their grazing. This native pasture area could constitute 10 to 20% of the paddock area and can be combined with timber shelter belts and shade clumps.

Setaria regrowth following a pasture burn and new spring growth following a dry winter are known to be dangerous. The horses may be attracted to this lush regrowth if hungry (very common in spring) and because of the more acceptable low growth of the pasture. Exposing horses to lush regrowth resulting from any of these factors should be avoided.

Setaria pastures should be locked up to allow other herbage to grow or be grazed by cattle for about 3 months in the spring flush. Grazing setaria pastures during prolonged

wet weather should be avoided as the horses may be forced to eat the taller setaria because of surface waterlogging.

Properties where horses graze setaria-based pastures all year round report that ODF incidence increases in droughts when there is nothing to graze but setaria.

Grazing horses on pure stands of any of the suspect grasses should be avoided if possible. If a horse has a wide selection of pasture, it will avoid the high oxalate species except in unusual instances.

Oversowing

Pure stands of grasses like kikuyu are commonplace in the coastal ranges and plateaus such as Maleny and Beechmont. Setaria-dominant pastures are similarly prevalent in the high rainfall and poorer coastal country where the sown legumes have failed to persist. In such situations, pasture renovation and legume oversowing can provide a wider grazing selection of low oxalate species.

Kikuyu pastures can be oversown with clovers in the autumn. Oats or ryegrass should also be included in situations where additional winter feed is required. Setaria pastures



Thoroughbred geldings grazing a kikuyu pasture on N. and A. Payne's property at Maleny. These horses which are used for dressage, eventing and show hacks are stall-fed a balanced ration of grain, lucerne hay, minerals and vitamins in addition to pasture.

may be cropped with a summer fodder legume such as cowpea or lablab, or a winter legume such as lupins or Namoi woolly pod vetch (*Vicia dasycarpa*) prior to over-sowing with tropical legumes or clovers in the following season.

Mineral supplementation

The current recommendations for calcium/phosphorus supplementation of an adult horse grazing hazardous pastures is 1 kg of rock phosphate mixed with 1.5 kg of molasses, and fed weekly.

Lucerne hay is a high calcium-low oxalate forage which will also assist recovery of any ODF affected stock.

This supplement, or one similar, is recommended for all grazing horses in the region during the winter months regardless of the pasture being grazed.

Pasture and fodder crop recommendations

The pasture species suitable for horses in the region are listed under four basic land units—wallum, coastal forest, scrub, and river frontage. Not all the listed species would be incorporated into the same mixture and usually only one grass and two legumes are sown.

Low fertility wallum soils

WET LOWLANDS

Grasses—
Pangola (runners)
Paspalum
Matgrass (*Axonopus affinis*)

Legumes—
Lotononis (*Lotononis bainesii*)
Safari Kenya white clover (*Trifolium semipilosum* cv. Safari)
N.Z. and/or Haifa white clover (*Trifolium repens*)

LOW RIDGES

Grasses—
Samford or Callide Rhodes grass
Pangola (runners)
Existing native grasses, e.g. kangaroo (*Themeda australis*)

Legumes—
Lotononis
Greenleaf desmodium (*Desmodium intortum*) (cv. Greenleaf)

Archer axillaris (*Macrotyloma axillare* cv. Archer)

Safari Kenya white clover

Coastal forest country

UNDULATING HILLS

Grasses—
Samford or Callide Rhodes grass
Green and/or blue couch (seed or runners)

Legumes—
Siratro (*Macroptilium atropurpureum*)
Green leaf desmodium
Archer axillaris
Safari Kenya white clover

CREEK FLATS

Grasses—
Samford or Callide Rhodes grass
Paspalum
Kikuyu (seed or runners)
Matgrass

Legumes—
N.Z. and/or Haifa white clover
Safari Kenya white clover

Scrub country

COASTAL VALLEYS

Grasses—
Samford or Callide Rhodes grass
Paspalum
Kikuyu (seed or runners)

Legumes—
Siratro
Greenleaf desmodium
Silverleaf desmodium (*Desmodium uncinatum* cv. Silverleaf)
Tinaroo glycine (*Glycine wightii* cv. Tinaroo)

Legumes—
N.Z. and/or Haifa white clover
Safari Kenya white clover

RANGE/PLATEAU

Grasses—
Kikuyu (seed or runners)
Paspalum

Legumes—
N.Z. and/or Haifa white clover
Safari Kenya white clover

River frontage

SANDY SOILS

Grasses—
Blue and/or green couch (seed or runners)

African star grass (*Cynodon plectostachyus*) (runners)

Callide or Samford Rhodes Paspalum

Legumes—
N.Z. and/or Haifa white clover
Safari Kenya white clover
Lotononis

CLAY-LOAM ALLUVIUMS

Grasses—
Paspalum
Kikuyu (seed or runners)
Callide or Samford Rhodes grass

Legumes—
N.Z. and/or Haifa white clover
Lucerne
Medics

Legumes—
Pure stands of lucerne (*Medicago sativa*) (irrigated)

Fodder crops

Winter fodder crops are widely grazed. Barley and oats are more popular than ryegrass because they produce more bulk. Although most horses prefer barley to oats, barley does not regenerate as well after grazing. Triticale is another possible winter fodder crop. It has not been widely used but has a longer growing season.

There have been reports of horses rejecting high density ryegrass which has been heavily fertilized with nitrogen. The high moisture/low fibre content of this forage again probably makes it unpalatable to horses.

Namoi woolly pod vetch, an annual winter legume, can be sown alone or with one of the fodder grasses. It will produce excellent stand-by green forage in the spring/early summer period, when green feed is scarce.

Lucerne is one of the best fodder crops for horses, but is limited to the deep, well-drained alluvial soils. Two groups of lucerne cultivars, the winter semi-dormant such as Hunter River and the winter active such as CUF 101 and others, are available.

If summer fodder crops are required, one of the millets such as white panicum or millet/cowpea mixtures are preferred to the forage sorghums because of their lower growth and better palatability.

A trap for sheep and cattle

By L. Dunlop, Sheep and Wool Branch

Trapping stock at watering points is becoming increasingly popular on western properties.

Traps for cattle have been used for a long time but it has proved difficult to trap sheep. Roger Arden of 'Akaray', Augathella, has found a novel solution to the problem by slightly modifying the spear concept which works so well for cattle. His trap not only works for sheep but will also trap cattle without any adjustment.

Roger uses weldmesh instead of wooden spears. One wing of the trap is fixed. The second wing is chained close to the fixed wing at ground level at the neck of the trap. This allows only the top of the second wing to move outwards as animals push past.

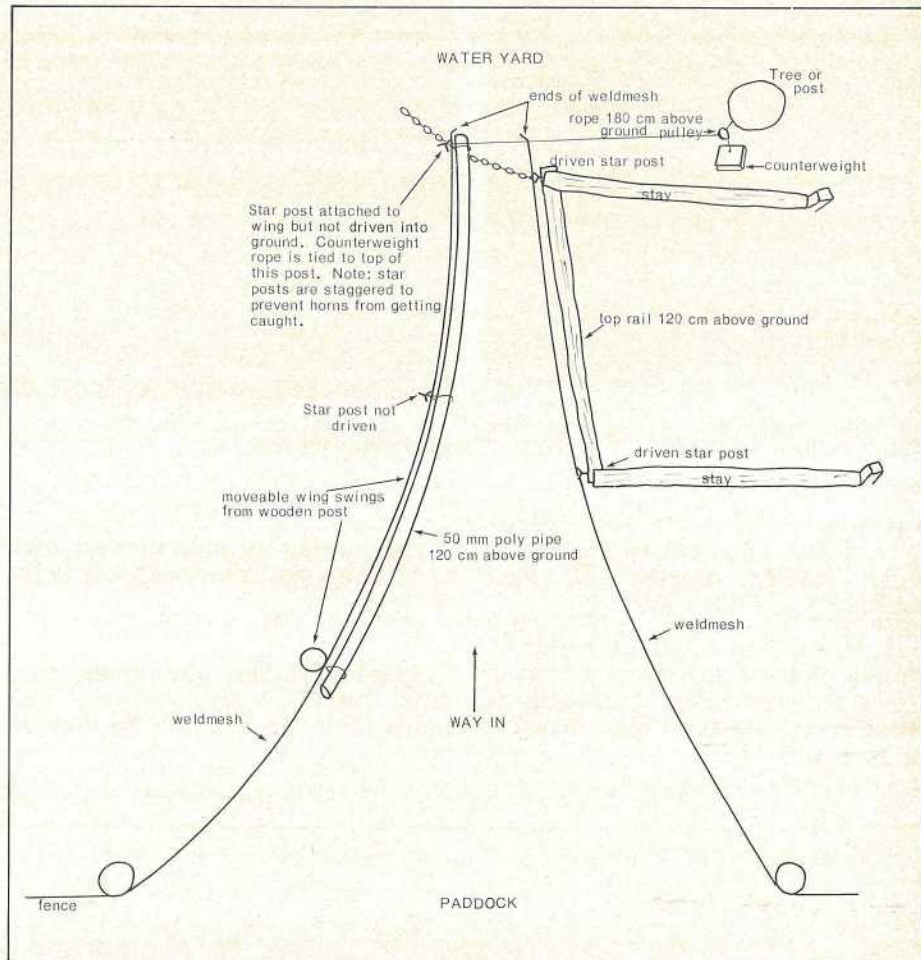
When sheep enter the trap there is little or no movement in the wing; when cattle enter, the top of the wing is pushed away, swinging back into position when the beast has passed. Cattle cannot return through the narrow gap. A sheep could conceivably return but is prevented from doing so by the ends of the weldmesh which are cut long and turned inwards so that they catch in the sheep's shoulder wool.

The movable wing is pulled back into position by a counterweight and pulley. Roger has fixed a length of 50 mm poly pipe to this wing to act as a belly rail for cattle. He found that cattle caught their horns in the two steel posts at the neck of the trap. He has staggered the posts so that both horns cannot be caught at the same time.

When the trap is not in use, the chain holding the wings close together at ground level is removed and the wings separated to allow stock space to enter and exit at will.

Training stock

To avoid losses due to perishing, it is essential that stock be trained to traps. A good way to do this is to provide two gateways on the holding yard around water and to place a trap in each—one for entry and the other for exit. This means that stock must operate two traps for each drink of water. It then only requires the exit



A conventional spear trap for cattle.



The chain anchors the free wing to the fixed wing at the base.



The chain is removed when the trap is not in use. Note the stock pad through the wide neck of the trap.

to be closed. The stock will be caught more readily because of their familiarity with the traps.

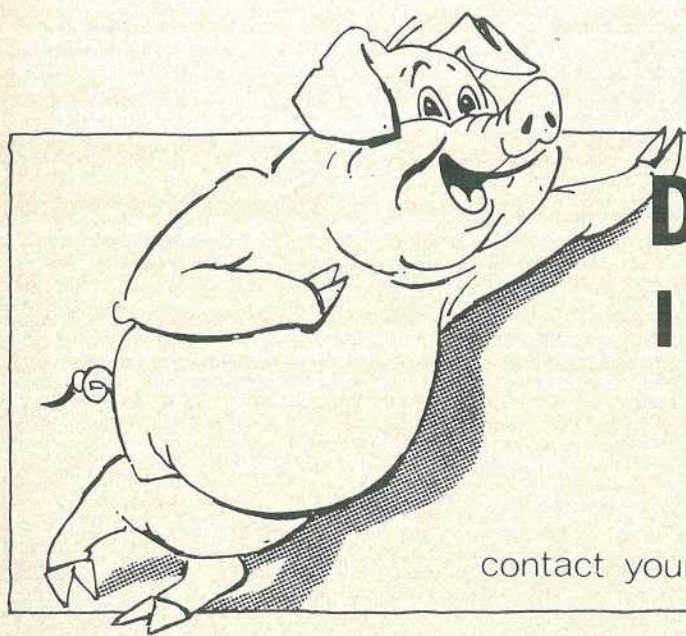
Roger's design allows for a gradual closing of the trap over a period of weeks by shortening the length of chain separating the wings. When it

is time to trap the mob they are used to brushing past the weldmesh to get to water.

Traps work best when there is no other surface water available. This limits their use generally to drought

and summer times. However, if stock have been trained to a trap, a good percentage of them may be caught when conditions are not so dry.

The trap yard should be of sufficient size to hold the largest mob of sheep or cattle.



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Controlling termites and other timber pests

By N. W. Heather, Entomology Branch

Because of the risk of serious damage to farm buildings and yards, maintenance must include protection from wood-destroying insects.

Subterranean termites are the major pest in most areas, but drywood termites and wood borers can also be serious problems. The incidence of attack varies from place to place and local experience is the best guide as to the actual hazard.

It is only rarely that buildings are completely free of susceptible materials so measures to prevent damage should be included in a normal maintenance programme.

Suitable chemicals are necessarily very persistent and great care must be taken to avoid environmental contamination leading to undesirable residues in animals and plants.

Subterranean termites

For subterranean termites, measures to prevent attack are better than subsequent control of infestations. Termites can be excluded by means of barrier systems of soil treated with chemicals or with impervious shielding such as 'ant caps'. Where barriers have been omitted or subsequently impaired and termite attack occurs, control treatments become necessary.

Neither barrier system is effective against drywood termites which require special control measures.

The Standards Association of Australia has produced three Codes of Practice detailing initial installation of chemical barriers or physical barriers and control measures against any infestations which may develop subsequently. These codes are: AS1694, for physical barriers, AS2057 for treatment of soil as a chemical barrier and AS2178 for treatment of infestations in existing buildings. (These codes may be purchased direct from the Standards Association of Australia at 447 Edward St., Brisbane, 4000, or from the Head Office, P.O. Box 458, North Sydney, 2060.)

The pests

A number of destructive subterranean termites occur widely in Queensland. The giant termite (*Mastotermes darwiniensis* (Froggatt)) is possibly most destructive, but it is restricted to the monsoon region of northern Australia. There is usually little difficulty in identifying termites from ants and other insects likely to be associated with wood. Termites resemble ants hence the common term 'white ant'.

Workers are the most numerous caste. They vary in length depending on the species from 3 mm to 12 mm. Most are pale coloured and blind but very active. There are also soldiers which mostly have large jaws or an otherwise modified head and the rarely found queen which usually has an enlarged body. Winged adults make swarm-like flights as a means of dispersal to start new colonies. The success rate is very low.

Habits

Subterranean termites live as highly-organised colonies in nests which vary according to species from complex structures made from soil and plant material to simple tunnels in wood. Infestations of subterranean termites in wood can be recognized by gallery walls plastered with faecal material. (Drywood termites have clean-walled galleries, and faeces are small frass granules which run freely).

A mound nest of *Coptotermes acinaciformis*. It consists of a strong outer crust and a cellular inner structure part of which forms the nest or nursery. *C. acinaciformis* does not build free-standing mounds south of the Tropic of Capricorn.

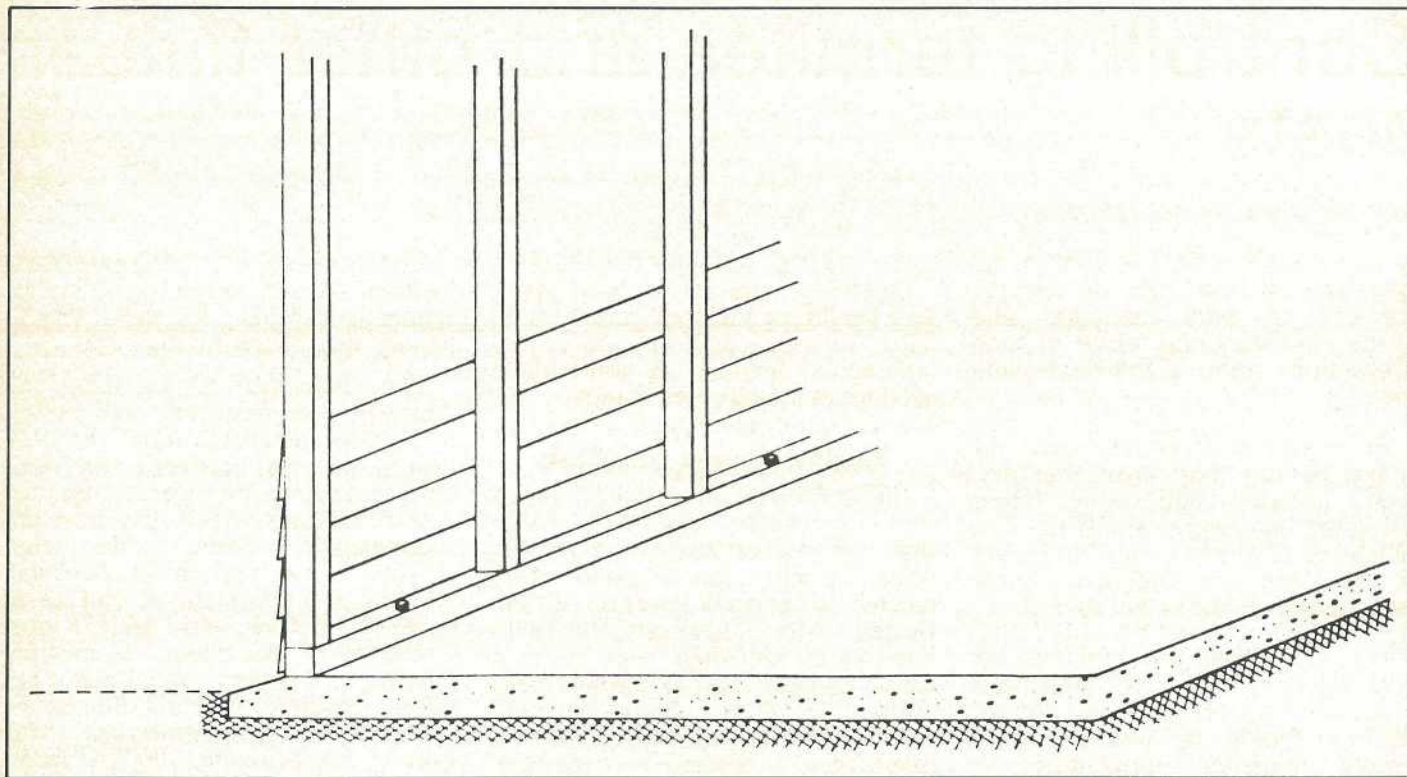


Figure 1. Zone of treated soil under a concrete slab supporting a wooden building.

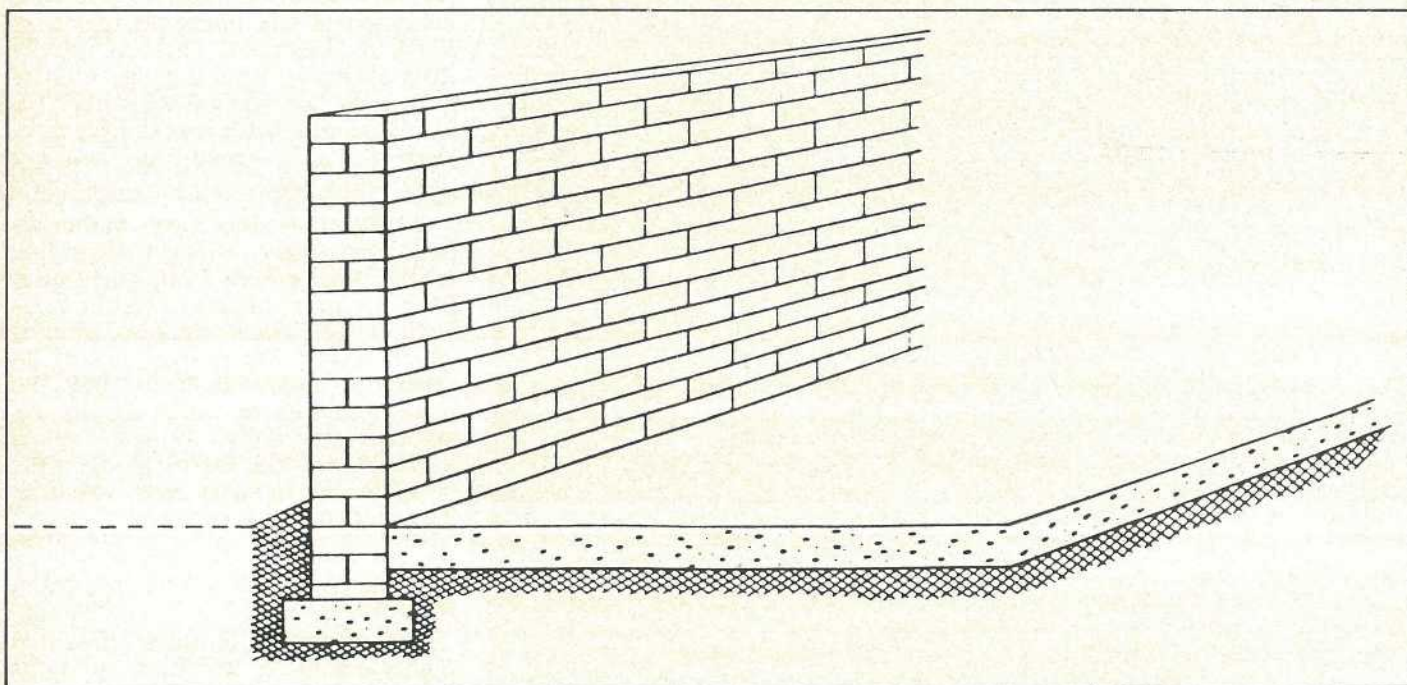


Figure 2. The extent of a chemically treated soil barrier under a concrete slab and around a wall and its footing.

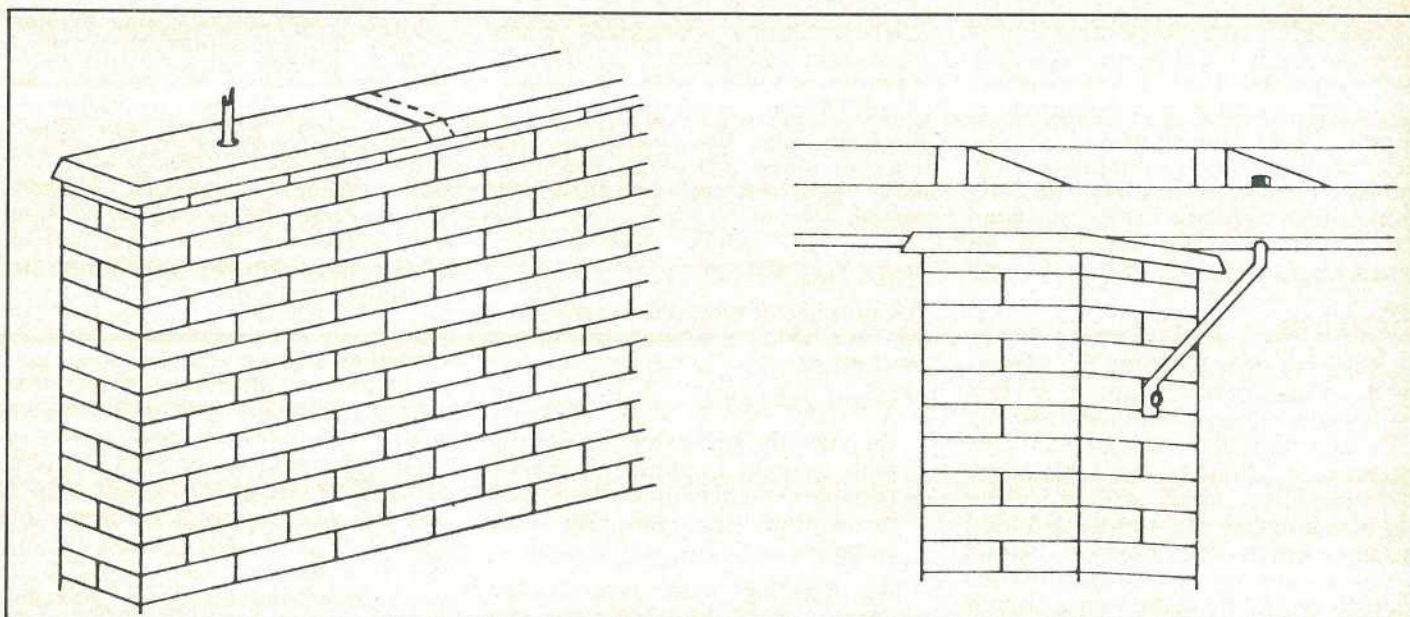


Figure 3. Physical barriers for substructure walls and piers.

Nests of subterranean termites may occur within trunks of living trees, logs, stumps and other timber in buildings and fences, or as free-standing mounds. Foraging galleries may extend more than 100 m from the nest to attack trees, fallen timber, stumps or wood in buildings and fences. Contact with the ground ensures an essential supply of moisture.

For most species of subterranean termites, if the central nest containing the queen is destroyed the remainder die out over a period of time. Exceptions include the giant termite which has multiple queens and a diffuse nest structure. Where access to the soil is broken, termites above the break will die quickly unless an alternative source of moisture is available.

Preventive measures

For the control of subterranean termites, a choice exists between barriers formed by the treatment of soil with an appropriate persistent insecticide, physical barriers of metal shielding, and the use of structural materials immune or highly resistant to termite attack.

CHEMICAL BARRIERS

These are formed by using one of the following insecticides:

Aldrin emulsion diluted 5 g/l (0.5% *m/v*) in water.

Chlordane emulsion diluted 10 g/l (1.0% *m/v*) in water.

Chlordane/heptachlor mixture emulsion diluted 5 g/l (0.5% *m/v*) chlordane and 2.5 g/L (0.25% *m/v*) heptachlor in water.

Dieldrin emulsion diluted 5 g/L (0.5% *m/v*) in water.

Heptachlor emulsion diluted 5 g/L (0.5% *m/v*) in water.

An application rate of 5 L per m² of soil surface is recommended for horizontal surfaces such as under slabs (figure 1). Where the soil will not absorb this amount, the quantity may be reduced provided that the strength is correspondingly increased for example, 5 L per m² of solution strength 5 g/L is equivalent to 2.5 L per m² of solution strength 10 g/L.

Scarifying or otherwise loosening the soil surface may be necessary to enable the minimum effective penetration depth of 50 mm to be achieved.

For treatment of excavations and backfill around foundation walls (figure 2) and posts or other situations requiring a vertical barrier, use 150 L per m³ of soil.

Vertical barriers should be 150 mm wide at the surface and may taper to 50 mm where they meet horizontal barriers. All barriers must be continuous under and around all foundation posts and other means of contact between a building to be protected and the soil. Only one treatment should be necessary during the lifetime of the structure to be protected provided that it is not subsequently disturbed.

PHYSICAL BARRIERS

Typically these are shields formed of galvanized iron, but other suitably durable metals may be used. Shielding is best installed a minimum of 600 mm above ground level and

should provide an impenetrable barrier between the foundations and the remainder of the structure.

Anchorage is best constructed to bypass shielding (figure 3), but where they must penetrate it, the opening should be sealed with solder or a lead washer. Shielding should extend at least 50 mm beyond the edges of foundations and should be turned down at an angle of about 45°.

Physical barriers prevent the unseen entry of termites, but for full effectiveness they require regular inspection and localized treatment of any infestations found. The barrier system must be continuous and care should be taken during any repairs, renovations or additions to ensure that the system remains intact.

RESISTANT MATERIALS

Timber to be placed into soil should be of the highest durability obtainable. Naturally, durable timbers differ from one locality to another and again local experience is the best guide. Treatments are available which can increase the durability to termites and decay of otherwise unsuitable timbers. These include vacuum-pressure impregnation with creosote, a proprietary wood preserving oil, or a copper chrome arsenate (CCA) salt mixture.

For hardwoods, only the sapwood absorbs the treatment and even for softwoods total impregnation is not always possible. Soaking of newly-cut posts in creosote or wood preserving oil can give satisfactory absorption, particularly if the preservative is first heated to 90°C then allowed to cool during soaking.

The use of specially treated timber throughout a building is frequently impracticable, but in areas where drywood termites are prevalent it would have advantages. Of the timbers naturally resistant to termite attack, cypress is possibly the only widespread species still in good supply and it is not suitable for all purposes.

GENERAL

Termites are favoured by dampness, so measures to promote dryness under and around buildings will act as a deterrent. Such measures involve attention to drainage and ventilation. Additionally, wood offcuts, dead stumps and tree roots provide a food source which can promote strong termite activity. Any threat of this nature should be removed as should falseworks and concrete form work which could enable barriers to be bridged.

CHOICE OF METHOD

Buildings with the main structure on steel or concrete piers, brick masonry or concrete walls having a minimum height above ground of 600 mm are possibly best protected with physical barriers.

Buildings constructed on a concrete raft or slab-on-ground or on stumps or other foundations less than 600 mm above the ground and any timber posts in the ground are more appropriately protected with barriers of chemically treated soil.

Where this involves a risk to persons or livestock or is environmentally undesirable, then modification of the design to permit efficient functioning of physical barriers could be the answer.

For timber yards the only suitable alternative would be to use naturally durable timber, pressure impregnation treated timber, or timber treated by soaking in a suitable preservative.

CAUTION. Where treated soil is subject to erosion, undesirable residues can be washed onto adjacent pastures. Refer to the final section on how to avoid undesirable residues.

Remedial control measures

DETECTION

Probably the most difficult aspect of termite control is finding infestations. An effective barrier system ensures that any infestation is readily apparent at the point of entry to the main structure. In any event, it is important to detect activity before damage occurs and frequent inspections for this purpose should become a routine maintenance practice.

Where activity is detected, several methods or combinations of methods of treatment are possible. The gallery system should not be disturbed until treatment as the termites may abandon those workings and only active galleries can be effectively treated.

TREATMENT

A number of methods of treatment are available. Choose the most appropriate:

- Destroy the nest:

By opening and carefully dusting with a small quantity of arsenic trioxide which is then distributed throughout the nest by the termites.

By flooding with one of the chemicals recommended for soil barrier formation.

- Treat the galleries at the sites of attack by dusting with small amounts of arsenic trioxide which is best blown as far in as possible using a puffer made from a plastic bottle with a suitable nozzle or with a rubber bulb blower adapted for the purpose. In humid areas, the arsenic trioxide may need to be formulated with a dry diluent such as ferric hydroxide (400 g/kg) or magnesium carbonate (200 g/kg).
- Install or reinstate chemical or physical barriers taking care to treat the pipe or voids in any wooden post when chemical barriers are used.
- Use any of the preceding methods in combination.

Considerable skill is involved in the detection and treatment of existing infestations of termites. Where the infestation is other than simple, it may be best to enlist the services of a professional pest control operator.

Drywood termites

Habits

In contrast to subterranean termites, drywood termites live entirely within galleries in timber and do not contact the soil as these insects do not need free moisture. Colonies are always relatively small and since multiple queens exist, fragments of large infestations will continue to develop.

Drywood termites are easily recognized by the presence of their granular faecal frass in galleries and under infested timber where it has been ejected. Softwoods and sapwood of hardwoods are preferred. Infestations frequently commence in old borer damage.

There is one native species *Cryptotermes primus* Hill which is a widespread pest. At present, an extensive eradication campaign is under way in Brisbane and Maryborough against an exotic species, the West Indian Drywood Termite (*Cryptotermes brevis* Walker). Other less destructive exotic and native species have limited distribution in North Queensland.

Treatment

To obtain effective control, use surface treatments with liquid insecticides. All infested areas must be treated to obtain the greatest possible penetration into galleries. Best results are obtained using a solution of insecticide in a light petroleum oil base such as household kerosene or wood preserving oil. Poor penetration can be expected with any insecticide where the surface to be treated is painted.

Drywood termites are very susceptible to insecticides and suitable materials include:

- Pentachlorophenol, approximately 50 g/L in wood preserving oil or in combination with aldrin, chlordane or tributyl tin oxide 5 g/L.
- Dieldrin, 2 g/L in light petroleum solvent.
- Sodium arsenite, 50 g/L in water.
- Copper naphthenate, 30 to 50 g/L in a light petroleum solvent.
- Pressure impregnation with copper chrome arsenate salts (CCA), creosote, or proprietary wood preserving oils as previously described.

Wood borers

Habits

Most borer infestations in seasoned timber are either the Queensland pine beetle (*Calymnaderus incisus* Lea) which infests only pine, or the powder post borer (*Lyctus brunneus* (Linnaeus)) which infests only the sapwood of many hardwoods. Green timber may be infested by a range of borers some of which continue to develop after timber seasons (dries) but are unable to initiate any new infestation, while others die as seasoning progresses.

Treatment

There are number of options for treatment:

- Surface treatments. Both the Queensland pine beetle and the powder post beetle are controlled by surface treatments with any one of the insecticides recommended for the control of drywood termites.

- Impregnation treatments. Sapwood portions of sawn hardwood of susceptible timber species purchased from a sawmill should have been rendered immune to powder post borer under the provisions of the Timber Users' Protection Act (administered by the Department of Forestry). Sapwood of round timber and softwoods for use in exterior situations can be made more durable by impregnation with CCA salts, creosote or a proprietary wood preserving oil as previously described.
- Resistant timber species. A number of species of timber are naturally resistant to borers and these should be given preference where they are available. Locally available timbers with good durability are usually well known

in each district. Advice on the durability of any timber is available from the Department of Forestry.

Residues

Undesirable residues can be avoided by attention to the following measures:

- Above-ground structures should receive only localised *in situ* treatment as necessary. Treated soil barriers provide excellent protection against termites. For infestations which become apparent where barriers of ant capping are used, localized treatment of any infestation is adequate.
- Treatment of timber with preservatives should be undertaken before a structure is built. Over-spray during *in situ* treatments is

a common source of general contamination. Such treatments have little or no long term value.

- Do not use chemical soil barriers where erosion may occur subsequently. Contaminated silt is spread widely in this way and the effectiveness of the barrier may be weakened. If there is no alternative to soil barriers in these situations, cover them with concrete paths or collars.
- Dispose of any used containers, spills of concentrate and unused mixed spray in a safe way. Either bury deeply at a suitable site or use a declared dumping area for noxious substances.
- Flush out thoroughly any pumps or sprayers used for termite or borer control before using them for other purposes.

Book review—'The Vine in Australia'

This facsimile reprint of Dr A. C. Kelly's book gives the reader a rare opportunity to study one of the first Australian textbooks on viticulture and wine-making.

A fascinating insight into the life of an outstanding pioneer of Australian grape growing is provided in the introductory biography written by Dennis Hall and Valmar Hankel. A definite wine enthusiast, Dr Kelly was prepared to apply all his considerable energies to the numerous problems and set-backs which faced him and his neighbours in the new colony.

His many voyages around the world, in times when travel was an adventure in itself, underlines the efforts he was prepared to make to develop his industry and market its product.

The book gives an enlightening account of the dominant influence of European viticulture on the early Australian industry and underlines the significant and long-lasting effect of 'the strong coarse wines' of Spain and Portugal on the British market which was so vital to the progress of early Australia.

Discussions on the influence of climate are mostly of historical interest with major advances made in this area in recent times. Collection of climatic data, interpretation of vine response and the development of methods for objective comparison of climates are a far cry from early times. Of particular interest, however, is the author's thorough appreciation of the importance of vine exposure to sunlight.

Discussions on the qualities and problems of the root environment are introduced in the section on soils and situation. Considerable knowledge on soils is demonstrated along with a creditable knowledge of the major grape soils of Europe. Soil and site preparation

are covered in minute detail which mostly highlights the massive manual effort to prepare a vineyard for planting. It is interesting to compare the vast range of equipment and machinery available today with the tools of that time and ponder on the idea of bullock teams and wooden ploughs.

In the chapter on pruning we find most useful information, and principles just as applicable now as they were then. While there have been major developments in vineyard management and training systems, the basics of vine growth and response to pruning are just as appropriate today. Well worth reading are the discussions on the need to restrict the number of shoots carried by a vine through the growing season to a level appropriate to the summer climate of the vineyard.

Dr Kelly demonstrates a thorough understanding of the grape varieties then available and outlines their strength and weaknesses both in the vineyard and in the wines produced from them. It is interesting to note the poor opinion of varieties still significant in present day production and the numerous varieties long since discarded by the industry.

'The Vine in Australia' can rightly command a place in the library of any student of Australian viticulture or any person interested in the history of the Australian wine growing industry.

This beautifully presented publication is available from David Ell Press Pty. Ltd., P.O. Box 284, Gladesville, N.S.W. 2111. The cost of \$45 also includes a copy of 'Wine Growing in Australia' by the same author.

C. Winks, Horticulture Branch

The Brachylomas of South-eastern Queensland

by Beryl A. Lebler, formerly of Botany Branch

Ludwig Preiss was a German plant collector who lived for 4 years in the Swan River Colony in Western Australia. Among the many plants he discovered was a colourful heath with deep green leaves and small, but rich, rose-pink or red flowers with rather broad corolla-tubes

A German botanist, O. W. Sonder, who was closely associated with the botany of Australia and South Africa, particularly the family Epacridaceae, recognized that the plant discovered by Preiss belonged to a new genus and described it as *Brachyloma preissii*.

The generic name is derived from two Greek words, *brachys* meaning short and *loma* which means a fringe. In the flowers of the new plant, the corolla was glabrous except for hairs forming a fringe on the reflexed scales in the throat of the corolla tube. The generic name alludes to these hairs.

Brachylomas are erect, bushy shrubs with small leaves which are firm in texture. The short flowers are axillary and solitary. In Western Australia, the flowers are deep pink or salmon-red, but in Queensland they are always white. The genus is found only in Australia. Two species grow in South-eastern Queensland—*Brachyloma scortechinii* and *B. daphnoides*.

Brachyloma scortechinii

This plant was named in honour of the Rev. B. Scortechini who first found it growing near sandy swamps in the vicinity of Burleigh Heads.

DESCRIPTION: It is a glabrous shrub which can grow to a height of 1.5 m. More frequently, it is found as a much-branched subshrub 30 to 60 cm high with spreading, twiggy branches from near ground level. Short lateral branches often form whorls towards the ends of the branches.



Brachyloma scortechinii

The leaves are sessile and about 1 cm long and are convex or have recurved margins. The corolla tube is white but its swollen base is translucent. It is 0.5 cm long, 0.2 cm wide and ends in imbricate rounded lobes. These free lobes spread out from the tube and are not recurved. Sessile violet anthers can be seen only when a flower is split open

The fleshy globular fruit is 0.5 cm in diameter and is flattened on both top and bottom. Young fruits are pale green and mature fruits dark green.

FLOWERING TIME: This heath blooms from midautumn to mid-winter.

HABITAT: It grows in mixed heath vegetation beneath banksias, she-oaks and eucalypts.

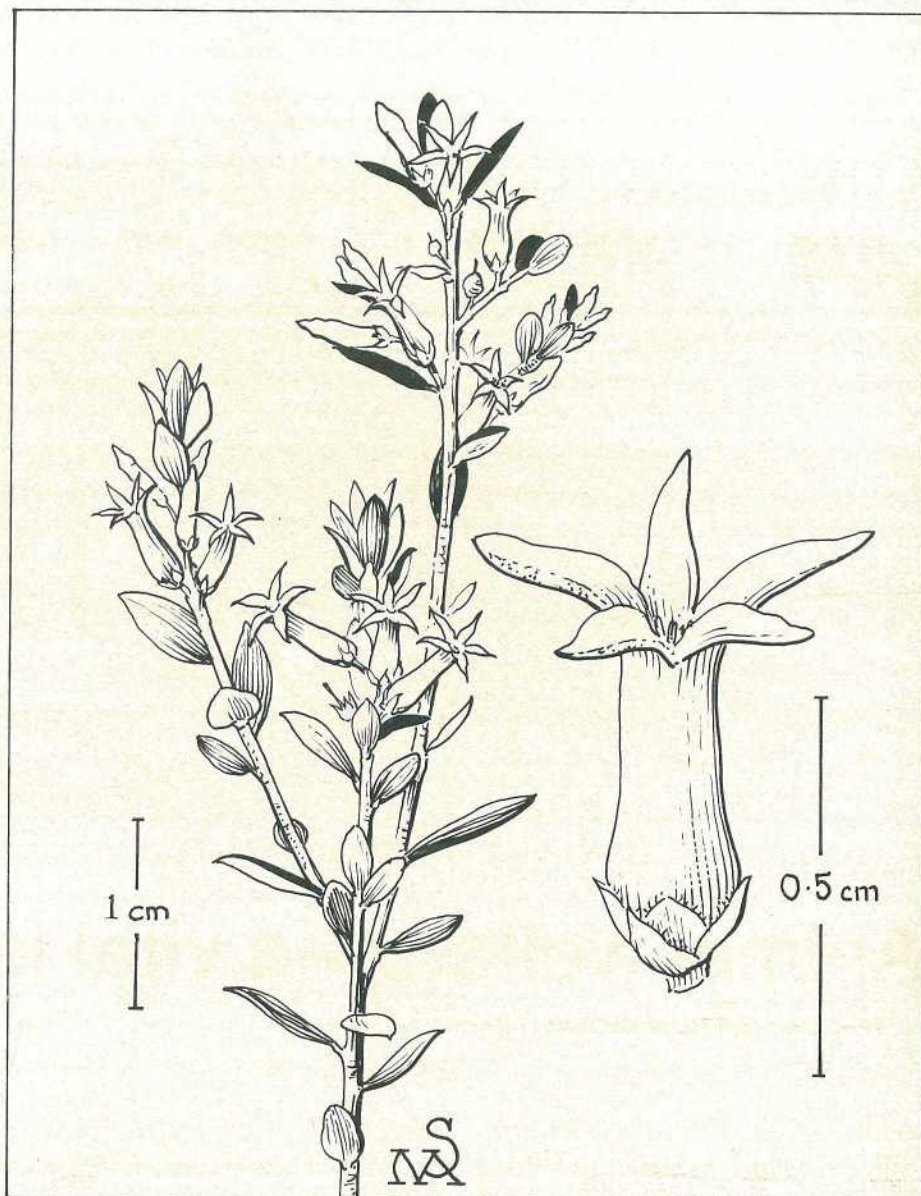
DISTRIBUTION: It is confined to Queensland and has a very restricted distribution. It has been found in the Cooloolah National Park, on the well-drained sand dunes at Noosa, and near Jacob's Well north of Southport. The area where it was originally discovered has long since vanished under housing development.

Brachyloma daphnoides

The specific epithet for this heath means resembling *Daphne*. *Daphne* is the Greek name for the laurel or sweet bay tree. This has simple alternate, stiff leaves and small, yellowish flowers.

DESCRIPTION: This is a shrub which usually grows to a height of about 1.5 m and has many thin, twiggy branches with sessile grey-green leaves. Magnification shows a fuzz of minute, white hairs covering the young stems. The leaves are oblong, lanceolate, obtuse and about 0.5 cm long and are more or less flat.

Usually, the white flowers are solitary and axillary; but often about six flowers are crowded together just below the tips of the branches with no subsidiary leaves. The petals are joined into a slender tube about 0.3 cm long. The free lobes taper gradually to a long fine point and are almost as long as the tube. In mature flowers, these lobes spread widely from the tube but do not reflex. The brown anthers can be seen attached at the end of the corolla tube. The fruits are fleshy and globular, and about 0.4 cm in diameter.



Brachyloma daphnoides

FLOWERING TIME: Although flowers can be found on this plant from early spring to late summer, the peak of flowering is in late spring.

but further inland in open forest it grows on soil derived from granite or sandstone.

HABITAT: This plant grows in a variety of soils on the coastal lowlands. It is found on old sand dunes in dry sclerophyll woodland,

DISTRIBUTION: This heath can be found in Tasmania and all the mainland States. In Queensland, it grows to as far north as Byfield, north of Yeppoon.

Field key to the *Brachylomas*

1. Corolla lobes rounded; leaves convex or margins recurved..... *Brachyloma scortechinii*
- Corolla lobes ending in a long, fine point; leaves $\pm$ flat..... *B. daphnoides*



Animal welfare—a vital issue

by J. R. Wythes, Beef Cattle Husbandry Branch

Animal welfare is basically good husbandry—the care and good treatment of animals.

A balance between the welfare of man and that of his cattle is imperative. Over-emphasis of either one can be detrimental to both parties, whereas they can gain mutual benefit from a balanced approach.

The astute and caring producer, like the stockman, transporter and abattoir operator, gains satisfaction from looking after his animals. At the same time, he will acknowledge that there are financial rewards.

Consequences of poor husbandry

Poor husbandry can cause injury, poor health, dehydration, stress and occasionally death in animals. This results in losses of both meat quality and quantity. Injuries can lead to the condemnation of part or all of the carcass, while all bruise tissue must

be trimmed before carcasses leave the slaughter floor. Dehydration means a loss of carcass weight.

Stress is an imprecise term. If the stress is intermittent and not protracted, then animals usually adjust. If it is severe, most animals adjust to some degree, but a few become fatigued and may die.

Stress can be measured in different ways, for example, by hormone levels or changes in heart rate, by behavioural patterns and from the commercial viewpoint by the pH value of muscle post mortem.

With good processing of carcasses, muscle should be most tender at a pH value of about 5.5. If glycogen concentrations in the muscle are reduced before slaughter, pH values will be high (that is, 5.8 or above at 24 hours post mortem).

Such meat is tough to 'mushy', susceptible to bacteria, has a short shelf life and is dark in colour. The carcasses are called 'dark cutters'. Consumers do not want to buy this kind of beef. It is also not suitable for ageing in vacuum packages.



The author, Jennifer Wythes, is a senior beef cattle husbandry officer. In her job, Jennifer is mainly involved with research into bruising and weight loss of cattle during transport.

Farm to slaughter considerations

Between the farm and slaughter, animals encounter unfamiliar noises, smells and surroundings. They are without feed and water for various periods and, regardless of welfare considerations, will lose liveweight and possibly carcass weight.

Even with good husbandry, it is impossible to alleviate all stress and bruising, because individual animals vary in their susceptibility to these factors.

On-farm

Good animal welfare on the farm depends on good handling, yard design and construction. The skills and attitudes of stockmen greatly affect the ease with which animals can be handled. Quiet and careful handling reduces the risk of injury, bruising and stress. Because rough handling undoubtedly causes bruising; noise, dogs and goads (whips, flappers, jiggers) should be used judiciously. Normal handling on the property is not a major source of bruising (table 1).

There are a number of husbandry practices that a producer can undertake to prepare his animals for transport to slaughter, to reduce potential stress, and as welfare insurance. Familiarizing cattle with yards and handling procedures will aid later handling in strange yards. Such training needs to begin while animals are young (for example, at weaning).

Dehorning calves or breeding polled cattle will improve animal welfare during the marketing process, since horns account for approximately half of all bruising in cattle. As a bonus, hornless animals are quieter and safer to handle. The tipping of horns does not reduce bruising, but it does make these animals easier and safer to handle than cattle with untipped horns.

Segregation of horned and hornless cattle is recommended during marketing, but it is often difficult to implement. Hornless animals in a mixed group bruise more than those transported separately, whereas bruising is the same for all horned animals.

Despite the overwhelming evidence against horns, there is currently little incentive for producers to sell hornless cattle.

Only healthy, strong animals should be selected for consignment to sale, but this is difficult to apply with weak, drought-affected animals. Animals of vastly different sizes and ages should be segregated while



Hornless cattle and horned cattle should always be handled and transported separately to minimize bruising.

travelling, as should strange groups of bulls. Mixing of strange groups of cows and steers of similar body condition does not increase bruising or muscle pH.

Denying animals feed and water before a journey is a contentious issue. In Queensland trials, bullocks fasted for 24 and 48 hours were more bruised than those not fasted. A possible reason was the butting and bullying between animals as they established a new 'pecking' order. Fasting did not affect the muscle pH of these bullocks (table 2).

On the other hand, if the floor of the vehicle is slippery from wet dung, there is a greater risk of unfasted animals 'going down' and being trampled. The likelihood of salmonella contamination is also greater.

No amount of welfare action will completely remove the stress and bruising associated with normal animal behaviour. Some degree of social interaction, fighting and butting will continue within any group of animals. These effects will be reduced by eliminating horned

animals, overcrowding and unnecessary mixing of strange groups or individuals.

The design and construction of yards can have a big bearing on the well-being of animals. They are also important for the safety of man.

Traditional designs have been based on straight fence lines and races, with square or rectangle yards. The designers of modern yards are learning to take advantage of the behavioural traits of animals by using circular yards, curved races and solid fences. These features make use of the tendency of cattle to circle and always maintain a critical distance from the stockman, plus the instinct to follow the leader.

Such designs improve the flow of cattle through the yards, because fewer animals are baulked. The application of animal behaviour to yard facilities is essential where cattle are handled in strange surroundings such as sale and abattoir yards.

Straight unloading ramps are being retained, but they should be wide enough for animals to see a direct

TABLE 1

Comparison of Bruising with Different Handling of Groups of Cattle During Four Trials

Handling procedure	Estimated mean bruise trim (kg)			
	1	2	3	4
Extra handling to tag and draft into groups	0.7	0.7	0.8	0.6
Normal for commercial property (no tagging).....	0.8	0.8	0.8	0.7

Source: Wythes *et al.* (1979) *J. Aust. Inst. Agric. Sci.* 45:128.

TABLE 2

Effect of Fasting Bullocks in Yards Before Transport on Mean Bruising and Muscle pH

Length of fast (i.e. time in yards) (Hours)	Bruise Trim (kg)	Muscle pH 24 hr post mortem
0	0.37	5.75
24	0.76	5.82
48†	0.72	5.72

† Water was available during the first 24 hours.

Sources: Dodt *et al.* (1979) *Aust. Vet. J.* 55:528 & Wythes and Underwood (1980) *J. Aust. Inst. Agric. Sci.* (in press).

few animals can be just as bad, because animals will not be able to support one another adequately.

While cattle should not be transported further than necessary, any attempt to limit animal movements for welfare reasons would presumably be a restriction of trade. Available evidence does not support such restrictions on welfare grounds. Bruising in cattle does not necessarily increase with the distance travelled or the length of the journey to slaughter (figure 1). The same is true

path and have flat landing aprons. Separate ramps for single and double-decker transports are most desirable and some saleyards are already installing these facilities.

The use of suitable materials for construction and diligent maintenance will reduce welfare hazards. Sharp objects, protruding spikes or bolts, narrow gates and slippery floors can injure cattle. In a series of Queensland trials, it was found that alterations to the yards at both the property and abattoir reduced the level of bruising from 1.4 to 0.65 kg trim.

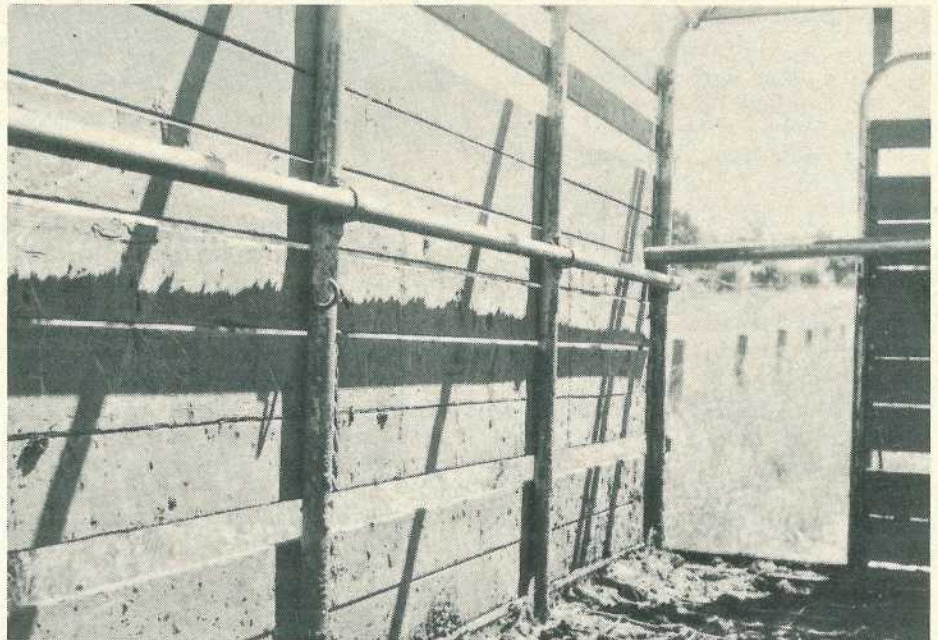
Transport

Well-designed stock crates and railway wagons have smooth sides, wide doorways, non-slip floors and in double-decker transports sufficient height between decks. Solid side walls, enclosing the front of the stock crate and some covering of the top deck will protect animals from wind chill during travel. However, the vehicles will need to be parked in the shade in hot weather to prevent heat stress.

Young animals require extra weather protection. In addition, road vehicles need to have adequate ventilation with exhaust fumes being directed away from stock.

Average loading densities have evolved for cattle of various sizes. The introduction of specific densities would be extremely complex and difficult to enforce objectively because animals vary too much in size and shape relative to liveweight. There are also too many different sizes and types of trucks, trailers and railway wagons.

In the few trials conducted, density did not affect the level of bruising, possibly because of the variation in animal sizes. Even so, overloading must increase the risk of injury, fatigue and death, particularly among horned cattle. Too



Internal structural supports and projections can cause bruising.



External structural supports ensure a smooth lining. A non-slip floor also helps reduce the risk of bruising.

for meat quality, when cattle are rested for similar periods on arrival at the abattoir (table 3).

TABLE 3

Effect of Distance Bullocks are Transported on Muscle pH

Distance travelled (km)	Muscle pH 24 hr post mortem
330	5.74
450	5.75
1 880	5.74

Source: A. E. Holmes unpublished data.

If cattle are allowed to settle down at the beginning of a journey, they will travel without difficulty. While the vehicle is moving, cattle usually stand parallel to one another and at right angles to the direction of travel.

Standing animals are careful not to tramp on those lying down. However, when the vehicle is stationary, animals soon become restless and stand haphazardly. Inspection stops should therefore be kept to a minimum, particularly for horned cattle because of the increase in bruising due to their aggressive behaviour (table 4).

TABLE 4

Effect of Number of Inspection Stops During 170 km Road Journey on Bruising in Bullocks

Number of stops	Mean Bruise trim per carcass (kg)	
	Horned	Hornless
10	1.5	0.8
4	0.7	0.6

Source: Ramsay (1976) *Aust. Vet. J.* 52: 285

There is no research evidence on which to decide how often and for how long cattle should be rested during journeys of various distances. Industry recommendations are based on experience, and when observed they have proved to be satisfactory.

Too many rest periods can be as bad as too few, because of the additional time cattle are without feed and in a strange environment. During the rest period, animals need access to feed and clean water, although this does not automatically mean every animal will eat and drink. Sufficient space to move without disturbing others and shade are necessary. Wind breaks are a help in colder areas.



Straight, wide unloading ramps allow cattle to see a clear pathway.

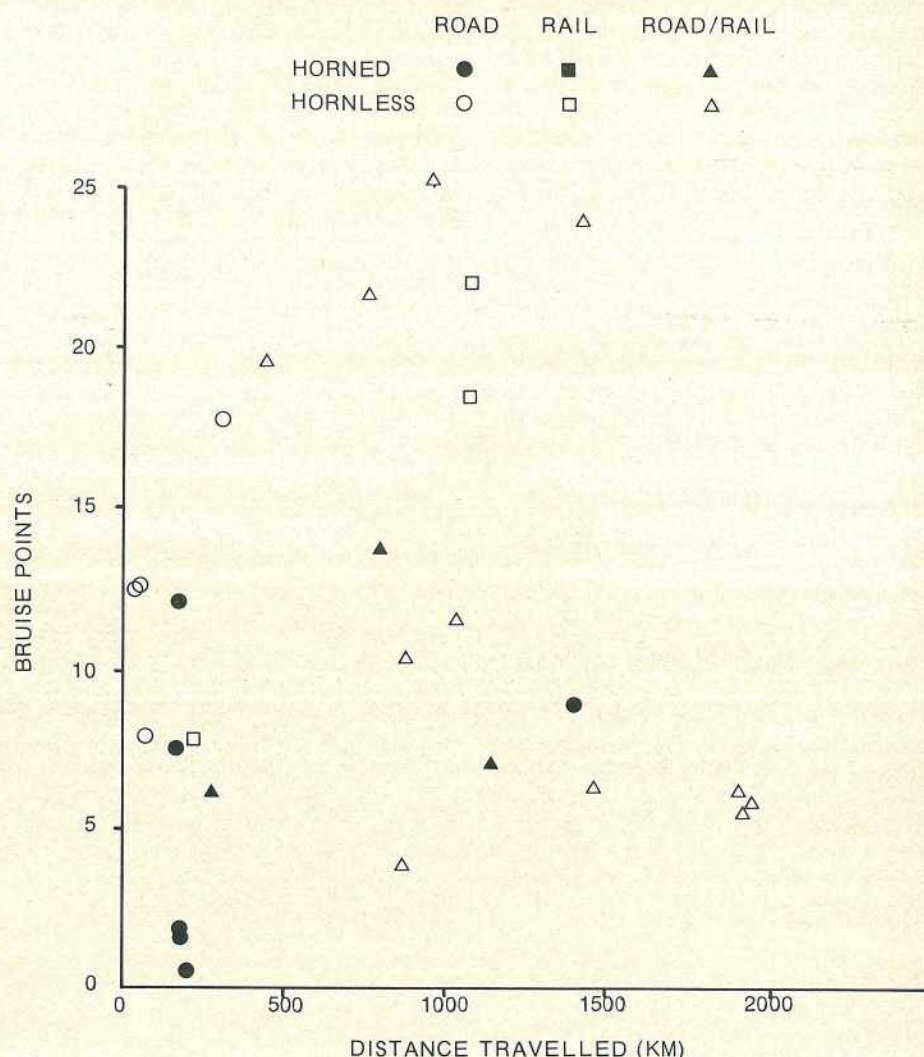
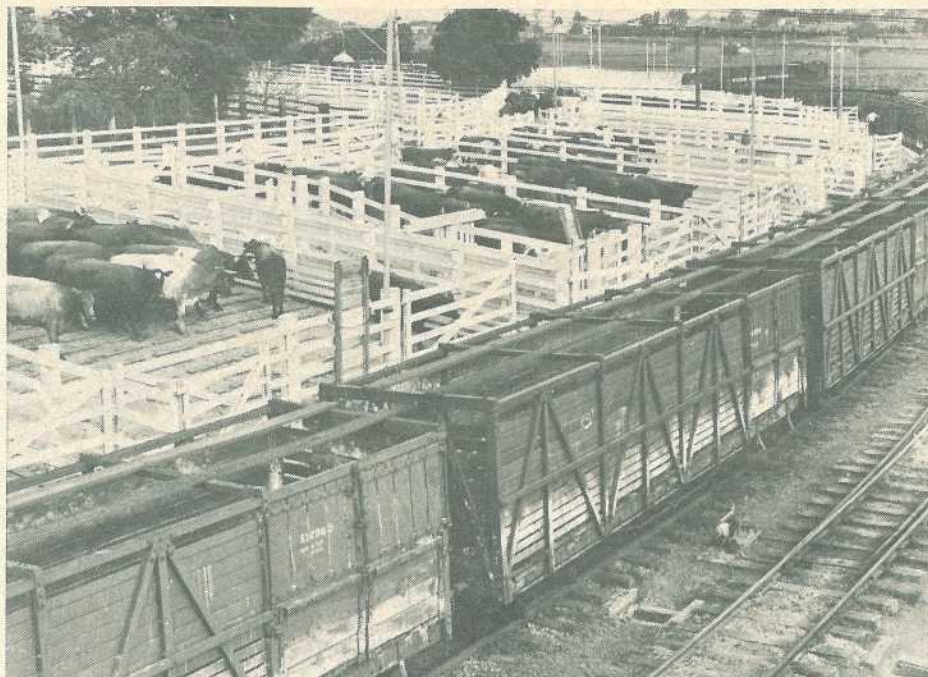


Figure 1. Distance effects on bruising.



Loading cattle quietly without rush reduces the chances of bruising and stress. Jiggers and whips need to be used sparingly.



Cattle sold through saleyards are as bruised as those sent direct to abattoirs. A recent survey by the Queensland Meat Industry Organisation and Marketing Authority revealed that one beast in 1 000 dies while being transported on trains.

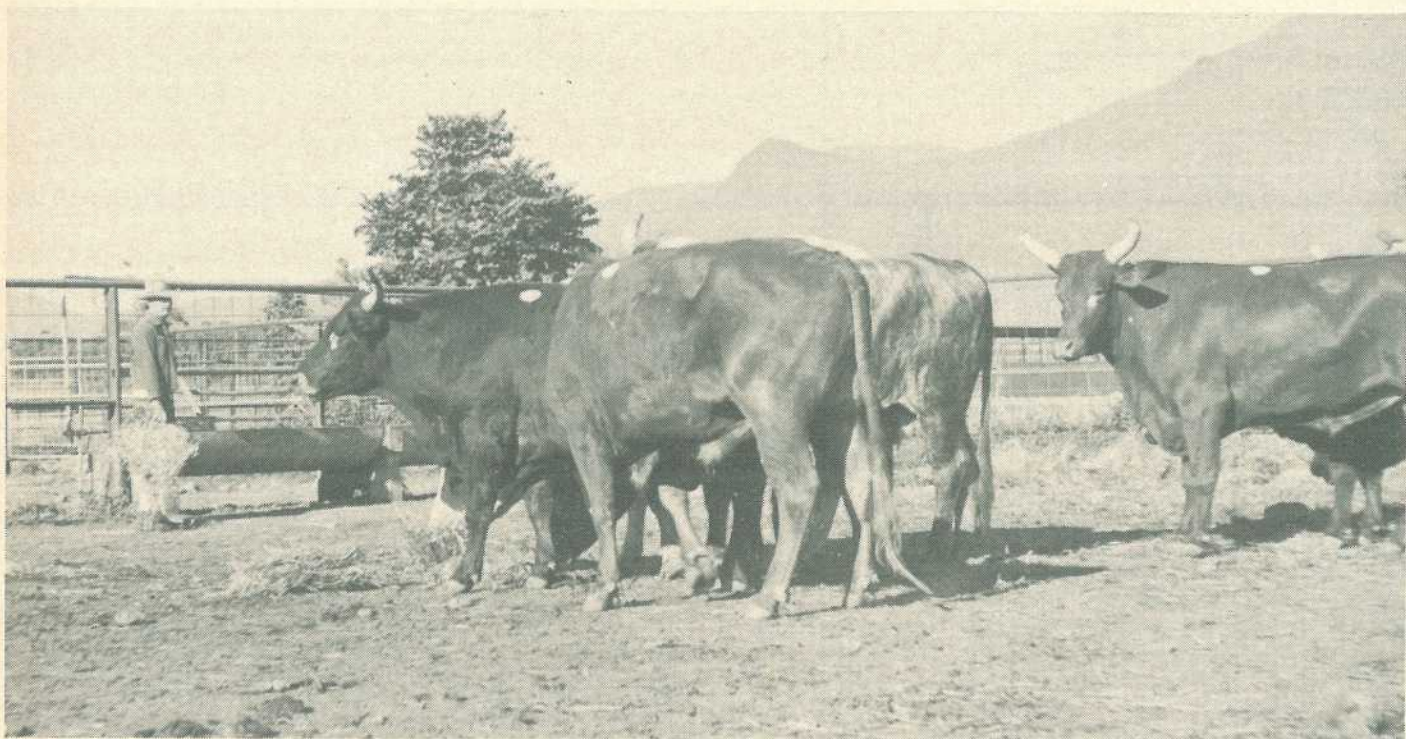
One problem with sale and trucking yards, which handle large numbers of stock and/or many mobs, can be insufficient yards with adequate water trough space. If space is restricted, bullying by dominant animals may prevent others drinking, particularly with mixed mobs of horned and hornless cattle.

How stressful is transport? Animals become weary while travelling and the glycogen concentrations in their muscle decrease. In turn, muscle pH is higher and the meat tougher. For example, when a group of animals was rested at an abattoir while others travelled to a distant abattoir for slaughter on the same day, the latter

group had higher muscle pH values (table 5).

At saleyards

Despite the greater risks of bruising when cattle are sold through saleyards rather than direct to an abattoir, it was found that bruising was similar for both methods of sale.



Resting, feeding and watering cattle at abattoirs is beneficial after a long journey. Increases in carcass weight of 4 to 6% have been recorded when dehydrated bullocks were watered after travelling 1 000 km.

One of the welfare problems at saleyards is the mixing of cattle from different properties in the buyers' pens, as some may be bullied by others, particularly horned animals.

The extra handling and noise at saleyards probably causes some stress to some animals. This is reflected in a CSIRO survey, in which the incidence of 'dark cutters' was greater among saleyard animals than those sent straight to an abattoir.

At abattoirs

The treatment which animals receive at an abattoir before slaughter affects not only their welfare, but also carcass weight and meat quality. Animals should be held at abattoirs for the least possible time.

Resting cattle before slaughter is most important as it gives them the opportunity to recover from travel weariness and adapt to the strange surroundings. After sufficient rest, their glycogen concentrations are

replenished and muscle pH falls (table 6). The incidence of 'dark cutters' is also less.

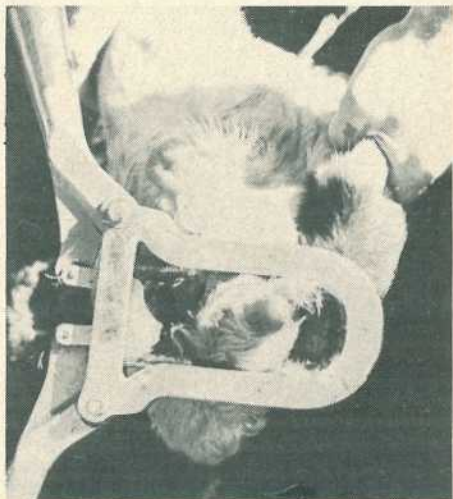
Animals will not rest adequately if they are disturbed by noise and abattoir activities. Mixing strange mobs of animals and/or redrafting them upsets the established 'pecking' order. This usually results in higher pH values.

Feeding cattle a small quantity of hay for 2 days before slaughter may make them feel better, but it does not improve pH values. We do not know if feeding larger amounts would be effective, but one problem is a likely increase in burst rumens on the slaughter floor which will contaminate carcasses. However, animals should be fed hay when rested for long periods.

For humane reasons alone, cattle should be watered on arrival at an abattoir, but an associated benefit is that rehydration increases carcass weight substantially. However, it is surprising to find that dehydrated and rehydrated animals had similar muscle pH values (table 7).



Good husbandry improves the welfare of cattle and avoids bruising losses.



Dehorning calves is one way to halve the bruising problem.

TABLE 5
Effect of Travel on Muscle pH of Bullocks and Cows

Class of animal	Distance travelled (km)	Days from mustering to slaughter	Muscle pH 24 hours post mortem
Bullocks.....	450	11	5.57
	1 880	11	5.75
Cows	460	8	5.58
	2 055	8	5.71

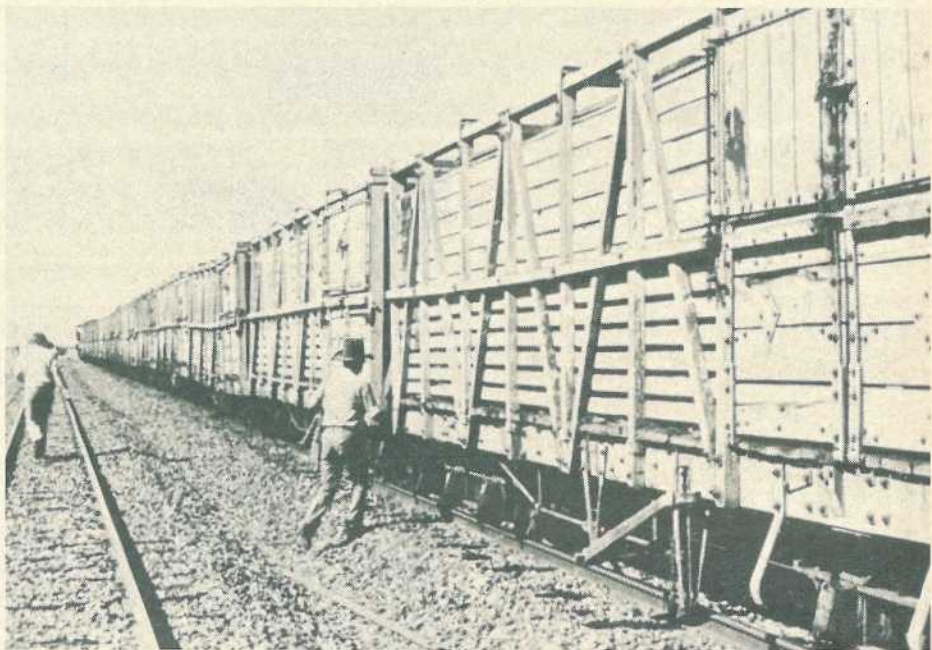
Source: A. E. Holmes and J. R. Wythes unpublished data.

Codes of practice

Animal welfare legislation exists in each State and Territory, as well as for the Commonwealth. These Acts relate mainly to offences of cruelty and the penalties to be imposed.

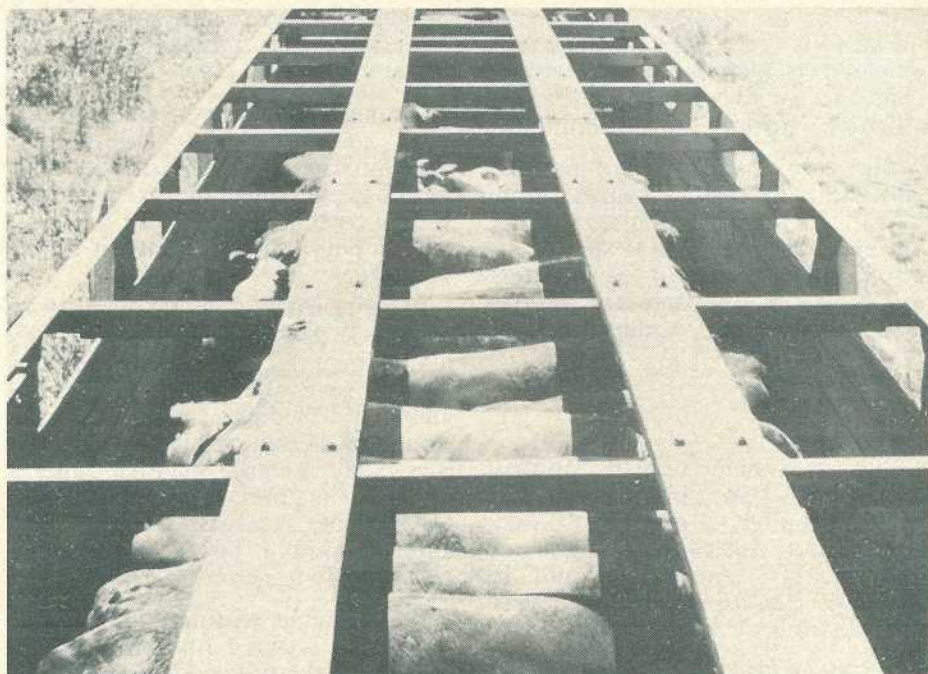
People in the rural and associated industries are conscious that not only is the welfare of their animals important, but it also affects their livelihood. Information on good husbandry practices has always been available from standard texts, scientific and popular press articles.

In more recent times, industry and Government, at both the State and national level, have begun to compile this information in a more readable form, by drafting codes of practice for rural and associated industries. The codes are based on objective scientific evidence and information gained from experience.

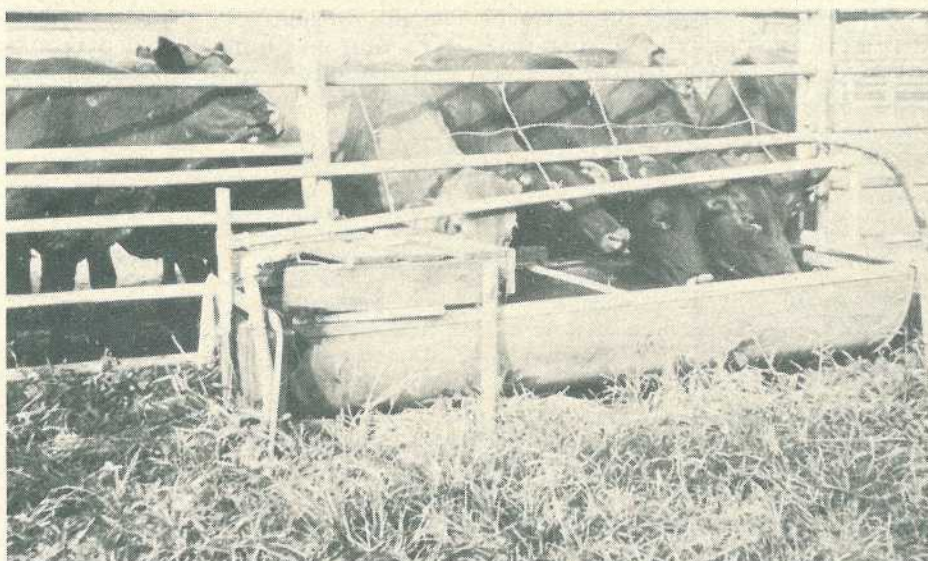


Train drivers make an important contribution to the welfare of cattle.

If cattle are loaded at the correct rate, there is less risk of their being trampled.



Plenty of trough space ensures that all the cattle get a drink. They should also be rested at least every 36 hours during a long journey, be fed and have space for exercise and some shade.



With a dead animal, there is no financial reward and no satisfaction from knowing that animals were cared for properly.



The codes will be relevant to modern industry and authoritative, but flexible enough to incorporate new knowledge and husbandry advances. They can be updated as gaps in our knowledge close and as

better husbandry methods and designs for facilities evolve.

Animal welfare is the concern of all sectors of rural industry, but a balance is essential between the welfare of man and that of his

livestock. In this way, all parties will benefit. Codes of practice are a worthwhile way to establish approved standards and provide safeguards for animal welfare within viable enterprises.

TABLE 6
Effect of Resting Bullocks at the Abattoir

Distance travelled (km)	Days rested abattoir	Days rest on feed	Muscle pH
1 420	1 2	0 0	5.64 5.57
1 288	2 4	2 3	5.74 5.70

Sources: Shorthose *et al.* (1972) *Proc. Aust. Soc. Anim. Prod.* 9: 387 & Wythes *et al.* (1980) *Aust. J. Agric. Res.* 31: 849.

TABLE 7
Effect of Hydration Status in Cattle

Hours on water	Water Intake (L)	Carcass weight (kg)	Water content of fat free muscle (%)	Muscle pH 24 hr post mortem
0	0	369	76.0	5.63
3.5	33	383	77.7	5.65
7	33	383	77.5	5.63
28	47	381	78.2	5.57
32	NA	376	78.0	5.57
32 (+feed)	58	379	78.1	5.57

Source: Wythes *et al.* (1980) *Aust. J. Agric. Res.* 31: 849

Book review—'Wine Growing in Australia'

The Author, Dr A. C. Kelly, obviously had a keen eye for detail. This is evident in his wide knowledge which is often quoted in this publication.

He discusses key aspects of classic red wine production, fermentation with stalk, open versus closed fermentation, and length of fermentation on skins as debated by the oenologues of the day.

It is significant that Dr Kelly draws comparisons between South Australia and other colonial experiences, rather than relate directly to French techniques.

Although Dr Kelly concentrated mainly on red grape vinification, he presents excellent thoughts concerning the value of pressings, storage in wood, iron discoloration, immediate racking from lees after fermentation, and sulphur dioxide usage related to white wine production. He devotes significant discussion towards an in-depth treatment of the use of gypsum in pH adjustment. This is highly commendable.

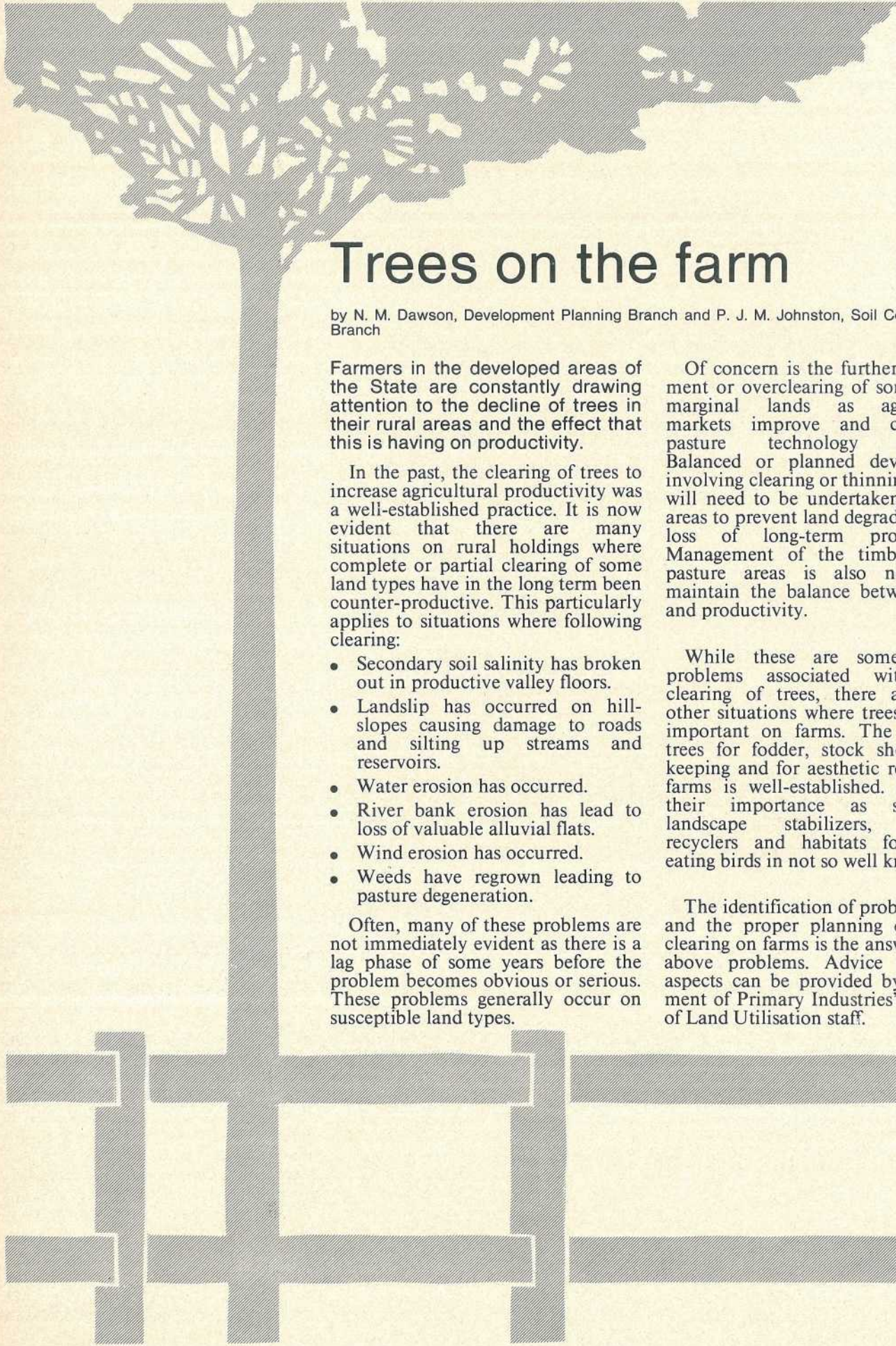
Despite his well-researched details, Dr Kelly has arrived at some conclusions which are confusing. It appears to originate from French historical data, where regional rivalry is apparent.

Dr Kelly as the purist, condones the need to fortify export shipments of South Australian wines, by stipulating closer attention towards the wines during transit and warehousing. This was a reasonable approach to remain competitive in regard to the Bordeaux trade.

I praise the moves to produce facsimile copies of the rare but basic textbooks which shaped the Australian Wine Industry of last century. Without this avenue, these valuable works would only remain in historical collections.

This beautifully presented publication is available from David Ell Press Pty. Ltd., P.O. Box 284, Gladesville, N.S.W. 2111. The cost of \$45 also includes a copy of 'The Vine in Australia' by the same author.

P. D. Scudamore-Smith, Horticulture Branch



Trees on the farm

by N. M. Dawson, Development Planning Branch and P. J. M. Johnston, Soil Conservation Branch

Farmers in the developed areas of the State are constantly drawing attention to the decline of trees in their rural areas and the effect that this is having on productivity.

In the past, the clearing of trees to increase agricultural productivity was a well-established practice. It is now evident that there are many situations on rural holdings where complete or partial clearing of some land types have in the long term been counter-productive. This particularly applies to situations where following clearing:

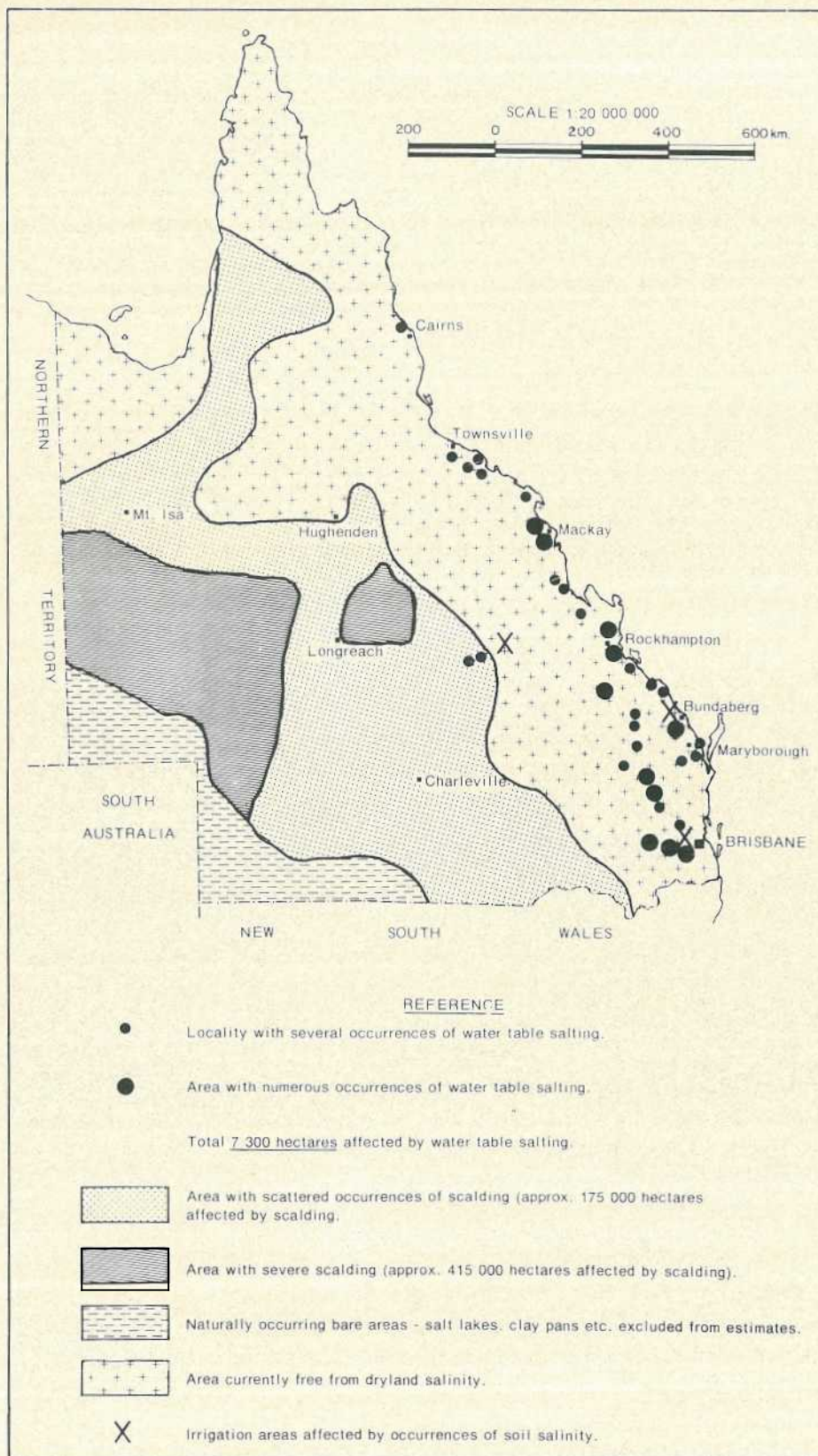
- Secondary soil salinity has broken out in productive valley floors.
- Landslip has occurred on hill-slopes causing damage to roads and silting up streams and reservoirs.
- Water erosion has occurred.
- River bank erosion has lead to loss of valuable alluvial flats.
- Wind erosion has occurred.
- Weeds have regrown leading to pasture degeneration.

Often, many of these problems are not immediately evident as there is a lag phase of some years before the problem becomes obvious or serious. These problems generally occur on susceptible land types.

Of concern is the further development or overclearing of some of the marginal lands as agricultural markets improve and crop and pasture technology develops. Balanced or planned development involving clearing or thinning of trees will need to be undertaken in these areas to prevent land degradation and loss of long-term productivity. Management of the timbered and pasture areas is also needed to maintain the balance between trees and productivity.

While these are some of the problems associated with over-clearing of trees, there are many other situations where trees are very important on farms. The value of trees for fodder, stock shelter, bee keeping and for aesthetic reasons on farms is well-established. However, their importance as soil and landscape stabilizers, nutrient recyclers and habitats for insect-eating birds is not so well known.

The identification of problem areas and the proper planning of timber clearing on farms is the answer to the above problems. Advice on these aspects can be provided by Department of Primary Industries' Division of Land Utilisation staff.



Problems which follow clearing

Soil salinity

Soil salinity is emerging as a significant problem in Queensland with water table salting now evident on 7 300 ha of land valued at \$1.8 million. The annual loss in productivity is estimated to exceed \$1 million. The areas affected are increasing in size and number.

A serious indirect consequence of soil salinity is the contamination of surface water supplies affecting both farm and urban water quality. All recent occurrences of water table salting are associated with cleared areas, poor quality groundwater and poor drainage.

The clearing of trees from both the upper and lower parts of susceptible catchments results in rising groundwater levels. Trees in critical areas in valley floors play an important role in keeping these water levels down.

Studies in the Lockyer indicate that removal of more than 50% of trees in susceptible catchments predisposes the land to salting development.

Areas in Queensland most likely to develop saline seepages after clearing are those areas with:

- Rainfall between 500 mm and 1 000 mm.
- Shallow groundwater.
- Poor quality groundwater.
- Poor drainage.

If the soil surface in the potential seepage area is bared through cultivation or overgrazing, this will intensify the evaporative action and increase salting.

There is considerable scope in Queensland for preventative measures against saline seepages by identifying salt susceptible areas and maintaining a protective vegetative cover. Many of these salt-prone areas can now be identified by Division of Land Utilisation personnel. Before indiscriminate clearing is carried out on any area suspected of having salinity problems, advice should be sought from local Department of Primary Industries' officers.

Practical and economical means of reclaiming these areas are being investigated. Tree and shrub replanting or natural regeneration play important roles in control and prevention of further development of this problem. However, this can be extremely costly. The most effective way to control future outbreaks is to avoid or limit clearing of susceptible catchments.

Landslip

Landslip and other forms of mass movement are problems evident in many of the cleared steep scrub and rain-forest lands. Landslip is generally related to clearing of trees and shrubs from steep slopes on certain land types. While it does occur naturally in rain-forests, the rate is accelerated in cleared areas.

In the Bremer and Lockyer Catchments of South-east Queensland, over 1 200 landslips have been identified. These are affecting productivity on approximately 6 000 ha. The problem is well known right along the coastal ranges.

There is often a considerable time lag between clearing and landslip occurrences with a series of wet years often triggering mass movement. Mass movement may affect roads and other infrastructure and result in loss of grazing land. Erosion of the exposed soils on these steep slopes leads to soil losses and sedimentation of streams. The maintenance of existing cover or replanting of deep-rooted trees in susceptible areas is the best means of controlling mass movement.

A number of studies of landslips have been completed in coastal Queensland and the susceptible areas have been identified. Where these occur, it is generally recommended that lands with slopes greater than 18% should not be cleared.

Generally, these steeper lands should be maintained as forest for water catchment protection. Some of the problems of landslip on the susceptible land types are associated with rising water tables and these are often found in catchments also affected by soil salinity.

Water erosion

The overclearing of trees followed by fire or overgrazing has led to sheet and gully erosion on highly erodible, texture contrast soils. Tree canopies and litter act to reduce raindrop impact and promote absorption of water into the soil profile. Concentration of run-off is spread in timbered catchments and this is important in preventing gully erosion and, in some cases, flooding. The practice of some graziers to allow fires to burn up into hills is a major contributor to soil erosion where trees are killed on these steep lands.

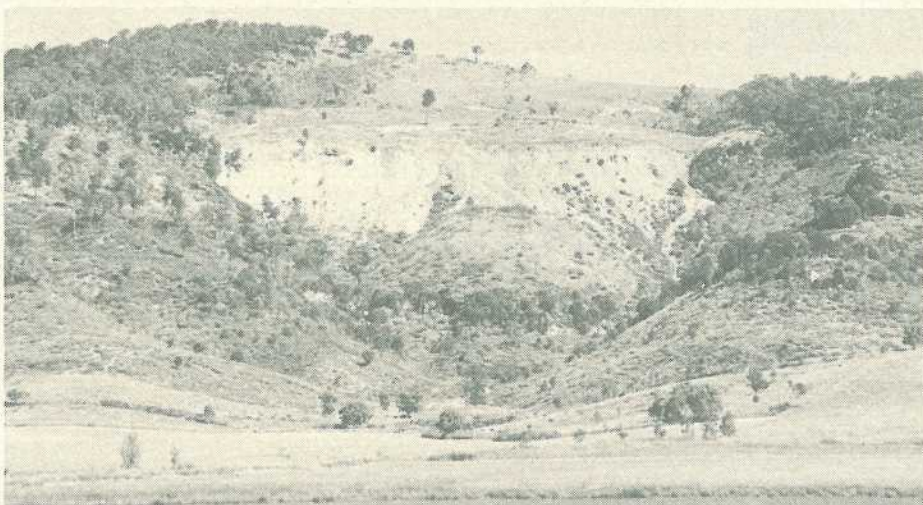
While it cannot be denied that the clearing of trees in pasture situations does improve productivity, there is also evidence to suggest that a



The retention of trees on the hill in the background is a sound land use as the cultivation areas below are protected.



The clearing of hillsides in the Lockyer catchment has resulted in the development of a massive saline outbreak.



Removal of deep-rooted vegetation on the hill has resulted in landslipping. These landslips do not only affect the immediate downstream landholders, but sediment also contributes to siltation of dams and culverts which may result in flooding.



Clearing of these erosion-prone lands in central Queensland has resulted in gully and sheet erosion, reducing productivity and increasing the sediment load into the downstream major water storage.

balance between tree density, land stability and pasture productivity can be achieved. Work in Western Queensland indicates that mulga densities of 175 tress per ha provide stability and allows a productive grass layer to develop.

In North Queensland trials, pasture production from uncleared areas was not significantly reduced in some woodlands. Information is being obtained on the relationship between tree density and pasture production for different land types.

River bank erosion

The rapid deterioration of our river banks due to clearing, erosion and siltation is a serious concern, particularly in those highly developed catchments east of the Dividing Range and on the Darling Downs. The alluvial flats bordering our streams are a most valuable resource, and their loss due to

erosion and the subsequent costs of siltation are very high.

Trees need to be maintained on river banks to prevent erosion and to slow flood waters. Trees play a very important role right throughout catchments in controlling soil erosion and flooding. This is a consideration in catchment or regional planning as individual farmers may not recognize the effects of clearing steep lands and river banks on flooding and erosion downstream.

Wind erosion

Where wind erosion occurs in Queensland, the maintenance of ground cover and tree and scrub cover is the most effective means of control. Currently, this is not a serious problem as much of our cultivation land is on clay soils, which are not susceptible to wind erosion. Despite this, many of the lighter-textured marginal cropping lands are susceptible to wind erosion and these may be more intensively cultivated in the next few decades.

Stubble cover and tree windbreaks are important means of reducing this form of erosion. As a general rule of thumb, tree breaks reduce wind velocities at the soil surface for distances up to five times the height of windbreak on the windward side and 20 times the height on the leeward side.

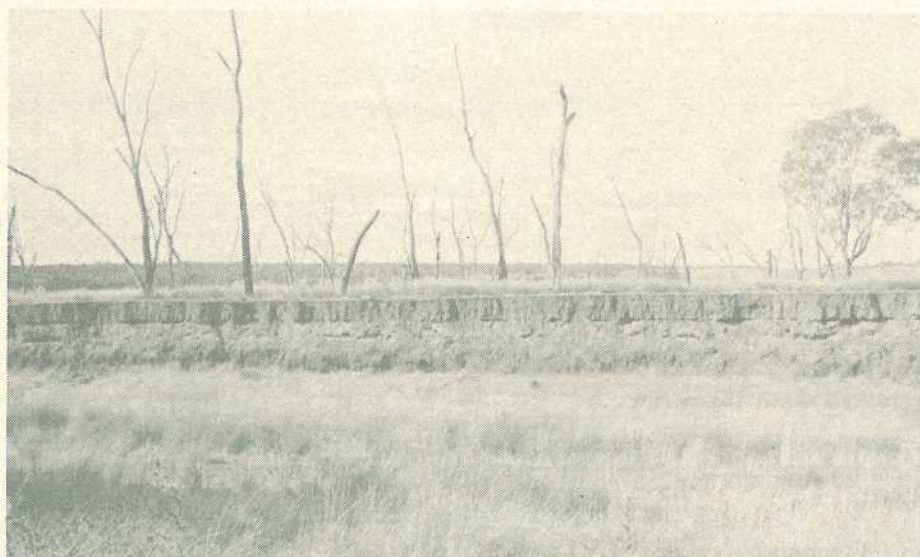
Wind breaks along fencelines in susceptible areas on the Western Darling Downs have been cleared in recent years to increase production by reducing competition for moisture by the trees. This is an undesirable practice, particularly on the lighter-textured belah and iron-bark soils.

Other benefits of trees

Nutrient cycling

The deep-rooted nature of trees allows them to draw nutrients and moisture from deep in the soil profile, and litter from the trees is eventually broken down in the surface soil. In poorer soils this is an important source of the major nutrients, particularly potassium and phosphorus, for plant growth.

The role of wattles and other legumes in fixing atmospheric nitrogen is well known. Clearing in these situations can lead to a pasture 'flush', but if the pastures are not adequately fertilized and managed, then pasture productivity on these poorer soils declines rapidly.



The removal of trees along the banks of this watercourse has resulted in severe stream-bank erosion.



Over-zealous clearing has resulted in wind erosion of this western Queensland paddock. Top soil has been removed and deposited in a 300 mm deep strip along this old fence line.

Fodder trees

Fodder trees play an important part in grazing lands in providing feed during drought. Many of the grazed species provide a high value source of fodder which supplements pasture even in good seasons. However, excessive reliance on fodder trees during droughts can lead to soil erosion as ground cover can be completely destroyed in critical areas.

Shade and shelter

Trees provide shade and shelter for stock from rain, high temperatures and wind. North-western Queensland work records increased lambing percentages of 10 to 15% for sheltered sheep. Windbreaks are also used to reduce evaporation and wind and frost damage. Shelter belts

need to be scattered throughout paddocks to avoid erosion of cattle camps.

Insects and birds

Trees provide a habitat for birds which in some cases help reduce insect populations affecting crops and pastures. Bee-keeping is an important part of agriculture and in many areas only 20 honey-producing trees per ha are necessary to allow maintenance of honey production. In many pastoral situations, this density of trees would only have a limited effect on productivity.

Trees and agricultural productivity

The most effective means of maintaining agricultural productivity

is by property planning based on agricultural land capability. Decisions to use any piece of land for a particular purpose should be made in the knowledge that a feasible system of management can be applied which will ensure that the land is capable of maintaining long-term productivity.

This means that those sensitive areas on farms where removal or destruction of trees will cause land-slip, soil salinity or other problems should be identified and treated accordingly. Much of this information becomes available as land resource assessment studies are completed in each of the agricultural regions of the State. On many farms, replanting or regeneration programmes may be needed on degraded areas.

Landsat 81 Exhibition

1981 marks the first complete year of operations for the Australian Landsat Station at Alice Springs and its associated processing facility in Canberra.

For the first time, Australian users of Landsat satellite data have access to timely repetitive coverage. The upsurge of interest that this has triggered in remote sensing is extending beyond the confines of Landsat itself into the fields of complementary study. This augurs well for the future use and development of remotely sensed data and systems throughout this decade.

Given these advances, the Australian Academy of Science, the Department of Science and the Environment, CSIRO, the INDUSAT group, and the Canberra College of Advanced Education in association with the Remote Sensing Association of Australia and the Australian National University have announced details of LANDSAT 81, the 2nd Australasian Remote Sensing Conference and Exhibition. This will be held

at the Australian National University in Canberra from 31 August to 4 September, 1981.

The Exhibition will display a wide range of equipment, goods and services related to remote sensing from all over the world. Equipment will include: digital image processing equipment, remote sensing imagery, graphics, image analysis systems, photo geological and geophysical interpretation maps, aerial photographs, sar imagery, computer software and hardware, interpretation and interactive data.

The Exhibition will be held in the same building as the Conference enabling delegates to attend the Exhibition on a regular basis. People wishing to visit the Exhibition are asked to contact the organisers for complimentary trade passes and special rates on accommodation and airfares that have been negotiated especially for the event.

The organisers are: Exhibitions & Trade Fairs Pty., Ltd., 49 Cardigan Place, Albert Park, VIC. 3206.

Red scale—a serious pest

by D. Smith, Entomology Branch

Red scale (*Aonidiella aurantii* (Maskell)), possibly the world's most serious citrus pest, has been known in Australia for about 100 years.

It occurs throughout Queensland, mainly on citrus but also on a number of other crops such as figs, grapes and carnations.

On citrus, it infests the fruit, foliage, twigs and limbs. Fruit are disfigured, and where serious infestations occur, severe dieback of the tree occurs.

Life history and habits

The adult female has a reddish-brown, semi-transparent scale covering which is about 2 mm across. Its body is shield-shaped and yellow in colour. It produces living young referred to as crawlers. These have legs, eyes and antennae and are able to disperse over the tree and are sometimes caught by the wind and blown to other trees.

The crawler settles within 24 hours, inserts its long tubular mouthparts into the plant cells and begins secreting its scale covering. The new female scale remains fixed in this position on the plant throughout its life, but the male scale ultimately forms a pupa from which emerges an adult winged individual.

The life cycle of the female from crawler to producing adult takes about 6 weeks during the summer. The scale moults twice during the first 3 weeks in changing from first instar to second and from second to third. The third instar or adult is fertilized by the male after a further week, and 2 weeks later the first new crawlers emerge.

Crawler production continues for a further 3 to 4 weeks before the scale dies. During moulting and after fertilization, the body of the insect is firmly attached to its scale, while at other times the scale can be lifted clear. This is an important feature in its susceptibility to some of its parasites.

The male completes its development in a little over 3 weeks. It moults from the first instar to the second and again to a prepupal stage with eyes. The scale is then mussel-shaped and readily distinguished from the more circular scale of the young female.

A third moult leads to the formation of the pupa, and after a final moult the fragile-winged adult emerges. It is attracted to the virgin females, whose development coincides with that of the male, and after mating with several of these females it dies. Most of the males emerge over a short period of 3 days.

The above details of the life cycle of red scale are summarized in figure 1.

About five generations are completed during the year in Queensland. During November, crawlers present on the leaves and twigs move on to the new season's fruit where they breed continuously for the remainder of the season.

Natural enemies

Natural enemies are of major importance in the control of the scale. At least four small parasitic wasps are active in Queensland, and predators such as the scale-eating ladybird (*Lindorus lophantae* (Blaisdell)) also occur. The most important natural enemy is the wasp *Aphytis lingnanensis* Compere and

the next important one is another wasp *Comperiella bifasciata* Howard. *A. lingnanensis* is yellow in colour and about 1 mm long, while *C. bifasciata* is shiny black and about 1.5 mm long. Both parasites were introduced into Australia from Hong Kong.

A. lingnanensis selects only second instar or virgin adult female scales (and second instar or prepupal male scales) in which to lay its egg. In these stages, the body of the insect and its scale are separated from one another and the parasite is able to bore a hole through the scale with its ovipositor and place its egg on the insect's body.

The egg is teardrop-shaped, glistening white but so small as to be barely visible with a x 10 hand lens. The larva is rotund and yellow, and eventually grows almost as big as the body of the scale itself. The pupa is up to 1 mm long, yellow with clear or green or red eyes and a strip of dark pigmentation down the dorsal part of the thorax and abdomen.

The best way to determine if the parasite is present is to lift the scale covering with a pair of tweezers and then examine the body of the scale with a x 10 hand lens.

While consuming the scale body, the *Aphytis* larva produces about a dozen dark brown faecal pellets. These pellets, together with the dark pigmented remains of the wasp pupa, confirm that the parasite has been active even if the adult has gone. A significant number of scales not parasitized are mutilated by the adult parasite when it wounds the scale with its ovipositor and feeds on the escaping body fluids. At 26°C the life cycle of *A. lingnanensis* takes 16 to 17 days and the adult females live a further 2 to 3 weeks.

Red scale - a



A heavy infestation of red scale on a twig. Magnified x 6.



Adult *Aphytis lingnanensis* preparing to oviposit in a virgin adult female scale. Note the wide grey margin of the scale. Magnified x 26.



Scale covering removed to show a virgin adult female. An *Aphytis* egg lies at the bottom left hand corner of the exposed scale. The upturned scale on the right is a maturing female firmly attached to its scale covering. Magnified x 20.



Scale covering removed to show an *Aphytis lingnanensis* pupa. Note the dark pigmented patch dorsally and the small excretal pellets. Magnified x 25.



Scale covering removed to show the pigmented remains of the *Aphytis* pupal case and the excretal pellets after the adult has emerged. Magnified x 26.

erious pest



Villafranca lemons infested with red scale.



Scale coverings removed or overturned to show the developmental stages of red scale. Upper left to right—first instar, first moult, second instar, second female moult, virgin female adult, maturing female adult. Lower left to right—male prepupa, male pupa, adult winged male, crawler producing female. Magnified x 18.



Scale covering removed to show two *Aphytis* larvae and remains of the scale body. Magnified x 21.



An adult female *Comperiella bifasciata* on a mature male scale. The scale on the right has a ring of dark discoloration indicating it is parasitized by *C. bifasciata*. The emergence hold of the adult parasite can be seen in the scale on the left. Magnified x 10.



Adult female scale dissected to show a pupa (upper right) and larva (lower left) of *Comperiella bifasciata*. Magnified x 10.

Red scale - a serious pest



A heavy infestation of red scale on a twig. Magnified x 6.



Villafranca lemons infested with red scale.



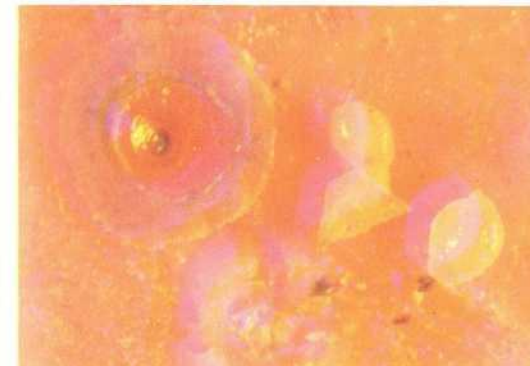
Scale coverings removed or overturned to show the developmental stages of red scale. Upper left to right—first instar, first moult, second instar, second female moult, virgin female adult, maturing female adult. Lower left to right—male prepupa, male pupa, adult winged male, crawler producing female. Magnified x 18.



Adult *Aphytis lingnanensis* preparing to oviposit in a virgin adult female scale. Note the wide grey margin of the scale. Magnified x 26.



Scale covering removed to show a virgin adult female. An *Aphytis* egg lies at the bottom left hand corner of the exposed scale. The upturned scale on the right is a maturing female firmly attached to its scale covering. Magnified x 20.



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An adult female *Comperiella bifasciata* on a mature female scale. The scale on the right has a ring of dark discoloration indicating it is parasitized by *C. bifasciata*. The emergence hold of the adult parasite can be seen in the scale on the left. Magnified x 10.



Adult female scale dissected to show a pupa (upper right) and larva (lower left) of *Comperiella bifasciata*. Magnified x 10.

By contrast with *A. lingnanensis*, *C. bifasciata* deposits its egg entirely within the body of the insect and is able to parasitise a wider range of stages. It prefers virgin adult female scales or second instar moulting females but also lays in all male stages except the second instar moulting stage and pupa.

The parasite's development is synchronized with that of the scale. For example if the egg has been laid in a first instar scale, the parasite larva develops slowly at first allowing the scale to grow. If the egg is laid in

a mature scale, the parasite's development speeds up. At 26°C the life cycle can vary from 3 to 6 weeks depending on the age of the scale at oviposition.

The larva is elongate, translucent-white and in its early stages, along with the egg, too small to be distinguished with a x 10 hand lens. Larger larvae and the pupae are more easily seen and the scale becomes darkened around the edge as the parasite develops. Parasitized scales sometimes have a bloated appearance. After five instars, the larva forms a black pupa about 1.5 mm

long. The adult emerges by cutting a circular hole in the scale. Adults live for 2 to 3 weeks and like *A. lingnanensis* feed on the body fluids of the host.

In Queensland, parasitism levels of over 90% of both species have been recorded and, in unsprayed orchards, levels of 50% are common. Scale control at these levels is usually very satisfactory. As toxic insecticides such as most organo-phosphates, carbamates and sulphur seriously affect the level of scale control by both parasites, their use must be either restricted or discontinued.

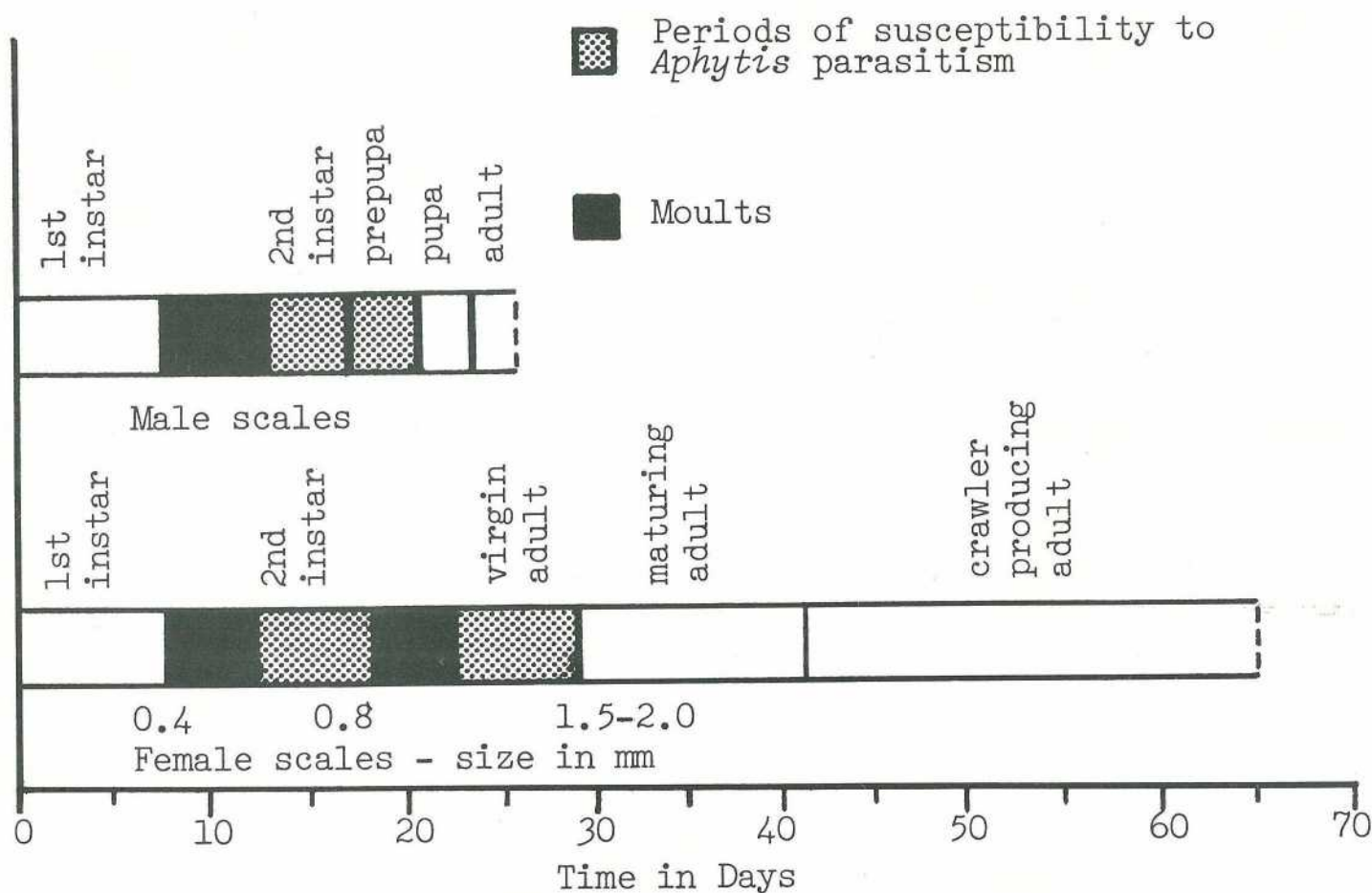


Figure 1. Life cycle of red scale at 26°C.

The how and why of tree planting

by L. G. Kleinschmidt, Department of Forestry

The value of trees on farms is often not fully recognized.

The traditional approach to the development of forest areas for pastoral uses has been to clear the majority of standing timber. However, for a number of reasons (see 'Trees on the Farm' in this issue) these attitudes are changing.

Rural land holders are retaining more vegetation on farms and planting trees on degraded areas.

Farm planning

Management of land should aim at maintaining long-term productivity. The development of a stable productive unit will often require the rehabilitation of degraded and marginal productive areas.

By early planning, the selection of appropriate tree species and good management, these areas can be brought back into production. It is sometimes possible to make dual use of an area of land, combining forestry and agriculture. This is termed agro-forestry.

Tree planting considerations

The development of an attractive system of shelter belts and shade trees on a farm, or the establishment of a small commercial plantation is the result of a planting programme implemented over a period of time. The main features and ideas should be recorded in writing or on a plan of the farm concerned.

Location and design of plantings

The first step is to mark the locations of any existing shelter belts, wooded areas, streams and major drainage lines.

Next, the locations of projected plantings and the proposed priority of annual plantings should be determined (for example, in year 1 plant species A, B, C at locations X, Y and Z etc.).

Complete planting of sensitive areas such as areas prone to landslip should be considered. These lands are generally unsuitable for cropping or of only limited value for grazing.

The density of general plantings should be determined at this stage. Where the value of the land is high (for example, intensive animal husbandry), single row may be preferable to multiple row plantings.

On extensive grazing areas and where there is a likely market for timber, larger belts will be the most practical method of combining shelter and timber production. It is often cheaper to establish shelter belts along fence lines to reduce fencing costs.

Soils

Consideration should be given to soil type. Most trees thrive on well-drained, fertile loams, but on poor, sandy soils or shallow clays, the number of suitable species is reduced. Where plantings are to cover quite large areas, it may be necessary to vary the species to suit the soils.

Selection of species

The best method is to inquire locally and select those species which have a proven record of satisfactory growth in the district. Further advice can be sought from the Queensland Department of Forestry who have lists of species suitable for each area.

There is a major difference in the performance of trees and shrubs around homesteads where they can be regularly watered and tended and those that are planted in low-maintenance areas such as shelter belts.

In general, the eucalypts provide high shelter and may be planted in multiple rows in conjunction with lower shrubs for windbreaks or planted in woodlots. Wattles provide a quick, low shelter but many of the coastal species have a comparatively short life and longer-living species are preferred.

Consideration should be given to selecting species with a high degree of fire resistance, so that in the event of a fire the shelter belts will not be completely destroyed. Wattles,



Replanting of a soil-eroded area.

banksias and eucalypts (such as the iron barks, some stringybarks and gums) have developed a high degree of fire resistance.

Most conifers are susceptible to low intensity grass fires until they attain a reasonable level of development (for example, 3 m high). Once they are over 6 m, regular burning may be introduced as part of the overall management.

Site preparation

Site preparation is necessary to provide a suitable environment for the young trees. They need loose soil to provide good aeration for the roots, to increase rain infiltration and to reduce competition from weeds.

Where possible, the site should be ploughed in strips along the planting lines to a depth of 250 mm about 3 months before planting. This is followed by a second plough or discing 1 month before planting.

If ploughing is not possible, then individual site preparation is necessary. A chipped circle of about 1 m diameter is best. The soil should be loosened with a grubber to at least 250 mm, then worked to break up the large clods.

Pastures should be slashed and the grass removed by line ploughing, rotary hoeing, strip or spot application of weedicides, or hand chipping of the planting sites.

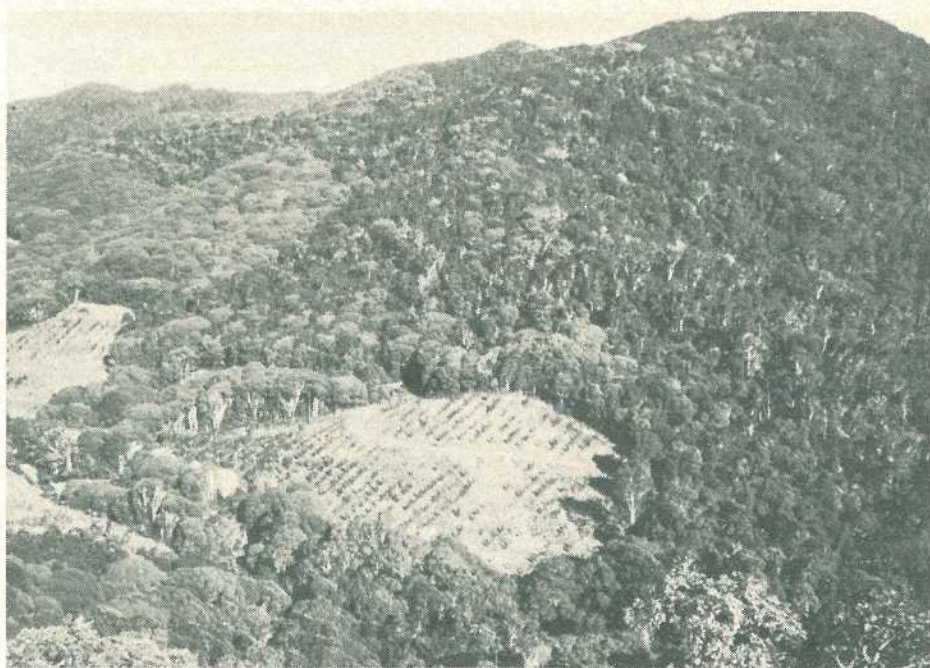
For areas of heavy weed regrowth it is necessary to clear the area by hand or machine. This may be followed by burning of the debris and possibly ploughing of the site for weed control and soil disturbance.

Planting

You may raise your own seedlings or purchase them from a commercial nursery or from the Queensland Forestry Department. Plants supplied by the Queensland Department of Forestry are in tubes, plastic pots, or smaller peat pots. In all cases, the trees do not have to be planted immediately. They can be stored (protected from full sunlight) and should be watered frequently (twice a day for peat pots and daily for the others).

If plants are in tubes or plastic pots, remove the plant with as little disturbance to the soil core as possible. There is no need to remove the plants from peat pots; just plant the pot undisturbed.

The planting hole should be just large enough to accept the tree. Plant so that the top of the soil core or peat



Replanting of old, degraded pasture land with exotic pines.

pot is at, or just below (no more than 10 mm), ground level. Firm the soil around the plant.

Establishment

All young trees must be protected from grazing animals, including hares and rabbits. In block plantings, some losses can be expected. Replanting of the losses should be done as soon as possible under good soil conditions. Refilling, as the operation is called, needs to be carried out in the same growing season as the original planting. Otherwise, there is a margin of development that the most recently planted trees cannot overtake.

A critical stage of the programme is at tree establishment. When the trees are young, it is important that competition from weeds and pasture are reduced. Trees will develop poorly and may even die if this aspect is neglected. The aim should be to keep the area immediately around the tree (about 1 m²) free of weeds and grasses. This can be achieved by the use of herbicides which can be spot or strip-sprayed. This sort of control is only necessary for the first few years.

While many Australian natives grow well without fertilizer, the application of a low N.P.K. fertilizer (5.1:6.0:4.9) will aid their early development. About 100 gm per tree should be applied at the time of planting. It should not be placed in the hole, but in a circle 250 mm away from the stem. In the case of *Pinus* sp. plantings on sandy,

low-nutrient status soils, phosphorus application may be necessary to enable reasonable growth to be achieved. About 250 gm per tree of a 19% P. fertilizer is recommended.

Maintenance

This is an aspect which is often forgotten. It is not enough to plant the trees and to subsequently neglect them. Weed growth affecting the development of young trees must be checked, fences need repairing and woodlots require thinning and pruning at the appropriate times.

If trees are subject to windthrow because of waterlogging at certain times of the year, it may be possible to stand them erect if they are not too large. Larger trees may need props.

Renewal of shelter

As trees become old and reach the end of their useful life, it is necessary to replace them. This should be done in sections over a period of years so that large portions of the farm are not left unprotected.

Availability of plants

The Queensland Department of Forestry has a number of planting schemes aimed at encouraging the growing of trees for timber production. Under these schemes, plants are supplied at concessional rates and information is provided to promote the growth and protection of the plantings. Plants are also provided at reasonable rates for amenity type plantings (for example, around the homestead).

Forest plot scheme

Under this scheme, concessional rates apply only to those bona fide property owners within the State of Queensland whose applications have been approved. Application forms are available from the local forest office.

The concessional rates apply to both plantation establishment and enrichment plantings of natural forests where the aim is the production of timber.

A list of species is available and there is a minimum order of 300 plants.

Windbreak plantings

Certain plant species may be supplied at concessional rates for the purpose of windbreak plantings. Application forms are available on request.

A minimum order of 150 trees is required to attract the reduced rate.

Rehabilitation

Upon application, the Forestry Department supplies plants at a concessional rate for rehabilitation following mining, quarrying or similar land disturbance.

To obtain this concessional rate, a minimum of 500 plants must be purchased. The actual rate is determined upon application.

Conclusion

On every farm there is generally somewhere where trees would exert a beneficial influence. All farming properties are likely to have areas of different soils, topography, etc. where trees would be more appropriately used separately or in conjunction with agriculture, while still being an integral part of the whole farm's activities.

For further information contact your nearest District Forestry Office or write to: Queensland Department of Forestry, G.P.O. Box 944, Brisbane Q. 4001.

Further reading

Brown and Hall (1968) *Growing Trees on Australian Farms* Aust. CSIRO Forestry and Timber Bureau

CSIRO Division Forest Research—*'Agro-forestry—A new kind of Farming'* Rural Research No. 99 July, 1978.

Hall et. al. (1972) *The Use of Trees and Shrubs in the Dry Country of Australia*. Australian Government Publishing Service, Canberra.

Queensland Department of Forestry (1979) *Trees and Shrubs*. Government Printer, Brisbane.

Victorian Department of Agriculture—*Trees on Farms*—Home study unit: 1 Introduction. McMillan Rural Studies Centre.

Plant movement controls for cattle tick relaxed

People are now free to move nursery plants, seedlings, shrubs, orchard stock, garden cuttings and plants, and pot plants from Queensland into N.S.W. without the need to have them treated for possible cattle tick infestation.

Mr Frank Berrill, Chairman of the Nursery Liaison Committee said this relaxation applied only to cattle tick control and did not affect the entry requirements specified under the N.S.W. Plant Diseases Act.

Logs, slate and other similar materials taken from the soil, and plants such as staghorns which have

been collected from their native environment, are still subject to movement control and treatment for cattle tick.

People wanting to move such material into N.S.W. should arrange to have it treated by a nurseryman with the necessary facilities and obtain the appropriate certificate. Alternatively, they could carry out the treatment themselves under the supervision of the D.P.I.

The relaxation of plant movement and treatment controls followed a recent review of procedures by the N.S.W. Cattle Tick Committee of Enquiry.

Herd recording charges to increase

Despite new production recording fees from 1 July, Queensland dairymen will still pay the lowest charges in Australia.

Mr Dave Mitchell, Director of the Queensland Department of Primary Industries' Division of Dairying, said the annual registration fee had been increased to \$36 per herd.

Service fees would be \$11 per milking plus 14c for each cow in excess of 50. Where two herds were recorded together on the same day, the charge would be \$7 per herd plus 14c per cow in excess of 20. In spite of these fee increases, farmers using the service will meet only about 60 per cent of the operating cost.

The basic herd recording service includes both milk production recording and free butterfat testing of samples. A new milk production only recording service was being introduced for farmers unable to take

samples for butterfat testing. The same charge would apply to the new service as the basic service.

Several new management information services were being developed as additions to the basic production recording system. A bi-monthly mastitis cell count service would be introduced for herd recording members from July 1. A fee of 10c per test would be charged. This service would eventually be offered to all farmers.

A reproduction management service, protein testing of milk and a 300-day milk and fat production record on the herd recording sheets would be among the future services to be offered.

Farmers should consult their local dairy adviser for full details of the services available. All farmers who are interested in better production need to use these modern production services.

Judging superporker carcasses

by L. J. Brown, Slaughtering and Meat Inspection Branch and R. N. Hassall, Economic Services Branch

The Royal National Associations' Exhibition in Brisbane in August 1979 included what is believed to be the first Australian carcass competition for superporker carcasses.

The D.P.I.-R.N.A. Superporker Competition offers a practical guide to pig producers on the type of pig required by superporker trade.

Because the competition received favourable support in 1979, it was included in the 1980 Exhibition.

Superporker

Superporker is the term used to describe a method of cutting up a pork carcass. This is an alternative to the conventional method, offering greater variety, value and versatility than previously available to the pork consumer (figure 1).

The superporker concept is becoming accepted throughout Queensland, with cuts being available from local butchers' shops and particularly major chain stores.

A recent development has been the increased interest shown by caterers, hotels and restaurants.

The superporker concept was developed for a carcass heavier than that required for conventional pork.

The retail trade requires superporker carcasses to be within the weight range of 65 kg to 75 kg hot dressed weight, compared with 30 to 35 kg for conventional pork carcasses.

For all sections of the trade to obtain maximum benefit from this concept,

- The producer has to breed and fatten the most suitable type of pig.
- The processor and the retailer must adopt new techniques for breaking up and presenting the carcass.
- Consumers have to cook and serve superpork so that the benefit of these new cuts are obvious.



A superporker carcass is shown on the left.



Boning-out the loin.



A steward measuring the thickness of fat cover.

Fat measurement

The amount of fat, measured at a point 65 mm from the midline of the back (P6 site) in line with the head of the last rib, is vital to both retailer and producer.

Excess fat has to be trimmed. This requires labour which is costly for the retailer. It is also costly for the producer to feed pigs to produce extra fat that will be trimmed off.

A fat measurement of 12 mm to a maximum of 18 mm ensures that the carcass has a high percentage of meat for sale, while still having premium palatability.

The age of the pig is not stipulated, but the economics of pig production encourages a high feed conversion ratio and rapid growth to enable turn-off as soon as possible, usually at about 24 to 26 weeks of age.

Marketing larger porker pigs is an economic advantage for the pig producer.

Basis of judging

Entries were judged on suitability for the superpork trade. Retail prices per kilogram of superpork cuts were taken as measures of the demand for those cuts.

The most suitable carcass was that with the highest average retail price per kilogram. This is a measure of suitability to the trade in terms of price of cuts.

The average value for each carcass was found after calculating the values of all cuts or portions of the carcass from the weight of each cut or portion and the current retail price for each cut.

Current retail prices for each cut were provided by Mr Howard Baker, Queensland Representative of the Pig Promotion Council.

The retail prices used in the 1979 and 1980 Competitions are listed in table 1.

Competition procedure

Normal abattoir slaughtering, dressing, weighing and inspection procedures were followed in preparing carcasses for judging. In both years, one carcass was disqualified because of damage during slaughter. Each of these two carcasses had been heavily trimmed to remove a localized infection.

K. R. Darling Downs, Doboy, purchased the pigs at the ruling market price.

The thickness of fat cover over the last rib was to be measured with an introscope. In 1979, this was attempted immediately prior to cutting up the carcasses, but the low temperature of the pork caused unsatisfactory readings. Therefore, a ruler was used to obtain fat measurements. Because of slaughter floor problems, the ruler was again used in 1980.

In future competitions, fat measurements will be taken by using the introscope on hot carcasses immediately after slaughter.

In the 1979 competition, five entries were disqualified—four being overweight and one being overfat. The 1980 competition saw three being disqualified—two for overweight and one for excess fat.



Stewards using a pH meter as an aid in determining colour score.

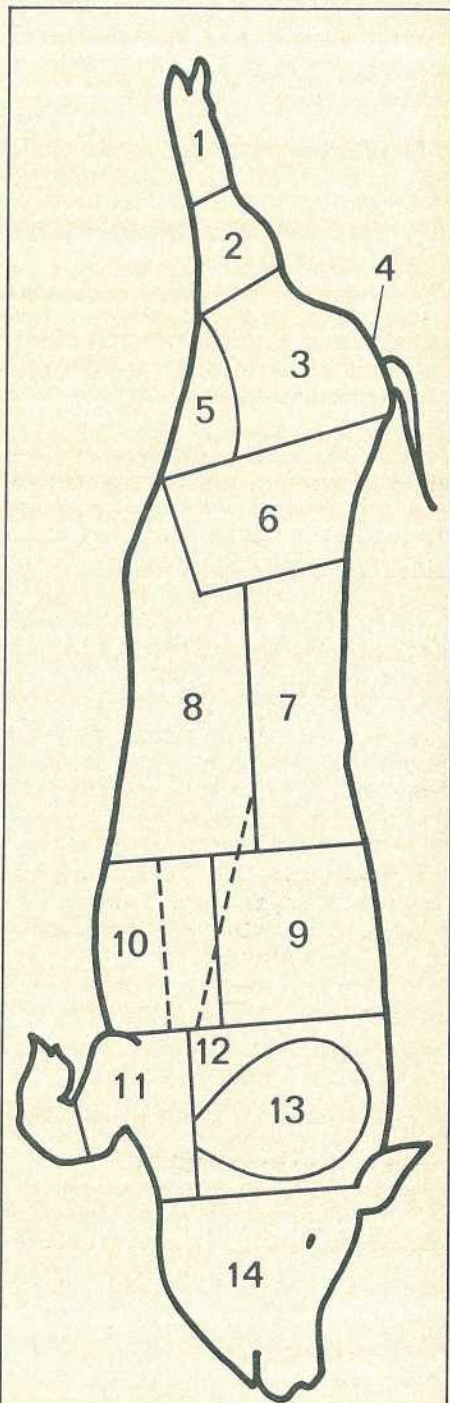


FIGURE 1

Cuts identification

1. Trotter
2. Ham hock
3. Porkaroast (silverside)
4. Pork schnitzel (topside inside)
5. Pork escalopes (buttock)
6. Porkahouse steak
7. Butterfly chops
8. Spring rolled roast (belly)
9. Pork medallion
10. Australian spare ribs
11. Spring rolled roast (hand)
12. Porkacue steak (shoulder)
13. Boston roast
14. Pig's head

The left side of each carcass was cut up using a procedure based on that devised by R. C. Baker, William Angliss College, Melbourne.

Developments in the trade could require modifications in the break-up technique at future competitions to give producers a guide to current market requirements.

To maximize accuracy and consistency, carcasses in the 1979 competition were cut up by one experienced knifeman.

In 1980, it was necessary to have more than one knifeman. Accuracy and consistency were achieved by having one person mark on each carcass the cuts to be made.

In addition, the competition judge inspected the cuts from each carcass before they were weighed.

The cuts were weighed and the weights recorded by two stewards who double checked weights and records to ensure accuracy.

There was a 5-day interval between slaughter and bone-out of carcasses, resulting in considerable loss due to shrinkage.

TABLE 1

R.N.A. Superporker Carcass Competitions
1979, 1980
Prices Used (Retail Prices, August 1980)

Cuts	Price (cents/kg)	
	1979	1980
Ham hock	190	120
Pork roast	545	550
Pork schnitzels	635	645
Pork escalops	635	650
Pork house steak	630	590
Fillet	710	760
Butterfly chops	640	653
Pork medallions	575	639
Spare ribs	360	349
Spring roll roast	450	480
Boston roast	435	410
Pork cutlets	565	570
Bone	160	120
Fat	110	130
Rind	110	80
Trim	310	360
Trotters	...	20c each

In future, an attempt will be made to reduce this loss by boning-out carcasses the day after slaughter.

The final step in the competition was to calculate the average value or price per kg of carcass, using the current retail price for each cut. The gross value of each cut can be found either by using computerized scales which give weight and value, or by using a calculator after the cuts have been weighed.

Table 2 gives the results of the competitions. The entries are listed in order of placing based on average price per kilogram of carcass.

The 1979 competition was very close with a range of 12.7 cents per kg covering all eight eligible carcasses.

The average values of the seven eligible carcasses in the 1980 competition covered a wider range of 22.9 cents per kg.

The results of each competition were displayed in the Meat Hall at the R.N.A. Exhibition.

Each exhibitor received the results of his exhibit showing the weight, price and value of each cut.

Other measurements

While the carcasses were not judged on the hook, for future reference objective measurements were made according to the Australian Pig Carcass Competition Judging System, 1979.

An important factor in meat is the pH level. It was measured at the time of judging using a pH meter as recommended by the CSIRO Meat Research Laboratory. Meat with a high pH (6.5) has an undesirable dark red colour. At low pH (5.3) pale soft and exudative (PSE) pork can result, while at a pH of 5.6 the meat colour is ideal for all facets of the pig meat trade.

In assessing points for colour score, pH was used in conjunction with a subjective appraisal of meat colour.

TABLE 2
R.N.A. Superporker Carcass Competition Results

1979			1980		
Placing	Catalogue No.	Av. Price	Placing	Catalogue No.	Av. Price
		\$/kg			\$/kg
1	497	4.257	1	387	4.298
2	495	4.232	2	394	4.227
3	484	4.223	3	395	4.197
4	494	4.207	4	384	4.136
5	490	4.198	5	393	4.132
6	486	4.173	6	386	4.079
7	492	4.149	7	388	4.069
8	485	4.130	Disqualified		
Disqualified			Overweight		
Overweight				392	
	487			385	
	488		Over-fat		
	491			389	
	496		Damaged		
Over-fat				390	
	489				
Damaged					
	493				

Irrigated sorghum at Emerald

by G. D. Keefer, Agriculture Branch

Grain sorghum has been an important crop in Central Queensland since the early 1940s, so it was only natural that it should be considered as a potential crop for the Emerald Irrigation Scheme.

This article reviews current information on the potential of sorghum as an irrigated crop at Emerald and recommendations for production of grain sorghum under irrigation are outlined.

The possibilities of ratooning the plant crop for a second cycle grain yield are also discussed.

Research on irrigated sorghum

Many plant and cultural factors are involved in the production of high-yielding grain crops. The Department of Primary Industries commenced research on the main factors that affect sorghum yields at Emerald in 1967.

These factors range from the preplanting decisions of hybrid selection, planting time, row spacing and plant spacing to the crop management factors of irrigation frequency and fertilizer type, amount and placement.

The financial reward to the grower depends on how well he has balanced these and other pertinent factors such as insect control against any constraints of water, land or finance.

Hybrids

In early irrigated sorghum trials, the Texas hybrids gave the highest yields. The yields of T610, T671, T626 ranged from 6 135 to 6 250 kg per ha with grain proteins of 12.1 to 12.6%. The Texas hybrids also performed well under irrigation on the Darling Downs and further south. They have often won prizes in grain sorghum yield competitions.

In trials at Emerald, other more recently-developed hybrids, particularly Dorado, Tropic and Pacific 303, have outyielded the Texas hybrids (table 1).

The photographs below show comparisons of single and multiple row plantings of sorghum. Note that the leaves do not meet across the 80 cm furrows.



Centre—five rows per bed. Left and right—single rows.



Left—five rows per bed. Right—single rows.

All the variety evaluation trials in the Emerald Irrigation Area were fertilized and planted in 1m rows. Row spacing investigations show that higher yields can be expected from the same hybrids planted in narrower rows.

Even so, it is now generally accepted that most of the presently available hybrids do not yield as well in the tropics as they do further south. Plant breeders are working towards developing hybrids with higher yield potential in the tropics under both dryland and irrigated conditions.

Newly-developed wheat varieties have already changed the prospects of irrigated wheat production at centres such as Emerald. It is not unreasonable to expect that plant breeders will achieve a similar breakthrough in grain sorghum.

In addition to high yield potential, other characteristics which must be considered in selecting grain sorghum hybrids for irrigation in northern Australia are:

- Open headedness for insect control.
- Leaf disease resistance.
- Lodging resistance.

Time of planting

A number of trials have indicated that there are advantages for planting in early spring. There are, however, several factors which should be considered:

- Soil temperature—this must be high enough at planting time to ensure satisfactory emergence. From 59 years of records at

Emerald, soil temperatures should remain above 18.5°C from the second week of September to the first week of October.

However, recent observations on the Darling Downs have shown that minimum temperature is not the critical factor in sorghum emergence. So long as soil temperatures rise above the minimum for a reasonable period each day, satisfactory emergence will be obtained.

Using this criterion, sorghum could be planted at Emerald as early as August. Planting as shallow as soil moisture allows would also speed up the emergence of early-planted crops.

- Heat waves—the earlier the planting, the greater the chance of avoiding heatwave conditions at flowering.
- Rain at harvest—rainfall interference with harvesting is also a factor to consider with early plantings. However, once again, the earlier the crop is planted the greater the probability of avoiding rain on the mature grain.

The use of grain driers enables harvesting once grain moisture falls below 25% and this avoids losses from wet weather, insects and lodging.

Mid August to mid October is the preferred planting time. Indications are that maximum yields are obtained if the plants flower before the longest day in the year. For a midseason hybrid, this means planting before the end of October.

The alternative is mid December to late January. These later plantings run a greater chance of midge damage.

Row spacing and population

A 70 to 80 cm gap between rows is the minimum that can be handled with row crop equipment. For every increase in this gap by 10 cm, a 10% reduction in yield can be expected. In trials, the hybrid T610 has yielded more than 8 000 kg per ha of grain in 70 to 80 cm rows and as mentioned earlier, around 6 000 kg per ha in 100 cm rows. Growers who are set up to grow crops such as cotton in 1m rows should consider planting two rows 18 to 30 cm apart on each hill.

Results with five 18 cm rows on beds with furrows 160 cm apart show that there is no particular yield advantage for multiple row plantings. There are indications that yields exceeding 10 t per ha of grain may be attainable if furrow gaps can be avoided by using spray irrigation.

In multiple rows, yield is reduced if an equidistant planting pattern is not maintained. Tillering becomes a complicating factor with such a square pattern. Unless the area is relatively weed-free, a pre-emergence herbicide would also be needed.

Planting in 70 to 80 cm rows offers greater precision in seed and fertilizer placement and in weed control.

At this row spacing, 250 000 plants per ha should be the aim (that is, plants 5 cm apart in the row). Provided seeds are evenly spaced, however, yields should not be greatly affected over a fairly wide range of density (plants 2.5 to 7.5 cm apart). The aims in choosing a row and plant spacing arrangement should be to obtain one harvestable head per plant and to avoid the complications of tillering. Overall, inter-row spacing is more important than intra-row spacing.

Fertilizer

All the trial work at Emerald has been carried out on cracking clay soils. On these soils, above-ground dry matter yields of 13 to 15 t per ha have been measured in crops yielding 6.5 to 7.5 t of grain per ha.

Nutrient uptake determined from the analysis of grain, stem and leaf material has been calculated. The deficits between these amounts and the amounts calculated from soil analyses at planting give an indication of fertilizer requirements. This information is summarized in table 2.

Nitrogen

Table 2 indicates that 30 to 170 kg per ha of fertilizer nitrogen (N) could be required, depending on previous cropping history, soil levels measured

TABLE 1

Irrigated Grain Sorghum Trial Results,
Emerald Irrigation Area

Hybrid	Planted 29 Sep., 1976		Planted 3 Jan., 1978	
	Yield kg/ha	Protein %	Yield kg/ha	Protein %
Dorado	5957 a	11.9	6888 a	10.6
Tropic	6416 a	11.6	6766 a b	9.2
Pacific 303	6299 a	12.8	6364 a b c	10.5
Monsoon	..	..	6339 a b c d	8.2
Goldfinger	5572 b	12.1	6137 b c d	10.5
E57	5713 b	13.4	6127 b c d	9.4
Texas 671	5532 b c	13.3	5953 c d	11.3
Texas 626	4968 d	12.1	5905 c d	10.5
Texas 610 SR	5082 c d	11.7	..	..
F64a	5096 c d	13.0	5764 d	10.9
Goldrush	6090 *	13.9	6047 b c d	9.7
Texas 610 SR	5276 *	12.7	..	..

Yields (adjusted to 12% moisture) followed by the same subscript do not differ significantly, $P \leq 0.05$.

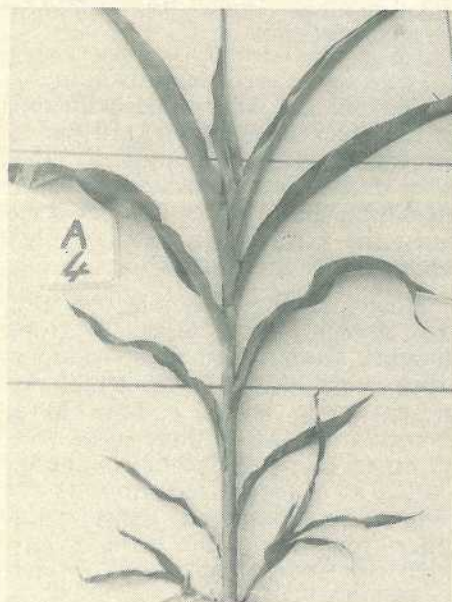
* Yields from a smaller adjoining trial in the same irrigation run.

The photographs on this page show the growth stages of sorghum.

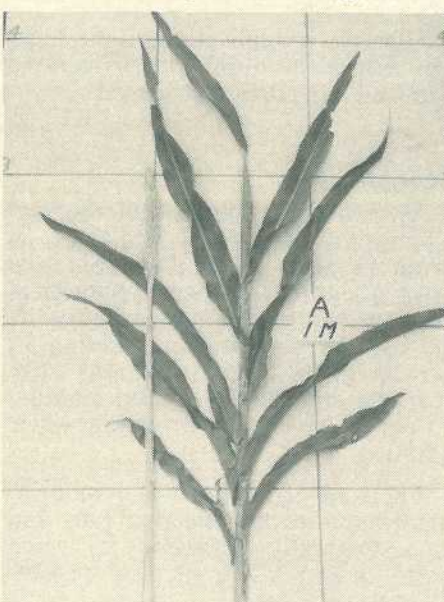


Head initiation 26 to 30 days from planting. The growing point changes from vegetative (leaf-producing) to reproductive (head-producing). The total number of leaves has been determined. Approximately half of the final leaves are fully developed.

Tip of flag leaf visible. The flag leaf is visible in the whorl at 36 to 40 days from planting. Note the two small tillers at the base of the stem. Leaves 1 to 4 have been lost.



Boot. This stage occurs at 47 to 50 days from planting. All leaves are now fully expanded. The head has developed to nearly full size and is enclosed in the flag leaf sheath. The head stalk or peduncle is beginning to elongate and this will result in exertion of the head from the flag leaf sheath prior to flowering.



prior to planting and the expected rate of mineralization of soil N to nitrate during crop growth.

Scientists based at the Queensland Wheat Research Institute carried out work on the recovery of residual fertilizer N by grain sorghum on a range of Darling Downs soils following a N fertilized wheat crop.

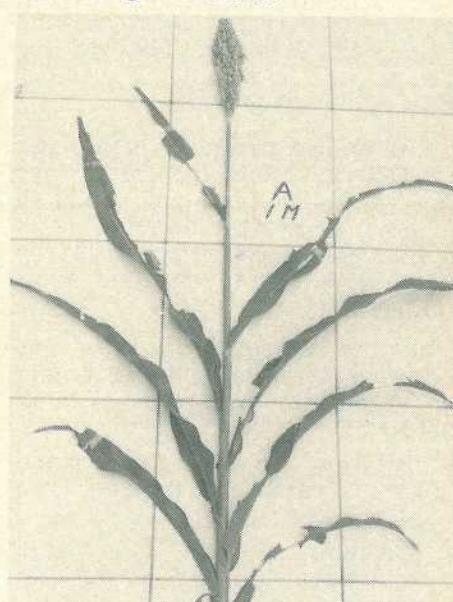
They found that freshly-applied N increased the recovery of residual N in the soils. Even when they measured 90 kg per ha of nitrate N at planting, the application of a further 100 kg per ha of N increased yields and raised protein levels from 10.3 to 12.7%.

The lower protein percentages in 1978 shown in table 1 are a reflection of differing N fertilizer applications—145 kg per ha in 1976 and 90 kg per ha in 1978.

The recommendation for N fertilizer is 50 to 150 kg per ha N, with the choice of rate being made using previous cropping history and soil analysis as a guide. Higher rates of N would be chosen if the crop were to be fully irrigated than if only two or three irrigations were to be given following planting.

The N fertilizer is best drilled into the hill prior to planting. Germination will be severely reduced if N fertilizer is drilled directly with the seed.

Grain filling. This occupies the period from flowering (56 to 60 days) to physiologic maturity or maximum grain dry weight (90 to 94 days). The head is fully exerted from the flag leaf. Following flowering, the grains are filled with photosynthate supplied mainly from the upper four leaves and the head. Note the locust damage to the leaves.



Phosphorus

The crop responds fully to applied nitrogen only if the soil phosphate supply is adequate and readily available to the plant. Table 2 indicates that on the cracking clays there could be a deficit of zero to 17 kg per ha of available phosphorus (P). This does not include the P requirements of the roots which are so important in tapping soil nutrient reserves, particularly reserves of P.

Irrigated crops on most of the cracking clays need P fertilizers. This phosphate is best applied in a band with or near the seed at planting.

Rate recommendations are based on soil test values obtained by the bicarbonate extraction method. The guidelines are:

- Where soil tests are below 20 p.p.m. P, apply 15 to 20 kg per ha P.
- Where soil tests are above 20 p.p.m. P, apply test strip at 10 kg per ha P.

Potassium and trace elements

The potassium (K) reserves on the cracking clays are adequate. At present, it should not be necessary to apply K fertilizers to irrigated sorghum at Emerald.

The only other fertilizer element which could be limiting in some situations on these cracking clay soils of the Emerald Irrigation Area is zinc. A zinc deficiency can be overcome by a single application of 30 kg per ha of zinc sulphate monohydrate, but is not generally recommended unless there is a history of zinc deficiency in the paddock.

Irrigation requirements

Trials at Emerald have shown that the level of irrigation determines the grain yield obtained. The yield is related to moisture availability throughout crop growth.

The critical period of high water use extends from the boot stage through heading and pollination to the grain filling stage. In recent work at Emerald, yields were reduced by 30 to 40% due to moisture stress during this period.

In the absence of rain, the following irrigation schedule would be needed to achieve maximum yields:

- Irrigation at head initiation approximately 3 to 4 weeks from planting.
- Irrigation at early boot stage approximately 6 to 7 weeks from planting.

TABLE 2
Nutrient Uptake of Irrigated Grain Sorghum on Cracking Clays at Emerald
Totals in kg/ha

—	Nitrogen-N	Phosphorus-P	Potassium-K
Grain at maturity.....	117-148	17-23	28-37
Grain† stubble at maturity	190-250	26-34	188-241
Soil at planting	80-160* (0-60 cm)	17-38† (0-20 cm)	320-1000 (0-60 cm)
Deficit minimum-maximum.....	30-170	Nil-17	Nil

* Nitrate N.

† Available P by bicarbonate extraction.

- Irrigation at 10 to 12-day intervals until the grain is physiologically mature and hard approximately 13 weeks from planting.

Under hot, dry conditions this irrigation interval may need to be reduced to 7 days, while under humid conditions it could be extended to 14 days.

Such a schedule would involve a preplant or planting irrigation followed by six to eight irrigations during the growing period, for yields of 7 to 8 t per ha.

The alternative is to schedule fewer irrigations at strategic stages of crop development:

- Three irrigations at head initiation, boot-flower, grain filling.
- Or four irrigations at head initiation, boot-flower, early grain filling, late grain filling.

Spring-planted crops maturing in hot, dry conditions need an irrigation during the hard dough stage (late grain filling) to achieve maximum grain weight and size.

Yields of 5 to 6 t per ha could be expected from this alternative irrigation strategy.

Effective rainfall at the right stage can reduce the number of irrigations required in a particular season.

Economics

An economic analysis of the two alternative irrigation strategies is given in table 3. In this table, the gross margins from two hypothetical crops developed from research results are compared—one crop yielding 5 t per ha given three irrigations after planting and the other crop yielding 7 t per ha given six irrigations after planting.

The total irrigation water requirement assumes no effective rain and is not greatly different for each crop—5 and 6 ML per ha, respectively.

For both strategies, a preplant irrigation of 150 mm would be required for a September planting. This would be followed by six 75 mm irrigations for the full irrigation strategy and by three 120 mm irrigations for the minimal irrigation strategy. As the irrigation frequency is decreased, deeper cracks develop on the clay soils and more water is required at each irrigation.

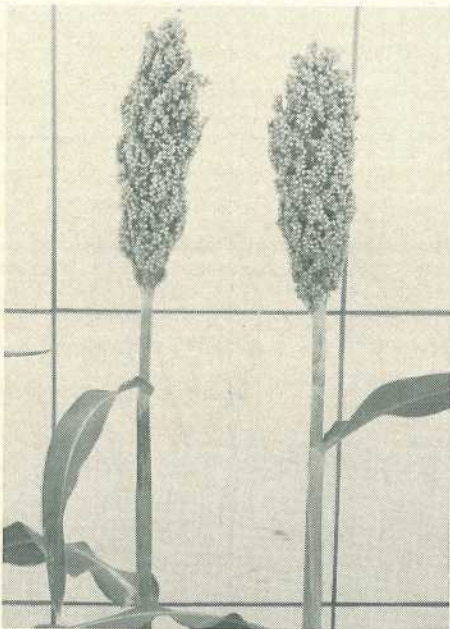
The following extra inputs and costs have been allowed for the full irrigation strategy (2):

- Fertilizer—100 kg per ha urea
22 kg per ha Super King
- Irrigation water—1 ML per ha
- Irrigation labour—for three extra irrigations. The labour was charged at casual labour rates allowing 0.40 man-hours per ha per irrigation. The labour is probably conservative both on the time allowed per irrigation and the cost of labour.
- Harvesting—extra harvesting charges at contract rates for extra 2 t per ha grain.
- Cartage—extra cartage charges assuming the property was 10 kilometres from the Emerald receival depot.

These extra variable costs amount to \$62 per ha. At a price delivered to the receival depot of \$110 per t; the increased gross margin for the extra difference would increase with increasing grain prices. On an area basis, the extra water, fertilizer and labour inputs are worthwhile.

When making decisions on the area of each crop to plant, the gross margins from alternative summer crops must also be considered. At present price levels, cotton has a gross margin two to three times that of other crops including sorghum. Cotton is a specialized crop which cannot be compared easily with other crops due to the extra investment in equipment and insect control.

The photographs below show the effects of moisture stress during the critical boot-flowering period.



Plants watered daily.



Plants watered at 2-day intervals. Extension of the head stalk has been restricted so that the heads have barely cleared the flag leaf. Some moisture blast is evident at the tip of the head on the left.



Plants watered at 3-day intervals. The primary head of the plant on the left is poorly exerted from the flag leaf and the stress has induced secondary heads in the axils of leaves 13 and 14 to develop. The primary head of the plant on the right is completely blasted and secondary heads in the axils of leaves 12 and 13 are in full flower.



Plants watered at 5-day intervals. The primary heads did not emerge from the flag leaf. The plant on the left has secondary heads in leaves 12, 13 and 14. The plant on the right has secondary heads in leaves 13 and 14.

Irrigated soybeans are a more direct competitor with sorghum. Depending on yields and prices, the gross margins per ha for soybeans are still ahead of those for irrigated sorghum grown under either irrigation strategy (1) or (2) in table 3.

Water is often the limiting resource in the production of irrigated

summer crops so that the gross margins per ML for both sorghum irrigation strategies should also be considered. Again, taking a price of \$110 per tonne the gross margin increased by \$17/ML for strategy (2). The increased return per ML for strategy (2) entailed an extra \$9.50 in water charges and an extra \$6.00 in irrigation labour costs.

Insects pests and diseases

To date, the main insects causing economic damage at Emerald have been sorghum midge (*Contarinia sorghicola*) and *Heliothis* spp. From 1973 to 1978, spur throated locusts (*Austracris guttulosa*) and migratory locusts (*Locustra migratoria*) caused damage that warranted insecticide spraying. The spur throated locusts mainly attacked developing heads, while the migratory locusts damaged the leaves.

In some years and in some paddocks, false wireworms have caused poor strikes. Seed treatment with chlorpyrifos is a good insurance against this problem.

Very occasionally, sap-sucking insects such as rutherfren bug (*Nysius* spp.) feed on the developing grain. This results in very pinched grains and dramatic reductions in yield if not controlled by spraying.

Recommendations are available for the control of all of these insect pests. The grower needs to scout the crop for signs of insects—particularly for midge at pollination or flowering and for *Heliothis* during heading. Early application of insecticides is critical for effective control.

The main leaf diseases are rust (*Puccinia purpurea*), leaf blight (*Drechslera turcica*) and sugar cane mosaic virus. More hybrids with some resistance to these diseases are becoming available, and they do not normally cause yield losses.

Ratooning grain sorghum

Successful ratoon crops have been grown at Emerald, both under trial and under commercial conditions. The first cycle crop needs to be planted before the end of November to ensure a ratoon crop before temperatures become too low in autumn.

A grain sorghum crop was ratooned at the Emerald Rural Training School during the 1976-77 summer on 24 ha of alluvial cracking clay. The plant crop log was as follows:

- Planted—20th September.
- Hybrid—Goldfinger.
- Population—250 000 per ha in 1 m rows.
- Fertilizer—100 kg per ha N prior to planting plus 45 kg per ha N as a side-dressing.
- Irrigations—preplant, head initiation, boot, flowering—total 455 mm estimated.
- Rainfall—200 mm October, November.

TABLE 3
Gross Margins for Two Sorghum Irrigation Strategies at Emerald

		Minimal irrig. strategy (1)	Full irrig. strategy (2)
Yields kg/ha		5 000	7 000
Variable costs (\$/ha)			
Tractor operations	9 hours/ha at * \$5.00 per hour	45.00	45.00
Seed	10 kg/ha at \$1.46/kg	14.60	14.60
Fertilizer	N (1) 200 kg/ha urea at 28.6 cents/kg	57.20	85.80
	(2) 300 kg/ha urea at 28.6 cents/kg	20.28	26.00
	P (1) 78 kg/ha Super King at 26 cents/kg	..	..
	(2) 100 kg/ha Super King at 26 cents/kg	..	..
Insecticide	1 spray midge	16.31	16.31
	1 spray <i>Heliothis</i>	..	..
Aerial spraying charges		9.00	9.00
Irrigation water	(1) 5.0 MI/ha at \$9.50 per MI†	47.50	..
	(2) 6.0 MI/ha at \$9.50 per MI	..	57.00
Irrigation labour	(1) 1.60 hours/ha for 4 irrig. at \$5.00/hr	8.00	..
	(2) 2.80 hours/ha for 7 irrig. at \$5.00/hr	..	14.00
Harvesting	Contract at \$17.29/ha plus \$3.72/t above 2t/ha	28.45	35.89
Cartage	at \$5.00 t	25.00	30.00
Total variable costs		271.34	333.60
Price per tonne (\$)		100 110 120	100 110 120
Gross return (\$/ha)		500 550 600	700 770 840
Gross margin (\$/ha)		229 279 329	366 436 506
Gross margin (\$/MI)		46 56 66	61 73 84

* The tractor hours include all land preparation, furrowing, and fertilizing operations. This will vary with the type of tractor and implements. The \$5.00 per hour rate covers fuel, oil, repairs and maintenance.

† Water charge at Dethridge Wheel, Emerald Irrigation Area.

- Insect sprays—two for spur throated locusts, 1 for midge.
- Harvest—January 20—17 weeks from planting.
- Grain yield—first cycle 6.45 t per ha. The stubble was removed as baled hay and yielded 2.221 t per ha.

After harvest, the soil was very dry and deeply cracked. A 250 mm furrow irrigation was applied on 7th February. The intention was to inter-row cultivate and side-dress with N following the irrigation, but weather prevented this prior to the boot stage.

The ratoon crop log was as follows:

- Fertilizer—85 kg per ha N as urea, flown on due to bad weather.
- Rainfall—198 mm February, March.
- Insect sprays—three for midge and *Heliothis*.

- Harvest—ready to harvest in early May (12 weeks from second cycle irrigation) when 226 mm of rain fell, causing grain loss and sprouting in the head.
- Grain yield—second cycle 2.740 t per ha, but losses due to insect damage and weather damage estimated at 40 to 50%. The stubble from the ratoon crop was baled for a yield of 2.267 t per ha.
- Total grain yield—first and second cycles—9.205 t per ha.

A grain yield exceeding 10 t per ha should be attainable by ratooning early-planted sorghum crops at Emerald. The difficulties of ratooning during the wetter months of January, February and March should be considered along with the disease and midge build up during this period.

Cutting and baling the first cycle stubble facilitates the ratooning operation. It also helps to make ratooning more economically

attractive, particularly for those landholders involved with cattle production.

The height of cut at ratooning does not appear to be critical, but between 10 and 15 cm from the soil surface is satisfactory. If the plants are cut or slashed too near the soil surface, the crown could be torn out or all the viable nodes removed. If the stalks are cut too high, secondary shoots will develop from the axils of leaves further up the stem. These will suppress the tillers from lower nodes which usually produce the biggest heads.

On most irrigation farms, the drawbacks to ratooning could outweigh the extra returns obtained.

Recommendations

- Irrigation. The decision on irrigation strategy for sorghum would depend on the availability of land and water and the commitment to other summer crops such as cotton and soybeans. With present sorghum prices and yield levels, it is likely

that the bulk of the water and land would be committed to the alternate crops. Any area of sorghum would be grown with irrigation at strategic growth stages only and a yield goal of 5 to 6 t per ha.

- Fertilizer. 100 to 150 kg per ha N; 15 to 20 kg per ha P.
- Planting Date. Mid August to mid October preferred and essential if ratooning. The

alternative is mid December to late January.

- Hybrids. Recommendations are made annually on the basis of trials and commercial experience. Some of the hybrids which have performed well in trials are no longer readily available. Commercially available hybrids worth considering are Dorado, Texas 671, E57. Goldrush is popular for ratooning in some areas.

- Population. 250 000 plants per ha in 70 to 80 cm rows.

Hybrids with higher yield potential, together with higher grain prices would make grain sorghum more attractive as a full irrigation crop. In the meantime, some good commercial crops have been grown with one to three irrigations, depending on rainfall.

'Dial-a-market report' for horticultural producers

A new marketing service which will allow growers 24 hour access to fruit and vegetable price and market information has been introduced by the Minister for Primary Industries, Mr Mike Ahern.

Mr Ahern said the Marketing Services Branch of the Department of Primary Industries has recently installed two telephone-accessed, recorded messages at the Brisbane Wholesale fruit and vegetable market at Rocklea. The purpose of this service is to provide more timely market information for growers who can then evaluate it.

The new service will ensure that price and market information is readily available to producers who can act quickly on it to meet the day-to-day needs of the market place. Mr Ahern outlined the nature and content of the recorded messages as follows:

- Telephone Number (07) 379 9745—carries a brief message of the highlights of the morning's trading on the Brisbane Wholesale Market, Rocklea and, when available, highlights of Queensland produce sold that morning on the Sydney, Melbourne and Adelaide markets. This brief message, of approximately 2 minutes duration, is designed to minimize costs for S.T.D. callers. It will be recorded by 10.30 a.m. each day.
- Telephone Number (07) 379 9746—carries a detailed message of the daily information on the same basis as above but with full details, not only highlights. This message will be recorded by 12.30 p.m. each day and will run for approximately 6 minutes.

The Minister said the service will be closely monitored over the coming months to test its acceptance by fruit and vegetable growers.

Individual cow mastitis cell count service

The Minister for Primary Industries, Mr Mike Ahern, has announced that a new individual cow cell count service for dairy herds will be introduced on July 1.

Initially, the service will be restricted to herd recording members but it was planned to eventually include all dairy farmers. Milk suppliers throughout Queensland have been receiving mastitis cell count results on their bulk milk samples from the Department of Primary Industries since 1977.

Mastitis can be a serious disease of dairy herds. It reduces both the quality and the quantity of milk produced. By using existing facilities and without any extra effort on the part of the farmer, the new service will provide much needed information for only a small charge.

High cell counts in bulk milk samples only tell the farmer that he has either a large number of cows infected or a severe herd mastitis problem. With the new service, farmers will know which individual cows are infected even if they have shown no visible signs of disease.

D.P.I. Dairy Field Services officers are keen to assist dairymen with mastitis infections in their herds to overcome this serious disease problem.

Mr Ahern said that Queensland has an excellent record in the control of mastitis in the State's dairy herd. Literally millions of dollars have been saved with the improvements in milk quality and production due to the major reduction in the level of the disease since 1977.

Hypocalcemia in dairy cattle

By I. D. Mutzelburg, Dairy Research Branch and B. S. Kettle, Veterinary Services Branch

Hypocalcemia is a metabolic disease of dairy cattle which occurs near calving and at the onset of lactation in high producing cows.

A metabolic disease is one in which biochemical reactions at the cellular level go astray. In this case, an imbalance occurs between availability and output of the calcium needed for milk production.

Common names for hypocalcemia are milk fever, parturient paresis, and parturient paralysis. The terms calving paralysis and parturient apoplexy are also sometimes used.

Incidence

Milk fever is more common in some breeds than others. It is most common in cows on their third, fourth or fifth calvings (that is, during their peak production). It is rare in cows on their first and second calvings. Highly productive cows are more liable to contract milk fever than poor producers. As cows are bred for high production, the susceptibility to milk fever is also inherited.

Cows most often develop milk fever in the first 72 hours after calving. It has been found to occur, though rarely, 2 to 7 days before calving. Cases may also develop in the following months of high production when cows are subject to stress from cold weather, sudden starvation or during oestrus periods.

Symptoms

The first evidence seen by the farmer of onset of milk fever is anxiety and restlessness, followed by a staggering gait. However, the cow is usually found lying on the ground, with her head turned towards the flank.

The way she is lying is an indication of the severity of the attack—mild if she is able to get up when roused, moderate if she is resting on her brisket and cannot get up, and severe if she is lying on her side and unable to sit up.

Once the cow is down, her pulse is weak and the heart-beat is rapid (over 80 a minute). She is off her

food, is not interested in her calf, the body and rectal temperature is 2 or more degrees below the normal temperature of 38°C. The ears, legs and teats are cold to touch, and the eyes are dull with dilated pupils insensitive to touch and dry due to lack of tears.

When attempts are made to take the rectal temperature, the rectum will be found to contain a firm, dark block of faeces.

Cows lying on their sides with legs extended cannot belch wind and so quickly become bloated, and die in a short time without treatment. A further complication from lying on their sides is the possibility of vomiting of rumen contents and breathing this material into the lungs, resulting in inhalation pneumonia.

Occasionally, cows will refuse to get up on to their feet, even though they have responded to treatment, are alert and have no apparent injury. Such downer cows pose a problem to the veterinarian giving treatment. Often, these cows may only be sulking and will respond to an external stimulus such as a shock from an electric prod.

If this is not successful, other problems should be suspected. A number of other conditions besides milk fever can cause the cow to go down (for example, calving injuries, muscular cramps or tears, limb dysfunctions or breaks)—Veterinary help should be obtained.

Treatment

Cows lying on their side should be sat up on their brisket, and if necessary choked with hay bales or similar, as a first priority.

The basic treatment is an injection of soluble calcium salts. The first record of successful treatment of milk fever with calcium salts in Australia was in 1931, when superphosphate was dissolved in water, filtered, sterilized and injected.

Today, many commercial preparations are available. These may contain glucose or dextrose, magnesium and phosphorus as well as calcium. 200 to 500 mL of 25% to 40% calcium borogluconate solution

is commonly used for cattle. A two-in-one commercial preparation, containing magnesium as well as calcium, is better to use even though it is more expensive.

Intravenous injections, if made too rapidly, may slow the heart, and it is necessary to listen to the heart-beat and stop injecting until the beat returns to normal. One item every dairy farmer should have on hand is a flutter-valve. This valve shows the flow of solution and allows the farmer to easily slow or stop injection when necessary. The effect on the heart can be avoided by injecting subcutaneously and spreading the solution under the skin by rubbing.

Recovery usually occurs only a few minutes after calcium injection. After treatment, the cow should not be fully milked out for one or two milkings as this is a frequent cause of relapse. Only enough milk to lower udder pressure should be removed to lower risk mastitis. The cow's calf should not be allowed to suck the cow dry as this can cause relapse as well.

Udder inflation, with air pumped into the teat canal with a pump and teat siphon, is an old and successful method which produces dramatic results, especially on cows which have not responded to other forms of treatment. The method is cheap, easy and convenient, with low relapse rates and it inhibits milk secretion.

Despite these advantages, the method has the major disadvantage of being the cause of coliform and staphylococcal mastitis unless rigid sterilization of equipment is carried out, and so it should be used only as a last resort.

Causes

Milk fever is caused by a large drop in the level of calcium in the blood. Calcium in the blood of healthy cows is normally 8.5 to 11.0 mg per 100 mL; below 8.0 mg per 200 mL, milk fever results. Levels down to 2 mg per 100 mL have been found in severe cases.

Milk fever is usually found in herds that are well cared for with lush, good-quality feed available and where milk production is high.

Blood calcium normally falls at calving due to the cow's metabolism being unable to adjust quickly enough to the loss of calcium from the body, through the udder, to the milk. The low levels of calcium in the blood do not indicate low calcium in the feed or lack of calcium in the body. The problem is that the body can not mobilize calcium fast enough from the storage depots in the bones, kidney and small intestines, in the first few days after calving.

Prevention

By feeding cows in the last 2 weeks of pregnancy a diet low in calcium, the metabolism of the cows will adapt to lower blood calcium and so mobilize calcium from storage before calving occurs. At calving, the body is adapted to calcium mobilization and no milk fever should occur.

Feeds which increase milk fever risk include crushed grains, concentrated or pelleted feeds and legumes, and these should be avoided

by restricting feed intake. A diet found to prevent milk fever consists of corn silage, ground shelled corn, dried molasses, urea and sodium dihydrogen phosphate. This could be varied by the farmer to suit the feed he has available.

Feeding of acid-treated silage has been found to lower the incidence of milk fever. Alkali-treated silage increases the incidence of the disease and should be avoided.

Vitamin D is important in the regulation of calcium metabolism, absorption in the intestines, and deposition and mobilization in the bones. Feeding of massive doses of vitamin D₃, starting 3 to 7 days before calving, has been found to lower milk fever by 80%. Larger doses cause loss of appetite and can be toxic.

It may be possible, in the future, to carry out a 'metabolic profile' test on a cow. This test, developed recently, is based on chemical analysis of the

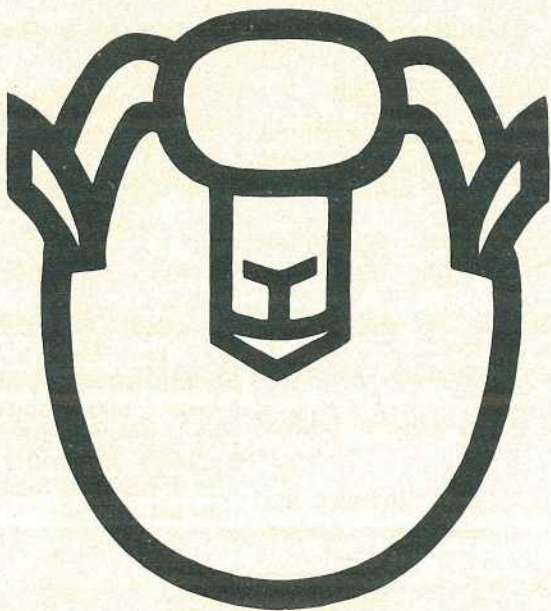
blood serum and indicates cows that are susceptible to certain diseases. The test results are intended to provide a basis for preventive measures.

Conclusions

To minimize milk fever, the following management practices should be carried out:

- Lower dietary calcium levels in the last 2 weeks before calving.
- Reduce feed intake during the pre-calving period.
- Avoid stress.
- Avoid full milking for 2 days after recovery to prevent relapse.
- Administer vitamin D₃ to troublesome cows in their third or later lactation. This may not be economical at present owing to the high costs involved.
- Call in your local veterinarian as quick treatment may save the cow's life.

SHEEP
SHEEP
SHEEP



NEED BRAND RETURNS TOO!

Current recommendations—field crops

by officers of Plant Pathology Branch

The following pages repeat the 'Current Recommendations' section of a *Handbook of Plant Diseases in Colour Volume 2—Field Crops*.

Both volumes of the handbook (Volume 1—Fruit and Vegetables and Volume 2—Field Crops) can be purchased over the counter for \$10 each from Department of Primary Industry offices at:

Mineral House, George Street, Brisbane; Meiers Road, Indooroopilly, Brisbane; Tor Street, Toowoomba, and Peters Street, Mareeba.

Mail Orders should be forwarded to the Department of Primary Industries, G.P.O. Box 46, Brisbane. Q. 4001. The cost is \$12 per volume for addresses within Queensland and \$13 (Aust.) for interstate and overseas surface mail.

The 'Current Recommendations' sections of both volumes have been updated and may be obtained over the counter at Mineral House, Indooroopilly, Toowoomba and Mareeba. They can also be requested by mail from G.P.O. Box 46, Brisbane.

The 'Current Recommendations' sections of these handbook are supplemented by notes which appear on the back of the coloured illustrations and elsewhere in the books. The notes name the cause of the disease, the symptoms, the source of infection and spread, and a brief reference, if applicable, to seed treatment, resistant cultivars, crop rotation, and other general control measures.

NOTE: This is a supplement and does not contain all control measures. Additional information is given in the notes under each disease. Fungicides and nematicides are referred to under their common name. A trade name is used only where there is no accepted common name.

All rates are expressed in terms of formulations currently registered for use in Queensland.

Trade names in all registered fungicides and nematicides are shown in Appendix 2.

Barley

Cultivars

Most cultivars including Clipper, the only acceptable malting cultivar at present, are susceptible to powdery mildew. Lara is less susceptible than most and Corvette has useful resistance in the field.

Seed dressings

All seed which may be used for grain crops should be treated with a fungicide before planting. Seed obtained from an approved source is generally considered to be free from loose smut and will probably have already been treated for covered smut. In this case, no further treatment is required. However, if it has not been treated for covered smut, arrange to have it treated with:

Benomyl 15% (dust) 100 g/100 kg seed

or Benomyl 10% (dust) 200 g/100 kg seed

or Carboxin 25% (dust) 100 g/100 kg seed

or Bawsan L (liquid) 90 ml/100 kg seed

If the seed source is unknown, there is a possibility that the seed may be infected with loose smut. This can be controlled by treating the seed with Carboxin 75% (dust) 125 g/100 kg seed

This treatment also controls covered smut. Loose smut is generally of minor importance and the cost of treatment needs to be considered in relation to likely yield gains. The presence of loose smut will not generally lead to downgrading of normal deliveries but will be a problem where crops are being grown for seed.

Note: 1. Dusts should be applied using a suitable dry seed dressing machine and Bawsan L liquid should be applied with either a Seedkem Liquid Applicator or a mist-type seed treater.

2. Operators applying dust treatments should avoid breathing the dust.

3. Operators applying Bawsan L should wear rubber gloves and face shield when handling the concentrate and an organic vapour respirator when working in a confined area.

4. Treated seed not sown immediately should be stored in a dry, well-ventilated place.

5. Clearly mark bags of treated seed and do not use these bags for other purposes.

6. Do not hold treated seed over for planting next season.

7. Do not use treated seed for human or animal consumption or allow it to contaminate seed for these purposes.

8. If seed treated with Carboxin is planted, do not graze or feed livestock on the area for 7 weeks after planting.

Current importance of diseases

Covered smut—Potentially important but generally controlled by seed treatment.

Loose smut—Generally minor.

Powdery mildew—Very conspicuous in most crops in most seasons. Probably the most important disease of barley in Queensland.

Net blotch—Generally seen only in the cultivar Cape and is usually not a problem. The cultivar Clipper has useful resistance.

Spot blotch—Minor.

Crown rot—Importance not known but probably not serious.

Leaf rust—Minor.

Stem rust—Occurs only in very late crops and is of minor importance.

Barley yellow dwarf—Rare.

Base rot—Rare.

Black point—May be a problem when wet conditions occur during the grain filling period.

Common root rot—Widespread but importance is unknown.

Barley stripe mosaic—Occurs only on the cultivar Cape. Minor.

Cotton

Current importance of diseases

Bacterial blight—Minor.

Verticillium wilt—Major. Limits the areas suitable for production.

Seedling blight—Minor.

Alternaria leaf spot—Minor.

Boll rots—May be serious in some seasons.

Anthraxnose—Rare.

Duboisia

Fumigate soil or potting mixture used for production of seedlings and cuttings (for control of damping-off and nematodes) with methyl bromide 1 kg/10 m² of seedbed or 600 g/m³ of potting mixture.

For details of application and precautions, see Appendix 1.

Current importance of diseases

Spotted wilt—Major on *Duboisia leichhardtii* and some clones of *Duboisia leichhardtii* x *Duboisia myoporoides*.

Root-knot—Moderate.

Damping-off—Minor.

Linseed

Current importance of diseases

Pasmo disease—Serious where linseed is repeatedly grown on the same ground.

Stem break—Rare.

Lucerne

Current importance of diseases

Phytophthora root rot—Major disease on heavier soils particularly in wet seasons.

Colletotrichum crown rot—Causes widespread thinning of stands.

Sclerotium crown rot—Minor.

Stagonospora crown rot—Minor.

Rhizoctonia canker—May be serious in inland areas. Minor in coastal areas.

Fusarium wilt—Occurs in isolated plants only.

Cultivar resistance

Cultivar	Resistance	
	Phytophthora root rot	Colletotrichum crown rot
Hunter River	MR	S
CUF 101	MR	HS
Pioneer 572	S	MR
Pioneer 581	MR	MR
Matador	MR	MR
Pioneer 545	MR	R
DK 185	MR	MR
DK 167	S	R

R—resistant
MR—moderately resistant

S—susceptible
HS—highly susceptible

Maize

Cultivars—disease resistance

Cultivar	Turcica leaf blight	Maydis leaf blight—Race 0	Head* smut	Maize dwarf mosaic	Wallaby ear
RX220	..	..	..	..	..
RX204	..	S	..	MR	R
XL45	S	S	..	S	S
XL66	..	..	..	S	..
XL361	S	S	..	S	R
XL77	I-MR	I	..	MR	R
XL81	I-MR	I	MR	MR	R
XL99	R	MR	MR	HR	S
XL399	HR	I	MR	MR	I
PX48	..	..	..	..	..
PX74	..	..	..	..	..
Colonel	..	..	..	S	R
Sergeant	R	S	MR	MR	S
Captain	HR	..	R	MR	R
Major	R	..	MR	MR	I
QK217	I-MR	S	HS	HR	..
QK231	MR	MR	S	HR	..
QK413	R	MR	HR	..	..
QK487	MR	HS	R	S	..
QK690	R	MR	MR	HR	..
QK694	R	R	MR	HR	..
GH128	R	I	R	HR	I
GH390	R	I	S	MR	I
GH5004	HR	R	..	HR	R
MH695	..	..	..	..	..
MH777	..	..	..	..	..

HR—Highly Resistant

R—Resistant

MR—Moderately Resistant

I—Intermediate

S—Susceptible

HS—Highly Susceptible

—Reaction not known at this stage

* Reaction of some hybrids to head smut may vary with the location.

Violet root rot—May be serious when it occurs.

Downy mildew—Minor.

Common leaf spot—Common but minor.

Rust—Minor.

Cercospora leaf spot—Minor.

Bacterial leaf and stem spot—Minor.

Black stem—Minor.

Mosaic—Rare.

Rugose leaf curl—Rare.

Witches broom—Minor.

Seedling blight—Minor.

Root-knot—Minor.

Note: When selecting cultivars, factors besides disease reaction need to be considered. Always consult your local extension officer for further information.

Seed treatment

(for protection against seed rot)

Maize seed is generally treated by the seed company. Seed dressings generally used are those containing Thiram.

NOTE: Do not feed treated seed to animals or poultry or mix with untreated seed.

Current importance of diseases

Maydis leaf blight—May be serious in North Queensland; not a problem in South Queensland.

Turcica leaf blight—May be serious in susceptible hybrids.

Common rust—Common but generally minor.

Brown spot—May be serious in North Queensland; rare in South Queensland.

Tropical rust—Has not been recorded in recent years.

Stripe—Minor in South Queensland, occasionally serious in North Queensland.

Maize dwarf mosaic—Major in susceptible hybrids.

Wallaby ear—Major in late coastal crops.

Charcoal rot—Moderate.

Diplodia rots—Ear rot may be serious particularly in North Queensland; stalk rot and leaf spot are generally minor.

Gibberella rots—May be serious in North Queensland; moderate in South Queensland.

Marasmius stalk rot—Moderate in North Queensland only; importance should decrease with use of resistant hybrids.

Pythium stalk rot—Minor.

Head smut—May be serious on susceptible hybrids in North Queensland; minor in South Queensland.

Nigrospora ear rot—Minor.

Seedling blight—Minor.

Bacterial top rot—Common in North Queensland in most seasons but generally minor.

Cereal chlorotic mottle virus—Minor.

Black bundle—Minor.

Crazy top—May be serious in flooded areas but generally minor.

Millets

Seed treatment

(for control of smut)

If seed has been harvested from a diseased crop, treat it with a seed dressing containing Thiram.

NOTE: Do not feed treated seed to animals or poultry or mix with untreated seed.

Current importance of diseases

Smut of white French millet—Minor.

Leaf and head blast of Italian millet—May cause serious losses in susceptible cultivars.

Bacterial leaf spot of Japanese millet—Minor.

Covered smut of Siberian millet—Minor.

Susceptibility of cultivars to leaf blast

Millet species	Cultivar	Disease reaction
<i>Setaria italica</i>	Dwarf setaria	Susceptible
	Chinese yellow	Resistant
	Panorama panicum	Resistant
<i>Panicum miliaceum</i>	White French millet	Susceptible
<i>Echinochloa frumentacea</i>	Shirohie millet	Resistant
	Siberian millet	Resistant
<i>Echinochloa utilis</i>	Japanese millet	Resistant

Mung beans

Current importance of diseases

Powdery mildew—Moderate to severe.

Bacterial blight—Minor.

Sclerotinia rot—Minor.

Root-knot—Rare.

Fungicide sprays

(for control of rust)

Spray with Mancozeb 80% 2.2 kg/ha or Metiram 80% at 2.5 kg/ha. Watch the crop carefully and spray as soon as the disease is first seen and then continue at 7 to 10 day intervals until the crop is 10-weeks-old. If the crop is 8-weeks-old without the disease showing, spraying is not necessary.

Current importance of diseases

Leaf mottle—Serious on susceptible cultivars when planted near peanuts.

Ashy stem blight—May cause significant stand losses.

Seedling rot—Generally minor.

Rust—May be serious in later planted crops. Can be controlled with fungicide sprays.

Sclerotinia rot—May be serious in certain localities.

Bacterial blight—Major.

Angular leaf spot—Minor.

Common bean mosaic—Minor.

Stem rots of mature plants—Minor.

Big bud—Minor.

Root-knot—May be serious but not common.

Fusarium foot rot—Minor.

Cercospora leaf spot—Minor.

Navy beans

Seed treatment

Seed is treated by the Navy Bean Marketing Board before sale. The general treatment is a slurry treatment with a mixture of 40% Captan and 40% Quintozene used at a rate of 120 g/25 kg seed.

NOTE: Do not use treated seed for human or animal consumption or mix it with untreated seed.

Oats

Cultivars

(a) CROWN RUST. All currently-grown cultivars are susceptible. However, Stout, Garry and Minhafer are generally not seriously affected.

(b) STEM RUST. Minhafer has some resistance and is generally not seriously affected. All other currently-grown cultivars are susceptible.

Seed dressings

All seed which will or may be used for grain crops should be treated with a suitable fungicide before planting. Check to see if your seed has been treated and if not, arrange to have it treated with Benomyl 15% (dust) 100 g/100 kg seed.

This controls both covered and loose smut.

NOTE: 1. Loose smut of oats in Queensland is distinct from loose smut in wheat and barley.

2. Benomyl should be applied using a suitable dry seed dressing machine.

3. Operators applying Benomyl should avoid breathing the dust.

4. Treated seed not sown immediately should be stored in a dry, well-ventilated place.

5. Clearly mark bags of treated seed and do not use these bags for other purposes.

6. Do not hold treated seed over for planting next season.

7. Do not use treated seed for human or animal consumption or allow it to contaminate grain for these purposes.

Current importance of diseases

Covered smut—Minor.

Loose smut—Minor.

Crown rust—Major in susceptible cultivars particularly in humid areas.

Stem rust—May be a problem in susceptible cultivars but is generally less important than crown rust.

Crown rot—Rare.

Yellow dwarf (red leaf)—Rare.

Foot rot—Rare.

Onions (also garlic)

Seed treatment

(for control of damping-off)

Dust seed just before planting with Captan 83% or Thiram 80% at a rate of 2 g/kg seed. After treatment, screen off excess dust.

Fungicide treatment of bulbs in storage

(for control of storage rots)

Before storage, dust bulbs with Dicloran 8% at a rate of 1 kg/t of bulbs. Apply by means of a hand shaker or automatic duster. As a proprietary line of Dicloran 8% is unavailable, use Dicloran 50% diluted with kaolin. For each kilogram of Dicloran 50%, 5.5 kg of kaolin will be required to dilute the fungicide to an 8% dust.

Current importance of diseases

Downy mildew—Major. Necessitates regular spraying with fungicides.

Macrophomina bulb rot—Rare.

Fungicide sprays

Disease	Fungicide	Rate	Remarks
Downy mildew	Ridomil 25WP	100 g/100 L or 1 kg/ha	1. Commence spraying when plants have 3 to 4 true leaves and continue at 7 to 14 day intervals when conditions favour disease development. 2. Add a wetting agent to the spray.
Downy mildew and purple blotch	Mancozeb 80% or Maneb 80% or Propineb 70% or Zineb 80% or Dek	150–200 g/100 L or 2.2–3.5 kg/ha	1. Commence spraying when disease is first seen and continue at 7 to 14 day intervals. Use the shorter interval if prolonged wet weather occurs. 2. Add a wetting agent to the spray. 3. Propineb and DEK are not registered for the control of purple blotch.

White rot—Major.

Fusarium wilt—Minor.

Pink root—Major. Limits production to cooler months.

Botrytis neck rot—Minor.

Smudge—Rare.

Black mould—Rare.

Seedling blight—Minor.

Purple blotch—Minor.

Storage rots—Minor.

Mosaic of garlic—Present in all crops but effect on yield has not been determined.

Pasture legumes (other than lucerne)

Current importance of diseases

STYLOSANTHES

Anthrachnose—Major, particularly in seed crops.

Botrytis head blight—May be serious in seed crops in wet periods.

Rhizoctonia web blight—Generally minor.

SIRATRO

Halo blight—Major particularly in wet autumns.

Rhizoctonia web blight—May cause serious damage.

Violet root rot—Generally minor.

COWPEAS

Stem rot—Major in susceptible cultivars.

Root-knot—Occasionally serious.

Cowpea aphid-borne mosaic—Minor.

CLOVERS

Rugose leaf curl—Minor.

Mosaic—Minor.

Root-knot—May be serious.

Rust—Minor.

Stolon death—Common in summer, sometimes serious.

Peanuts

Cultivars

The cultivar Red Spanish is more susceptible to leaf spot and Sclerotium rot than the cultivar Virginia Bunch. However, Virginia Bunch is more susceptible to Aspergillus crown rot.

NOTE: When selecting cultivars, factors besides disease reaction need to be considered. Always consult your local extension officer for further information.

Seed treatment

(for control of pre-emergence rots and Aspergillus crown rot)

It is recommended that all seed be treated with a recommended seed dressing before planting. The industry uses a mixture of 40% Captan and 40% Quintozene applied at a rate of 1 kg/330 kg seed.

NOTE: Do not feed treated seed to animals or poultry or use for human consumption. Do not mix with untreated seed.

Fungicide sprays

A. NORTH QUEENSLAND (for control of leaf spot and rust)

Spray with Chlorothalonil (flowable) 72% or Fentin 45.3%.

Commence spraying when the disease is first observed (generally 4 to 6 weeks after planting) but no later than 6 weeks after planting and continue at 14-day intervals until 4 to 5 weeks before pulling.

If prolonged wet weather or heavy rain occurs, spray every 7 to 10 days. Five to six applications are generally required in a season.

NOTE: 1. The systemic fungicides Benomyl and Thiophanate-methyl are no longer recommended because resistant strains of the leaf spot fungus are now widespread.

2. It is not necessary to add oil or wetting agents to the fungicides. This may cause burning of the leaves.

3. Do not feed peanut hay treated with Chlorothalonil to stock.

B. SOUTH QUEENSLAND (for control of leaf spot, rust, net blotch and pepper spot)

Sprays should not be applied on a fixed time basis but instead according to whether disease is present and weather conditions.

Inspect the crop regularly and delay spraying until some disease is evident within the crop.

From then on spray only if rainfall or warm, moist nights are expected. The fungicides Chlorothalonil (flowable) 72% 1.1–1.8 L/ha Fentin 45.3% 500 g/ha provide control of all foliage diseases but are protectants only and must be used before conditions are suitable for infection. Each spray gives 7 to 14 days' protection, the shorter period being provided during heavy rain.

If wet conditions occur and the crop is unprotected, spray with a mixture of Chlorothalonil (rate as above) or Fentin (rate as above) plus Benomyl 50% 140 g/ha.

This spray must be applied within 3 days of infection for eradication to be effective.

NOTE: 1. Benomyl is not effective against rust, net blotch or pepper spot.

2. Use the higher rate of Chlorothalonil where rust is a serious problem.

3. It is not necessary to add oil or wetting agents to the fungicides. This may cause burning of the leaves.

4. Do not feed peanut hay treated with Chlorothalonil to stock.

5. Now that resistant strains of the leaf spot fungus have been found in this area, Benomyl should not be used alone.

A note on nematicides

The nematicide DBCP available for use in recent years for nematode control in peanuts has now been withdrawn from sale. There are at present no suitable alternative nematicides registered for peanuts.

If root-knot is the only problem, recommended crops to grow in rotation with peanuts are maize, sorghum, sunflowers or winter cereals. If root-lesion nematodes are a problem, grow winter cereals in rotation with peanuts.

Current importance of diseases

Leaf spot—Serious in seasons of good rainfall. Necessitates regular spraying particularly in North Queensland.

Rust—May be serious in North Queensland but can be controlled by fungicide sprays. Not yet a serious problem in South Queensland although some losses have occurred in the Central Burnett district.

Net blotch—May cause rapid defoliation in cool weather.

Pepper spot/scorch—Minor.

Sclerotium rot—The major disease in South Queensland, particularly serious on 'old' cultivations.

Verticillium wilt—Major disease on certain soil types.

Diplodia blight—Serious only on depleted soils.

Aspergillus crown rot—Generally a problem only when untreated seed is sown.

Spotted wilt—Yield from affected plants is severely reduced, but incidence is high only if numerous weed hosts are present nearby.

Peanut mottle—Effects largely unknown but probably minor.

Rugose leaf curl—Minor.

Root-knot—May be serious in isolated fields.

Root lesion nematodes—Widespread but generally minor.

Pre-emergence rots—May be serious in isolated fields.

Rhizoctonia peg and pod rot—May be serious.

Sclerotinia stem rot—May be serious.

Bunchy plant—Minor.

Potatoes

Preplant fumigation

(for control of nematodes when planting infested areas)

Treat the soil with EDB15 220 L/ha. Use other formulations of EDB at recommended label rates. Inject the liquid in lines 30 cm apart at a rate of 140 ml/20 m of row. Seal the surface after injection by light rolling or a light spray irrigation. Leave the soil undisturbed for 7 to 14 days, then cultivate to aerate the soil.

For best results, soil should be free from undecomposed organic matter, warm and moist. If the soil is too wet, the fumigant does not diffuse properly and, if too dry, diffusion from the soil is too rapid.

Fungicide dip of seed

(for control of black scurf, powdery scab and silver scurf)

Remove obviously affected tubers. Pre-damp the rest for 24 hours before dipping to improve control of black scurf. After pre-damping, dip in Methoxy Ethyl Mercuric Chloride 6% or Phenyl Mercuric Acetate 6% used at a rate of 250 g/100 L water. Add a wetting agent. Dip for 10 to 15 minutes in wire baskets or open mesh bags and raise and lower containers several times to ensure thorough wetting.

After dipping 150 kg of seed, top up the dip with 5 L of a double strength suspension (i.e. 500 g/100 L) of the fungicide with wetting agent added at normal rates. Discard the dip completely after treating each tonne of seed. After dipping, spread the tubers out to dry.

NOTE: 1. Do not feed treated tubers to animals or use for human consumption. Bury seed that is not used for planting.

2. As the fungicide may injure sprouts, dip before sprouting.

Fungicide rates and spray volume

Time after planting	Application method	Fungicide	Rate/ha	Spray volume L/ha
0–8 weeks	Overhead boom	Chlorothalonil (flowable) 72%	1 L	100–150
		Fentin 45.3%	400 g	100–150
	Aerial	Chlorothalonil (flowable) 72%	1.5–1.8 L	50–100
		Fentin 45.3%	680 g	50–100
8 weeks onwards	Overhead boom and droppers	Chlorothalonil (flowable) 72%	1.5–1.8 L	250–350
		Fentin 45.3%	680 g	250–350
	Aerial	Chlorothalonil (flowable) 72%	1.5–1.8 L	50–100
		Fentin 45.3%	680 g	50–100

NOTE: Use the higher rate of chlorothalonil where rust is a serious problem.

Cultivar	Disease Reaction			
	Irish blight		Powdery scab	Target spot
	Tubers	Foliage		
Sebago	R	S	PR	S
Sequoia	R	S	S	PR
Exton	R	S	R	S
Kennebec	R	R	PR	HS
Kurriel	R	S	R	PR
Bungama	R	S	PR	S
Pontiac	S	S	R	HS

R — resistant.
PR — partially resistant.

S — susceptible.
HS — highly susceptible.

Cultivars

NOTE: Cultivars should not be selected on the basis of disease reaction only. Some may be unsuitable for your district for other reasons. Always consult your local extension officer.

For best results, use Certified seed on ground that at least has not grown more than two crops of potatoes in 5 years.

Fungicide treatment of cut seed (to prevent seedpiece breakdown)

As soon as possible after cutting, dust the entire surface of the seedpieces with Mancozeb 40% potato dust used at a rate of 500 g/50 kg seed.

NOTE: Plant as soon as possible after treatment. Do not feed treated seed to animals or use for human consumption. Bury seed that is not used for planting.

Fungicide soil treatment (for control of powdery scab)

Apply Quintozene 75% at a rate of 44 kg/ha mixed with the fertilizer at planting so as not to contact the seedpieces.

Treatment of potatoes prior to storage

Treat potatoes as soon as possible after harvesting with Thiabendazole 45% at a rate of 1 L/20 L of water/10 t of potatoes. Apply as a mist over the potatoes on the conveyor line. Ensure even and complete coverage by adequate rotation of the tubers but minimize moistening.

Fungicide sprays

Disease	Fungicide	Timing and Remarks
Target spot Irish blight	Chlorothalonil 75% — powder 1.1–1.7 kg/ha or 100–150 g/100 L — flowable 1.1–1.8 L/ha or 100–160 ml/100 L or Mancozeb 80% } or Maneb 80% } 1.7–2.2 kg/ha or Metiram 80% } or Propineb 70% } 150–200 g/100 L or Zineb 80% } or Dek 150 g/100 L or 2.2–3.5 kg/ha or Copper oxychloride 50% 500 g/100 L or 5 kg/ha or Copper oxychloride–maneb/ zineb combinations	1. Commence spraying when plants are 5 to 15 cm high and continue at 7 to 10 day intervals. Use the shorter interval when prolonged wet weather occurs. 2. Copper oxychloride or combinations are least preferred, but as they weather well they are useful where spray retention is a problem, e.g. where crops are watered frequently. 3. Chlorothalonil and DEK are not registered for the control of Irish blight.
Irish blight	Ridomil 25WP 80 g/100 L or 800 g/ha	1. For protective spraying, apply at 14 to 18 day intervals when conditions favour disease development. 2. As a curative spray, apply when symptoms are first visible and continue at 5 to 7 day intervals. When the outbreak is controlled, continue spraying at 14 to 18 day intervals. 3. Add wetting agents to the sprays.
Sclerotinia rot	Benomyl 50% 1.1 kg/ha or 100 g/100 L	Commence spraying at flowering and continue at 14 day intervals as required.

Current importance of diseases

Target spot—Major. Necessitates regular spraying with fungicides.

Irish blight—Causes foliage damage only due to the use of resistant cultivars. The spray schedule recommended for target spot gives useful control.

Seedpiece breakdown—Major.

Black dot—Minor.

Black leg—Minor.

Sclerotinia stalk rot—Moderate. May cause complete haulm loss in cool weather.

Armillariella rot—Very rare. Only seen in crops grown in newly-cleared land.

Bacterial wilt—Minor.

Spotted wilt—Rare.

Leaf roll—Major in autumn crops grown from locally-saved seed.

Purple top wilt—Moderate in autumn crop. Minor otherwise.

Rhizoctonia stem rot—Minor.

Black scurf—Minor. Higher incidence in imported seed.

Root-knot—Rare.

Common scab—Rare.

Powdery scab—moderate.

Dry rot—Minor.

Powdery mildew—Rare.

Verticillium wilt—May be serious in autumn crops. Often limits crop production where rotations are not possible.

Bacterial soft rot—Minor.

Calico—Rare.

Rugose mosaic—Rare.

Silver scurf—Rare.

Mosaic—Minor.

Fusarium wilt and stem-end rot—Minor. More serious in North Queensland.

Sclerotium rot—Rare.

Pimple—Minor.

Safflower

Current importance of diseases

Alternaria blight—May be serious under wet conditions.

Rust—Generally minor.

Phytophthora root rot—Serious in many areas.

Mosaic—Minor.

Damping-off—Minor.

Sclerotinia rot—Minor.

Anthracnose—Minor.

Verticillium wilt—Minor.

Flower blight—May be serious in very wet seasons.

Cercospora leaf spot—Minor.

Sorghum

Cultivars—Disease reaction

Seed Company	Hybrid (experimental designation)	Disease Reaction				Standability or lodging resistance status
		Head smut Race 1*	Rust*	Turcica leaf blight*	Sugarcane mosaic virus (SCMV)†	
Asgrow	Dorado E.....	R	R	S	RS	++
	Dorado A.....	R	S	S	M	+
	Dorado TX.....	R	..	..	..	..
	Topaz	..	..	..	..	..
	Dorado	R	S	R	M	+++
DeKalb	B17	HS	HS	S	M	+
	C42t	R	HS	S	M	+++
	C43	R	S	S	M	++
	E55e	R	S	S	M	++
	E57	R	S	S	M	+++
	F64a	R	R	R	M	++++
	X5065	R	S	..	M	+++
Hylan	Texas 626.....	R	S	S	M	++
	Texas 610SR.....	R	S	S	M	++
	Star	S	R	R	R	++
	Trojan 1.....	S	R	..	R	+++
	Q5161	HS	R	HR	RL	+++
	4X8	S	R	..	R	+++
	Texas 671.....	R	S	S	M	++
Northrup King	NK006 (NK30E)	R	R	S	M	++
	NK150	R	..	HR	M	++
	NK250	R	R	..	M	++
	NK280	R	R	..	M	++
	NK330	R	..	..	M	..
	NK350	R	S	..	M	..
Pacific Seeds.....	Nugget (Pac1023).....	S	R	S	M	+++
	Goldfinger	R	S	R	M	++
	Goldrush	S	HR	S	M	+++
	Pac710	R	R	HR	M	++
	Tropic (L1).....	R	S	S	M	++
	Monsoon	R	..	..	M	++
	Sundowner	S	R	..	R	+++
Golden Acres Y101 ...	Golden Acres Y101 ...	R	S	R	M	+++
Pioneer	Gem (P.E7).....	R	HS	S	M	++
	Pride (P.M1)	R	S	S	M	+++
	Leader	R	R	S	M	+++
	Big Red (P.M5).....	R	S	S	M	++
	P846	R	HS	HS	M	++
	Solo (P.M15).....	R	R	R	R	+++
	Sunlover 1	HS	R	R	RL	+++
Trump	Trump	R	S	..	M	..
Selected Seeds	S.S.E.94	..	..	R	R	..
Yates	Yates 212	R	S	S	M	++
	Yates 233	R	S	R	M	++
	Yates 266	R	S	R	M	++
	Yates 275	R	S	HS	M	++
	SM 5.....	R	S	R	M	+++
	SM 8.....	S	R	R	M	+++
	SM 9 (SM 11).....	R	S	R	..	+
	SM 10.....	S	R	S	M	++
Panorama	New Red SR	R	..	S	M	++
	VIR-RES 610	S	..	..	R	++
	VR 5161	S	..	..	R	..
Miscellaneous Open pedigree hybrids produced by various seed companies	TX610SR	R	S	S	M	++
	TX626	R	S	S	M	++
	TX671	R	S	S	M	++
	Q5161	HS	R	HR	RL	+++
Open-Pollinated cultivar.....	Alpha	S	HS	R	M	+++

* HR : Highly resistant
R : Resistant
S : Susceptible
HS : Highly susceptible
.. : Not determined

† M : Mosaic
RL : Red Leaf
RS : Red Stripe
R : Resistant to all three symptoms
.. : Not determined

+ : Below average
++ : Average
+++ : Above average
++++ : Very good
.. : Not determined

NOTE: When selecting cultivars, factors besides disease reaction need to be considered. Always consult your local extension officer for further information.

Seed treatment

(for control of seed-borne diseases and protection against seed rot)

Seed treatment is normally done by the seed company. Recommended seed dressings contain 30% or 75% Thiram plus insecticides. The dressings may be applied as dusts or as slurries at 300 g/100 kg seed.

For slurry treatment, 600 ml of water are generally adequate to treat 100 kg seed. Grain should be as dry as possible before slurry treatment as it adds approximately 0.5% to the moisture content of the grain.

NOTE: Do not feed treated seed to animals or poultry or mix with untreated seed.

Current importance of diseases

Leaf blight—May be serious on susceptible hybrids under humid conditions and in coastal areas.

Rust—May be serious in late crops of susceptible hybrids in humid areas.

Grey leaf spot—Minor in South Queensland. Moderate in Central and North Queensland.

Sorghicola leaf spot—Minor.

Bacterial streak—Minor.

Zonate leaf spot—Minor.

Mosaic—May be serious on susceptible hybrids.

Anthraxnose—Minor in South Queensland. May be serious under humid conditions in Central and North Queensland.

Crazy top—May be serious where flooding occurs during crop establishment but generally minor.

Charcoal rot—Major, particularly in hot, dry seasons in Central Queensland.

Fusarium stalk rot—Major.

Sclerotium base rot—Prevalent in wet seasons but generally minor.

Head smut—May be major in Spring sowings of susceptible hybrids in South Queensland. Minor elsewhere.

Mouldy head—Minor, except in humid, tropical areas where it is a major problem.

Covered kernel smut—Very rare, possibly eradicated by the widespread use of seed dressings.

Seedling blight—May be serious in early plantings, particularly under cool, wet conditions. Minor otherwise.

Periconia root rot—Common but minor.

Sooty stripe—Very rare.

Nigrospora stalk rot—Minor.

Soybeans

Cultivars

The cultivars Semstar and Fitzroy are susceptible to bacterial pustule and wildfire. The cultivar Ross may show low levels of bacterial pustule. All other currently recommended cultivars are resistant.

Fungicide sprays

(for control of rust in wet coastal areas and the Tablelands of North Queensland)

If rust occurs, spray with Mancozeb 80% 2.2 kg/ha at 7 day intervals from flowering to pod-filling particularly when showery weather is prevalent.

Current importance of diseases

Bacterial pustule—Minor.

Bacterial blight—May be serious in wet seasons.

Wildfire—Minor.

Rust—May be serious in wet seasons, particularly in coastal areas.

Charcoal rot—May be serious in hot, dry seasons. With irrigation available, it is generally minor.

Mosaic—Minor.

Sclerotinia rot—May be serious in the Lockyer Valley district. Minor elsewhere.

Diaporthe blight—Generally minor.

Purple stain—Minor.

Seedling blight—Minor.

Root-knot—Generally not now a problem because most crops are grown on heavy soils.

Cercospora leaf spot—Generally minor.

Alternaria leaf spot—Generally minor.

Peanut mottle virus—Minor.

Big bud—Minor.

Sclerotium base rot—Occasionally serious.

Phytophthora root rot—May be serious in susceptible cultivars under wet conditions.

Sunflowers

Cultivars

(resistance to rust)

Hysun 30, Hysun 10, Sunburst, Suncross 150 and Sunking are immune. Polestar, a cultivar grown for birdseed, is the most susceptible of currently recommended cultivars. Sunfolia 68-3 is less susceptible.

The hybrids Suncross 51, Suncross 52, Hysun 21, Hysun 31, Sunbred 707, Sunbred 727, Sungirl, Sungirl 2, Cargill 205, Sunace, Sungold and

Dekalb 500 may become heavily infested if grown in rust-prone areas late in the season. However, the rust levels on these hybrids should be lower than on Sunfolia 68-3.

Current importance of diseases

Rush—Not generally a serious problem now that resistant hybrids are available.

White blister—Minor.

Septoria leaf spot—Minor.

Alternaria spot—May be serious if prolonged wet and overcast weather occurs.

Rhizopus head rot—May be serious in insect-damaged heads, particularly under prolonged high humidity conditions.

Sclerotinia rot—May be serious under cool, wet conditions.

Charcoal rot—May be serious under hot, dry conditions.

Verticillium wilt—Not important at this stage.

Sclerotium base rot—Generally minor.

Powdery mildew—Minor.

Noogoora burr rust—Minor.

Sweet potatoes

Current importance of diseases

Big bud (little leaf)—Periodic epidemics.

Scurf—Generally minor.

Root-knot—Occasionally serious.

Rhizopus storage rot—May be serious.

Tobacco

Legislation governing planting

(to prevent carryover of blue mould)

Under "The Tobacco Industry Protection Act of 1965" periods of the year for each district during which tobacco must not be sown or transplanted are as follows:

a. Northern region—1st November–31st March

b. Burdekin district—1st December–1st June.

c. Bundaberg–Miriam Vale district—1st December–1st July

d. South-east district—1st January–1st June

e. Inglewood district—15th January–1st August

Inspectors may order the destruction of tobacco plants sown or transplanted during these periods as well as volunteer plants and tobacco residues.

Fumigation

(a) SEEDBED (for control of nematodes and soil-borne diseases)

Treat with Methyl bromide 500g/5m² of seedbed under a gas-tight cover left in position for 24 to 36 hours. A standard 680 g can is sufficient to treat 6 m of a 1.2 m wide seedbed.

NOTE: 1. Soil should be moist but not wet before treatment.

2. Commence treatment preferably at midday as the higher temperatures expedite the release of gas and its entry into the soil.

3. Details of the application of Methyl bromide gas are given in Appendix 1.

4. After removing the cover, aerate the soil by chipping to a depth of 5 to 10 cm. As reinfestation may occur if contaminated tools are used, wash free from soil and dip in a 2% Formalin solution before use.

5. Where practicable, let seedbeds air for at least 2 days before sowing.

Cultivars—disease reaction

Cultivar	Disease Reaction				
	Blue mould Strain 1	Blue mould Strain 2	Bacterial wilt	Black shank	Vein banding
Hicks Q46.....	S	S	S	PR	S
Hicks Q34.....	S	S	S	PR	S
NC95.....	S	S	R	R	VS
NC2326.....	S	S	S	PR	S
ZZ100.....	R	S	R	R	VS
Sirogo.....	R	S	S	S	S
Sirone.....	R	S	S	S	S
CSIRO 40T.....	R	S	S	PR	S

VS — Very susceptible.
S — Susceptible.

PR — Partially resistant.
R — Resistant.

6. Methyl bromide is a dangerous and highly toxic chemical. Use with extreme care strictly according to directions. Do not breathe the fumes when removing covers. If damping-off does occur despite these precautions, drench the affected patch and a narrow buffer zone of healthy seedlings around it with Thiram 80% 8 g/5 L using 3 to 5 L/m² (for

control of *Pythium spp.*) or Captan 83% 6 g/5 L using 2.5 L/m² (for control of *Rhizoctonia solani*) or Cheshunt mixture 17 g/5 L (using 5 L/m²).

The Cheshunt mixture must be washed off immediately afterwards by light watering to prevent leaf burn. Do not repeat drenching unnecessarily.

Fungicide sprays

Disease	Fungicide	Rate	Timing and Remarks
SEEDBED Blue mould	Ridomil 25WP	6 g/15 L water Apply spray so that seedling leaves are evenly wet. It is not necessary to spray until run-off.	Spray at 7 day intervals. Make the first application 7 to 10 days after emergence. Make the final application the day before planting out. NOTE: Do not allow pre-mixed spray to stand for more than 1 hour.
Ascochyta leaf spot	Chlorothalonil 75%— powder flowable	20 g/10 L 20 ml/10 L	1. Spray weekly commencing when plants are 1 cm in diameter and continue at 7 day intervals until transplanting. 2. Necessary only in the Inglewood tobacco district. 3. Do not mix with Ridomil 25WP as compatibility is unknown.
FIELD Blue mould	Ridomil 25WP	40 g/100 L Increase the volume of spray applied as plants increase in size using the following as a guide: Initial spray— 200 L/ha minimum Plants approx. 1 m high— 500 L/ha minimum Fully grown— 800 L/ha minimum	Spray every 7 days commencing 10 days after transplanting and continuing throughout the growing season until 7 to 10 days before the first harvest. NOTE: Do not allow pre-mixed spray to stand for more than 1 hour.
Frog eye leaf spot Brown spot	Mancozeb 80%	2.2kg/ha or 200 g/100 L Minimum volume of spray/ha for fully grown crop—800 L	1. Spray only when the diseases are seen and then every 7 days as required. 2. Both diseases are most likely to occur in periods of wet weather. 3. Ridomil 25WP applied for blue mould control has no effect on these diseases. 4. Mancozeb may be mixed with Ridomil 25WP

The Cheshunt mixture formula is 2 parts of powdered bluestone (copper sulphate) and 11 parts of fresh powdered rock ammonia (ammonium carbonate). The two are thoroughly mixed and kept in an air-tight glass or earthenware vessel for at least 24 hours before using. This time is necessary for the chemical reaction to take place between the ingredients. To use, dissolve the dry mixture in water at a rate of 3 g/L.

(b) FIELD (for control of nematodes)

Treat soil with EDB15 220 L/ha. Use other formulations of EDB at recommended label rates.

Inject the chemical at a depth of 20 cm through tines 25 to 30 cm apart.

NOTE: 1. Soil should be moist when fumigated and rolled immediately after treatment.

2. Do not plant for at least 2 weeks after treatment.

3. Soil should be free from clods and plant residues. Commence preparing land as early as possible (in North Queensland as soon as possible after the wet season) by ploughing and discing. Disc again 4 to 6 weeks later. EDB may be applied one month after this second discing. A third discing may be necessary immediately before fumigation.

4. The cost of fumigation may be reduced by applying EDB in 2 rows each 15 cm to the side of the proposed planting row. The marks left by the tractor wheels or tines enable the treated strips to be relocated when fertilizing and planting. Any interim cultivation should be in the direction of the rows.

Chemical control of fungal barn rot

1. Before curing, spray sticks, racks, barns, and sheds with Dicloran 50% 400 g/100 L. If barn rot is a recurring problem, spray the butts of the leaves with the same suspension before placing in the barn.

2. Observe strict hygiene precautions and destroy all tobacco trash and residues around barns.

3. Avoid harvesting during wet weather.

A note on other crops

As capsicums, tomatoes, eggplant, potatoes and gooseberries may be a source of the virus PVY which causes vein banding in tobacco they should not be grown near tobacco seedbeds or young crops.

As the weeds blackberry nightshade and wild hops are also susceptible to the virus, they should be eradicated from adjacent areas.

Seed treatment with silver nitrate

(for control of seed-borne blue mould and frog eye leaf spot)

Place the seed in a muslin or cheese-cloth bag and immerse in a silver nitrate solution of 1 g/L of water. Leave the seed in the solution for 15 minutes, stirring from time to time. After treatment, rinse the seed in clean water several times until the rinsing water remains clear. Spread the seed on trays lined with muslin and dry in the shade.

If large amounts of seed are being treated, these should be dried in an oven at temperatures below 35°C for 48 hours after being spread in layers 1 to 2 cm thick. Stir the seed after 24 hours.

Current importance of diseases

Blue mould—Serious if fungicidal control not adequate.

Black shank—Generally minor unless susceptible cultivars are grown.

Bacterial wilt—Moderate. Serious in certain areas.

Rhizoctonia stem rot—Common but not serious.

Hollow stalk—Generally minor.

Root-knot—Serious if fumigation is not adequate.

Brown spot—Moderate in late crops.

Ascochyta leaf spot—Restricted to the Inglewood area. May be serious on occasions.

Mosaic—Generally minor.

Vein banding (PVY)—May be serious in susceptible cultivars.

Big bud—Minor.

Bacterial barn rot—Major.

Fungal barn rot—Major.

Frog eye—Moderate in late crops during wet weather.

Damping-off—Minor in North Queensland. May be serious in South Queensland.

White stem—Minor.

Wheat

Cultivars

(a) FLAG SMUT. All currently recommended cultivars (Timgalen, Gatcher, Songlen, Kite, Banks, Oxley, Cook, Shortim) are resistant.

(b) STEM RUST. Oxley is susceptible while some rust may develop on Gatcher late in the season. Under favourable conditions, a low level of stem rust may also develop on Banks late in the season. All other currently recommended cultivars (see above) are resistant.

(c) LEAF RUST. All currently recommended cultivars (see above) are susceptible to various extents. Most are resistant to some field strains, Kite is the most susceptible.

(d) CROWN ROT. All currently recommended cultivars (see above) are susceptible to various extents. Timgalen, Cook and Shortim are more resistant than the others and should be given preference in areas where the disease is a problem.

(e) BUNT. Kite is resistant. All other currently recommended cultivars are susceptible.

Seed dressings

With the exception of the cultivar Kite, all seed which may be used for grain crops should be treated with a fungicide before planting. Seed obtained from an approved source is generally considered to be free from loose smut and flag smut and will probably have already been treated for bunt. In this case, no further treatment is required.

However, if it has not been treated for bunt, arrange to have it treated with:—

Fenaminosulf 5% (dust) 150 g/100 kg seed
or Fenaminosulf 42% (slurry) 25 g/100 kg seed
or Benomyl 15% (dust) 150 g/100 kg seed
or Bawsan L (liquid) 75 ml/100 kg seed

If the seed source is unknown, there is a possibility that the seed may be infected with loose smut. This can be controlled by treating the seed with:

Carboxin 50% (dust) 200 g/100 kg seed
or Carboxin 75% (dust) 125 g/100 kg seed

This treatment also controls bunt and flag smut on the seed. Loose smut is generally of minor importance and the cost of treatment needs to be considered in relation to likely yield gains.

The presence of loose smut will not generally lead to down-grading of normal deliveries but it will be a problem where crops are being grown for seed.

NOTE: 1. Dusts should be applied using a suitable dry seed dressing machine and Bawsan L liquid should be applied with either a Seedkem Liquid Applicator or a mist-type seed treater.

2. Operators applying dust treatments should avoid breathing the dust.

3. Operators applying Bawsan L should wear rubber gloves and face shield when handling the concentrate and an organic vapour respirator when working in a confined area.

4. Treated seed not sown immediately should be stored in a dry, well-ventilated space.

5. Clearly mark bags of treated seed and do not use these bags for other purposes.

6. Do not hold treated seed over for planting next season.

7. Do not use treated seed for human or animal consumption or allow it to contaminate grain for these purposes.

8. If seed treated with Carboxin is planted, do not graze livestock on the area for 7 weeks after planting.

Current importance of diseases

Bunt—A potentially important disease but has not been recorded in Queensland for many years. Widespread use of fungicide seed treatments minimizes the chances of an outbreak.

Loose smut—Generally minor.

Flag smut—Rare. All currently recommended cultivars are resistant.

Crown rot—Although serious in the past, now generally of minor importance. Occasional severe outbreaks occur most commonly on the Darling Downs, particularly in drier seasons.

Common root rot—Widespread but importance not yet determined.

Stem rust—Potentially important but most currently recommended cultivars are resistant.

Leaf rust—Potentially important but partial resistance in currently recommended cultivars is helping to reduce losses.

Take-all—Rare.

Yellow spot and pink grain—May be a problem in wet seasons.

Black point—May be a problem when wet conditions occur during the grain-filling period.

Head scab—Rare. Occasional outbreaks when wet conditions occur after ear emergence.

Powdery mildew—Minor.

Base rot—Rare.

Yellow dwarf—Rare.

Speckled leaf blotch—Rare.

Glume blotch—Generally minor. Frequently confused with genetic black chaff.

Spot blotch—Rare.

Foot rot—Rare.

Appendix 1

Fumigation of soil with methyl bromide

(a) SAFETY PRECAUTIONS

1. METHYL BROMIDE IS A HIGHLY TOXIC CHEMICAL AND SHOULD BE USED STRICTLY ACCORDING TO DIRECTIONS.

2. Methyl bromide is supplied as a liquid under pressure in cans or cylinders. The 680 g can is the container most commonly used by growers. When the liquid is released, it evaporates rapidly, particularly at high temperatures.

3. As methyl bromide is odourless, 2% Chloropicrin is included. This causes watering of the eyes and indicates the presence of methyl bromide.

4. Always wear protective clothing including impervious gloves when handling methyl bromide. If working in a covered area, a respirator fitted with an appropriate canister should be worn.

5. If the liquid splashes onto the body, remove clothing and shoes immediately and wash affected areas with soap and water. If the liquid contacts the eyes, flush them with water for at least 15 minutes. Get medical attention. Do not re-use contaminated clothing or shoes until they have been thoroughly aired.

(b) APPLICATION

1. Soil should be of fine tilth, moist but not wet, free from clods and undecomposed organic matter and at a temperature above 10°C.

2. Dig a narrow trench 15 cm deep around the area to be treated.

3. Place an evaporating container (a 1 L narrow-neck glass bottle is adequate for each 680 g can) in the middle of the area to be treated. If the area is a long seedbed, a number of these may be required at intervals. The generally recommended rate for control of damping-off and nematodes is 1 kg/10 m² (1 kg/20 m² for nematode control only). In other words, a 680 g can is sufficient to treat 6 m of a 1.2 m-wide bed (or 12 m of bed for nematode control only).

4. From each evaporating container, lead out a plastic tube long enough to reach out under the cover. This enables the fumigant to be discharged into each container from outside the cover. If a bottle is used as an evaporating container, ensure that the end of the tube is pushed well down into the bottle so that it will not be forced out when the methyl bromide enters.

5. Cover the area with a plastic sheet held 20 to 30 cm above the surface of the soil with hoops or inverted bottles. Ensure there are no holes in the sheet. Place the edge of the sheet in the trench and cover with soil, tamping it down firmly.

6. Cans of methyl bromide should be opened with a special dispenser. Connect the end of the tube to the dispenser and open as directed. When using a cylinder, ensure that the evaporating container does not overflow as this may cause patches of poor growth in the subsequent crop.

7. Remove the tube carefully remembering to tamp down that part of the edge of the cover where the tube was located.

8. Leave the sheet in place for 24 hours (48 hours when the soil temperature is 10 to 15°C). Then lift all or part of the sheet and allow the area to air. Avoid breathing the vapour. Soil from the trenches should be turned outwards from the bed to avoid recontamination of the treated area.

9. Allow the treated area to air for at least 2 days before seeding. Double these times if the soil temperature is 10 to 15°C.

NOTE: 1. To avoid recontamination of the treated area, sterilize all tools and shoes with formalin before commencing work in the area. Keep animals off the treated area.

2. Store cans of methyl bromide in a cool, dry place.

Appendix 2

Formulations of fungicides and nematicides whose trade names appear in this article

Trade name	Formulation	Active Constituent
Bawsan L.....	solution	320 g/L 2-(thiocyanomethylthio) benzothiazole 26.5 g/L lindane
DEK	wettable powder.....	624 g/kg ethylene bisdithiocarbamate 21 g/kg zinc ions 145 g/kg manganese ions
EDB 15 (also available as Soil fumigant 15% and Nematox)	solution in kerosene	325 g/L ethylene dibromide
Other formulations of EDB:		
(a) EDB EC, EDB 193% miscible oil	emulsifiable concentrate	1.93 kg/L ethylene dibromide
(b) EDB 50.....	solution in kerosene	1 080 g/L ethylene dibromide
Ridomil 25WP	wettable powder.....	250 g/kg methyl <i>dl</i> -N- (2, 6-dimethylphenyl) -N-(2'-methoxyacetyl) -alaninate

Trade names and formulations of recommended fungicides and nematicides

Common Name	Trade name/s	Formulation	Active Constituent
benomyl 10%.....	Bennel	seed dressing	100 g/kg benomyl 5 g/kg lindane
benomyl 15%.....	Bennel 15	seed dressing	150 g/kg benomyl 5 g/kg lindane
benomyl 50%.....	Benlate	wettable powder	500 g/kg benomyl
captan	Captan 83, Captan 80, Captan A	wettable powder	830 g/kg captan
captan-quintozene mixture	Lane peanut seed dressing	seed dressing	400 g/kg captan 400 g/kg quintozene
carboxin 25%.....	Pro-gro 25L	seed dressing	250 g/kg carboxin 10 g/kg lindane
carboxin 50%.....	Vitavax 50L	seed dressing	500 g/kg carboxin 10 g/kg lindane
carboxin 75%.....	Vitavax 75	seed dressing	750 g/kg carboxin
chlorothalonil	Bravo W75	wettable powder	750 g/kg chlorothalonil
	Bravo flowable	suspension concentrate	720 g/L chlorothalonil
copper oxychloride	Copper oxychloride, Oxydul, Copper 50, Green copper 50, Cupravit, Copper nordox, Cobox	wettable powder	500 g/kg copper as copper oxy- chloride
copper oxychloride-maneb mixture	Man-cop	wettable powder	350 g/kg copper as copper oxy- chloride 240 g/kg maneb
copper oxychloride-zineb mixture .	Zinocop, Copper curit, Zinox	wettable powder	230 g/kg copper as copper oxy- chloride 340 g/kg zineb
dicloran	Allisan	wettable powder	500 g/kg dicloran
fenaminosulf 5%.....	Le-san ELL	seed dressing (dust)	50 g/kg fenaminosulf 5 g/kg lindane
fenaminosulf 42%	Le-san SL	seed dressing (wettable powder)	420 g/kg fenaminosulf 50 g/kg lindane
fentin	Du-Ter extra	wettable powder	453 g/kg fentin as fentin hydroxide
mancozeb 40%	Dithane M-45 potato dust, Mancozeb potato seed dust	seed dressing	400 g/kg mancozeb
mancozeb 80%	Dithane M-45, Manzion, Mancozeb 80, Manzate 200, Mancozeb, Mancozeb 800	wettable powder	800 g/kg mancozeb
maneb	Maneb, Maneb 80, Brymazine, Manzinc	wettable powder	800 g/kg maneb
methoxy ethyl mercuric chloride	Aretan 6, Shirtan 6, Baytan 6, Adstan, Barmatan 6, Cane-tan, Tan 6, Mercurial fungicide dip	wettable powder	60 g/kg mercury as methoxy ethyl mercuric chloride
methyl bromide	Agrigas MC-2, Dowfume MC-2	liquified gas	980 g/kg methyl bromide 20 g/kg chloropicrin
metiram	Polyram combi, Polyram 2000	wettable powder	800 g/kg metiram
phenyl mercuric acetate	PMA, PMA 10, PMAS	solution	60 g/L mercury present as 100 g/L phenyl mercuric acetate
propineb	Antracol	wettable powder	700 g/kg propineb
quintozene	Chloroturf, Terraclor	wettable powder	750 g/kg quintozene
thiabendazole 45%	Tecto flowable	suspension concentrate	450 g/L thiabendazole
thiram (sorghum seed dressing)	Lane sorghum seed slurry	seed dressing	750 g/kg thiram 10 g/kg maldison 5 g/kg lindane
	ICI sorghum seed dressing	seed dressing	300 g/kg thiram 10 g/kg maldison 5 g/kg lindane
thiram 80%.....	Thiram, Thiotox, Thiram 80	wettable powder	800 g/kg thiram
zineb	Zineb 65	wettable powder	650 g/kg zineb
	Zineb 75	wettable powder	750 g/kg zineb
	Zineb 80, Curit	wettable powder	800 g/kg zineb

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Pests of legumes

compiled by officers of Entomology Branch

Bean spider mite (*Tetranychus ludeni* (Zacher))

Adults are up to 0.5 mm in length and their spider-like appearance can just be made out with the naked eye. The mites feed on the underside of the leaf and damage is seen as a mottling in the leaf colour. Severely affected leaves become yellow and fall from the plant. The life cycle is brief, about 11 days in summer. The rapid build up in numbers which occurs during periods of hot, dry weather is accentuated when broad spectrum insecticides are used as these destroy predators.

Mites are not a problem in inland soybean areas but can be a problem in that crop when grown in the Lockyer Valley.

Soybean looper (*Diachrysia orichalcea* (Fabricius))

Soybean loopers are foliage feeders and are characterized by their 'looping' form of movement. The caterpillar is green with light-coloured stripes and grows to 38 mm in length. The adults have a wing span of 35 mm and a shiny golden area on the forewings. The soybean looper can occur on both soybeans and navy beans. It caused major losses in soybeans when it first appeared in Australia in 1977 but has been a minor pest since that time. The plain green larvae of the green looper also occur in these crops but rarely cause economic damage.

Lucerne crownborers (*Corrhenes stigmatica* (Pascoe)) and (*Zygrita diva* (Thomson))

These soybean pests are the larvae of small longicorn beetles, characterized by long antennae. The most common species is the lucerne crownborer (*Zygrita diva*). The adult is about 14 mm long, coloured light orange with black markings and long black antennae. The larvae grow to 13 mm in length and are white and elongate with deep constrictions between the body segments. There appears to be only one generation per year on soybeans in southern Queensland. The adults lay eggs into soybean stems in early and midsummer. The larvae tunnel within the pithy section of the stem. When fully grown, they excavate an over-wintering chamber in the stem just below ground level. As the larvae excavates this chamber, it can 'ring bark' the stem from within causing premature plant death. If this occurs before crop maturity, significant yield losses can result.

Podsucking bugs (*Riptortus* spp.)

Podsucking bugs are about 16 mm long with an elongate body and long legs. They are predominately brown in colour with a yellowish stripe along each side of the body. The podsucking bugs are very active in the crop, running and flying when disturbed. While the green vegetable bug is the main pest of grain legumes, the podsucking bug can occasionally occur in sufficient numbers to cause economic damage.

Pests of legumes



Bean spider mites and eggs (x 20).



Soybean looper (x 2.5).



Adult of *Corrhenes stigmatica* (x 3.8) above; *Zygrita diva* (x 2) below.



Adult pod-sucking bug (x 2.8).