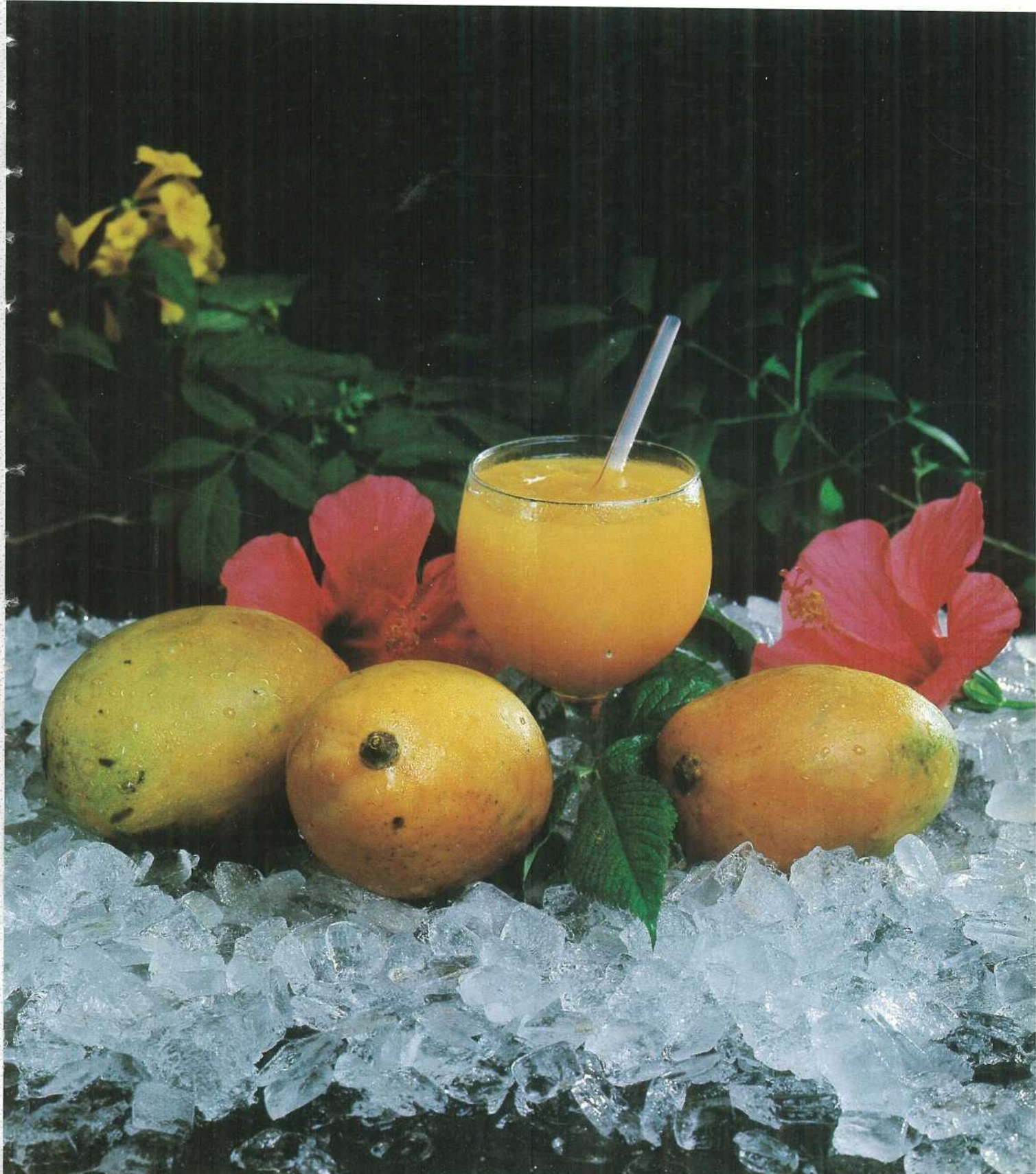


QUEENSLAND **AGRICULTURAL** **JOURNAL**

November–December 1981. Vol. 107, No. 6





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Cover: Fresh, cool mangoes—a natural for Queensland's summer. Photograph by J. Black.

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Agriculture gears up for 21st century

by Dr G. I. Alexander, Director-General



Dr G. I. Alexander, Director-General.

THESE days so much is written and spoken about Queensland's mineral wealth that, in popular opinion, mining has completely overshadowed rural industry.

Yet the earnings from rural production substantially exceed the returns from mining.

In the 1980-81 financial year, the value of Queensland's rural production exceeded \$2,800 million, which is one-quarter of Australia's total rural production. Returns from mining were in the region of \$1,813m.

The agricultural and pastoral industries are of basic and permanent importance to this State and the nation as a whole—a fact well recognized by all those connected with agriculture.

It is summed up by Dr John Longworth, of the Agricultural Economics Faculty, University of Queensland. In the March 1979 issue of *The Current Affairs Bulletin*, he wrote:

'One facet of Australian life taken for granted by the vast majority of us who do not live and work on farms

is our food supply. In the E.E.C. and Japan, for example, the situation is very different. Within living memory, a significant proportion of the population of these countries has known widespread starvation. Food self sufficiency, therefore, is a major national goal accepted by the population almost as a pre-condition to any lower-order goals such as economic growth. The rural sector is treated as the very life-blood of the nation.

'In Australia, the city person never entertains the thought that one day there may not be enough food to go round'.

It is true that, in countries like Australia with surpluses of food and fibre, the city dweller assumes with an almost blissful ignorance that his daily recurrent need for food will be satisfied with a minimum of fuss and a minimum of delay.

In this review of development in Queensland and the prospects for the rural industries in the 1980s, I wish to deal with three main topics:

1. the custodial nature of the office of Director-General of the Queensland Department of Primary Industries and the implications for management;

2. some impressions of those factors which are most likely to affect developments in agriculture in the next 10 years; and
3. the changing face of agriculture, particularly in terms of its adoption and application of new technology.

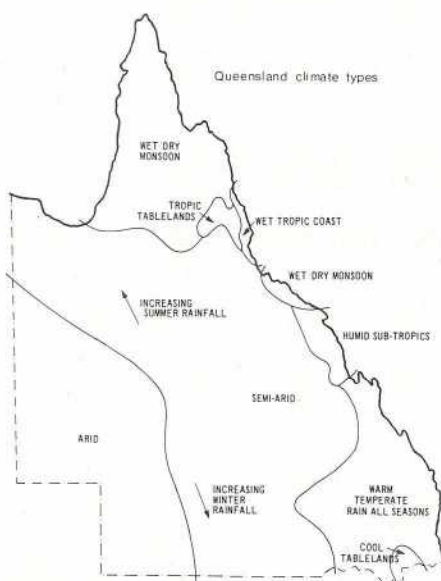
In so doing I hope to provide some picture of the emerging scene that is unique to Queensland.

Optimum output

Even in our largely free-enterprise or mixed economy, the office of Director-General of a Department of Agriculture implies some responsibility for, or a measure or trusteeship over, the food-producing resources of the State. It also implies a commitment to ensure that these resources are allowed to achieve some long and short-term optimum level of output.

As I have already indicated, the agricultural and pastoral resources of Queensland combined last financial year to produce more than \$2,800m worth of production or about one-quarter of the value of Australia's agricultural output.

For this production, the land resources used were some 35 000 rural holdings encompassing 158m



hectares of land. In area, this is a little less than one-third of all rural land holdings in Australia.

The human resources used were represented by the 70 000 or so people who own, operate and provide services to agriculture in Queensland on a full-time basis. Taken as a whole, the human resources engaged in agriculture in Queensland represent about one-fifth of the national agricultural labour force.

That is a summary of our rural production and the land and human resources that are producing it.

Those cold, unqualified statistics, which do not include the farm machinery, fertilizer, seed, stock and other capital inputs, suggest an economic or conventional simplicity to agricultural and pastoral production. To draw such a conclusion would indeed be grossly misleading.

Challenges and uncertainties

The aggregated statistics do nothing to reveal the challenges and uncertainties that the agricultural sector continually confronts in dealing with the vagaries and vicissitudes of international markets, the unpredictability of our own and the world's climatic conditions and the fluctuating fortunes that follow even relatively minor changes in international rates of growth, exchange rate realignments and politically-determined adjustments to the marketing environment.

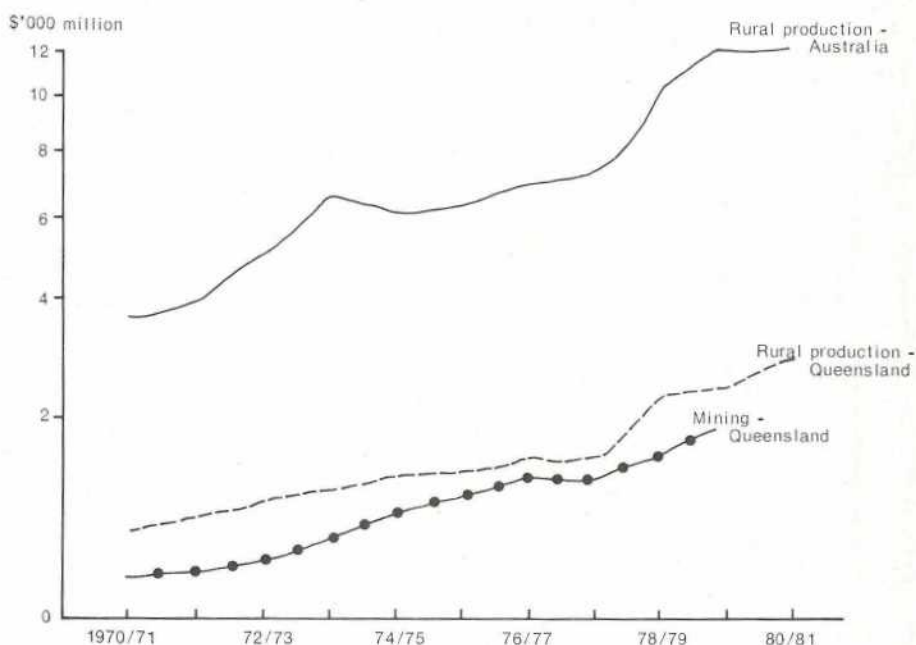
I quote briefly from the keynote address given at this year's National Agricultural Outlook Conference by the Director of the Bureau of Agricultural Economics. In a broad sweep at agricultural prospects in the coming decade he observed:

'We seem very likely to face more constraints on our beef shipments to international markets towards the middle of the decade. A surplus of grains is likely to occur at least once, and possibly two or three times, before 1990 and the residual international sugar market will probably go through two complete boom and bust cycles' [in that time].

What are the implications of all that for management? The complexity of agriculture and the complexity of management as a concept when applied to agriculture makes this a difficult question to deal with satisfactorily in this brief review. However, a number of salient points can be made.

Perhaps the most important precondition to efficiently and effectively help shape the economic destiny of agriculture in Queensland

Value of production:
mining and rural production:- 1970/71 - 1980/81



Notes: (1) Rural production does not include forestry, fishing and hunting.
(2) Levels of rural production for 1980/81 are estimates.

is to understand the nature and problems of resource usage in agriculture.

This requires both a shorter and longer term appreciation of the problems and potential of our agricultural sector. In this respect, I regard the next 10 years as being in the shorter term.

Even if it were possible to pinpoint precisely the U-turns and deviations that the market will take in the short term, and most of these deviations will be reflected in the prices of agricultural commodities, there is in the nature of agricultural resources a very limited flexibility that precludes their quick manoeuvrability to meet rapidly changing market conditions. To use the economist's terminology agriculture has 'an inbuilt and notoriously low price elasticity of supply', particularly in the shorter term.

Transfer of resources difficult

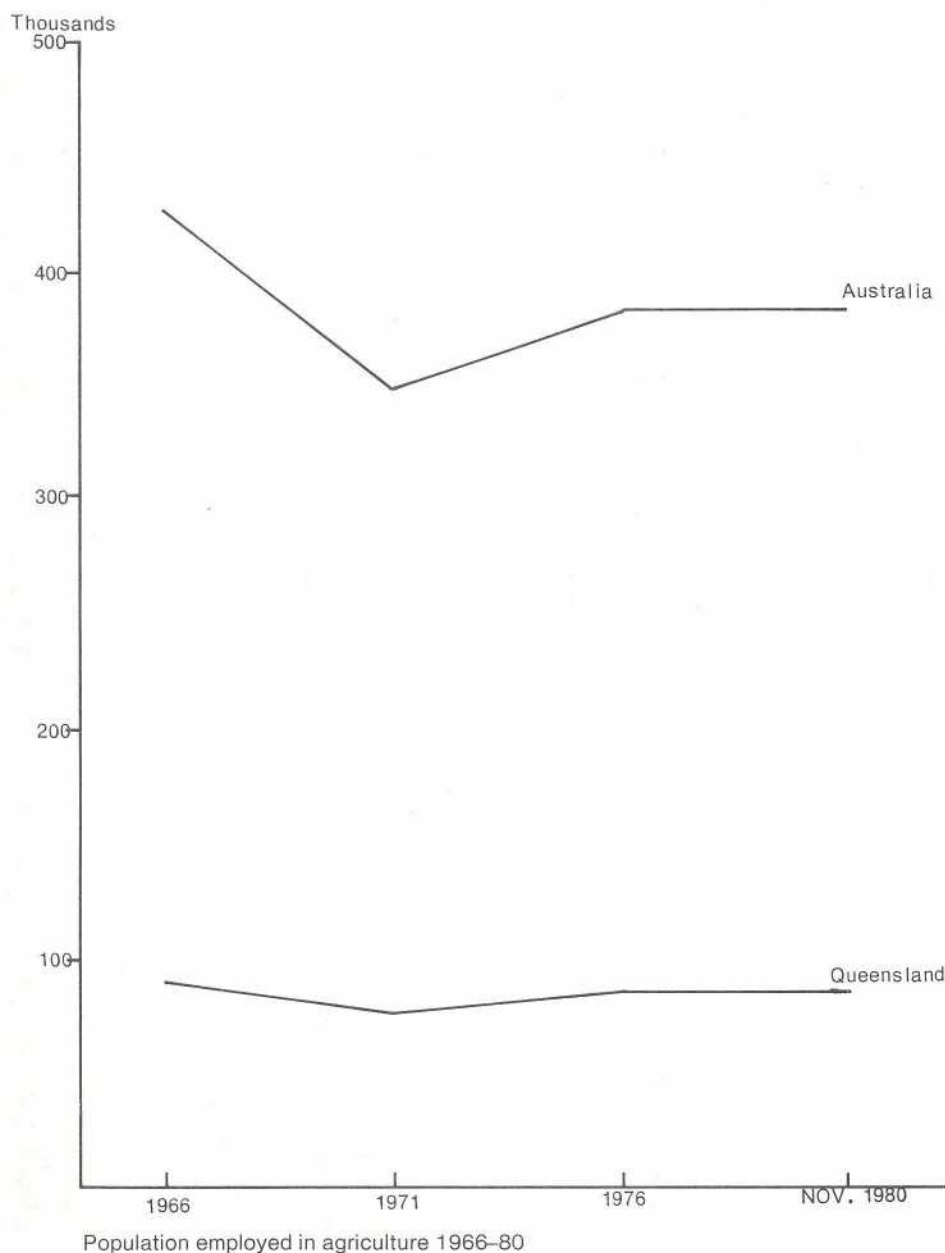
Certainly the nature of the capital, the experience and training of farmers and the location and nature of arable land ensure that these resources are not easily transferable into and out of agriculture. But even within agriculture, resources are not always as readily transferable as economic theory would frequently suggest.

The biological lead time alone for some forms of agricultural production dictates that the wisdom or otherwise of a shift in output strategy today may not be ultimately determined until some years in the future. An orchardist, for example, may have to wait 8 to 10 years for his fruit trees to reach full production. The beef cattle breeder has to think in terms of at least a 3 to 5-year time frame.

Apart from biological factors, complex cost considerations also rule out rapid changes in the level or nature of agricultural output. For example, it is not easy to switch from beef to grain production or from sheep to beef. Most agricultural operations are characterized by a high, fixed-cost structure which impedes their flexibility. In addition, the lumpiness of capital precludes even a partial re-adjustment.

Because of this, the modern world of agribusiness is characterized by a rapidly changing market environment on one side and a relatively inflexible unmanoeuvrable production process on the other. This gives rise to a lively dilemma which the public servant is frequently called upon to resolve.

Paradoxically, agricultural and pastoral interest groups feel somewhat reluctant, if not powerless, to



Population employed in agriculture 1966-80

(Source: population and housing census except for 1980)

alter the course of their own production processes and see as their only option a reshaping of the political, economic and infrastructural environment within which they must operate.

In this rather inverse form of evolution, serious welfare considerations are always at stake and while, to those outside agriculture, it may be a case of 'things never going right down on the farm'. The Department of Primary Industries is expected, and indeed has a responsibility, to understand the seriousness of the issues involved. Moreover, from a management and policy development point of view, the Department must seek to formulate solutions that strike a balance between the economic pressures and the human realities involved.

Where do the solutions lie?

In the short term there is no option but to 'fight the bushfires': in the longer term some re-adjustments will be unavoidable.

Managed change

It is my view that the realities of the twentieth century dictate that much, but not all, of this re-adjustment process will take the form of a managed change rather than an abandonment to the uncertainties of a completely laissez-faire approach.

In shaping appropriate strategies, it is therefore necessary to anticipate not only the factors that will influence agricultural development in the years ahead, but also the problems that are likely to emerge.

At the global level, it is generally predicted that demand for agricultural products will outstrip supply during the 1980s, with the result that the pressure on the world's agricultural resources will be maintained. A report published in the United States in 1980 projects an annual increase in world demand for food of about 2.2% during the 1980s. This projected increase is lower than in the previous 20 years, largely because of a slow-down in world population growth.

However, it will still exceed the forecast rate of growth of agricultural production. It is expected that the annual growth of world agricultural production during the 1980s will be only 2% compared with an average of 2.6% during the last 20 years. The major reasons for this revolve around the adverse effects of higher energy costs together with increasing economic and environmental constraints on the expansion of arable land.

Of particular interest to us in this part of the world is the possible emergence of a more affluent Asia and the likely shift in the nature and volume of trade. In this regard, the deliberations of trade rounds such as the current Multinational Trade Negotiations may have important implications for sectors such as agriculture where Australia enjoys such an obvious comparative advantage.

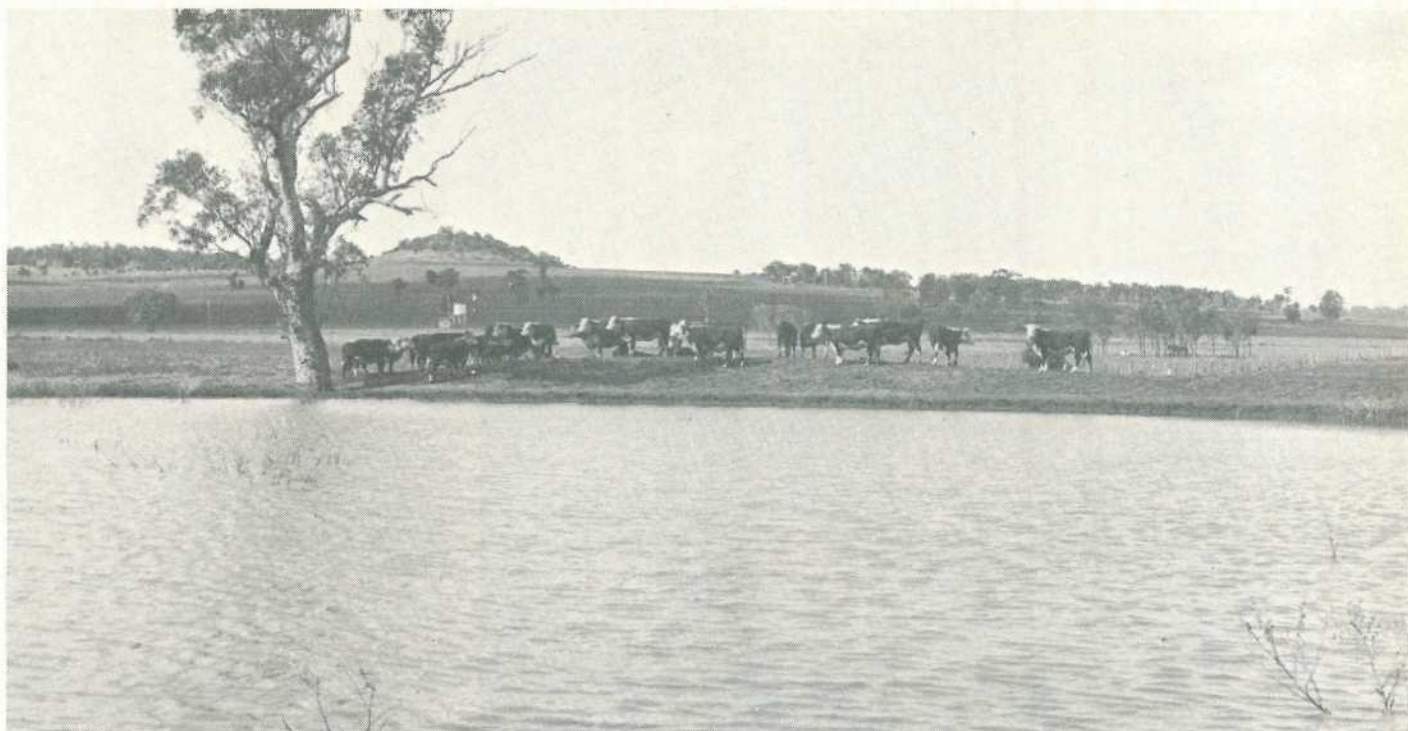
Given this situation, it is clear that the demand for Queensland and Australian agricultural commodities, especially grains, will be limited only by our total resource capability and our capacity to produce at prices that will enable us to remain internationally competitive.

How, then, are Queensland's resources placed to achieve an expansion of agricultural production to meet the increasing world food shortfall and to take advantage of the growing market opportunities in Asia and the Middle East?

Although the potential for agricultural expansion in Queensland is promising the outlook must be tempered by:

1. the rate at which technology can be adapted to meet the demand for expansion; and
2. the existence of factors that will place competing demands on the availability of land and other resources for agricultural development.

I want to make it clear that a significant stage has been reached in Queensland agriculture at this time.



The potential exists for expansion of grazing areas and cattle numbers in north Queensland. Changing this potential into actual production will depend on the success of pasture research and pasture improvement in the sub-humid tropics and subtropics.

Much of the best agricultural land, that is, areas with few limitations to use, has already been developed and current agricultural development is beginning to expand onto soils that have more limitations or which require more intensive management practices to maintain them in a productive state. Departmental resource studies are being directed towards identifying these marginal soils, their potential, and their management needs in terms of soil-water management, soil conservation, soil fertility and maintenance of soil structure.

Land assessment

My Department has recently undertaken an assessment of the agricultural and pastoral potential of Queensland. Land was assessed on the basis of the criteria of soil, climate and landform, and net agricultural potential was determined by allocating arable soils preferentially to a range of well-adapted crop species. The results illustrate the scope for very large expansions in field crops, particularly in the western section of the Darling Downs, the South-west, Fitzroy, Mackay and the Far Northern regions of the State.

This is an exciting and worthwhile assessment of our State's resources but there are further pertinent issues.

To what extent, and at what rate, will expansion into these areas actually occur? Limited projections to the year 2000 were prepared in



The Burdekin River Irrigation Project is expected to lead to the expansion of rice production. The present 15 000 t could rise to 50 000 t with some 10 000 ha under rice.

conjunction with the current study of the future storage, transport and port requirements of the grain industry being undertaken by the Queensland Planning Committee on Future Grain and Oilseed Handling, Storage and Transport. The projec-

tions indicated a doubling of winter and summer grain areas in this period. At existing prices, this expansion would represent increased export sales of about \$220m a year, and an increase of about \$380m once every 5 years.



The northern latitude gives horticultural crops in the Burdekin a start on their competitors in the traditional growing areas farther south. On current projections, 2 000 ha of horticultural crops could be planted each year.

These predictions are a forward extension of the present moods and motivations of producers, reflected in current rates of land acquisition, clearing and development assuming there are no changes in the present price and demand climate. They are also based on the assumption that grain handling authorities will make at least the minimum provisions for storage, transport and shipping.

In the Weipa hinterland, the existing land resource amounts in total to more than 700 000 ha of potential agricultural area. If developed agriculturally and pastorally, this resource could generate export earnings of the order of \$200m to \$300m in current values. The challenge will doubtless emerge—in a very real sense it is already there—to provide the technology, infrastructure, transport and marketing necessary to realise the potential.

The availability of water, or rather lack of it, has always been a limiting factor in agricultural development.

Burdekin Irrigation Project

One of the major sources of potential expansion in agriculture in Queensland, indeed in Australia, is the Burdekin River Irrigation Project. This vast land and water resource development scheme has

wide-ranging direct and indirect or secondary benefits, of which an expansion in agricultural production is only one.

On the basis of agronomic and market considerations, the most favourable opportunities for expansion relate to the production of sugar, rice, soybeans and horticultural crops.

1. There will be adequate soil areas to permit a doubling of the region's current annual sugar production capacity of 500 000 tonnes by the year 2000.
2. It is estimated that it will provide the potential for an expansion of rice production, currently around 15 000 t a year to 50 000 t a year. This will involve a rice planting of some 10 000 ha annually.
3. An annual crop of 5 000 ha is considered feasible for soybeans. The soybean is a new crop for the Burdekin area and would most likely be grown in rotation with rice.
4. Horticultural crops have an advantage in north Queensland areas such as the Burdekin because summer crops can be produced much earlier than in the traditional growing areas in the south. On current projections, 2 000 ha of horticultural crops could be planted each year.

The potential exists also for substantial expansion of grazing areas and cattle numbers in north Queensland. The conversion of potential into tangible production will depend very much on the success of pasture research and pasture improvement in the context of the natural grasslands of the sub-humid tropics and subtropics.

What demands would this possible expansion place on current technology?

Developing and testing new technology entails allocating resources into research. Much of the technology necessary to support such an expansion of land usage and agricultural production is still in the embryonic stage. Indeed, there is a backlog of technology for use in the years immediately ahead.

Research into fields such as soil conservation, genetic improvement of plant and livestock for food and fibre production, plant breeding, insect and disease control and the on-farm use of computers is continuing and encouraging results are being achieved.

Soil erosion threat

Soil erosion is one of the greatest impediments to agricultural expansion particularly where intensive land management practices are necessary. Soil erosion through water alone accounts for 98% of degradation in cultivated lands and 75% in grazing lands. Given this, one can perhaps appreciate the emphasis that is placed on research and extension into conserving this most important resource.

Queensland's rural industries encompass a wide environmental diversity from tropical to temperate and from humid to arid conditions. Thus our research activities adopt a unique orientation in the genetic improvement of livestock and plants.

Livestock breeds must be evaluated for a wide variety of environments and our plant breeding and selection effort must be geared to improving yield, product quality and disease resistance for a particular set of environmental conditions.

In a different sphere, new technology in the form of computers and micro-computers is already playing an increasing role in decision-making at the farm level in fields such as genetic improvement programmes, crop and pasture rotation systems, pest and disease diagnosis and management, and irrigation scheduling. In addition, there is scope for the application of

computers to financial and farm management uses such as cash flow projections, taxation, market information for crops and livestock and the assessment of lease or purchase decisions for land and farm machinery.

As well as being engaged in research ourselves, we must be curious and vigilant about the research of others. It is also important that we foster the skills and experience in our own staff to recognize the applicability of research findings to the farm situation. We must also maintain and engender a sense of confidence within the farming community that our recommendations on the introduction of new techniques, new management practices and new plant and livestock strains can help the farmer himself achieve his own aspirations and, in so doing, better realize the full potential of our agricultural resources.

Ultimately, growth in the agricultural sector of this country is very much an interactive force in which the knowledge, skills, enterprise and initiative of the farmer himself are central factors. The importance of personal motivation in farming cannot be over emphasized. It is worth noting that one-quarter of Russia's food production comes from about 3% of land devoted to private arable farming.

Through all of this one can also detect a change in the very face of agriculture. The commercial environment is certainly a changing scene. Rural marketing organizations are hiring new skills not so much from among the agriculturally minded but from among the commercially oriented people of our community. Today agriculture is indeed a business. It embraces not only the farmer with 'mud' on his boots but also the man in the business suit who understands the world of finance, the intricacies of futures markets, international exchange rates and the political, social and cultural nuances of the markets which we serve.

Agriculture is also a business which is probably more vulnerable today than ever before because of an increasing exposure to industrial disputation and because of its dependence upon a complex range of infrastructural factors.

My discussion thus far has been couched solely in terms of developments within the agricultural sector. However, agriculture forms but one

part of a larger tapestry of sectors within the economy. It is impossible to analyse the prospects for agricultural developments in Queensland in the next 10 years without recognizing the inter-dependencies between agriculture and other sectors and the implications for agriculture of developments in other sectors and other countries.

In broad terms, any change in the economic environment will have ramifications for the development of agriculture in Queensland, for example, changes in inflation, interest rates or other aspects of monetary policy, taxation policy, government expenditure, wages policy and industrial relations, tariff policy and of course the very important energy issue. Likewise, international factors such as trends in world trade, trade barriers in overseas countries and movements in exchange rates will also alter future prospects for agricultural development. All have very complex implications for agriculture.

Mineral expansion

While it is not appropriate to undertake a detailed discussion, I would be remiss if I did not make some brief and special mention of the impact of mineral expansion on Queensland agriculture.

The renewed interest and capital investment in mining represents very much a mixed bag for Queensland agriculture. Mining competes for land, water and labour resources but also creates growing market demand for some agricultural commodities in localized areas.

Moreover, agriculture is likely to reap some external economies through the provision of better transport facilities and in the development of improved electricity and communications systems.

Its more serious implications lie in the Balance of Payments area where the inflow of foreign capital is generating a steady upward pressure on the Australian dollar which will reduce rural earnings and erode the competitiveness of our rural industries. As a consequence, we see today an increasing call from agricultural and pastoral interests for reduced tariffs both to reduce farm costs and to relieve the upward pressure on the exchange rate.

Long-term prospects promising

In the course of this analysis, I have attempted to provide some perspectives on the longer term

prospects for Queensland agriculture through the 1980s and beyond. Overall, I believe that the prospects are very optimistic. But if the foundations for success are to be properly laid, it is my view that the development of a comprehensive and imaginative macro policy package is both opportune and a critical prerequisite.

I have already mentioned that my Department is, in conjunction with personnel of other Queensland Departments and industry groups, already engaged in a major study of future handling, storage and transport needs of the grain and oilseed industries through to the year 2000. But even this study with its wide charter has a more narrow frame of reference than the undertaking that I envisage.

Accordingly, in recent months, officers of my Department have been engaged in developing the guidelines for a major policy paper on agriculture in Queensland. The paper will not duplicate the discussion paper recently commissioned by the Federal Minister for Primary Industry but will focus attention on areas of special concern to Queensland as well as those issues where we have complementary interests.

Clearly, the developments to which I have alluded in this article are not the exclusive interest of the rural sector and the Queensland Department of Primary Industries. They are, or should be, matters of great interest to the entire nation.

The progress of which I have spoken will not be achieved without a good deal of interdepartmental co-operation within Queensland, nor will it be achieved without the support of Federal Government bodies.

Formal institutions for Government-to-Government exchange are already well established through the meetings of the Standing Committee on Agriculture and the Australian Agricultural Council. The Commonwealth Extension Services Grant has also been of considerable assistance in the funding of our activities.

I am sure that, in the years ahead, the good relationships that have existed in the past will continue to flourish. Doubtless many of you will, by virtue of your office, be charged with ensuring that a spirit of co-operation is fostered at the very highest levels of the State and Commonwealth Public Services.

Electrical stimulation for more tender meat

by R. G. Robotham, Veterinary Public Health Branch.

A new processing system to produce more tender meat is now being used in Queensland.

The consumer will benefit from this new system. So will the butcher as he will be able to guarantee a tender product to his customers and thus receive fewer complaints.

Consumers have had to put up with increased prices for meat. However they do not mind so much if their meat is tender.

There are a number of reasons for tough meat and some of these are:

- Meat from aged cattle.
- Stress factors before and during slaughtering.
- Cold shortening, which toughens meat appreciably.

Cold shortening occurs if the temperature of meat falls below 10°C before it is in rigor (rigor is the change of muscles in a carcass from when it is slaughtered to the time the carcass has set, which can take up to 20 hours). Muscles that are already in rigor will not cold shorten

regardless of the temperature at which they are held. The carcass will not toughen as much if the rigor process is allowed to take place without great changes in temperature.

Modern abattoir chillers are designed to decrease the temperature of meat quickly to avoid bacterial growth, to enhance keeping quality and reduce the risk of food poisoning. Unfortunately, as desirable and necessary as refrigeration is, it does produce the adverse effect of cold shortening.

However, the effects of cold shortening can be decreased by:

- The tenderstretch process.
- Electrical stimulation.

Electrical stimulation of a freshly slaughtered animal greatly increases the speed of rigor and thus substantially reduces the ability of muscle to shorten while the carcass is being chilled. Trials of electrical stimulation have shown that it can produce a real improvement in tenderness. This result is comparable with that produced from 2 weeks of ageing at 0 to 2°C, or by the tenderstretch method.

Early models of low voltage electrical stimulation systems, extensively used under country slaughter-house conditions, are rectal probes. These have been superseded by one using nasal rectal probes which are more effective. The nasal rectal probes may be connected to the power supply box of the existing rectal system. These systems can be implemented immediately, at very low capital cost, in almost any works especially those with no space to spare on the slaughter-house floor.

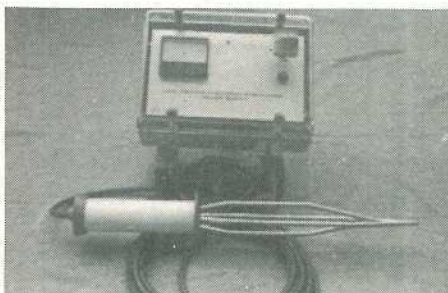
It is important that the carcass be stimulated within 4 minutes after the animal is slaughtered, otherwise maximum benefit is not obtained. The stimulation excitation is applied for 90 seconds after sticking and while the carcass is hanging from the bleeding rail. After this, the electrodes are removed and cleansed. The stimulation excitation is pulsed at 40 pulses per second and up to 45 volts peak, which is extra low voltage.

These methods are successful, and though the mechanism is not fully understood, it is thought to stimulate the muscles via the nervous system to expend energy stored in them. One of the disadvantages of this system is its manual operation. With tenderstretch, the muscles of the striploin, rump, topside, cube roll, silverside and round are stretched to varying degrees and their shortening and toughening prevented.

Safety is important. The extra low voltage is safe to touch. If the voltage is above extra low voltage, the electrode and the entire carcass must be guarded from human contact. It is important to stress that it is not a safe practice to devise an electrical stimulation system with a voltage above 45 volts peak without safeguarding the operator.

The electrical stimulator is made up of only two components—power supply box, and the probes.

There are commercially produced low voltage electrical stimulation systems available in Brisbane and information may be obtained by contacting the C.S.I.R.O., Meat Research Laboratory, Cannon Hill or the Queensland Department of Primary Industries' Meat Inspection Service. Phone (07) 224 4232.



This single rectal electrode system is available commercially.

Lucerne—a vital forage crop at Monto

by G. A. Lambert, Agriculture Branch

Monto's dairying industry has been dependent on lucerne (*Medicago sativa*) since it started 50 years ago. It is a long-lasting, easy-to-grow forage which can produce up to 16 000 kg per ha of dry matter annually without applying nitrogen fertilizers.

Newly-imported, aphid-resistant, winter-active varieties offer the dairy farmer an opportunity to base the full year's feeding programme on lucerne and reduce the cost of winter production. The main concern with lucerne is bloat. However, careful grazing management can minimize this problem.

Most of the Monto Shire's 1 500 ha of irrigated lucerne is made into hay, chaff and, more recently, wafers. Wafers and chaff are widely used as a vegetable protein additive in intensive pig and poultry rations and in rations fed to racehorses and horses used for recreation. The more traditional lucerne hay is used in supplementary feeding of beef and dairy cattle as well as for working horses.

Soil types and requirements

Lucerne is grown on the river and creek flats throughout the Monto district. These are mostly alluvial soils which are deep, friable, extremely fertile with good internal and external drainage. Soil reaction is slightly acid to neutral with a pH range of 6.3 to 7.5 and this suits lucerne very well.

Phosphorus and potassium levels are normally very high. However, soils with available phosphorus levels of 30 p.p.m. or less require superphosphate applications.

Sulphur, zinc, copper and molybdenum have been applied to lucerne on numerous sites throughout the district but no yield differences have been measured. The only fertilizer responses obtained have been from nitrogen applications in winter to Hunter River—a winter semi-dormant variety.



Lucerne is the backbone of feed year programmes on nearly all Monto dairy farms.



Travelling irrigators are used on some larger lucerne farms to minimize labour inputs.



Spraylines are still widely used at Monto.

Climate

Monto is approximately 160 km due west of Bundaberg. It has an annual average rainfall of 820 mm and 70% of this falls between November and March. Winters are dry and cool with an average of 21 frosts expected between May and September each year. Summer temperatures range from an average daily maximum of 26°C to 35°C in midsummer.

Water requirements

Lucerne is very deep-rooted—the roots are capable of reaching a depth of 10 m or more. In some instances, the crop is grown on creek flats which have a shallow water table of 4 to 6 m and the plant roots can tap this moisture.

However, studies have shown that 70% of the total water requirement for crop growth comes from the top 1 m of soil. Soil moisture in this root zone must be maintained if production is to be optimized. Usually this requires 75 to 125 mm of irrigation water for each cut of lucerne.

Monto growers have traditionally applied this quantity in one irrigation but with the advent of travelling irrigators, many farmers are applying two applications of 55 mm each per cut. This strategy is also used by farmers with hand-shift spray lines on the heavier soil types which have low infiltration rates.

Spray line irrigation systems are the most common type used on lucerne. They give a better coverage and apply more water in each

irrigation than do travelling irrigators. Spraylines are also much cheaper to buy and operate than travelling irrigators. However, they do have much higher labour requirements.

Most of the irrigation water used at Monto is suitable for watering all crops. However, there are a few areas where the water is suitable for moderate to high salt-tolerant crops only. Lucerne is one of these crops and good production has been achieved using this water provided the quantity of water applied at each watering is increased to 150 mm to leach excess salt from the profile.

Cultivar selection

Prior to the arrival of the lucerne aphids in 1977, Hunter River was the only cultivar planted at Monto.

TABLE 1

LUCERNE CULTIVARS AT A GLANCE

Cultivar	Collectotrichum Crown rot (1)	Phytophthora root rot (1)	Spotted alfalfa aphid (2)	Blue green aphid (2)	Dry matter yield (t/ha/year) Biloela
Relatively winter dormant					
DeKalb 167	S	R	R	S	18.2
Pioneer 545	R	MR	R	HS	16.9
Winter semi-dormant					
Pioneer 573	MR	S	MR	HS	18.2
WL 451	MR	MR	R	HS	19.9
Hunter River	R	HS	HS	HS	18.9
Relatively winter non-dormant					
DK 185	MR	MR	R	HS	18.2
WL 512	MR	MR	R	S	19.0
WL 514	S	S	R	MR	18.9
WL 508	S	HS	R	HS	20.1

TABLE 1—continued

LUCERNE CULTIVARS AT A GLANCE

Cultivar	Collectotrichum Crown rot (1)	Phytophthora root rot (1)	Spotted alfalfa aphid (2)	Blue green aphid (2)	Dry matter yield (t/ha/year) Biloela
Winter non-dormant					
Pioneer 572	S	S	R	HS	20.1
Matador	MR	MR	R	MR	20.0
CUF-101	HS	R	R	MR	20.0

1. Based on data compiled from a number of independent assessments at Biloela and Gatton.

2. Assessed on plants in the seedling stage under natural attack in the field near Toowoomba.

R = Resistant

MR = Moderately resistant

S = Susceptible

HS = Highly susceptible

Source: D. Gramshaw (1979) 'Growing Lucerne for Hay in Central Queensland.

It is a relatively high-yielding, winter semi-dormant type which produces excellent quality hay. However, it is susceptible to soil-borne fungal diseases and both the blue green and the spotted alfalfa aphids.

A number of American aphid-resistant lucerne cultivars were imported during 1977. These varieties were selected on their yielding ability, aphid resistance and disease resistance in areas of similar climate in the U.S.A. to those experienced in Australia. Information collected since 1977 has confirmed that many of these cultivars have a place at Monto.

Matador and CUF-101, both winter non-dormant types, are the most popular. Both are capable of high yields of good quality hay but, as with all winter active cultivars, have a tendency to drop their leaves quickly after physiological maturity. Cutting must be timed precisely otherwise stalky, inferior quality hay is produced.

In the last 2 years, predators of the aphids have increased considerably and insecticide spraying for these pests has now been reduced to one or two per year.

The selection of a lucerne cultivar at Monto is now based on yield, hay quality, longevity and the importance placed on winter hay production.

Research is being conducted to improve the disease and aphid resistance of Hunter River. Several lines have been selected from Hunter River and CUF-101 crosses. Most of these, including Siriver, are showing winter non-dormant characteristics although semi-dormant aphid resistant cultivars are also being sought (table 1).



A heavy crop of CUF 101 in its third season on Three Moon Creek flats near Monto.



The haybine mows, conditions and windrows.



The side delivery rake is still widely used to turn windrows and ensure quick and even drying prior to baling.

Establishing the crop

Soil preparation

The seed bed should be firm, fine, level and weed-free and a long weed-free fallowing period is necessary. Lucerne seedlings are small and take time to establish. It is important that these seedlings have little or no weed competition in their life.

Time of planting

Autumn-early winter is the ideal time to plant lucerne. Fallowing through the summer will encourage soil moisture storage and ensure effective weed control.

Frequently, irrigation is used to establish the crop and this usually results in the germination of winter-growing broad-leaved weeds with the lucerne seedlings. These weeds can be controlled with 2,4-DB.

It is preferable to use irrigation to plant the crop during autumn or early winter than to delay and plant on rainfall in spring. Vigorous competition from summer grasses, particularly liverseed (*Urochloa panicoides*), is almost inevitable in spring plantings.

Planting rate

Trials at the Biloela Research Station suggest that maximum yields from lucerne can be achieved at densities around 200 plants per m^2 . About 85% of this maximum yield can be achieved from winter semi-dormant or winter non-dormant varieties at densities of 40

plants per m^2 . At lower plant densities, yield declines rapidly and weeds are likely to become a significant component of hay.

The aim should be to establish about 200 plants per m^2 . Allowing for 40% establishment, this would mean planting at about 10 kg per ha.

Local observations indicate that most stands reduce to 100 plants per m^2 after the first few cuts and after 12 months, only 60 plants per m^2 remain. Stands seem to stabilize at this level until disease or prolonged wet soil conditions reduce them further.

Sowing depth

Dryland crops must be planted into moist soil no more than 4 cm deep. Most growers plant with a winter cereal cover crop which is sown at 15 to 20 kg per ha. The lucerne seed is planted through a small seed box on a combine.

Irrigation farmers have adopted the technique of spreading the seed on the soil surface and harrowing and/or rolling it in. This buries the seed 2 to 3 cm deep. The paddock is watered quickly with 25 to 30 mm and a second irrigation of the same quantity follows. This ensures that the top 8 to 10 cm of soil is kept wet for at least 10 days. This provides ideal conditions for germination of lucerne seed.

The most common method of spreading seed is by removing the planting hoses at the seed box. Fertilizer spreaders have been used but they are too inaccurate in distribution.

Nodulation

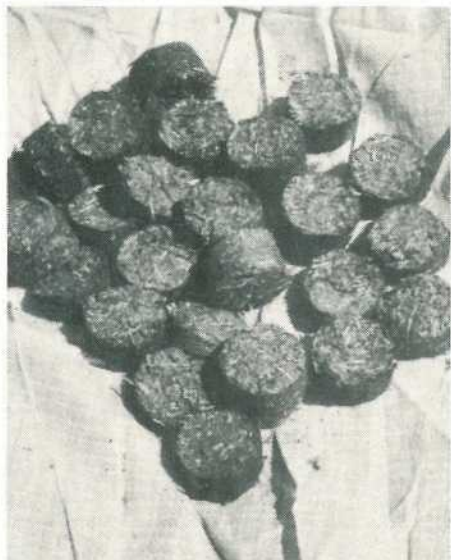
The specific lucerne rhizobia *Rhizobium meliloti* must be present in the soil for effective nodulation. It is not normally present and all new plantings must be inoculated. The bacteria will persist in the soil but it is good insurance to inoculate each planting regardless of the time interval between lucerne crops. The correct strain of inoculum is readily available commercially. This should always be stored in a refrigerator before use.



Bulk forage harvested lucerne being loaded into a drier before being made into wafers.



The dried, compressed lucerne coming out of a wafer machine. This machine makes about 1 t per hour of wafers.



The lucerne is dried and compressed into a column 8 cm in diameter and then cut into lengths of about 3 cm. Digestible protein of the wafers varies from 19 to 25%.

Management

Weeds are controlled with 2,4-DB. This herbicide should be applied when the weeds are young and actively growing and when the lucerne is in the two to eight trifoliate leaf stage. Rates of 2.8 to 4.0 L per ha of 40% 2,4-DB are recommended but 2.0 L per ha will give excellent weed control if the weeds are young and vigorously growing.

Effects from this herbicide may not be visible for 2 weeks and repeat applications should not be attempted within this period.

The first cut of a newly established crop of lucerne should not be taken too early. A minimum of 3 months from planting is required for lucerne to establish an effective root system and defoliation should not be considered before then.

During the warmer months of the year, the optimum stage of crop growth for harvest is at the one-tenth bloom stage. The balance between quantity and quality of material is then optimized. The plant's food reserves taken up from the roots in the initial regrowth are also replenished. If cuts are taken too frequently, these reserves are depleted and regrowth is slower. If the process is continued indefinitely, plants will die and weeds will invade the crop.

In winter, cutting should be timed to coincide with the emergence of new shoots from the crown. Earlier harvesting will reduce yields from each cut and increase harvesting costs. Research at Biloela indicates that this time interval is about 6 weeks for both winter non-dormant and winter semi-dormant varieties despite the relative height differences. For example, a height ratio of CUF-101 to Hunter River of 1.6 gave a yield difference of 1.2.

Sound grazing management of lucerne stands demands short grazings followed by recovery periods of the order of 6 weeks if stands are not to deteriorate.

Bloat is always a consideration when grazing lucerne crops and dairy farmers who regularly graze lucerne, spray the crop with anti-bloat oil immediately prior to grazing.

Haymaking

Still a very skilful operation, haymaking has been made easier by recent machinery developments. Cutting is done with a haybine which combines cutting, conditioning and windrowing. Side delivery rakes turn the lucerne regularly to ensure a quick and even drying. Monto growers prefer to rake early in the morning or at night when the dew starts to form to avoid leaf loss.

Baling is the crucial operation, fine judgement being required to bale at the correct moisture content of 20 to 25%. With practice, farmers can judge this by feel and by the bark on the stems not peeling off easily. Most growers bale at night just as the dew starts to form. This slightly moistens the hay making it more pliable and lessens leaf loss in the baling operation.

If hay is baled at moisture contents of 30 to 35%, the bales must be less compact to enable the passage of air into them. They should also be left in the paddock for a day or so before stacking as wet hay will heat and go mouldy. In extreme cases, sufficient heat will be generated to cause a fire.

A new method to hasten the curing of hay is being assessed at Monto. It involves the spraying of a 5% potassium carbonate solution on to the newly-mown hay as it is picked up to go through the rollers of the haybine. Curing time was reduced to 4 days in winter. Treated material, which was wet by rain and left in the paddock for 8 days in September before baling, did not bleach.

Lucerne wafers

This high quality lucerne product with 19 to 25% crude protein is now being made at Monto. The lucerne is cut with a forage harvester and the material is dried to 12% to 15% in an oil-fired drying machine. The material is then compacted into an 8 cm diameter tube and then cut into lengths of about 2 cm.

The curing process takes less than 60 minutes. There is no loss of quality due to leaf loss and there are no storage problems. Lucerne can be harvested at any time as the wetness of the crop and the weather prospects are immaterial.

Wafers have been used as an additive to pig, poultry and race-horse rations. Weight gain and production advantages, particularly in egg production, are claimed by the manufacturer and users alike. However, most dairy farmers consider them too expensive and of an awkward size to feed safely to dairy cows.

Pests and diseases

Lucerne leaf rollers and *Heliothis* spp. are the most troublesome leaf-eating insects in Monto. The larvae of the leaf roller spin a web binding the new, growing terminal leaves together. They shelter in this and eat the tender new leaves. The usual method of control is to cut or graze the crop. Spraying with carbaryl immediately after baling helps to control the remaining larvae and adults.

Sporadic outbreaks of *Heliothis* spp. require control. This pest invades in such devastating numbers at times that they can completely defoliate a near mature crop within a few days. They favour hot and dry conditions. Under humid conditions,

their populations can be reduced to insignificant levels very rapidly by a disease.

Aphids, jassids and thrips are the main sap-sucking insects of lucerne.

There are now three lucerne aphids in Australia, the spotted alfalfa aphid, the blue-green aphid and the pea aphid. Both the spotted alfalfa and blue-green aphids invaded the Monto district in 1977.

Initially, their effects were severe. More recently, however, aphids have caused far less economic loss because of control exercised by native predators such as ladybirds and lacewings and introduced wasp parasites coupled with judicious insecticide use. There has also been a swing to imported lucerne varieties which are resistant to spotted aphids and tolerant to blue-green aphids.

All cultivars of lucerne are susceptible to aphids in the seedling stage, but the granular insecticide disulfoton can be drilled in with the

seed at the rate of 5 kg per ha. The commercial products, Disyston and Solvirex, both contain disulfoton. Such treatment gives protection to the young lucerne for 5 to 6 weeks.

Jassids and thrips cause periodic damage to lucerne by sucking the leaf sap. The leaves eventually turn yellow and fall off. Yields are not affected even by heavy infestations of these insects, but quality may be reduced and growers can spray to maintain quality.

Late summer is the most troublesome time for jassids (table 2).

Fungal diseases, root rot (*Phytophthora megasperma* var. *sojae*) or crown rot (*Colletotrichum trifolii*), play a major role in determining the persistence of lucerne. They are soil-borne diseases which can be controlled by allowing 5 years between lucerne crops and selecting resistant varieties. Several of the imported American lines show fair resistance to both diseases while Matador, and the winter semi-dormant variety WL 451, are highly resistant.

Selections for disease resistance from Hunter River have been made. This material is now being used by plant breeders to introduce some aphid resistance in Hunter River types.

Economics of hay production

The average yield at Monto is 14.8 t per ha per year.

Table 3 shows the actual costs taken from a number of successful lucerne growers in the first half of 1981.

A price of \$50.48 per tonne must be achieved to cover the cash outlay that a farmer makes to produce his lucerne. He must receive \$102.84 per tonne in order to replace machinery and to pay himself wages.

The 10% investment allowance is calculated on the value of all his assets required to make and store hay and is the interest he could get on his money if invested elsewhere.

TABLE 2
Insect Damage and Control

Insect pest	Damage	Control
Spotted alfalfa aphid* (<i>Therioaphis trifolii</i>)	Sucking insect which cause internode shortening, stunted plants, mis-shapen leaves.	1. Demeton-S-methyl (Metasystox) at 150 to 300 mL of product/ha.
Blue-green aphid (<i>Acyrtosiphon kondoi</i>)	Leaf drop can be severe. Seedlings rapidly killed. Aphid secrete a sticky, heavy dew making all aspects of harvesting difficult. Black mould caused by the dew reduces hay quality.	2. Pirimicarb-100 to 150 g of 40% conc./ha. 3. Pirimicarb-100 to 150 g of product/ha. (Pirimor) 4. Thiometon (Ekaton) 150 mL product/ha
Lucerne leafroller (<i>Merophyas divulsana</i>)	Larvae web terminal leaves together sheltering within and feeding on the leaves. A pest in spring and summer and occasionally in autumn.	1. Carbaryl-1 100 g of 80% wettable powder. 2. Methidathion (Supracide)-850 mL of 40% product/ha. Cut and remove material.
Jassids and thrips	Sucking insects. They generally do not warrant treatment alone. They can cause loss of quality in lucerne hay.	1. Jassids-Dimethoate-350 mL of 40% product per ha and carbaryl-1.4 kg/ha of 80% product. Cut and remove material. 2. Thrips Dimethoate-350 mL of 40% product/ha.
<i>Heliothis</i> spp.	At times they infest crops in sufficient numbers to completely defoliate entire crops. A pest in a dry spring or early summer.	1. Carbaryl-1.4 kg/ha of 80% product. Cut and remove material.

*The parasitic wasp, *Trioxys complanatus*, was released in the Monto district in 1978 to help control the spotted alfalfa aphid. It has been relatively successful. Wherever possible, applications of carbaryl and methidathion should be avoided as these chemicals are very damaging to populations of the parasite. Pirimicarb and demeton-s-methyl are the least damaging.

TABLE 3
Production Costs as at June, 1981

Description	\$/tonne	\$/ha
Production expenses		
Electricity	8.00	120.56
Establishment costs	3.50	51.60
Casual wages	7.50	111.00
Chemicals	4.36	62.50
Twine	2.40	35.52
Fuel and oil	2.00	29.60
Repairs	3.50	51.80
Sundry	2.00	29.60
Total (1)	33.26	492.58

TABLE 3—continued
Production Costs as at June, 1981

Description	\$/tonne	\$/ha
Selling costs		
Freight	8.40	124.32
Commission	5.90	87.32
Total (2)	14.30	211.64
Overheads		
Accountancy	.40	5.92
Bank charges	.20	2.96
Insurance	1.00	14.80
Postage and telephone	.60	8.88
Rents and rates	.17	2.52
Registrations	.35	5.18
Travelling and subscriptions	.20	2.96
Total (3)	2.92	43.22
Total cash costs = (1) + (2) + (3)	50.48	747.44
Depreciation	34.66	512.97
Farm labour	17.70	261.96
Total costs	102.84	1 522.37
Allowance for 10% return on investment	35.30	522.44
Price to cover all costs of production	138.14	2 044.81

Cabbage for all seasons

CABBAGE varieties for all seasons and all districts in Queensland can now be recommended by the Queensland Department of Primary Industries.

This is the result of a large-scale varietal screening project at the Redlands and Gatton research stations, followed by district evaluation from Stanthorpe to Mareeba.

D.P.I. horticulturist Mr Allen Hibberd said most of the evaluation was conducted at Redlands where the humid coastal climate aided evaluation. The varieties were tested under stress by promoting the development of disease and physiological disorders.

The effectiveness of the selection procedures was confirmed when the selected varieties performed satisfactorily in trials in other districts. The new varieties, which were selected specifically for Queensland conditions, were replacing the older varieties Greygreen and Greengold.

Mr Hibberd said some of the characteristics of the new varieties varied in different districts and at different planting times. These characteristics were head weight, core length, resistance to lodging and susceptibility to black rot.

He advised growers to make trial plantings to observe the performance of the new varieties before undertaking large-scale plantings.

The first new recommendation, Rampo, was selected primarily for summer production but there was an increasing trend for it to be grown in winter. Its main advantage was its early maturity. It produced well in all districts in most seasons.

Selection 1488 was suited to the Redlands district. It was an excellent quality cabbage, but had to be harvested at early maturity because of its susceptibility to bursting.

Hi-Yield and Beauty were excellent cabbages, well suited to the Lockyer, Toowoomba and Granite Belt districts. However, they could develop black rot during summer and were not recommended for coastal districts.

Green Coronet was an excellent quality cool season variety, best suited to subcoastal districts. An undesirable characteristic was a tendency to form sprouts at the base of the head; consequently it was not recommended for summer cropping. It was more susceptible to insect attack than other varieties.

Hybrid 33, a large winter variety of good quality, was grown mainly in the Redlands district. It should not be grown in summer.

Georgina gidyea poisoning in cattle and sheep

by P. B. Oelrichs, Biochemistry Branch

GEORGINA GIDYEA, known botanically as *Acacia georginae*, was identified by Department of Primary Industries workers in 1955 as the cause of a highly fatal disorder of cattle and sheep.

This disorder had been responsible for heavy stock losses in the Georgina River watershed in the Northern Territory and north-western Queensland since settlement began in the late nineteenth century.

The numbers of deaths and rate of mortality may reach spectacular levels. For example, 500 cattle were lost on one property alone in 1946, and in the same year 300 of 900 cattle placed on a new bore died. During October–November 1951, about 500 sheep died near a bore located in a strip of *Georgina gidyea*. In the Northern Territory, cattle losses are thought to be even higher than in Queensland and there is one report of 30 000 cattle being lost in one year.

By 1918, the disorder was known over an area of about 240 kilometres (150 miles) in length and about 140 km (90 miles) in width in the Georgina River basin. This is about its present distribution in Queensland, but an adjacent area of comparable size is affected by the problem in the Northern Territory. Deaths occur almost every year in some localities or intermittently or not at all in others.

Accurate information on stock losses is difficult to obtain mainly because many properties are very large (up to 260 000 hectares in area) and extensive areas are unfenced. Because drinking water supply is poor in this area stock are dependent on more-or-less permanent water holes or sub-artesian bores.

Grazing limits are therefore determined largely upon walking distance from water and, from the incidence of deaths at these watering places, owners designate the area as 'poison' or 'safe'.

The effect of this plant is reputed to be the most important factor, except drought, that limits production in this area. Many instances of fatalities involving 300 to 500 animals have been recorded. In addition to actual stock losses, there has been also a great reduction in potential production because the risk involved makes it necessary to leave extensive areas unused.

Description of gidyea

Georgina gidyea is a large shrub or small tree generally with crooked branches and a dense leafy crown. If grazed regularly, it may remain a bushy shrub, but it can attain a height of 6 metres in inaccessible places. The bark is dark grey in colour, hard and flaky, the leaves grey green, slightly curved, tapered at both ends, with numerous fine parallel veins usually 5 to 10 cm long and 2 cm wide. The flowers are very small yellow, in globular heads in groups in the forks of the leaves.

The pods are about 5 to 10 cm long and 2 cm wide, flat and curved, the few seeds in each pod are disc shaped about 6 mm in diameter, thick in the centre and thinner towards the margin, glossy brown and hard when ripe.

It is distinguished from the more widespread but non-toxic gidyea (*Acacia cambagei*) by its broad curled pods and disc shaped seeds. The leaves and flowers of both species often have a characteristic odour resembling that of rotting onions particularly when the air is damp.

Poisoning of cattle and sheep

There is a marked seasonal incidence in mortalities; most occur in the dry period of October to December when grass is scarce and animals have to travel long distances to obtain water. At this time, Georgina gidyea produces most of its pods, but stock losses may occur at any time of the year when sufficient pods are available.

In both cattle and sheep, the disorder is characterized by suddenness of death and this is often precipitated by excitement, exercise or fright. If affected animals are driven, they become sluggish, tremble and fall or lie down, difficulty of breathing is seen. The disorder occurs in cattle and sheep of all ages other than lambs and young calves, and the strongest and best conditioned animals are often the first affected.

With cattle, the most striking feature of the disorder is the suddenness with which death occurs; apparently healthy animals have collapsed and died within a few minutes. The nervous symptoms seen in some affected sheep are rarely seen in cattle.

Sheep also can collapse suddenly and die in a few minutes, often death being preceded by trembling of the muscles and struggling at intervals. If left alone, the affected animal may apparently recover and rejoin the flock, but if disturbed in the following 24 hours again collapse and show nervous symptoms. This may lead to death or eventual recovery of the animal probably depending upon the amount of toxin ingested.

Post mortem examinations of cattle and sheep shown marked cyanosis in the visible mucous membranes, congestion of the lungs, haemorrhages in the liver, congestion of kidneys, congestion of the mucous membranes of the small intestine, but there are no lesions which can be related to the cause of death in animals.

Toxic and non toxic areas

Although both pods and suckers of Georgina gidyea have been proved toxic, the plant is considered a valuable fodder in the Georgina River area. As it is also widely spread, eradication would be both undesirable and impractical. Indeed, it is held by some landholders that destruction of this species would be

followed by heavy losses of stock in droughts. Even when other feed is abundant, cattle have been observed to eat considerable amounts of leaves.

A considerable variation in toxicity between localities has been noted. In certain areas where Georgina gidyea grows in dense stands, no deaths have ever occurred. Other areas can be safely stocked for many years and then losses of animals occur. In addition, it has been suggested that trees are toxic on certain types of soil and not on others; this has not been demonstrated but needs to be investigated further.

Research

Extensive trials were carried out in the 'toxic' area by workers of the Department of Primary Industries from 1947 to 1953 to establish that Georgina gidyea was responsible for the disorder. This proved to be a very difficult and confusing problem mainly because other species of toxic plants were growing in the same area.

Feeding trials carried out at Ardmore Station showed that *Eremophila latrobei* and *Eremophila longifolia*, when force-fed to cattle and sheep in small quantities over several days, caused death and symptoms not unlike those seen in natural cases. In no instance, however, were lesions like these seen in the natural disorder.

On the other hand, sheep fed a sole diet of Georgina gidyea leaves over 2 weeks showed no ill effects. Freshly collected branches and leaves of the shrub, mixed with chaff when fed to cattle over a period of 7 days, produced no ill effects.

Force-feeding with mixtures of *A. georginae* and *E. latrobei* leaves over 6 days resulted in death of another sheep. The effects seen were typical of those in animals fed *E. latrobei* alone. Indeed it was stated by one author that 'the pods of *A. georginae* have been said to be poisonous, but the weight of evidence is against this, and it is now considered that they may supply the "key" which unlocks the poison always present in native fuchsia (*E. latrobei*)'.

As a result of these findings, it was decided to extend the investigations to field trials, and an area containing a good growth of both *E. latrobei* and *A. georginae* was fenced and stocked with sheep. Mortalities were observed soon, and these were not reduced by completely removing the *E. latrobei* and other *Eremophila* species from the area.

The Georgina gidyea trees were destroyed by ring barking in another area, sheep were placed in this and left until the feed was eaten out. The animals became weak, but none developed the disorder. It now seemed plain that Georgina gidyea was responsible for stock losses, and this was demonstrated conclusively by further yard tests using sheep and cattle.

In this study, the animals were fed a mixture of pods and leaves and were exercised daily. In all cases, the symptoms and lesions were similar to those seen in natural cases. Further convincing evidence was obtained from paddock experiments with cattle and sheep. In addition, these trials showed that suckers of ringbarked trees and aqueous extracts of these were toxic to sheep.

Isolation of the toxin

Research has been aimed at isolating and identifying the toxin in Georgina gidyea responsible for killing the animals. Knowledge of the chemical structure is a prerequisite for attempts to devise an antidote and for the development of a method of quantitative analysis. Such a method would allow determination of the level and duration of toxicity in affected areas.

There is a time lapse of nearly 10 years between when it was established conclusively that Georgina gidyea was responsible for the stock losses and the isolation and identification of the toxin responsible for these losses. This was not due to inactivity, as a considerable amount of work was done at the University of Queensland in an attempt to achieve this, but the toxin proved to be very elusive and all attempts to isolate it were unsuccessful.

The problem was then returned to the Animal Research Institute, Yeerongpilly, where the isolation of the toxin was finally achieved by workers at this Institute. To do this, ground seeds of Georgina gidyea were first extracted with a suitable solvent to dissolve the toxin. In the initial work, the toxin in this solution was isolated by a series of six different steps to give a pure chemical compound which was identified as monofluoroacetic acid.

This is related chemically to sodium monofluoroacetate (commonly known as 1080 poison). As a lot is known about monofluoroacetic acid it was now possible to use a much simpler isolation procedure of four steps and obtain complete recovery of the toxin.

Concentrations of the toxin were measured in Georgina gidyea

samples of mature and immature seed pod and leaf from three different 'toxic' areas in north-western Queensland. The results of these measurements showed that, in any one area, the concentration of toxin in immature seed and pods was much higher than in mature. The highest concentration was found in immature seed (400 mg per kg) and the lowest in mature leaf (14 mg per kg). These concentrations of toxin found can fully account for the stock losses.

Nature of the toxin

The toxin monofluoroacetic acid in Georgina gidyea is not a new compound. In fact it was known as early as 1896, but its toxicity was not fully investigated until the early 1940s. Interest in monofluoroacetic acid increased considerably in 1943 when J.S.C. Marais discovered that it was the toxin in a well known South African plant *Dicapetalum cymosum* (commonly known as Gifblaar) which causes severe cattle losses in the Transvaal region.

The action of the toxin was discovered in 1953 by Sir Rudolph A. Peters working at Cambridge, England. In a number of biochemical experiments, he was able to show that the toxin blocks the vital citric acid (or energy) cycle in animals by producing fluorocitrate instead of citrate. This production of fluorocitrate he called a 'lethal synthesis' and is the cause of death.

There is a wide variation in the dose of monofluoroacetate which is toxic: the dog can be killed by 0.05 mg per kg, the sheep 0.4 mg per kg whereas the toxic dose for the toad is 300 to 500 mg per kg. The variation is explained by the relative ease of conversion of monofluoroacetate to monofluorocitrate.

Other plants with the toxin

Since the isolation of monofluoroacetic acid in Georgina gidyea, the number of plants known to contain it has risen to about 36. Many of these have been found in Western Australia where the species *Gastrolobium* and *Oxylobium* are mainly found. Some of these are the most toxic reported so far.

Search for an antidote

Attempts by many to find an antidote for monofluoroacetic acid poisoning have not yet succeeded. Monoacetin (glycerylmonoacetate) has curative effects if introduced early enough. This is thought to stop the production of fluorocitrate. Recent evidence demonstrates that available (ionized) blood calcium plays a major role in monofluoroacetic acid poisoning.

With laboratory animals, their survival time is doubled if dosed with calcium salts. This needs to be tried with sheep and cattle as it is possible that some animals receiving marginal doses may survive if dosed with calcium salts.

Next step, an antidote

Considerable progress has been made in solving the problem of

(*Acacia georginae*) poisoning. It is now possible to relate deaths of cattle and sheep with a specific cause monofluoroacetic acid, a toxin which is well known and whose biochemical action in the body understood. Much work is being done world wide to develop an antidote for this toxin.

Further research is needed as there is still little information on the extent of the toxic and non toxic

areas, and whether this is due to a soil factor such as high fluorine content. The treatments monoacetin and calcium salts need to be tried as those may be helpful in marginal cases of poisoning.

A publication by A. T. Bell, L. G. Newton, S. L. Everist and J. Legg on *Acacia georginae* poisoning of cattle and sheep has been used in preparing this article.

New packaging for tick fever vaccine

NEW plastic packs with convenient numbers of tick fever vaccine doses have just been released on the Queensland market.

The Queensland Department of Primary Industries through the Tick Fever Research Centre at Wacol supplies the State's cattlemen with vaccines to combat tick fever, one of Queensland's most serious cattle diseases.

'Tick fever kills hundreds of cattle each year. This is a sad state of affairs because a very effective vaccine is readily available,' said Mr Peter Timms, a D.P.I. microbiologist at the Wacol laboratory.

'The vaccine itself is unchanged, the dose is still 2 mL and the method of inoculation remains the same. It is only the method of packaging which has been improved.'

Mr Timms said the new packs were easier to use with both disposable and repeating syringes. Each pack was stamped with an expiry date. Provided there was no delay in transport and the packs were kept refrigerated, the vaccine could be used until that date.

The new plastic packs contained enough vaccine for either 100 or 50 animals. The smaller one could be half filled to contain 25 doses.

He said the vaccine was a living laboratory strain of tick fever parasites. To keep the parasites alive, the vaccine had to be kept chilled. It should not be stored in freezers as freezing killed the organisms and made the vaccine useless.

'The new packs are sent with ice inside foam coolers. These coolers need not be returned so they're a bonus for our clients,' he said.

'Tick fever vaccine can be ordered directly from the Tick Fever Research Centre, Wacol, or through agents, veterinary officers or stock inspectors. Cattlemen should advise the quickest and most reliable method of transport to their areas.

'The vaccine is still very cheap. It costs 25c a dose for ordinary vaccine and 32c a dose for two germ vaccine. Minimum charges, to cover transport costs, are \$8 for parcels by road or rail and \$11 by air.

'We're confident the new packs will help the vaccine travel to cattlemen better,' concluded Mr Timms.

Dip strength must be right

FAR too many Queensland cattlemen are dipping their stock in chemicals at the incorrect strength, according to Mr Trevor Reid, a tick extension officer with the Queensland Department of Primary Industries.

He said: 'All tickicides should be used at the recommended concentration. Dipping in below-strength chemicals results in poor tick control. Over-strength dips are just as unsatisfactory because they can lead to problems with chemical residues in slaughter cattle and toxicity. They waste both chemical and money.'

Mr Reid said all tickicides had been tested to determine the most economical and effective concentrations. When used on susceptible ticks at the recommended strength, the chemicals gave good control at reasonable cost.

If a dip at normal strength would not control ticks, increasing the concentration would not solve the problem. It only led to a stronger resistance as well as risking residues and toxicity. It was more efficient and economical to change to a tickicide that would kill that particular strain of resistant tick at normal strength.

Mr Reid encouraged cattlemen to have their dips tested regularly to ensure that they were using the chemical at the correct strength. If they had trouble in killing ticks, they should go to their local D.P.I. stock inspector for advice.

He added: 'It's easier to maintain the correct concentration of chemical if the volume of the dip is known exactly and the vat is correctly calibrated. This cuts out the guesswork that can lead to problems.'

Fencing with sawn posts in Cape York

by J. Boorman, Beef Cattle Husbandry Branch

John Harris, of Violet Vale Station, Cape York, has used sawn posts milled on the property in all the fences he has erected since 1977.

The posts which are cut from ironwood are 10 cm by 5 cm and 1.8 m long. Ironwood is the timber of choice in Cape York as it is very durable and naturally immune to termite attack. However, species such as ironbark should be suitable in termite-free areas.

In 1977, the ironwood posts which were cut and bored by station labour, and erected by a contractor using a cable driver, cost \$2 each to cut, bore and erect. This was exactly equivalent to the cost of purchasing, carting and erecting steel fence posts.

The average post spacing used in 1977 was 12 m and the cost per kilometre for erected posts in 29 km of fencing was \$164.

At 12 m spacings, one dropper was used between the posts. John Harris tried some experiments with post spacings in 1977 and as a result he has since spaced posts 18 m apart with two droppers between the posts.

Strainer assemblies are spaced 400 m apart.

Cutting posts

Trees to be cut into posts are felled and cut into 1.8 m lengths before being taken to the saw bench. Cutting the logs to exact lengths is important as sawing logs which are 5 to 10 cm too long wastes time and effort. Logs with a pipe up the centre are avoided as an ants' nest in the pipe will blunt even a tungsten-tipped saw.

At the mill, a flitch is taken off the side of each log with a hargen saw so that the log will lie flat when it first goes on to the saw bench. This operation is carried out with the logs placed in a cradle on the ground.

The posts are bored to carry three wires as they come off the saw bench.

As a bonus, John Harris is able to cut 75 mm by 25 mm and 50 mm by 25 mm battens from the logs.



Sawn ironwood posts measuring 10 cm x 5 cm x 1.8 m cost as much to cut, bore and erect on Cape York as purchased steel posts.



A flitch is cut from one side of each ironwood log with a hargen saw before the log goes on to the saw bench.



Posts are bored at the drill press as they come off the saw bench.



John Harris uses a friction-drive tractor-mounted post driver.

Erecting posts

In 1977, Bill Raymond, of Pinnacle Station, erected the posts and ran the wire on contract.

The posts were erected by driving with a home-made driver which uses a winch to pull a 180 kg weight to the top of the post guide. When the weight reaches the top, the winch kicks out of gear and the weight drops.

Bill Raymond's driver has one weakness—it does not pivot. The ground is never level and it is easier to drive the posts straight when the driver can be pivoted.

In 1978, John Harris bought a tractor-mounted friction-driven post driver, and used station labour to drive as well as cut the posts.

Posts only drive straight when they have a square end. If the end is off square, the posts finish up slightly off line at the top.

Pointed posts need an even taper on each side or they do not drive straight. Pointed posts are only of benefit in hard clay soils but the same effect can be achieved by making a pilot hole before driving the posts.

Posts with a square end drive better in gravelly soils than posts with a pointed end, according to Bill Raymond.

The posts are driven in 60 cm and stand 1.2 m out of the ground.

In 1977 Bill Raymond started driving the posts at the end of the

dry season when the ground was very hard. Towards the end of the job, rain fell and driving was much easier. After the rain, Bill Raymond, with the assistance of one other person, was able to drive the posts, run three 1.6 mm barbed wires, and strain and tie them on at the rate of 1.6 km a day. Strainers had been erected previously.

Both John Harris and Bill Raymond consider 10 cm by 5 cm posts to be the optimum size. They feel that 7.5 cm by 5 cm posts would be more inclined to shatter under the driver and also more inclined to 'spring' rather than drive in hard soil. The extra load that larger posts will carry in a flood should also be an advantage.

Spotting bugs a problem in avocados

THE most important pest of avocados in the near North Coast area is the fruit spotting bug. These insects can cause heavy losses of fruit even when only small numbers are present in an orchard.

The thin skinned varieties, Fuerte in particular, are the first to be attacked.

Mr Jim Lewis, Horticultural Extension Officer with the Department of Primary Industries at Gympie said that the bugs were most active on the young fruit from September to February. The best approach for control was to spray when fresh damage was seen during this period. One or two sprays with endosulphan or trichlorophon might be all that was necessary for control. If the spotting bug problem were severe, a monthly spraying from October to January might be necessary.

The adult bug was pale green, with a narrow almost rectangular shape, and about 12 mm long. It gave off a distinctive sweet 'bug' odour when crushed or handled.

The young stages or instars were wingless, greenish orange and had an ant-like appearance. The bugs moved quickly out of sight when disturbed and therefore were difficult to detect.

Much more obvious was the damage they caused. The insect fed by sucking and this caused a deep wound because the feeding insect secreted an enzyme which caused tissue breakdown. The external damage could vary from pitting to a crack or to a large water-soaked blotch. The recent damage exhibited by the water-soaked areas were often accompanied by a white sap exudation which later dried to a white residue.

Fruit which were damaged when very young initially developed only a 'dimple' at the feeding point.

Mr Lewis said: 'Many of the damaged fruit fall from the tree and those remaining are usually unmarketable, so control measures should be applied as soon as any damage appears.'

Life cycles of the cattle tick and tick fever parasites

by N. P. Stewart, R. J. Dalglish and T. Tratt, Pathology Branch

The cattle tick (*Boophilus microplus*) has been a major problem to the Queensland cattle industry for almost 100 years.

The tick probably arrived in Australia with 12 Brahman cattle brought from Java to Darwin in 1872. During the 1890s, unrestricted movement of infested cattle allowed the tick to spread into Queensland, and by 1895 it had reached the coast near Townsville. At the turn of the century, the tick had become established near Brisbane, and was first found in New South Wales in 1906.

The tick brought with it a serious disease, tick fever, which killed many thousands of cattle as the vector spread through the susceptible cattle population. Today, the tick and tick fever are confined to an 'enzootic' area of Queensland by the controlled movement of cattle, and by climatic conditions which limit the spread of the tick.

Tick fever still kills hundreds of cattle in Queensland each year. There is also a production loss and cattle may die from anaemia caused by the blood-sucking tick. The effects of tick fever and its vector, now thought of as 'old' problems, provide a good example of the initial devastation and continuing loss that could be caused by the introduction to Australia of other 'exotic' diseases and pests.

Knowledge of the nature and habits of the tick and the disease agents it transmits helps in control. This article outlines the life cycles of the tick and the tick fever organisms, and describes how and when the disease is transmitted. An accompanying article in this issue describes how tick fever can be controlled by vaccination.

Life cycle of the Cattle Tick

This can be considered in two parts, the parasitic part during which the tick feeds on cattle, and the non-parasitic part which the tick spends on the ground. The two parts of the life cycle of the cattle tick are shown in Figure 1.

Parasitic part of life cycle

When 'seed' ticks (larvae) infest a host they usually bite immediately and begin feeding. However, during the first 2 days following infestation, feeding is intermittent, and the larvae frequently detach to move about on the host. After 5 to 6 days, they ingest a large meal of tissue fluids and blood, and moult to become eight-legged nymphs. Nymphs also feed on the host's blood, and moult after 6 to eight days to young adults.

At this stage, the sex of the tick can be determined. Males usually moult first, and can be found lying underneath engorged nymphs and female ticks. The male is much smaller and more active than the female.

The parasitic life of the tick is completed 8 to 12 days after the nymphal moult, and so usually ranges in total from 19 to 26 days. Fully engorged female ticks drop from the host. Male ticks may either remain on the host or detach with the female. Males have been known to survive for 70 days either on

the host or in vegetation (relying on dew or plant juices for their fluid intake).

Non-parasitic part of life cycle

This begins when the fully engorged female tick, the stage most easily seen on infested cattle, falls to the ground and finds a suitable place to lay eggs. The pre-egg laying period is dependent on environmental temperature and relative humidity, and can be as short as 1 to 2 days or as long as 40 days.

The duration of egg laying is also temperature-controlled and can range from 2 to 44 days. Each female tick may lay up to 3 500 eggs.

During summer when both temperature and humidity are optimal, eggs hatch in approximately 18 to 21 days. However, eggs laid during late Autumn may not hatch until the following Spring. In the laboratory, eggs have been known to hatch after 146 days storage at 17°C, but fail to hatch if exposed for long periods to low relative humidities (below 70%).

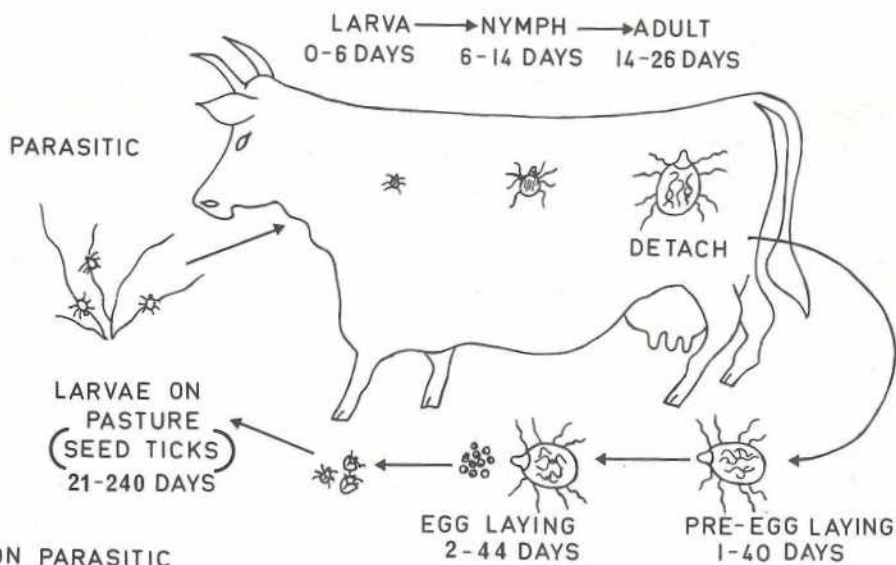


Figure 1. Life cycle of the cattle tick.

The parasitic part of the life cycle which is spent on the host is in three stages—larval, nymphal and adult. The non-parasitic part is spent on the ground and its duration depends on prevailing environmental conditions.

The six-legged larvae which hatch from eggs are known as seed ticks. These are extremely active in response to moving objects. The close proximity of an animal is sufficient to activate them to climb to the tips of grass, where they can attach more easily to a passing host. During the evening, seed ticks seek protection in the vegetation to spend the night.

The longevity of seed ticks is influenced by temperature and humidity and may range from 21 to 240 days. They are extremely vulnerable to very low ambient temperatures and low humidity, though they have been known to hatch and spend up to 9 days under water without apparent harm.

The non-parasitic part of the life cycle ends when seed ticks find a suitable host. This may not necessarily be cattle. The cattle tick has been known to infest horses, sheep, dogs, buffalo, deer, pigs and hares, though cattle are the preferred host.

The Disease Complex

Tick fever refers to a disease complex. The three pathogenic parasites transmitted by *B. microplus* are *Babesia bovis* (previously called *Babesia argentina*) and *Babesia bigemina* which cause babesiosis, and *Anaplasma marginale*, which causes anaplasmosis. *B. bovis* is by far the most common cause of tick fever in Queensland. *B. bigemina* is very widespread in the enzootic tick area but outbreaks of disease caused

by it are not common. *A. marginale* ranks between the two babesias as a cause of disease.

Life cycles of tick fever parasites

B. bovis and B. bigemina

The life cycles of *B. bovis* and *B. bigemina* are similar in both cattle and ticks. The following is a composite description for the two parasites.

Development cycle in cattle

The developmental cycle in the bovine host is shown in figure 2. Infective forms called small merozoites are produced in large numbers in the salivary glands of feeding ticks. The infective forms of *B. bovis* are injected into cattle by larval ticks, and those of *B. bigemina*, by nymphal and adult ticks.

In infected cattle, the parasites invade red blood cells, where they undergo development and division and then destroy the red cell. More parasites are thus released into the blood stream and invade other red blood cells. The destruction of blood cells releases the red pigment, haemoglobin. In severe infections, sufficient haemoglobin is excreted by the kidneys to discolour the urine—hence the common name—'red-water'.

The blood cell cycle is repeated until the animal dies or until its immune system is able to control the infection. In this case, the parasites remain in the blood stream in very

small numbers, perhaps for years, without causing sickness. The animal is then a carrier of the disease.

Development cycle in the tick

In the tick, the developmental cycle is more complex, with the parasites undergoing many changes in size and morphology. The parasites invade and multiply in various tissues including gut epithelial cells, haemolymph cells, muscle cells of the developing embryo, and gut epithelial cells and salivary gland cells of the new generation of larvae. This cycle is simplified in figure 3.

When a female tick feeds on an infected animal, babesial parasites present in the red blood cells enter the gut lumen of the tick. In the gut lumen, the parasites escape from the red cells and invade gut epithelial cells where they undergo massive multiplication (figure 3—1 to 4). The end result is the production of large parasites called vermicules or large merozoites (plate 1) which are released into the haemolymph, that is, the tick's 'blood' (figure 3—5 and 6).

Vermicules are motile and able to swim in the haemolymph. Some enter the oviduct and invade the developing eggs (figure 3—7 and 8). Here, the parasites multiply again and then remain dormant until the eggs hatch and the larval progeny infest a suitable host.

After attachment of infected seed ticks, the *Babesia* are activated and development recommences. The main stimulus for this seems to be

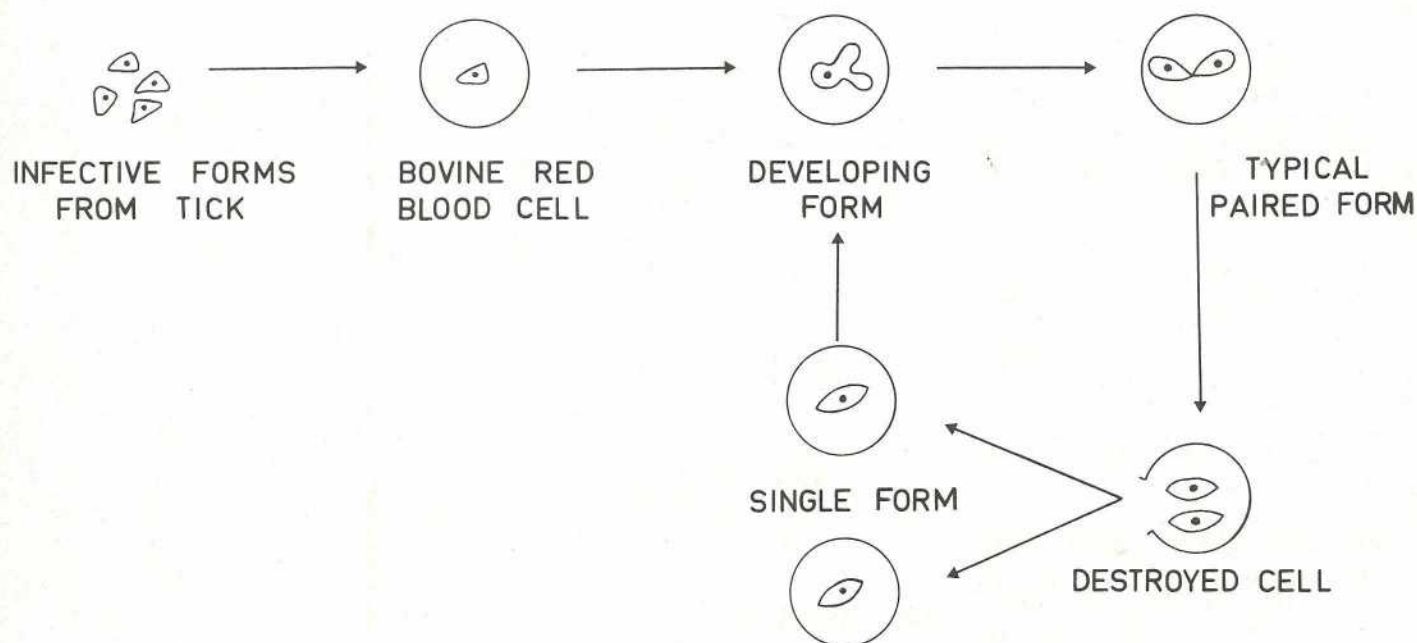


Figure 2. Life cycle of *Babesia* in the bovine host.

The development cycle in the bovine is responsible for the destruction of red blood cells. The released pigment, haemoglobin, is excreted in the urine which becomes dark red in severe cases of babesiosis—hence the common name of 'red-water'.

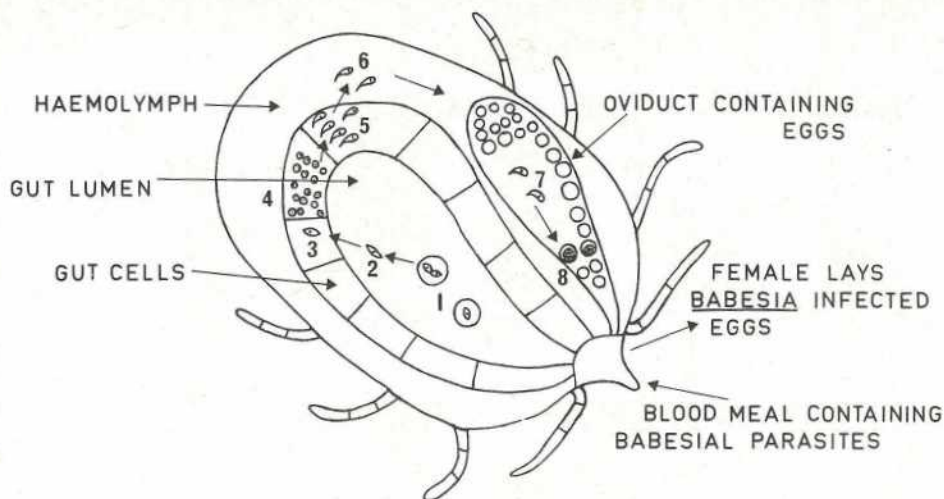


Figure 3. Life cycle of *Babesia* in *Boophilus microplus*.

Babesial parasites enter the gut lumen of the adult female tick during final engorgement. After a series of multiplications in various tissues of the adult tick, the parasites infect her eggs and are thus transmitted to her larval progeny.



Plate 1. Vermicules or 'large merozoites' are motile and able to move in the haemolymph to other tick tissues. This is essential for the life cycle of the parasite to continue.



Plate 2. 'Small merozoites' of *Babesia* are produced in large numbers in tick salivary gland cells and are injected into cattle during feeding of the tick.

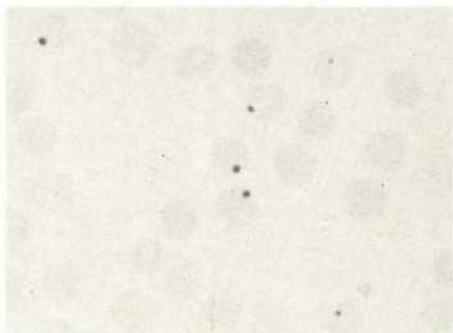


Plate 3. *Anaplasma marginale* parasites in bovine red blood cells appear as discrete black dots. Usually more than 70% of the parasites are located near the edge of the cell. Infected red blood cells are destroyed causing anaemia.

heat, provided by proximity of the larvae to the warm-blooded animal. The first developmental stages seen in feeding larvae are vermicules, which invade the larva's salivary gland cells, and form large numbers of small merozoites, the forms that are infective for cattle (plate 2).

A. marginale

A. marginale is a different type of parasite to *Babesia*, but is similar in that it is spread by the cattle tick and also invades and destroys the red blood cells of cattle.

Development cycle in cattle

In specially stained blood from infected cattle, *A. marginale* organisms viewed under an ordinary microscope are seen as black, irregular-shaped dots, usually at the edge of infected red blood cells. Except for variations in the size and position of these dots, the appearance of the parasite changes very little (plate 3).

However, studies with the more powerful, electron microscope have revealed that the large and small dots have a slightly different composition. Apparently, the small dot, or initial body as it is called, is the stage that enters the red blood cell.

Here, it divides and enlarges within its thin, outer membrane thus forming a large dot. This larger stage of the parasite may contain up to eight initial bodies. When an infected red blood cell ruptures, the parasite's membrane also ruptures,

releasing the initial bodies into the blood stream to invade other red blood cells.

As the infection progresses, more and more red cells contain parasites and are destroyed. The disease is usually more protracted than babesiosis, and anaemia, jaundice and illthrift occur. Red water is not seen, but the urine may become brown in colour. As with babesiosis, animals which survive the acute disease become carriers of the infection.

Development cycle in the tick

Little is known about the developmental cycle of *A. marginale* in the tick. The infection does not appear to be passed via the eggs from the infected parent tick to her larval progeny. However, ticks do become infected when they ingest infected red cells, and they can retain the infection for at least several weeks. We are not sure which tissues of the tick become infected with *A. marginale*, or how the parasite reaches the tick's salivary glands.

Transmission of *Babesia* and *Anaplasma*

Babesia

The transmission of *B. bovis* and *B. bigemina* is depicted in figure 4. Babesiosis occurs following infestation of cattle with larval ticks carrying the parasites. Not all larvae carry the infection.

The proportion of larvae infected, referred to as the 'infection rate' varies considerably. The infection rate in larval ticks depends mainly on the concentration of parasites in the blood of the animal on which the 'mother' tick fed. The infection rate in larvae from ticks which have fed on 'carrier' cattle is likely to be extremely low, and may be zero.

However, if female ticks engorge on an animal sick from babesiosis, the larval progeny will have a high infection rate, and the chance of a subsequent outbreak of the disease in other cattle within the herd is increased. It is obviously a good practice to reduce tick numbers on cattle suspected of having tick fever.

Other factors which influence the infection rate in larval ticks are temperature, and time after hatching. Recent experiments at the Tick Fever Research Centre suggest that

larvae which spend 2 to 4 weeks on the ground before infesting cattle are more likely to spread babesiosis than newly-hatched larvae.

It seems that babesia need a dormant period within non-parasitic larvae to develop fully. Cool weather (about 14°C) appears to enhance this development. The experiments indicate that seed ticks are most infectious about 3 weeks after hatching, and may be potentially dangerous even when paddocks are spelled for several months.

B. bovis is transmitted to cattle only by the larval tick, and infection is not retained by the tick following its first moult. *B. bigemina* continues its development in both nymphal and adult stages. The nymph is undoubtedly the principal infecting stage for *B. bigemina*, but adult stages are also capable of transmission.

Because the adult male has a relatively long life span, and is readily transferred between cattle in close contact, this stage may also have a role in the spread of *B. bigemina* infection.

Anaplasma

Larvae, nymphs and adult ticks can all transmit *A. marginale*. The infection is probably spread when the ticks feed on an infected animal and then transfer to another susceptible animal. This is most likely to occur when tick-infested cattle are in close contact with others, such as when calves suckle, or during yarding of stock for routine management procedures. Mixing of tick-infested and clean cattle should thus be avoided.

Anaplasmosis can also be readily spread in small amounts of infected blood. Procedures such as dehorning, castration, vaccination and collection of blood samples may spread the disease within a herd if precautions are not taken against the transfer of blood on surgical instruments and needles from infected to non-infected cattle. In some countries, biting flies can spread anaplasmosis, but there is no evidence to indicate that this occurs to any significant degree in Australia.

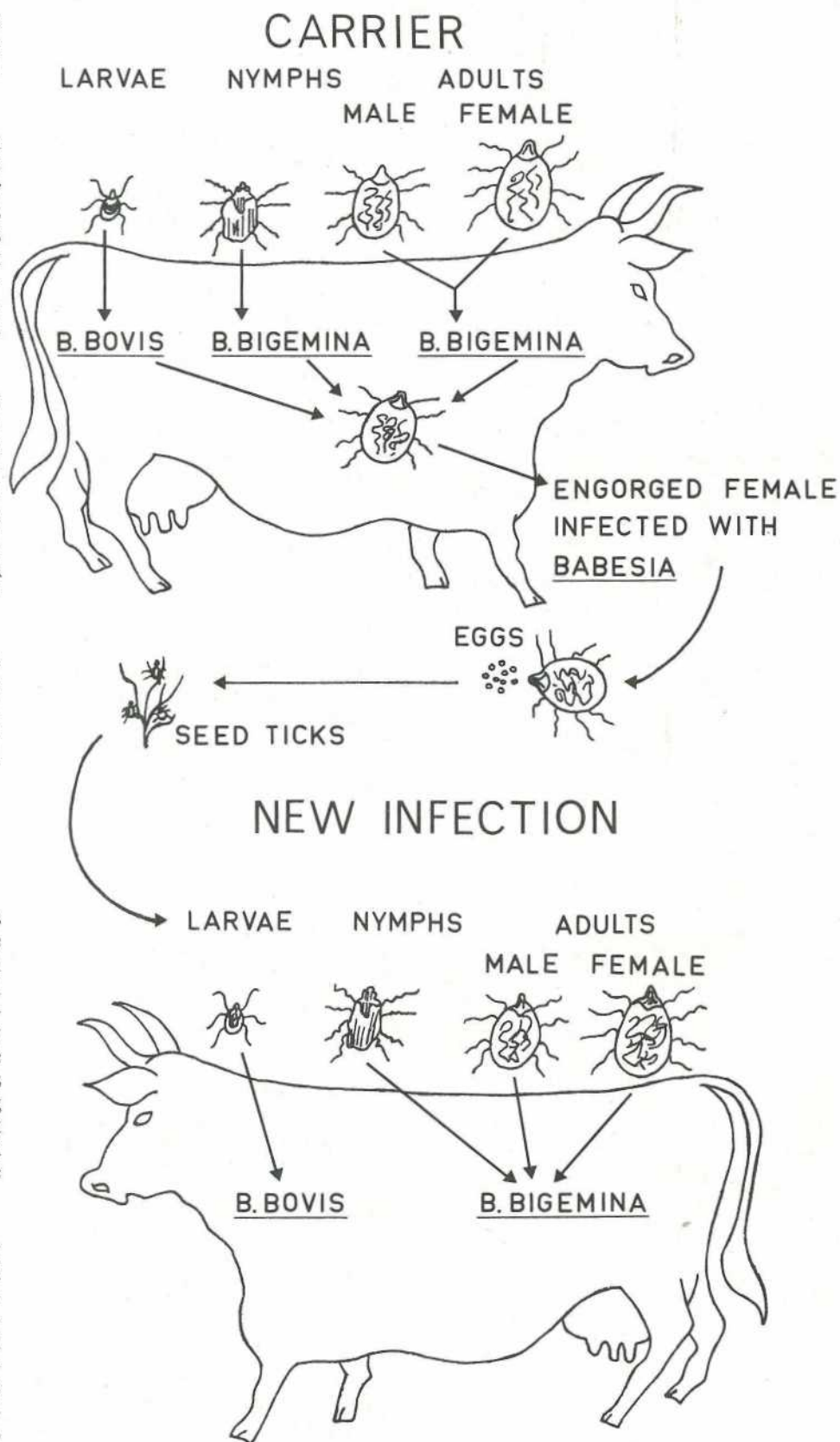


Figure 4. Transmission of Babesia.

B. bovis is transmitted to cattle by larval ticks only, and *B. bigemina* by nymphs and adults. After the animal recovers from initial infections it remains a carrier for many years. Adult female ticks subsequently feeding on this animal can become infected with Babesia. The progeny of these ticks is capable of transmitting babesial infections to other animals.

Goats and goat meat

by T. Foley, M. Boyle, D. Kerslake and B. Bridgemann, Veterinary Public Health Branch

Goats belong to the family of hollow-horned ruminants (or Bovidae) and are members of the genus *Capra*, closely allied to the sheep.

Domesticated goats are descended from the pasang. The East was probably its original home; the earliest records being Persian.

In China, Great Britain, Europe and North America, the domesticated goat is primarily a milk producer. For large-scale milk production, goats are inferior to cattle in the temperate zone, but superior in the torrid and frigid zones.

Goat's milk is pure white in colour and compares favourably with cow's milk in flavour and keeping qualities under sanitary conditions. It is more easily digested by infants, invalids and persons allergic to cow's milk. The fat globules are smaller and remain in emulsion (naturally homogenized).

The Angora and Cashmere goats produce mohair and cashmere respectively and are bred for that purpose.

The flesh of the goat is edible, that from young kids being quite tender and resembling lamb, and in some areas is a common source of meat. Goat meat is sometimes called 'chevon'.

The old recipe for cooking goat—boil the meat with a stone till the stone is soft—gives quite the wrong idea. In fact, in a test done at the Queensland Agricultural College, students were unable to distinguish goat from hogget mutton.

There are many breeds of goat which may be roughly grouped—the prick-eared (for example, Swiss goats); the Eastern or Nubian with long, drooping ears; and the wool goat (for example, Angora).

In Australia, goats were originally brought out from Britain as a milk supply, and with progress and affluence their progeny were allowed to roam free. As a result, it is not now unusual to see large herds of goats browsing on town commons and the outskirts of country towns in

the western areas of New South Wales and Queensland. It is estimated that there are over 1 million head in Queensland roaming as feral animals.

There is a limited local market for goat meat in the larger Australian cities among ethnic communities. However, many local butchers are loath to become involved in selling goat meat as they fear it would jeopardize their mutton trade.

Export markets are various—the Middle East, Sweden, the West Indies and Hong Kong being the most common.

The slaughtering and dressing of goats for human consumption is very labour intensive, and this seems to be the controlling influence on large-scale operation. Slaughtering, dressing and handling fees are in the vicinity of \$5 per head for goats, compared with about \$3.50 for sheep.

Goats are more difficult to 'dress' than sheep. In fact they are so difficult to skin in a clean and hygienic manner that some abattoirs have recently begun to 'dress' them leaving the skin on—like pigs.

Most processors are not interested in handling goats while there are adequate supplies of sheep and lamb. In recent times, however, with declining numbers of sheep available for slaughter, the handling of goats is becoming a source of revenue for some meat works and abattoirs.

In early September, 1977, the Toowoomba Public Abattoir commenced slaughtering goats for a Melbourne firm for export to Hong Kong. Their throughput is 700 to 800 per week, but is subject to fluctuation.

Slaughtering procedures

At the Toowoomba Public Abattoir, there are two different methods of dressing procedures:

- Skin off; similar to calf dressing. This method only applies to white goats and goats over 18 kg or for specific markets.

- Skin on; similar to that of pig slaughtering. This usually applies to goats under 18 kg.

Skin off

The goats are stunned and stuck in the same manner as sheep using 220 volts. They appear to be easier to stun than sheep. The horns are then cut off with a hand-operated circular saw.

Butchers seem to think that they are twice as hard to leg as sheep, the reason being that the selvage will not separate from the skin as readily. The male goats are harder to 'front out' than sheep. The hide is then pulled off in the same manner as calves. This is a very simple method, whereby a chain is hooked around the two back feet that are attached to the hide, and then tied down to the floor. The continuous movement of the conveyor chain pulls the hide off the carcass.

The heads are not skinned as there is no market for goat brains. From then on, they are eviscerated and inspected, washed and chilled in the same way as sheep.

Skin on

The stunning, sticking and dehorning is the same as for skinned goats. The front feet are also cut off below the knee joint. The goats are then scalded in 64°C to 66°C water, which is about 2°C to 4°C hotter than for pigs. The higher temperature is required because of the longer and thicker hair of the goat.

Some difficulties were encountered in the dehairing; due to the fact that goats have longer necks and legs and are much lighter than pigs. This was overcome by welding sheets of metal between the slats in the dehairer, so as to allow only the beaters to pass through them. This in no way affected the dehairing ability of the machine when it came to pigs, but greatly increased its efficiency when goats were being handled.

Smaller goats have a tendency to get their heads caught between the bars, and the constant spinning of the beaters on the body produces broken ribs and subsequent puncture

of the stomach. This results in contamination of the area around the kidneys. It takes about 1½ minutes for the carcass to be dehaired.

On coming out of the dehairer, the carcass is washed down by a continuous spray, and then manually shaved to remove any remaining hair. Before the carcass is placed on the chain, the back feet are removed as with sheep. From here on, the young 'billies' and 'nannies' require little further treatment. The old 'billies', however, usually have hair left on the withers and neck that is difficult to remove due to the excessive amount of wrinkles in the skin. This hair is usually removed by skinning the affected area.

After receiving a final wash before evisceration, the remainder of the front leg is removed at the knee joint. The reason for the removal of the feet before scalding and the removal of the bone that is left after the wash, is to prevent contamination of the surface area of the shank. From this point on, the procedure is the same as for skinned goats or sheep.

Diseases

Generally speaking, goats are subject to the same diseases, conditions and parasites as sheep. The incidence of diseases and parasitic infections appear to be much lower in goats. (Editor's note—The authors refer to parasites of importance in meat inspection. Internal parasites of importance in husbandry are a very serious problem).

Bruises and fractures seem to be the most common cause of condemnation. Fever is not an uncommon condition, and jaundice is occasionally found. Emaciation is also found, but some active male goats show a brown gelatinous condition of the heart and kidney fat, although the carcass is in fair condition. This is thought to be due to the male's sex drive because he may not eat for several days in the mating season.

Caseous Lymphadenitis is also found in goats, but to a less significant degree than in sheep. The livers seem to be remarkably free of parasitic infections. On rare occasions, cancer may be found.

In the case of skin on goats, skin lesions in the form of small nodules with a yellow core are sometimes found. They vary in size from pin-head to pea size. In affected carcasses these lesions might be quite numerous. This condition is usually treated by skinning the carcass, and judging it on its merits.

In the tropics, careful watch should be kept for Melioidosis as it has been found in goats in North Queensland.

The relatively low incidence of disease and parasitic conditions may be due to the arid conditions of the area from which the goats are derived. The animal's browsing habit in those areas may also be important in this context.

Differentiation between carcasses

Points of differentiation between the carcass of the goat and the sheep are that in the goat the head, pelvis and neck are longer than the corresponding structures of the sheep. The back and withers are more pointed, the chest wall flatter, and the long bones longer and more slender.

All these items, however, are merely relative, and an unsuspecting inspector may easily overlook a headless dressed goat carcass mixed among dark, rangy Merino carcasses when in the freshly chilled state. However, as the carcass ages, it becomes darker and more conspicuous. Castrated males and sterile females will be even more difficult to detect, being superficially well fatted.

Poor quality sheep usually have little kidney fat, while a poor quality goat may have reasonably good

kidney fat. The tissue of the dressed carcass if warm may have a goaty odour. This odour is very objectionable to some people, while other people may be quite unable to detect it. The presence of hair on goat carcasses is sometimes useful for identification. However, under modern conditions, its presence would indicate poor dressing and inspection techniques.

The goat tongue possesses only 12 circumvallate papillae on each side as compared with 18 to 24 papillae found on each side of the sheep tongue.

Skeletal differences may also be detected. These are:

Goat

- Radius twice the length of metacarpus.
- Scapula relatively long with distinct neck; superior spine, narrow and not bent backwards.
- Lateral borders of sternum thin and sharp.
- Tail 4 to 6 inches long and ending in a point. Any shortening, will obviously be post-mortem.

Sheep

- Radius one-quarter longer than metacarpus.
- Scapula short and broad; superior spine thick and bent backwards.
- Lateral borders of sacrum thickened.
- Tail usually docked, and therefore square at the end with a covering of connective tissue and/or fat following healing.
- Even when alive, some breeds of long-wool sheep may be difficult to differentiate from Angora or Mohair goats.

Important points to remember are that the goat's tail points upwards, the sheep's tail downwards. Sheep do not have long hair 'smegs' under the chin, nor wattles.



Tick fever vaccines . . . how they are made and how to use them

by P. Timms, W. McGregor and R. J. Dalgliesh, Pathology Branch

Of the 11.5 million beef and dairy cattle in Queensland, approximately 66% are in areas infested with the cattle tick, *Boophilus microplus*.

These cattle, as well as those travelling from tick-free country into ticky areas, are potentially at risk from tick fever. Fortunately, cheap, effective tick fever vaccines are readily available in Queensland and these are one of our most valuable weapons against the disease. It is rather surprising therefore that only 23% of stock owners in the ticky area vaccinate their cattle against tick fever.

This article describes the present methods for producing tick fever vaccines, and outlines recommendations for their use in controlling and preventing disease outbreaks.

General nature of the vaccines

The accompanying article in this issue describes tick fever as a disease complex caused by three blood parasites—*Babesia bovis*, *Babesia bigemina* and *Anaplasma marginale*. The principle of vaccination is to immunize cattle with special laboratory strains of these parasites. *B. bovis* and *B. bigemina* parasites, isolated some years ago from natural field infections, were modified at the Tick Fever Research Centre to reduce their virulence, and are now used in the vaccines.

Anaplasma centrale, a nonpathogenic relative of *A. marginale*, was brought to Australia from South Africa in 1934 especially for use in vaccination against anaplasmosis. All three vaccine parasites cause a relatively mild form of tick fever which protects cattle against the more severe natural infections (plates 1, 2, 3).

The Research Centre can supply vaccine containing each of the parasites alone, or in any combination. 'Monovalent' or 'ordinary' vaccine contains *B. bovis* only, and approximately 40% of vaccine supplied is this type. 'Bivalent' or 'two-germ' vaccine contains both *B. bovis* and *A. centrale*, and represents the remaining 60% of vaccine usually supplied. Vaccine against *B. bigemina*, a parasite common in ticky areas but which rarely causes disease, is available for use if it becomes a problem on a particular property.

Preparation of the vaccines

The preparation of an effective tick fever vaccine involves a number of steps. The basic procedures are to infect young calves with the laboratory strains of the parasites, collect blood from the calves when large numbers of parasites are present, and mix the blood with a serum-based diluent. These steps are shown diagrammatically in figure 1.

From the time the parasites are removed from the calves they must be chilled to prolong their survival. Vaccine is therefore packed with ice in foam coolers for transport to the property where it is used.

Preparation of parasitized blood

The same methods are used for preparing vaccine containing either *B. bovis*, *B. bigemina* or *A. centrale*. Young calves, 2 to 4 weeks of age, are purchased from an area of Queensland free from cattle ticks. This ensures that they have not previously had tick fever and will be fully susceptible to laboratory infection with the parasites. Precautions are taken to ensure that the calves are also free of other blood infections and are in good general health.

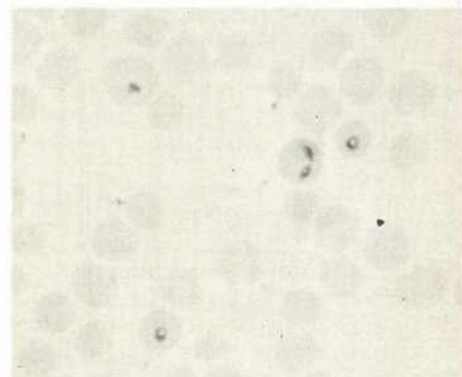


Plate 1. *Babesia bovis* in red blood cells. This organism causes most field outbreaks of tick fever.

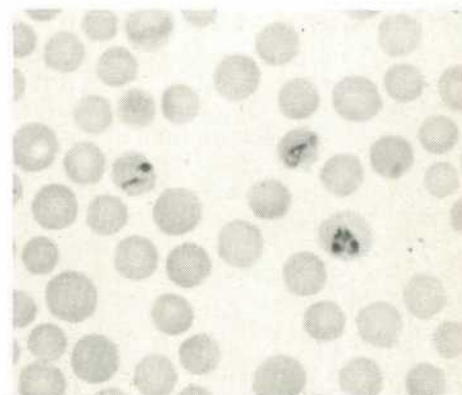


Plate 2. *Babesia bigemina* in red blood cells. This common tick fever parasite rarely causes tick fever in the field.

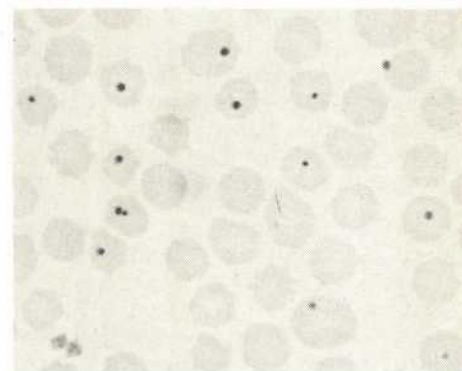


Plate 3. *Anaplasma centrale* in red blood cells. This parasite is included in bivalent vaccine to protect against anaplasmosis.

The next procedure is to surgically remove each calf's spleen. This makes the calf even more susceptible to the tick fever parasites. After the calf is infected by inoculation, a rapid build-up of parasites occurs in its blood. Frequently, there are more than 200 m parasites in each mL of blood at the height of infection. To collect these parasites, the calf's blood is exchanged with that of a healthy bullock. Approximately 4 L of highly infective blood are drawn from the calf, which, in return, receives uninfected blood drawn from bullocks held at the laboratory for this purpose.

Great care is taken to prevent the blood from becoming contaminated with bacteria that may be in the environment. The method of collection prevents blood from being exposed to the air at any stage. As an additional precaution, antibiotics are added after collection.

It is vitally important to keep the parasites alive, and because heat is the most damaging influence, the blood is chilled immediately it is collected, and is then kept at about 4°C. However, even at this low temperature the parasites still die slowly. Blood is not kept for use in vaccine for more than 7 days after collection.

Preparation of vaccine diluent

The solution used for diluting the parasitized blood to the correct vaccine dose is termed vaccine diluent. The vaccine diluent plays a very important role in maintaining the quality of tick fever vaccine. It must be nutritionally adequate to prolong survival of the parasites for at least 7 days after being mixed with the blood.

Before 1971, parasite-free whole blood was used as the diluent. From 1971 to 1979 the diluent consisted of a balanced salt solution supplemented with glucose (BSS+G) and containing 25 to 50% bovine plasma.

An important change was made in 1979 when the bovine plasma component was replaced with 10% sterile bovine serum. This meant that all components of the diluent could be easily passed through very fine filters to ensure bacterial sterility.

Sufficient serum for 12 months' vaccine supply is collected over a 3-week period from a group of special bullocks held at the laboratory. These bullocks, together with those used as donors for blood transfusions, have never been exposed to cattle ticks or tick fever and are also subjected to regular

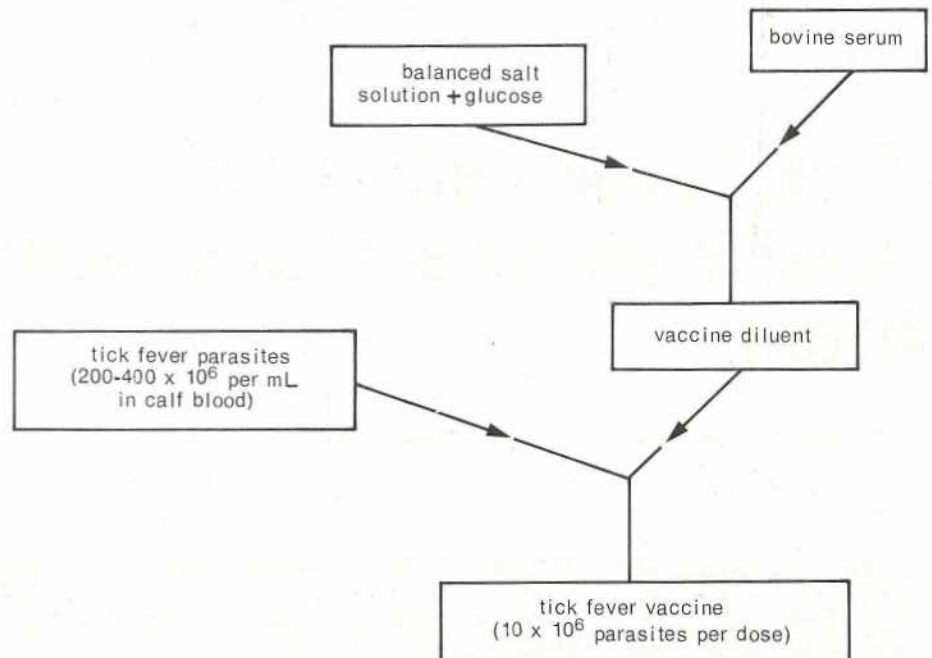


Figure 1. Tick fever vaccine is prepared by mixing calf blood containing large numbers of tick fever parasites with special diluent. A standard 2 mL dose contains 10 million parasites.

health tests. After collection, the serum is sterilized by filtration and kept frozen at -20°C until required.

To prepare vaccine diluent, the stored serum is thawed and 400 mL volumes are added to 3.6 L volumes of filtered BSS+G in a sterile cabinet. Tests are then made to ensure that each batch of diluent is suitable for use in the vaccine.

Apart from being sterile and able to provide nutrition for the parasites, the diluent must have the correct acid-base balance and a suitable concentration of salts. All of these factors affect the 'shelf-life' of the parasites and thus the quality of the vaccine.

Vaccine production

Before the parasitized calf-blood is mixed with diluent, a sample of the blood is taken and the tick fever parasites are counted under a microscope. Once the number of parasites in the blood is known, an appropriate volume of diluent is added to provide the standard vaccine. This contains 10 million parasites in each 2 mL dose. Monovalent vaccine contains 10 m *B. bovis* parasites per dose and bivalent vaccine contains 10 m each of *B. bovis* and *A. centrale* parasites in the same volume.

A fresh batch of vaccine is prepared daily from parasitized calf blood stored at 4°C. The proportion of calf blood is increased each day during the week of its usefulness to

compensate for the slowly diminishing number of live parasites during storage.

After each day's vaccine supply has been prepared, it is dispensed into plastic containers. Two sizes of containers are now used to provide three standard pack sizes; 25, 50 and 100 doses. Polypropylene containers, which recently replaced polyvinyl-chloride bags, are suitable for use with either single shot or repeating syringes (plates 4 and 5).

Packaging

The filled vaccine containers are packed with ice inside foam coolers. This ensures that under normal transport conditions the vaccine remains chilled for at least 18 hours after it leaves the laboratory. Each vaccine container is clearly labelled with the type of vaccine, number of doses, dose rate and expiry date.

Foam coolers recently replaced cardboard cartons, filled with polystyrene beads, for packaging the vaccine. The coolers are better able to protect the vaccine and keep it chilled during transport. They need not be returned to the laboratory.

Each order also contains instructions on the use of the containers, recommendations for vaccination and after-care of vaccinated animals.

Ordering and delivery

Orders for tick fever vaccine should be received at the laboratory at least 24 hours before despatch. Laboratory staff need to know the

quantity and type of vaccine required, the date and method of despatch, the address of the consignee and the person to be charged. Orders are received by mail, telegram and telephone.

Consignments of vaccine are delivered from the laboratory daily to various transport terminals in Brisbane. Transport is by rail, road or air, as required. It is preferable not to transport vaccine on Sundays, long weekends or public holidays as these are the times when parcels are most likely to go astray or be delayed. Arrangements can also be made to collect vaccine at the laboratory.

Monovalent vaccine presently costs 25c per dose and bivalent vaccine, 32c per dose. There is a minimum charge of \$8 by road or rail transport and \$11 by air. All charges include freight. Charges are subject to review as production and distribution costs rise.

Recommendations for use

Care of the vaccine

It is preferable for the vaccine to be used on the day it is received. If this is not practicable, the vaccine should be refrigerated, but not frozen. Provided there has been no undue delay in transport and the vaccine is cool on arrival, refrigerated vaccine should be effective until the expiry date shown on each pack. This date is 6 days after the date of despatch.

Vaccine parcels should be carried in the coolest area available during transport. The foam cooler used for transport can also be used to keep the vaccine cool and out of direct sunlight at the stockyards.

Small clots are occasionally noticed in the vaccine, but provided they are small enough to go through the syringe, the efficiency of the vaccine is not affected. If the vaccine is allowed to stand undisturbed for some time, the red blood cells will settle on the bottom. Gentle shaking is necessary to redistribute the cells before using the vaccine.

Use of the vaccine

The vaccine is injected into cattle either subcutaneously or intramuscularly using a single shot or repeating syringe. The polypropylene packs facilitate the use of either type of syringe. The syringe and needles should be thoroughly cleaned and boiled before and after use.

A suitable needle is about 15 to 20 mm long by 16 gauge. It is advisable to change needles regularly during the inoculation procedure to prevent spreading possible contamination with a dirty needle. Avoid using disinfectants or alcohol as residues can be harmful to the vaccine.

Although each pack of vaccine contains a slight excess, it is important to adjust the syringe to deliver an accurate 2 mL dose. Overdosage will not affect the animal, but may exhaust the supply of the vaccine prematurely. Test the syringe by using water and measuring into a medicine glass.

By inserting string or ribbon through the holes at its base, the vaccine pack may be tied to the operator's forearm (plates 4 and 5). This allows easy, one-handed administration of the vaccine and reduces the chance of air bubbles forming in the delivery tube. If other inoculations are to be combined with tick fever vaccination, it is essential to use a separate syringe for each type of inoculation and preferable to inject each on opposite sides of the animal.

Reactions to vaccination

Some degree of reaction to the vaccines should always be anticipated. For *B. bovis* vaccine, the reaction may occur between 7 and 21 days after vaccination, but is usually between the ninth and the twelfth day.

For *A. centrale* vaccine, the reaction occurs 4 to 6 weeks after vaccination. A reaction is not altogether undesirable, as it indicates the vaccine is taking effect. The animal becomes immune after the reaction period.

In general, reactions are mild, and a high proportion of animals show no visible symptoms. Fever can usually be detected if the animal's temperature is taken during the reaction period. Severe reactions, that is, when the animal is obviously sick or its temperature is 40.5°C or more, should be controlled by giving a suitable drug (see treatment section). A second treatment can be given next day, but is rarely needed.

Vaccinated cattle should not be disturbed or stressed unnecessarily during the reaction period. They should be kept in well-watered, shady paddocks close to yards so that animals with reactions can be drafted off and treated.

Treatment

At present, the only tick fever drug readily available in Australia is 'Imizol'. Small stocks of other drugs, such as 'Acaprin', 'Ludobal' and 'Diampron', may be available in some areas. These are all effective against babesiosis, but unlike Imizol, have no effect against anaplasmosis.

When Imizol was first marketed in Australia in the 1970s, the active ingredient was a 4.5% concentration of imidocarb dihydrochloride. Imizol with a slightly different formulation is now marketed, the active ingredient being a 12.5% concentration of imidocarb dipropionate. The two formulations have similar properties, but the new product, because of its higher concentration of active ingredient, has smaller dose rates. The dose rates given in following sections are for the newer product which is the only one marketed at present.

Imizol should be given only subcutaneously. Cattle treated with Imizol should not be slaughtered for at least 28 days after treatment. Treatment of lactating dairy cows should be avoided because of milk residues.

Babesiosis

The dose rate for Imizol is 1 mL per 100 kg liveweight. This dose rate should also be used for cattle which experience severe vaccination reactions. A second dose can be given after 24 hours if necessary.

Anaplasmosis

The dose rate for Imizol is 2.5 mL per 100 kg liveweight. Another drug used for the treatment of anaplasmosis is the antibiotic, oxytetracycline (Terramycin). This drug may be injected subcutaneously, intramuscularly or intravenously (slowly). The dose rate is 10 to 12 mL per 100 kg on 2 successive days.

Treatment of either type of tick fever is effective if given during early stages of the disease. Cattle that are extremely sick or in a state of collapse should be treated, but may not respond.

Imizol and vaccination

Apart from being an effective treatment for tick fever, Imizol has two unique properties which should be discussed in relation to vaccination. The first property is that Imizol protects cattle against babesiosis for some weeks after the drug is given. A dose rate of 2.5 mL per 100 kg protects for about 4 weeks.

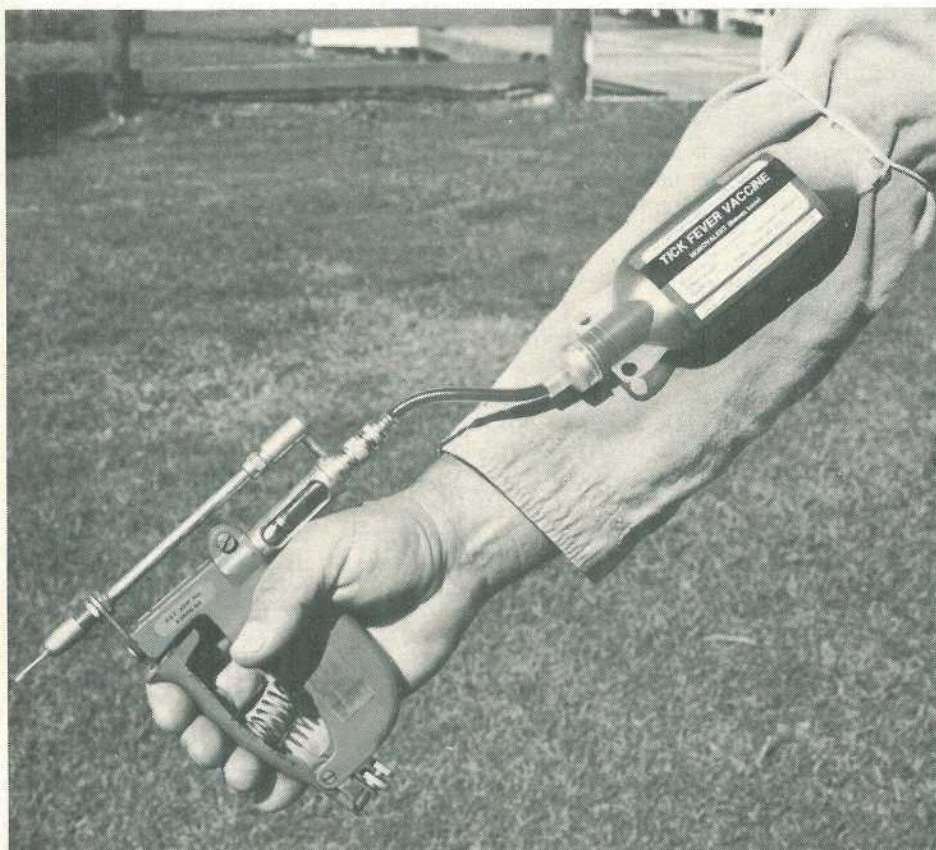


Plate 4. A vaccine pack attached to a repeating syringe allows quick vaccination of large mobs.



Plate 5. Individual 2 mL doses can also be withdrawn from the pack using a hypodermic needle and syringe.

The protective property of Imizol can be applied in several situations. For example, when cattle from tick-free areas are moved into ticky country and prompt vaccination or adequate supervision following vaccination is not practicable, Imizol can be used to provide immediate protection against tick fever. In this case, vaccination should be undertaken about 3 weeks later, to provide long-lasting immunity. With this procedure, the chance of severe reactions following vaccination is reduced due to the residual protective effect of Imizol.

Another situation in which Imizol's protective property can be applied is for cattle travelling through ticky country en route between two tick-free areas. Imizol can give temporary protection against tick fever and vaccination would not be required.

The second unique property of Imizol is that high doses completely eliminate existing babesial infections from cattle. Caution is therefore necessary when cattle are treated to control vaccination reactions. Doses higher than 1 mL per 100 kg should be avoided as these may 'sterilize' the animal of *Babesia* before immunity has developed. The practice of giving small doses of Imizol on the day of vaccination is not recommended because it prevents the development of effective immunity.

When cattle are treated with Imizol at the high dose rate (for example for anaplasmosis) they may need revaccination against babesiosis. This should not be necessary if the cattle are thoroughly immune at the time of treatment. Such immune cattle would be older animals that have been vaccinated at least once when young or that have been bred in a heavily tick-infested area.

Which cattle should be vaccinated?

Cattle born and bred in ticky country

Calves from immune mothers receive temporary protection against tick fever from maternal antibodies in the colostrum. This protection lasts about 2 months. In most calves, an age resistance then develops. This natural resistance is not absolute, but helps protect the calves until 6 to 8 months of age. Their resistance then wanes and the animals become very susceptible to tick fever. Clinical cases occur mostly in weaners or older cattle.

It is rather a paradox that cattle heavily infested with ticks all their life rarely get tick fever. The reason

is that they acquire tick-borne infections early in life when they have a natural age resistance. These infections are not usually obvious but provide life-long immunity. However, in many areas of Queensland tick numbers are extremely variable, and natural immunization of cattle against tick fever is haphazard and unreliable. Thus vaccination is the only sure way of providing complete herd immunity.

Calves can be vaccinated at any age, but it is obvious from the foregoing that they are best done before 6 to 8 months of age. To suit management practice, calves may be vaccinated at branding or at weaning. Vaccination at 4 to 6 months takes advantage of the calves' natural resistance to the infection, thereby decreasing the chance of reactions to the vaccine being a problem.

Vaccination should also be considered when outbreaks of tick fever occur. It should be remembered, however, that the vaccines take time to work—they are a preventative, not a cure. Animals already sick from tick fever require treatment with a drug.

The recommendation for controlling severe outbreaks is to treat all animals in the affected group immediately with Imizol at 2.5 mL per 100 kg liveweight (see treatment section). This cuts off the outbreak sharply. Tick burdens should be removed by dipping or spraying the affected group, except for obviously sick animals which may succumb to the added stress. The group should be vaccinated 3 to 4 weeks after Imizol treatment to give them long-lasting protection.

Less severe outbreaks can be controlled by treating the sick animals in the mob and vaccinating the remainder. Again, the mob should be dipped to remove infecting ticks. Following vaccination, the cattle should be kept under surveillance for 3 weeks, particularly during the first 9 to 14 days when most reactions to the vaccine occur. The ill-effects of natural infections incubating in the mob may also become apparent during this time and can be confused with reactions to the vaccine.

Cattle travelling within the tick areas

Tick fever sometimes occurs in cattle moved from one district to another within the ticky area. Even movement from one paddock to another has precipitated outbreaks. Immunity may be low because few infecting ticks are present on the property of origin. Differences in

pathogenicity between tick fever parasites in different areas may also cause some of these outbreaks.

Vaccination of all travelling stock is recommended, particularly when purchases are made at saleyards and the history of the cattle cannot be verified.

Cattle from tick-free areas entering ticky country

These animals are fully susceptible to tick fever and should be vaccinated. Timing of the vaccination in relation to movement of the stock will depend on how far in advance the movement is planned, and on whether facilities for handling

and supervising the cattle are better at the origin or at the destination. The following alternatives are given as a guide.

- Vaccinate 1 month before movement is due if monovalent vaccine is used or 2 months if bivalent vaccine is used. These periods allow cattle to fully recover from possible reactions, and also allow full development of immunity before exposure to ticks. For these reasons, this method is strongly recommended if suitable facilities and experienced personnel are available at the origin.



Plate 6. Vaccinating cattle against tick fever. The vaccine pack is tied to the operator's arm to allow easy, one-handed vaccination. This also reduces the chance of air bubbles entering the delivery tube.



Plate 7. Tick fever vaccine packaging. Vaccine is supplied in plastic containers and packed, with bags of ice, inside foam coolers. This helps keep the vaccine chilled during transport.

- Vaccinate just prior to movement, providing the cattle arrive at their destination in 4 to 5 days. This would suit cattle being transported by road or rail. Timing of the movement is critical, however, as the stress of travelling must be avoided during the reaction period.
- Vaccinate at the destination. This procedure is widely practised, but there is the risk of cattle being exposed to infecting ticks and developing tick fever before, or even during, the period of reaction to the vaccine. The result is that cattle appear to have extremely severe vaccination reactions. This complication can be avoided by first giving the cattle Imizol as described earlier, and vaccinating later, or by keeping the cattle free of ticks for about 1 month after vaccination.

Special animals

All valuable stock should be kept under surveillance for at least 3 weeks after vaccination. Two types of cattle that merit special attention are pregnant cattle and large (particularly, fat) bulls. Both types seem to be abnormally susceptible to the adverse effects of fever, and it is desirable that vaccination reactions be closely monitored in these animals.

The recommended procedure is to record the animal's rectal temperature each morning from the second or third day after vaccination. This provides an average normal temperature for the animal before the

reaction period. If, during the reaction period, there is a rise in temperature of 1°C or more above 'normal', or if the animal's behaviour changes (off its feed, reluctant to move, depressed), a drug should be given.

If treatment is given for a raised temperature alone, half the recommended dose rate (for example, 0.5 mL per 100 kg for Imizol) can be used and the temperature checked later that day or next morning to ensure that a favourable response has been achieved. However, if the animal shows signs of sickness, with or without a rise in temperature, a full treatment dose (1 mL per 100 kg for Imizol) should be given.

When such close attention to individual animals is not possible, another approach can be used. This is to vaccinate and, 7 or 8 days later, treat all the animals with half doses of the drug. This timing of the treatment allows the vaccine to 'take', and forestalls possible severe reactions.

Although this approach is attractive from a practical viewpoint, it has disadvantages. Too much drug at this time may prevent effective immunity from developing; too little may not prevent severe reactions. Dose rates for Imizol should be measured carefully, and follow-up observations during the week following treatment are recommended.

Cattle can be vaccinated safely at any stage of pregnancy providing that reactions are anticipated and

controlled. A procedure sometimes used to avoid vaccination of cattle within several weeks of full term is to give a protective dose of Imizol (2.5 mL per 100 kg) and delay vaccination until the calf is born. Both calf and mother can then be given vaccine.

Which vaccine to use

B. bovis

This parasite is by far the most frequent cause of tick fever, so all cattle being vaccinated for the first time should receive *B. bovis* vaccine. When cattle are being revaccinated, *B. bovis* should be used.

A. centrale

No clear-cut recommendation for the use of *A. centrale* vaccine can be given. Anaplasmosis is a problem in certain areas, but these are not clearly defined. As a general rule, cattle, particularly adults, which have never been exposed to ticks should receive *A. centrale*. Cattle born in tick-free country and moved into ticky areas are in this category.

However, there is no point in vaccinating cattle against anaplasmosis if they are to be kept for only 1 to 2 months before being slaughtered because the vaccine takes this long to produce immunity. Calves born in ticky areas where anaplasmosis has been diagnosed should receive *A. centrale* at their routine vaccination.

In general, cattle moved from one ticky area to another would not require *A. centrale* vaccination unless their destination is an area of known high risk and they had not been vaccinated previously.

B. bigemina

B. bigemina vaccine should be used when this parasite has been diagnosed as the cause of a continuing problem on a particular property.

In summary, monovalent or ordinary (*B. bovis*) vaccine is for routine vaccination of calves in most areas, for cattle being moved within ticky areas, and for revaccination when this is required. Bivalent or two-germ (*B. bovis* and *A. centrale*) vaccine is for routine vaccination of calves in known anaplasmosis areas, and for cattle moved into the ticky area.

How many vaccinations are required?

Several years ago, the strain of *B. bovis* used in the vaccine was changed at 5 to 6 monthly intervals.

Age classification—lamb and mutton

by K. Maynard, Veterinary Public Health Branch

Lamb is tender and has a delicate flavour. Its eating qualities are superior to meat from older classes of sheep and therefore it attracts a higher price.

For that reason, carcasses are classified as lamb, hogget or mutton and are placed in those classes according to age.

Approximate ages of the classes can be determined by comparing their dentition category with table 1.

As indicated in table 1, sheep have two sets of teeth—deciduous and permanent.

The permanents number 32 and are described by the following formula:—

$$\begin{array}{cccc} 0 & 0 & 3 & 3 \\ 2 \times (I - C - P - M) = 32 \\ 4 & 0 & 3 & 3 \end{array}$$

The top line represents one side of the upper jaw, the bottom line, one side of the lower jaw. The letters in the middle line stand for I = incisors, C = canines, P = pre-molars and M = molars.

Incisors and pre-molars are preceded by deciduous teeth commonly known as temporary or milk teeth.

The formula for the deciduous teeth is:

$$\begin{array}{ccc} 0 & 0 & 3 \\ 2 \times (DI - DC - DP) = 20 \\ 4 & 0 & 3 \end{array}$$

They erupt prior to or within a few weeks of birth.

The textbook definition of lamb is, a young animal of either sex which has no permanent incisor teeth.

When the first pair of permanent incisors (centrals) erupt at from 12 to 18 months, the carcass is classified as a hogget or teg and although less tender than lamb is still good eating.

When the second pair of permanent incisors erupt the carcass is considered to be mature and lacks the tenderness and delicate flavour so desirable in the younger classes.

The differences between a typical lamb mouth and a typical full mouth are readily apparent.

The full set of temporary incisors (top of plate 1) are small and have a pronounced outward curve. The full set of permanents (bottom of plate 1) are large and straight-sided.

These differences are not so apparent when both sets are worn to the degree shown in plate 2. The only readily apparent difference is that the temporaries (top of plate 2) are more widely spaced.

It is easy to pick the hogget carcass. The two large permanents contrast starkly with the remaining temporaries (plate 3). Four and six tooth categories display a similar contrast.

Plate 4 shows a lamb mouth with the central incisors shed and an old, well-worn set of permanents. The opposite is also common. Temporaries may be well worn but all intact while some permanents may be missing due to extreme age or injury.

Also, at the time of examination, teeth may be masked by blood and ingesta making it even more difficult to place the carcass in its correct category by inspection of incisors.

Where doubt exists, the category can be confirmed by checking the cheek teeth.

In abattoirs where dressing procedures require the head to be skinned, the cheek muscles are usually torn, exposing the underlying molars and pre-molars (cheek teeth). In some cases, it may be necessary to cut the muscles of one side of the mouth to expose them.

TABLE I
Dentition—Sheep

Tooth	Temporary	Permanent
First incisor.....	Birth to 1 week	1-1½ years
Second incisor.....	1-2 weeks	1½-2 years
Third incisor.....	2-3 weeks	2½-3 years
Fourth incisor.....	3-4 weeks	3½-4 years
First pre-molar.....	2-6 weeks	1½-2 years
Second pre-molar.....	2-6 weeks	1½-2 years
Third pre-molar.....	2-6 weeks	1½-2 years
First molar.....		3 months lower 5 months upper
Second molar.....		9-12 months
Third molar.....		1½-2 years

Age classification



Plate 1. Top. Note outward curve of full set of deciduous incisors. Bottom. Permanent incisors are larger and straight-sided.

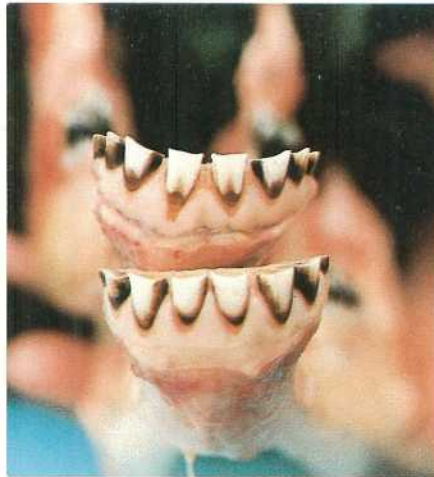


Plate 2. Two well-worn sets. The only apparent difference is that the temporaries (top) are more widely spaced.



Plate 3. The hogget is easily identified by the two large, central permanents. Four and six-tooth categories show similar contrast.

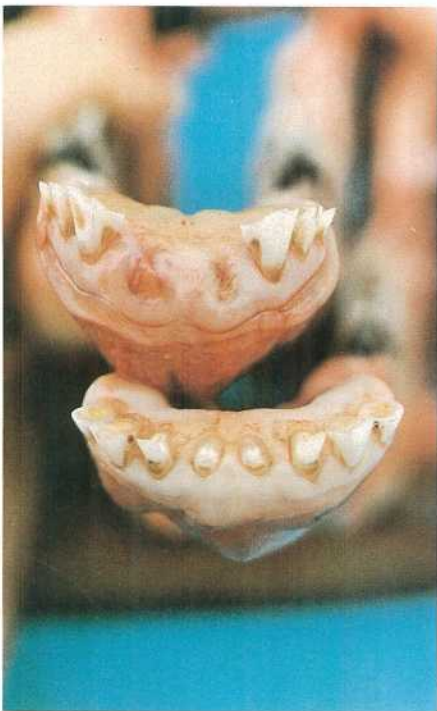


Plate 4. Old animals often have teeth missing (broken mouth). They can be confused with lambs which have shed temporaries prior to eruption of permanents (top).

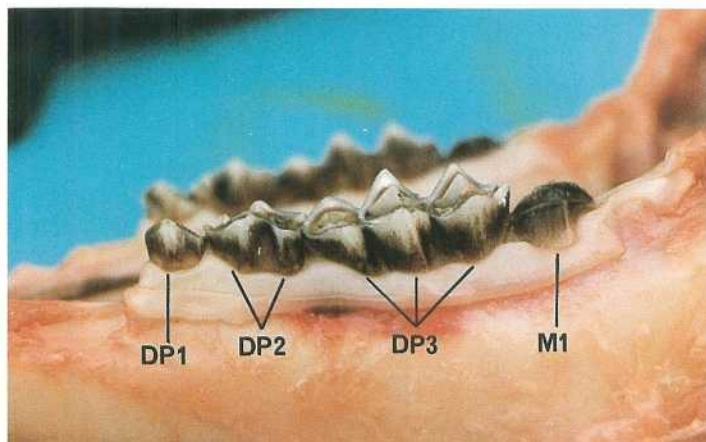


Plate 5. First, second and third deciduous pre-molars, first molar (note—DP3 is tricuspid). Lamb mouth.

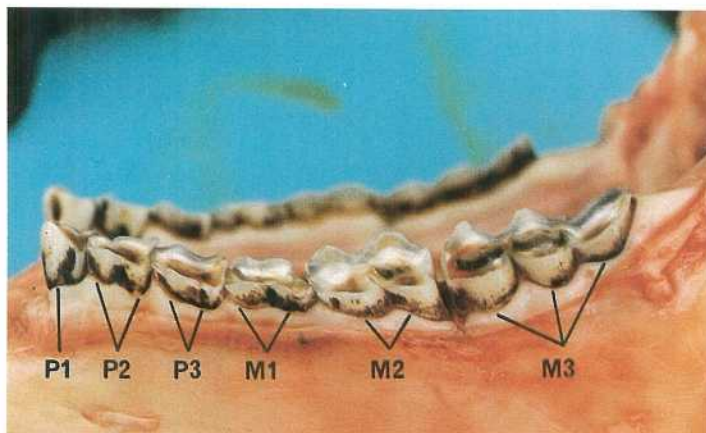


Plate 6. First, second and third pre-molars; first, second and third molars (note—P3 is bicuspid). Adult sheep.

lamb and mutton



Plate 7. The lamb carcass on the left is 'chubby', legs are short and muscle colour is pink. Mutton carcass is 'rangey', long-legged and muscle colour is reddish-brown.

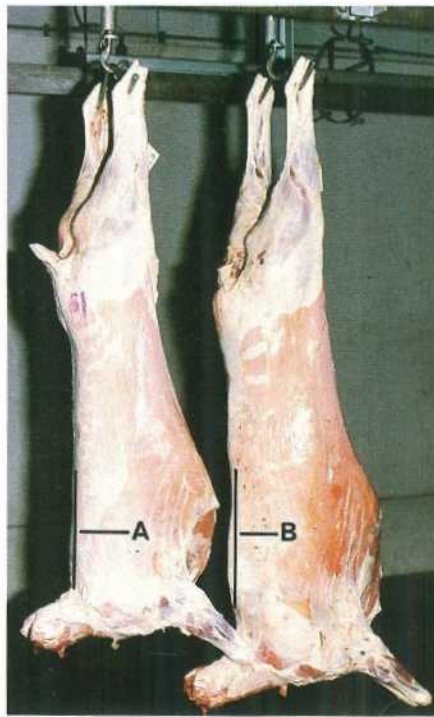


Plate 8. A side view of the same carcasses showing similar contrasts. Note the flatness of the lamb's withers (A) compared to mutton (B). The bars on the back of the mutton carcass are more pronounced because the muscle colour is darker.



Plate 9. The same mutton carcass compared with an older lamb carcass. Differences in conformation are not so obvious.

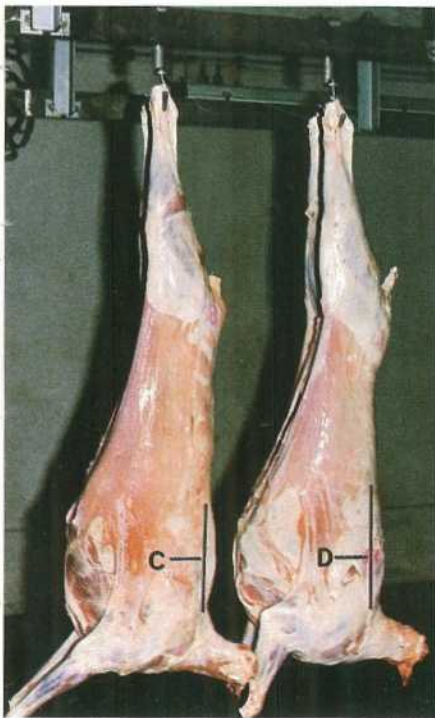


Plate 10. Side view of the same carcasses. The lamb (on right) is no longer flat over the withers (D) and is similar to mutton (C). The muscle colour of both is similar.

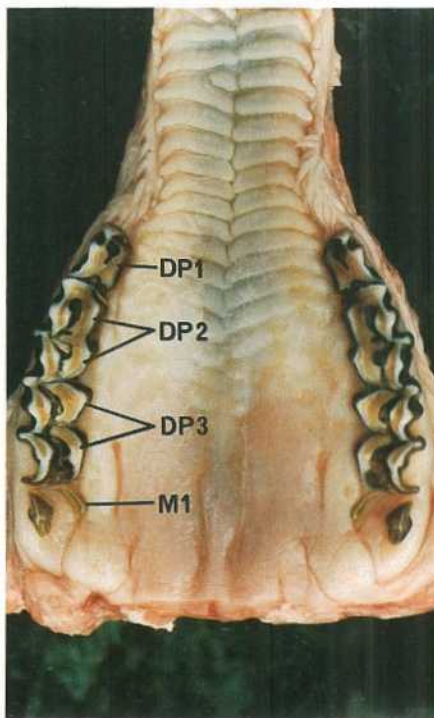


Plate 11. Deciduous pre-molars upper jaw. First molar also erupted. Sucker or spring lamb would only have the three temporaries.

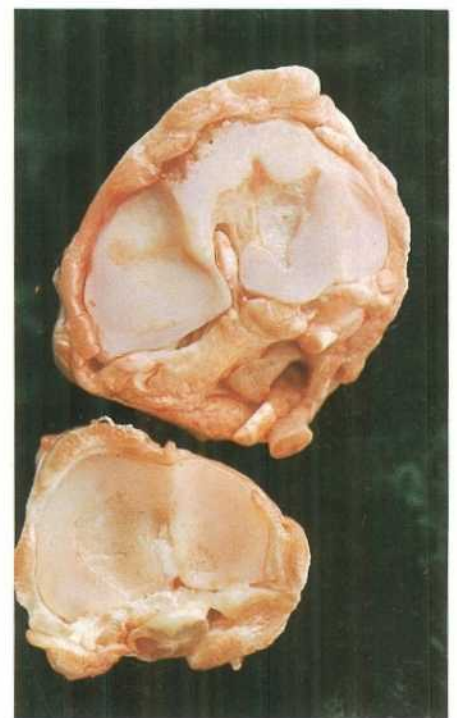


Plate 12. Carpal cartilage of lamb (top) is bluish-pink. Off-white specimen (bottom) is from a mutton carcass.

A lamb mouth can have up to five cheek teeth, three deciduous pre-molars and two molars. Plate 5 shows three deciduous pre-molars and the first molar partially erupted. Note the third deciduous pre-molar DP3 is three-pointed (tricuspid).

Table 1 shows that the third molar (M3), erupts at from 1½ to 2 years, about the same time as the first pair of central incisors. Therefore if six cheek teeth are up, the classification would be hogget or mutton.

Plate 6 shows three permanent pre-molars and three molars. Table 1 shows that the third cheek tooth (P3) also erupts at from 1½ to 2 years, the same time as the first permanent incisor and (M3). Note P3 is a double tooth (bicuspid) in contrast to its predecessor DP3 which is tricuspid.

When examining cheek teeth, it is therefore unnecessary to look any further than DP3 or P3. It is a more accessible reference, particularly if a cut has to be made.

As well as separating lambs from older sheep by their dental status, it is also possible to separate spring or sucker lambs from the older summer lambs.

Reference to table 1 shows that the first molar in the upper jaw erupts at 5 months (3 months lower). The spring lamb should have only the three deciduous pre-molars in which case it would be less than 6 months old.

Plate 11 shows the upper jaw with three deciduous pre-molars and a point of the first molar barely visible.

Another method of classification is by carcass characteristics.

As animals mature, physical changes take place which alter the shape and colour of parts of the carcass.

The obvious changes are in the areas of conformation, colour and cartilage.

There are obvious differences between a young lamb and a mutton carcass. The typical lamb carcass on the left of plates 7 and 8 has a rounded, 'chubby' shape. The legs are short, the withers relatively flat and the torso roughly cylindrical. Muscle colour is pinkish.

The mutton carcass on the right of plates 7 and 8 is 'rangey', with long legs, deep chest, peaked withers and the muscle colour is reddish-brown. The darker muscle colour highlights the superficial panniculus muscles on the back which show up in a distinct barred pattern.

Comparison of an 'old' lamb with the same mutton carcass shows the differences are not so readily apparent (plates 9 and 10).

The differences between old lamb and hogget and hogget and young mutton are even less apparent.

Other colour changes can be seen in bones and exposed cartilages.

Young bones have a degree of transparency which permits the red cancellated tissue inside the bones to show through to the surface.

As a result, such bones as the ribs of young lambs have a definite red streak down their length.

As animals age, their bones become dense and opaque. Ultimately, they become a uniform dull white.

When feet are removed from the carcass, exposed carpal cartilages vary in colour depending on age.

In plate 12, the bluish-pink specimen on the left is from a lamb. The dull off-white specimen on the right is from a mutton carcass.

Lambs also have a sharp ridge of cartilage over the front part of the pelvis where the two halves of this structure join.

It can be readily felt in lambs but is duller in hoggets. As age progresses, the ridge regresses and in older ewes completely disappears.

Colour of carpal cartilages and the pelvic ridge are the signs most commonly used when classifying by carcass characteristics.

In the domestic trade, they are useful in identifying the typical lamb carcass from the typical mutton carcass but are of little use in separating summer lambs from hoggets and hoggets from young mutton.

If there is a need to place carcasses in specific categories based on approximate age, then dentition is obviously the best and most objective means available.

However, if examination is confined to incisors only, mistakes will occur. All classifiers should be aware of the alternative method of confirming dentition categories by checking cheek teeth.



Two vaccinations 6 months apart were recommended so that revaccination with a different strain provided slightly improved immunity. Problems with severe reactions to some vaccine strains led to this practice being discontinued. Since December 1979, only one strain of *B. bovis* has been used.

The present strain appears to be a particularly good one, and a second vaccination is not necessary for most cattle. Nevertheless, revaccination is not harmful, and should be con-

sidered for cattle that have had minimal exposure to ticks for long periods (18 months or more).

The tick fever vaccine service is unique in that each order is processed individually, sometimes within hours of receipt. The required quantity of fresh vaccine is made up, packed carefully and sent perhaps 1 600 km, sometimes by up to four different modes of transport. Most consignments reach their destination in less than 24 hours.

Occasionally, however, parcels go astray or are held up in transit. The laboratory is aware of the inconvenience this causes on the property, and expects to be notified immediately the expected vaccine fails to arrive. Sometimes missing consignments can be traced or the vaccine resupplied at short notice.

Vaccines and information concerning their usage are available from the Tick Fever Research Centre, Grindle Road, Wacol, Q. 4076. Phone: (07) 271 2577.

Raising quality papaw seedlings

TO produce good quality papaw seedlings, growers must be willing to spend time, effort and a little money. This was stated by Mr Paul O'Hare, of the Department of Primary Industries Horticulture Branch.

Mr O'Hare said that experience had shown that container growing of seedlings permitted closer attention and the production of more uniform, healthier and vigorous papaws than direct field seeding.

Container-grown seedlings had also proven superior to seedlings from seedbeds which often had problems associated with transplanting.

The best time for sowing the seed into the container was late December-January. By autumn, the seedling should be ready for field planting. Early autumn was suggested for field planting for cold slopes, and late autumn for warm or fertile slopes.

If a sturdy seedling 15 to 30 cm high was field planted in March under reasonably good conditions, it should flower in October of the same year and be approximately 1 m high by the following January. Plants as small as 9 to 10 cm could be field planted if care was taken.

Papaws planted too early usually grew too high before flowering and fruiting. Two disadvantages found with tall cropping trees were that the second crop often had to be ladder harvested; and the tree stem could either break or lodge from carrying the fruit high up.

Field planting too late produced short plants in spring which might not flower until midsummer when they were much taller. Papaws appeared to need both a minimum age (7 to 8 months) and height (0.6 m) before they would flower. Field planting in autumn appeared to produce both early flowering and a low fruiting tree.

Bush-house is ideal

Mr O'Hare said that a bush-house arrangement was ideal for raising papaw seedlings. A bush-house which provided 30 to 40% shade and kept out heavy rain was best.

He said papaw seedlings could be raised in a wide range of containers, including 8 to 10 cm deep pots, soft drink or beer cans, plastic drink cups, and paper pots. However, he warned that wax-coated containers should not be used as they completely inhibited root growth.

A wide range of potting mixtures was suitable provided they allowed for free drainage and did not pack. Dolomite or lime, plus fertilizer, should be added and mixed well into any mixture before potting. Approximately 300 g of dolomite and 100 g of low analysis (5 : 6 : 5) fertilizer per 90 L (20 gal) of mixture should be sufficient.

Mr O'Hare said that a quick method sowing seeds was to fill most of the container with the mixture, leaving 12 to 15 mm head room in the container. Three to five seeds could then be placed into each container before covering with 8 to 10 mm of very open soil or mixture. This still left some head room in the container.

Regular watering

Regular waterings during the hot part of the day (up to 3 times per day) were essential to keep the mixture constantly moist until plant emergence. Waterings should then be reduced to once a day. Mid morning was best but, if extremely hot dry weather occurred, another watering in mid afternoon might be necessary. Plants should not be watered after mid afternoon as this led to damping off problems.

Plants should start to emerge after 8 to 10 days in midsummer and usually continued emerging for approximately 2 weeks. The cooler the weather the longer they took to emerge.

It was not advisable to thin out the plants in the container to only one, because quite often the less vigorous plants, which would normally be removed, were females. Few adverse effects were encountered by leaving multi-plant pots. Only one container per planting site was then required for field planting.

Mr O'Hare said that, once plants began to grow well, soluble plant fertilizers should be applied every 2 to 3 weeks to maintain plant health and vigour. A constant lookout should be kept for damping off in the younger seedlings. If damping off occurred, a complete drenching with either captafol or captan was necessary for control.

Prior to field plantings, 3 to 4 days of full sunlight would harden off the seedlings. If the plants were particularly soft or the sun particularly intense, the seedlings should be exposed gradually over this period.

Plants should be ready for field planting at 2 to 3 months when 100 to 200 mm high. If they were not required immediately, they could be kept by putting on a maintenance-only fertilizer schedule or by cutting back each plant.

Not all meat is steak

by J. Hackett, Veterinary Public Health Branch

A person buying a 50 kg hind-quarter does not get 50 kg of edible beef. Bones and fat account for a considerable portion of the total weight.

This article explains what carcass yield actually is and how yield may affect a butcher's profit. It also shows bulk buy consumers what loss they can expect.

'Carcass yield' is the total weight of the individual primal cuts and trimmings (that is, saleable meat) expressed as a percentage of the total weight of that carcass. Bones and fat are not part of the carcass meat yield, however, they do make up a large part of the carcass.

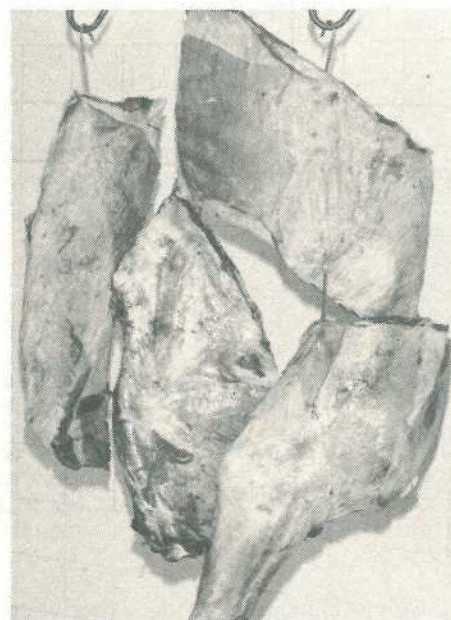
Table 1 gives an example of carcass yield expressed as a percentage.

These figures are the result of a trial conducted at Brisbane's Coorparoo School of Food under the author's supervision on 29 January 1981. With the co-operation of the teaching staff and the apprentice butchers attending the school at the time, a side of beef weighing 89 kg was weighed and boned out into saleable meat, bones and fat. These items were then weighed again to give the carcass yield. The boning of the side was carried out in a conventional butcher's shop style of carcass breakdown using a one rib hind, four rib chuck etc.

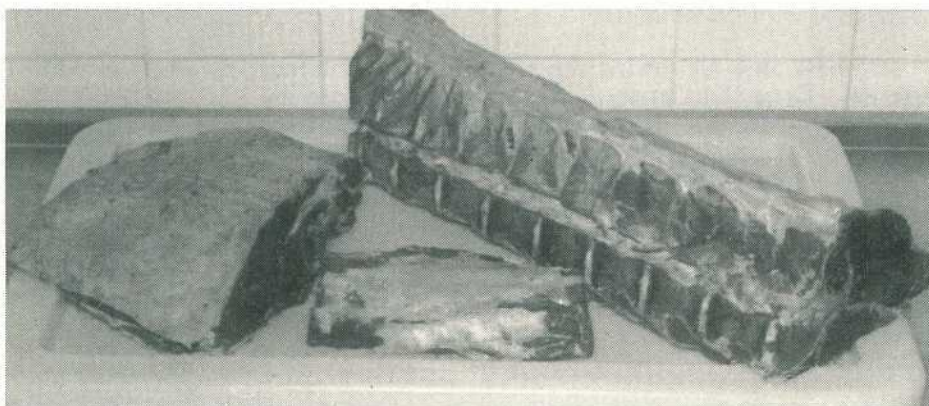
Importance of carcass yield

The success of a butcher depends to a large degree on his ability to select and purchase carcasses that will yield a good percentage of saleable meat after breakdown. If a carcass is too fat and therefore requires extra trimming, the percentage of fat will increase and the percentage yield of saleable meat will decrease.

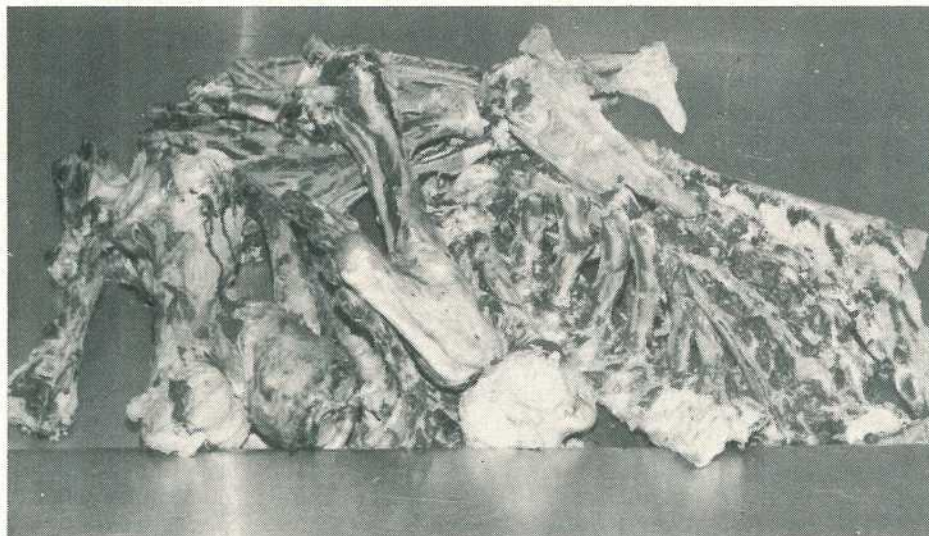
A lean carcass is not as attractive when broken down and put on display as is a carcass with an even minimal selvage of fat. The fat measurement is taken between the twelfth and thirteenth ribs and 12 mm in from the edge of the rib eye. Lean carcasses may be sold, provided they are acceptable to the consumer.



A forequarter of beef broken up but not boned out with the primal cuts being hung in their respective positions. From left to right—the brisket, chuck, ribs, blade and shin.



The rump, T-bone, sirloin and eye fillet after trimming ready for slicing and sale.



The bones leftover after trimming present 18.2% of the total carcass weight. This earns the butcher 5.5 cents per kg from the rendering plant.

Boning skill

This is a major factor in the overall yield of a carcass. When breaking down and boning of a carcass is not done skilfully, varying amounts of meat are left on the bones. These amounts of meat can, over a week, cost the butcher a substantial amount in lost profit, unless the boning out technique is improved.

Example of one cut

200 g of topside left on the bone, which should have sold as:

\$

200 g of topside steak
at \$5.00/kg = 1.00

Instead, the 200 g of topside trim is sold as:

0.52

200 g of topside mince
at \$2.60/kg =

This makes a loss of \$0.48



Most of the fat leftover from the carcass after trimming can only be used for rendering down. This brings the butcher only 12.5 cents per kg at present. Suet (kidney fat) is not in great demand.

It is easy to see from this example how a body of beef boned out carelessly can reduce carcass yield and profit.

Formula

$$\frac{\text{Weight of cut}}{\text{weight of carcass}} \times \frac{100}{1} = \% \text{ of that cut to the body}$$

Similarly:

$$\frac{\text{Percentage of cut}}{100} \times \frac{\text{Weight of carcass}}{1} = \text{Weight of cut}$$

TABLE 1

Breakdown of the 89 kg side of beef (costing the consumer \$1.99 kg)

	kg	Percentage
Skirt	1.02	1.1
Kidney	0.29	0.3
Rolled brisket	3.67	4.1
Rib roast (fillet in)	5.34	6.0
Rump	3.11	3.5
Silverside	5.22	5.9
Topside	5.69	6.4
Chuck	6.47	7.3
Round	3.42	3.8
T-bone	5.99	6.7
Hindquarter shin	1.33	1.5
Muscle of silverside	1.3	1.5
Eye fillet	0.77	0.9
Blade	5.71	6.4
Forequarter shin	2.5	2.8
Fat	9.01	10.1
Bones	16.16	18.2
Trim	12.0	13.5
	<u>89 kg</u>	<u>100.0</u>

Total percentage of saleable meat produced is 71.7%.

The weights shown were taken after all trimming was completed. This is why the weights and percentages of trimming may appear slightly high, but no further trimming of any piece of meat is required and it is now acceptable for sale.

Carcass weight before and after breakdown

Carcass weight before breakdown is taken as being the weight of a chilled carcass as delivered to a butcher's shop.

When doing a costing exercise of a carcass of beef, lamb or pork it should be possible to get 100% recovery of the weight of the carcass providing the exercise is carried out carefully.

When a proper costing is carried out, all the factors such as return for bone and fat should be taken into account so as to give a true costing. Some butchers, however, leave these items out and when their cheque arrives from the rendering plant they treat it as extra profit.

Saleability

It should be remembered that the whole of a dressed carcass is saleable, irrespective of what part it is. Without limiting ourselves to thinking only of the primal cuts, all fat and bones can be processed into either an edible or inedible product. From a registered or licensed premises, fat and bones may be

rendered down for human consumption, or bones may be sold as soup bones or dog food. A considerable amount of bone meal can be processed into stock feed.

However, the owner of licensed or registered premises receives a lesser return for selling fat and bones for rendering down purposes.

A carcass of beef is not all meat and not all meat is steak. At least 28% of a side of beef is bones and fat (table 1). Out of the remaining 72% only 33.6% is sliced steak (rump and T-bone). The other

38.4% is made up of roast, corned meat and casserole steak.

The side of beef costs the butcher approximately \$1.30 per kg. When he sells meat over the counter, that is, 1 kg or 2 kg at a time, he must charge more than if he sells meat in quarter or side form. This is to allow for the fat and bones that he cannot sell at the same price as the meat.

The 28% fat and bones cost the consumer \$1.99 per kg, the price of the side per kg. Therefore, the actual cost to the consumer of the meat in the side of beef is as follows:

Cost of side	89 kg at \$1.99
	= \$177.11
Weight of the side	89 kg
Less weight of the fat	-25.17 kg
and bone weight =	63.83 kg saleable meat.

The actual price per kg of 63.83 kg of saleable meat is $\$177.11 \div 63.83 \text{ kg (weight of saleable meat)} = \2.77 .

Obviously, it is important for both butchers and consumers to realise that not all of a carcass is meat.

New iron-efficient Tyson chickpea

A new line of the Tyson chickpea variety will be released to Queensland farmers in 1982 to overcome the problem of iron inefficiency which has occurred in about a quarter of the plants in the original line.

Mr Bob Brinsmead, a supervising agronomist with the Queensland Department of Primary Industries at the Hermitage Research Station near Warwick, said soon after commercial production of Tyson commenced, it was discovered that some plants in Tyson suffered from iron chlorosis. This meant these plants were unable to extract sufficient iron from the soil for normal growth.

'This condition is much more evident when affected crops are grown on alkaline soils such as the black earths and brigalow soils of the Queensland wheat belt,' said Mr Brinsmead. 'Symptoms include a bright yellowing of the younger leaves prior to flowering. Affected plants appear to recover but flowering is noticeably later and seed yields are sharply reduced.'

The aim of the initial selection programme was to eliminate plants affected by iron chlorosis and other offtype plants from the commercial seed used by farmers for sowing. Seed from selected healthy uniform plants was bulked and 15 tonnes of this reselected Tyson seed had been produced.

Seed of this new line was available for sale from R. E. and M. G. Lange of Bongeene, and D. Clapham and Sons, at Jimbour. The Queensland Graingrowers' Association would also be distributing seed to growers in a wide range of districts for further increase in 1982.

Mr Brinsmead said: 'Farmers should use this new re-selected line of Tyson when growing chickpeas on alkaline clay soils. It is most important that seed of this new line not be mixed or contaminated by the original Tyson if the benefits of this reselection are to be realized. Hopefully, no original Tyson will need to be retained for seed within a couple of years.'

Rice expansion at Mareeba

A \$1.2 million farming enterprise has grown up in the far north of the State over the last 7 years and Queensland consumers are enjoying the fruits of this expansion under the Mahatma rice label.

Mr Don McNee, Director of Agriculture with the Queensland Department of Primary Industries, said the rice industry at Mareeba had expanded rapidly following its establishment in the summer of 1975.

'Plantings have expanded from a mere 24 ha initially to 1 500 ha,' he said. 'The grey and brown clays of the Arriga flats are well suited to the crop. The rice soils at Mareeba have a slightly acid surface while the subsoils are strongly alkaline.'

The 1 100 ha summer crop had just been planted at Mareeba, most of which had been planted to Starbonnet. Bluebonnet 50 was the only other variety

that had been grown at Mareeba. These were long-grain, high yielding, dry cooking, premium quality rices, for which there was a ready market.

This latest crop should be harvested in late May. The winter crop would be planted in June but it took 5 months to mature before harvest in December.

The crop was grown as a paddy culture under continuous flood using contour bays. Mr McNee said that water control was the most important factor in rice production. Adequate irrigation and drainage systems must be established from the outset.

Mr McNee said: 'Rice growers are issued with quotas based on past production by the Rice Marketing Board. The harvested paddy is milled at Home Hill and is sold on both the domestic and export markets.'

Management of cotton pests

by G. K. Waite and D. A. H. Murray, Entomology Branch

INSECTICIDE use is necessary in the production of high yielding cotton. Careful selection of the most appropriate chemicals, their precise timing and careful application have many advantages for the producer. Chief among these is lower costs per unit of return.

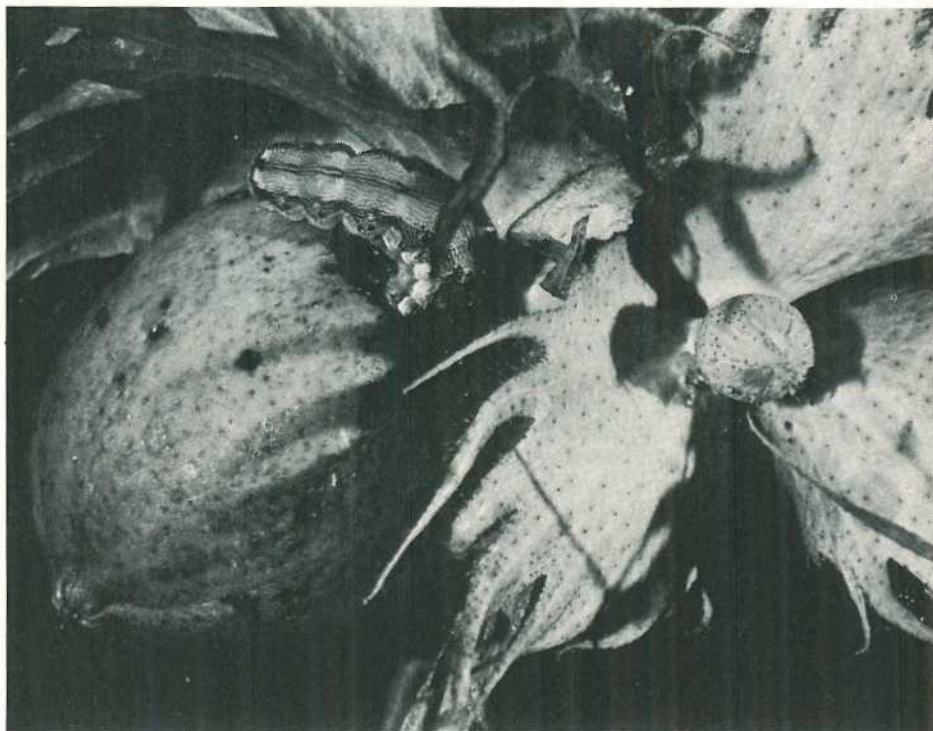
There are presently a wide range of insecticides available for pest control in cotton. Some are particularly efficient in killing insects to the extent that not only are pest species controlled but most beneficials are also destroyed.

Widespread use of such insecticides has resulted in the emergence as major pests of species which were previously of no real concern. This has resulted when the chemicals have reduced parasites and predators of the 'pest' and allowed it to develop more freely. Mites constitute a good example of such an induced problem.

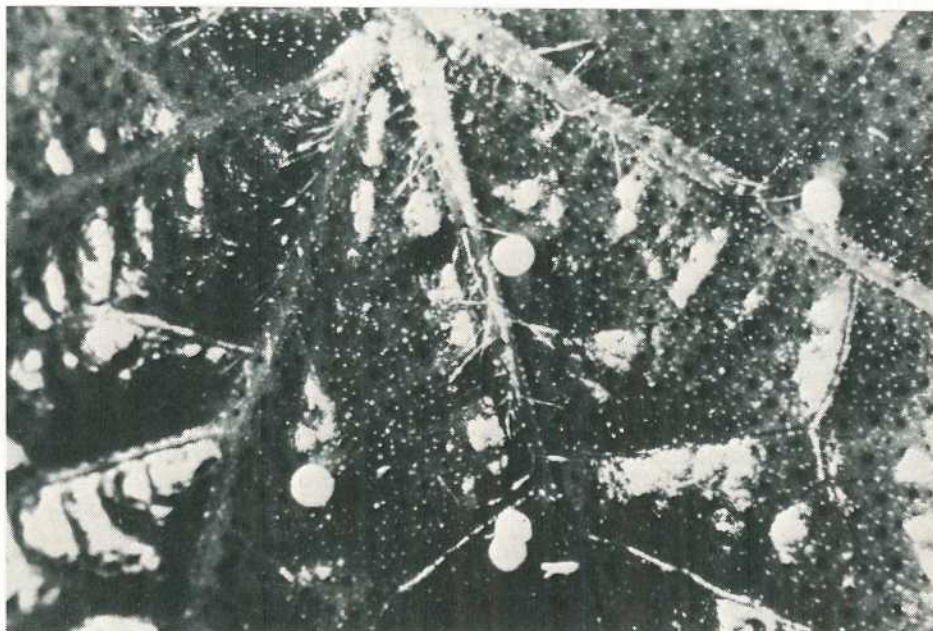
Furthermore, the destruction of beneficials often results in rapid resurgence after treatment of the target species. This applies to aphids.

Regular use of a particular insecticide or group can, and has, resulted in the development of pest populations resistant to the chemicals concerned. Increased dosages and more regular applications may then be necessary. Intensified resistance can follow and issues such as pesticide residues and damage to wildlife may be of significance should higher dosages of the chemicals be applied in an attempt to overcome the resistance problem.

Pesticide resistance in *Heliothis armiger* is recognized as a major factor in the abandonment of cotton production in the Ord River area of Western Australia. Serious problems were encountered in New South Wales and southern Queensland in 1973 as a result of similar problems, and already some insecticide resistance has been shown in *Heliothis* populations in the new cotton growing area centred on Emerald in the Central Highlands.



Heliothis attack on cotton. Many larvae indicate that pest management in a crop has not been successful.



Heliothis eggs on a cotton leaf. Monitoring of eggs is essential in pest management.

These situations, disasters and near disasters arising from insecticide resistance, not only in Australia but also in many overseas cotton areas, highlight the importance of careful selection and use of chemicals in the cotton industry.

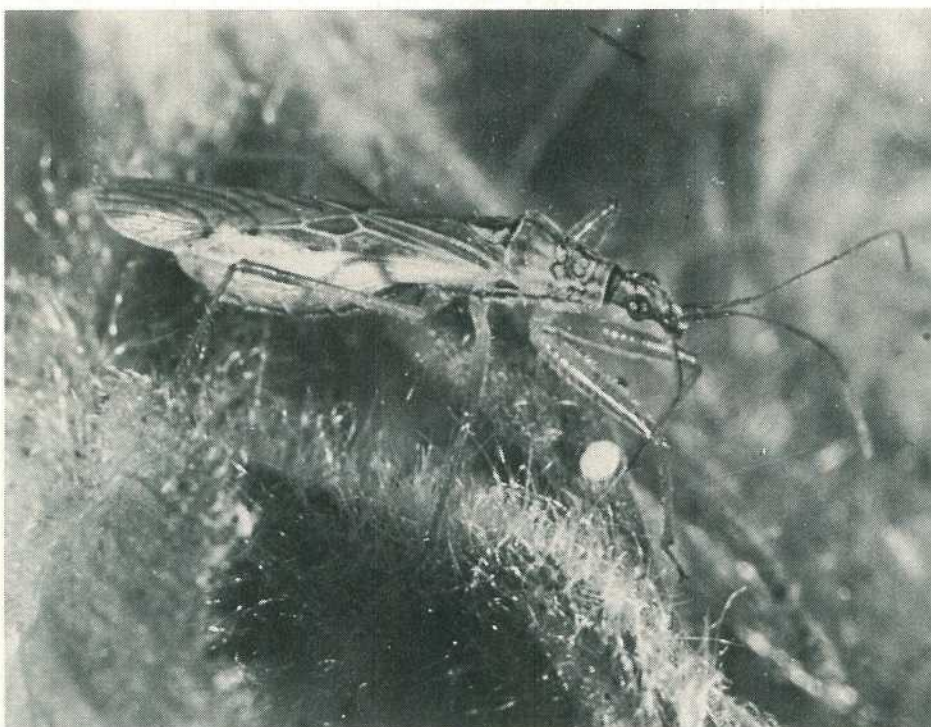
The concept of pest management rather than total control has received considerable attention from entomologists over recent years both overseas and within the Australian cotton industry. There is no doubt that the concept offers much to growers both in regard to the short term economics of the individual producer and to the longer term viability of the industry.

In essence pest management involves regular monitoring not only of pest populations within crops but also of the beneficial fauna present and the use, whenever possible, of those insecticides which are least damaging to the beneficial fauna but which effectively control the pests, chiefly *H. punctiger* and *H. armiger*. In seasons of relatively light pest infestation, the system is particularly attractive to growers. In those years in which infestations are severe and prolonged, the chemicals which are most effective against the pest species, and also unfortunately most effective against the beneficials, may have to be used more often, though with dubious results.

The Central Highlands is presently the most northerly area in which irrigated cotton is grown commercially in Australia. As such it has the most tropical environment and the potential for the development of the most rapid and intense pest problems.

Over the past four seasons, trials carried out in the Emerald irrigation area have demonstrated that the management concept works in that area. Data from these trials are summarized in table 1. The results are of particular interest in that the seasons were markedly different.

In 1977-78 pest infestations were relatively light and this was reflected in the number of sprays required in both the management trials and in commercial cotton. The trials allowed the production of yields equivalent to the district average at a lower cost and with fewer spray applications.



A damsel bug adult, one of the important predators of *Heliothis*. Predator numbers are important in pest management.

Pest pressure was more severe in 1978-79 and 1979-80 and the number of sprays required was higher. Again, however, the management system allowed for fewer insecticide applications and considerable savings for equivalent or better yields.

While the first three seasons' trials at Emerald aimed at demonstrating the viability of the pest management approach, the fourth season's trial introduced computer technology as an aid to decision-making. The SIRATAC computerized pest management system was tested in co-operation with the CSIRO, New South Wales Department of Agriculture and University of Queensland. Results for this first season were very encouraging and further testing to refine the system for the Emerald area is planned for the 1981-82 season. Limited commercial application of SIRATAC will also commence in some southern cotton growing areas.

Although some commercial crops at Emerald achieved better yields than the management trials, the result probably follows from better agronomic practices than from better pest control. In the last three seasons, the trials ranked among the

top yielding commercial crops and in no season did any pest management trial yield less than the district average. Generally, for equivalent agronomic management, a pest management system can produce yields equal to those obtained under a schedule spraying system at less cost and with less environmental impact.

For the present, the management system involves considerable entomological skills and growers are advised to seek advice from relevant experts before embarking on such a programme. Furthermore, although *Heliothis* species constitute the major pest problems and can generally be handled by a management system, other pests such as pink-spotted bollworm, rough bollworm and spur-throated locust can on occasions, require the use of insecticides which may disrupt the system by eliminating beneficial insects.

The pest management system, however, is strongly recommended for consideration not only on economic grounds. Wide implementation within the cotton industry will minimize the critical long term problems of insecticide resistance development, residues and damage to non-target fauna.

TABLE 1

Insecticide treatments, costs and yields for cotton grown under various insect control strategies—Emerald

Crop	Insecticides used	Total Sprays	Approx. cost (\$/ha)	Yield (bales/ha)
1977-78 Pest management trial	5 endosulfan	5	40	3.95
Average district commercial	1 chlorcam/DDT 8 fenvalerate (2-3 with parathion added)	9	157	3.70
1978-79 Pest management trial	(1) 6 endosulfan 1 methomyl (1/4 normal rate) 1 chlorcam/DDT plus parathion 2 profenofos	10	95	5.50
	(2) 4 endosulfan 2 Elcar* plus amitraz 2 Elcar* plus methomyl (1/4 normal rate) 1 fenvalerate 1 profenofos	11	135	6.25
Average district commercial	1 endosulfan 5-6 fenvalerate 4-5 fenvalerate plus parathion	10-12	225	4.50
1979-80 Pest management trial	1 endosulfan (full rate) 2 endosulfan (3/4 normal rate) 3 endosulfan (1/2 normal rate) 2 endosulfan (1/2 rate) plus methomyl (1/4 normal rate)	8	24	6.70
Average district commercial	2 endosulfan 7 fenvalerate 1 profenofos	10	173	5.00
1980-81 SIRATAC	6 chlordimeform plus Dipel† 4 endosulfan 1 thiometon	11	124	5.15
Average district commercial	1-2 endosulfan 5-6 fenvalerate (3 with parathion or dimethoate added) 1 monocrotophos	7-9	155	3.2

* Elcar is a commercial formulation of a nuclear polyhedrosis virus specific to *Heliothis* species.† Dipel is a commercial formulation of the bacterium *Bacillus thuringiensis* which affects a range of Lepidopterous larvae.

Who are primary producers?

WITH the New Year approaching, it may be worthwhile to consider just who is classified as a primary producer in order to qualify for special taxation advantages.

Mr Ralph Donnet, an agricultural economist with the Queensland Department of Primary Industries, said persons were eligible for special taxation concessions if they were taxpayers who carried on the business of primary production in Australia.

'Primary production means production resulting from the cultivation of land, fishing or forestry operations, or the maintenance of domestic animals or poultry for sale of their bodily produce,' said Mr Donnet. 'What distinguishes a business from a mere hobby is much harder to determine but it depends on questions of both fact and degree.'

A number of factors would be considered by the Taxation Department to determine whether the enterprise were a business or a hobby. These included the number of livestock or the area of cultivation on the holding; its capital backing; plans for future

development and whether or not the property was being run as an economic proposition.

Taxpayers classified as primary producers included people who shared in the profits from a farming venture such as owner-operators; partners; owners who employed farm managers; farmers paid on a share basis; tenants or lessee-operators of farms and a beneficiary entitled to an income from a farming trust.

People would not be classified as primary producers if they received only a fixed wage or salary from working on a farm. These included some farm managers; owners who rented their farms to others to operate; shareholders in agricultural companies; people engaged in the canning of fish and people who treated timber which was felled by another person.

'People eligible as primary producers receive special depreciation allowances, averaging of incomes, use of income equalization deposits and special carryover provisions for losses,' said Mr Donnet. 'They may also be eligible for certain sales tax concessions for goods used in their particular agricultural industry.'

Government assistance for primary producers

by J. K. Thompson, Economic Services Branch

This article provides a summary of both Commonwealth and State Government assistance available to primary producers in Queensland.

Commonwealth Government Department of Social Security

Regional offices provide a full range of services including social workers.

Benefits available are:

- Age pension.
- Invalid pension.
- Widow's pension and supporting parent's benefit.
- Wife's pension.
- Unemployment Benefit—this benefit is available to farmers under special circumstances. Ask the D.P.I. and the Department of Social Security (who actually accept or reject the claims) for more details. Apply at the Commonwealth Employment Service.
- Sickness benefit. This can be claimed when you have been off work for at least 7 days. If you have not employed someone to take your place you will have to show loss of income. Benefit for a single adult person is about \$66 a week and for a married couple about \$111 a week. Ask the department of Social Security or D.P.I. for the leaflet and more details. Consider illness and accident insurance if this benefit would not be adequate.
- Special benefit. This may be paid to people unable to provide for themselves or their families without assistance and who are not eligible for other assistance. You must have exhausted liquid assets and borrowing capacity (even Rural Reconstruction Board household support).
- Child endowment and student child endowment.
- Orphan's pension.
- Handicapped child's allowance.
- Rehabilitation service for handicapped people.

Department of Employment and Youth Affairs

The Department provides a number of services for both work seekers and employers through the offices of the Commonwealth Employment Service in each state.

- Assistance to employers in finding suitable employees.
- Assistance in work placement and applying for the unemployment benefit.
- National Employment and training system (NEAT) provides retraining assistance and special youth employment training.
- Relocation assistance scheme assists people to shift to new areas to find employment.

The services given to employers cover a subsidy towards the cost of providing 'on-the-job' training under NEAT, apprentice subsidies, as well as providing industrial information.

Employers are urged to contact the CES for details of these training schemes.

Department of Veteran's Affairs

This Department, formerly Repatriation Department, provides a number of benefits and services to veterans and their dependents.

- Service pension (also available to certain British Commonwealth and allied veterans).
- War widows' and defence widows' benefits.
- Disability pension and treatment.
- Medical benefits (includes free medical treatment for any cancer).
- Funeral benefits.
- Soldiers' children education scheme.

Any enquiries should be directed to the Department's Queensland branch office located in the Australian Government Centre, 295 Ann Street, Brisbane (G.P.O. Box 651, Brisbane 4001), or to the Department's regional office located on 3rd floor, Commonwealth Offices, 42 Sturt Street, Townsville 4810. Officers visit other country centres regularly and conduct interviews at the local R.S.L. sub-branch.

Department of Education

The schemes administered by the Department are:

- Assistance for isolated children scheme.
- Secondary allowances scheme.
- Tertiary education assistance scheme.

- Adult secondary education assistance (for adults over 19 to undertake Grade 12 studies).
- Aboriginal study grant scheme.
- Aboriginal secondary grant scheme.

Tertiary education assistance scheme

Provides a means-tested living allowance and travelling allowance to Australian students enrolled in approved full-time courses at colleges of technical and further education, pastoral colleges, colleges of advanced education, some private business colleges and universities.

Secondary allowances scheme

May provide, subject to a means test, benefits to parents for children studying full-time in either Year 11 or Year 12 at an approved secondary school or through a State Department correspondence school or a college of technical and further education.

Assistance for isolated children

Provides assistance to parents whose children, because of geographic isolation, itinerant parents, or disability*, must live away from home to attend school or a special course or receive remedial tuition; study by correspondence with the Primary or Secondary correspondence schools or the Pre-school correspondence unit; or live at a second home maintained for the purpose of giving the children access to appropriate schooling. Basic benefits are not subject to means testing.

Commonwealth Education Department offices are located at Brisbane, Cairns and Townsville.

State Government

Department of Education

- Remote area allowances (primary, secondary and special).
- Senior remote area scholarship.
- Boarding-out allowance for sensorially handicapped students.
- Conveyance allowance.
- Text book allowance.

* Disability—handicapped categories include: physical or intellectual handicap; psychological or behavioural problem; medical condition.

- Student allowances (secondary school students and special school students).

For details of student assistance schemes see the Department of Education's publication, Information Statement No. 44, Financial Assistance: A Guide to Assistance Available to Queensland Parents and Students from the State and Commonwealth Governments; Supplement to the Education Office Gazette, November, 1980.

This information statement has been sent to principals of all Queensland schools and to regional education offices.

Further copies are available from the Department of Education, P. O. Box 33, North Quay, Brisbane, Qld, 4000.

Queensland Legal Aid Commission

The Legal Aid Commission of Queensland has been set up to ensure

that members of the community who require the services of a solicitor, but cannot afford to pay for them, should not be denied access to the law. People who cannot reasonably afford their fees may apply to the Legal Aid Commission for legal aid and if that aid is granted then the Commission will meet part of all their reasonable legal expenses.

Any application must be made before any legal fees are incurred.

The Legal Aid Commission has offices at Cairns, Townsville, Mackay, Rockhampton, Ipswich, Inala, Southport and Brisbane. You will find the addresses for these offices in your telephone directory.

In addition, almost all private solicitors in Queensland undertake work on behalf of legal aid clients and the Legal Aid Commission. Accordingly, if there is no Legal Aid Commission office near you, you

may enquire at your local solicitor's office and he should be able to advise you as to whether you are eligible for legal aid. He should also be able to help you to apply.

If you have a legal problem and if you feel you cannot reasonably afford the fees then you should make an enquiry to determine whether you may be eligible for free legal advice or for assistance.

Further information

Though your local agricultural economist from the Department of Primary Industries can provide some information, people seeking information about a particular form of assistance should contact the appropriate Commonwealth or State Department.

The Commonwealth and State Government sections of your telephone directory list addresses and telephone numbers.

Community tackles erosion

CO-OPERATIVE action by the local community, the local authority and the government will allow landholders on the Atherton Tableland to solve serious soil erosion problems on their properties.

Mr Howard Briggs, Director of the Soil Conservation Branch of the Queensland Department of Primary Industries, said action was being taken to have the Cherry Creek catchment in the Atherton Shire constituted as a soil erosion project.

This was the first time in Queensland that a local community had requested action of this kind. Landholders would be subsidized by the Government on a dollar-for-dollar basis with a limit of \$1,500 per

farm. The Atherton Shire would also be eligible for some financial assistance.

Mr Briggs said: 'The decision means that the whole catchment will be so planned that soil erosion works are implemented and linked together to lessen drainage and erosion problems.'

Landholders would be encouraged to adopt improved farming methods such as crop rotation and minimum tillage. These measures would reduce soil erosion to a minimum while increasing the productivity of the land.

He said that a revival in cash cropping, especially peanuts, had added to the serious erosion, siltation, flooding and drainage problems of the area. Damage amounting to tens of thousands of dollars was done to council roads each wet season.

Southern tourists enjoy Queensland fruit

QUEENSLAND has a wide range of fresh fruit and vegetables to tempt southern visitors, from the many tropical and sub-tropical varieties to the deciduous fruits of the Granite Belt.

Dr G. I. Alexander, Director-General of the Queensland Department of Primary Industries, said that there were no quarantine restrictions preventing travellers from enjoying the fruits of this State during their return trip south.

'Restrictions on the movement of fresh fruit and vegetables are not encountered by travellers until they reach the Murrumbidgee and Coleambally irrigation areas or the Murray valley in southern New South

Wales,' said Dr Alexander. 'The restrictions on taking fruit into Victoria, Tasmania and South Australia are aimed at preventing the spread of fruit fly to southern fruit growing areas.'

Interstate plant quarantine regulations varied between the States but were all designed to prevent the introduction of specific pests and diseases from States where they were prevalent into States where they were not active.

Dr Alexander said that travellers were always encouraged to observe plant quarantine as it was aimed at protecting the primary industries that produced the many fruits and vegetables Australians had become accustomed to.

Diesel and electrical power costs— a comparison at Goondiwindi

by I. F. Whan, Economic Services Branch

IRRIGATED farming is expanding rapidly at Goondiwindi and this, for the farmer setting up a pump installation, can mean deciding between diesel or electricity.

The choice is difficult because operating costs with electricity are lower than for diesel but initial set-up costs are higher. The farmer wants to know which alternative will be cheapest in the long run. This article attempts to provide the answer by looking at both operating and capital costs.

Farmers are especially sensitive to the size of capital costs in the establishment phase of irrigation due to the high costs all round of growing irrigated crops. Accordingly, this analysis will use a 'present day cost' approach; cost streams associated with diesel and electricity will be discounted back to present day values. The process of discounting allows unlike cost streams to be expressed as a single present day value and thus be easily compared. The general framework for the analysis is outlined below.

The costs used are those applicable to the Goondiwindi area in mid 1981. Both motors have a continuous power rating of 100 kW and do 1 200 hours of work per year. For the diesel motor, this means a gross rating of approximately 125 kW on which costs should be estimated. The diesel motor has a minor overhaul in years 4 and 8, costing \$1,500 each time.

The diesel motor costs \$13,000 all set-up ready to work. Its running costs are estimated as follows:

$$\begin{aligned}\text{Annual fuel consumption (L)} &= \text{kW} \times \text{hours} \times 0.34 \\ &= 125 \times 1\,200 \times 0.34 \\ &= 51\,000 \text{ L}\end{aligned}$$

(The figure of 0.34 is an allowance for engine efficiency).

$$\begin{aligned}\text{Annual fuel cost (\$)} &= \text{consumption} \times \text{price} \\ &= 51\,000 \times 28.8\text{c/L} \\ &= \$14,688 \\ \text{Oil consumption} &= 1.5\% \text{ of diesel consumption by volume} \\ &\quad + \text{operating hrs} \times \text{sump capacity/250} \\ &= .015 \times 51\,000 + \left(\frac{1\,200 \times 8}{250}\right) \\ &= 803 \text{ L} \\ \text{Cost of oil (XD3)} &= 803 \times \$1/\text{L} \\ &= \$803\end{aligned}$$

Annual cost of fuel plus oil, \$15,491 or \$12.91/hour.

The major capital costs with three-phase power are the connection charges, namely:

Posts and line, approximately \$4,500/km
Substation and transformer approximately \$5,200
Augmentation contribution \$120/kVA

This analysis assumes the power has to be brought 4 km to a 120 kVA motor so the above costs alone come to \$37,600. Additional capital costs include the motor and installation; details of capital costs are given in table 1.

The operating costs are based on flood demand rates with the motor pumping for 600 hours per 2 months. The flood demand tariff consists of two sections:

- demand or kVA charge at \$5.29/kVA; and
- a kilowatt hour charge broken into two parts;
 1. kVA $\times$ 40 hours at 11.75c
 2. Balance of hours at 2.46c.

Assuming the motor draws 120 kVA the demand charge will be \$634.80 for 2 months. The energy is calculated thus:

$$\begin{aligned}\text{Electricity consumption} &= \text{kW} \times \text{hours} \times \frac{1.11}{1} \\ &= 100 \times 600 \times 1.11 \\ &= 66\,600 \text{ kWh}\end{aligned}$$

(The figure of 1.11 allows for motor efficiency).

	\$
First (kVA $\times$ 40)	
(120 $\times$ 40) = 4 800 at 11.75c	564.00
Balance 66 600 - 4 800 at 2.46c.....	1,520.28
	2,084.28

The account for 2 months is thus \$634.80 + \$2,084.28 = \$2,719.08.

The annual cost of electricity (based on 1 200 hours) is therefore \$5,438.16 or \$4.53 per hour.

It is assumed the capital costs given in table 1 are paid for with cash at the beginning of year one.

Operating costs can include repairs and maintenance, insurance and labour as well as fuel. These costs will usually be higher for the diesel motor. This analysis will ignore labour and insurance since the actual costs of these items will not differ significantly between power systems. A breakdown of all costs is given in table 2.

The cost components detailed on table 2 can be used to project the cost stream applying to each power system. Planning periods or horizons of 5 and 10 years have been adopted.

TABLE 1
A Summary of the Capital Costs

Item	Electricity \$	Diesel \$
Power lines, substation and transformer	23,200	..
Augmentation contribution.....	14,400	..
Basic motor (100 kW)	1,950	12,000
Starter	1,380	..
Labour	1,600	500
Coupling and frame	700	500
	43,230	13,000

TABLE 2
Components of cost for electric and diesel power systems

	Electricity		Diesel	
	\$/h	\$/yr	\$/h	\$/yr
Operating—				
• fuel	4.53	5,438.16	12.91	15,491.00
• repairs and maintenance	0.05	60.00	1.00	1,200.00
Capital cost (first year only)	..	43,230.00	..	13,000.00
Overhaul—				
(year 4)	..	..	..	1,500.00
(year 8)	..	..	..	1,500.00

TABLE 3
The projected and present day cost of electric and diesel power systems

Year	Electricity		Diesel	
	Projected total cost \$	Present day cost \$	Projected total cost \$	Present day cost \$
1	48,728	48,417	29,691	28,746
2	5,498	4,893	16,691	14,854
3	5,498	4,616	16,691	14,014
4	5,498	4,355	18,191	14,409
5	5,498	4,109	16,691	12,473
6	5,498	3,876	16,691	11,767
7	5,498	3,657	16,691	11,101
8	5,498	3,449	18,191	11,413
9	5,498	3,254	16,691	9,879
10	5,498	3,070	16,691	9,320
		83,696		137,976

The projected cost streams have been reduced to present day values using discount rates of 6 and 16%. The lower rate is thought to represent the real discount factor applying to money after allowing for inflation. The higher discount rate favours diesel because it diminishes the impact of diesel's relatively high costs in later years. Details of the discounting exercise using a planning period of 10 years and a discount rate of 6% are given in table 3. In year one, the discount factor is not applied to the capital

cost component of total cost because this is outlaid at the very beginning of the investment period.

The cost totals in table 3 show electricity to have an advantage over diesel; \$6.97 per hour for electricity versus \$11.50 per hour for diesel, that is, a 39 % saving. This is a worthwhile saving but the comparison has been made over a fairly substantial period which may not suit the investor wanting a quick return.

When the planning period is reduced to 5 years and the discount rate raised to 16%, the costs become \$10.20 and \$11.40 per hour for electricity and diesel respectively, a saving with electricity of about 10%.

For and against

Apart from being cheaper over the long and medium term, electricity has the advantage of being quiet and convenient to use. It is also a safer power source where mechanical knowledge or supervision is lacking.

Despite these advantages, some large-scale pumping systems to be established over the next few years will still use diesel power. This is simply because of the relatively high costs of connecting electricity. Capital is extremely limiting in the establishing years or virtually any irrigation scheme and this consideration strongly favours diesel power. Also, with diesel power, second-hand motors can be used to give further worthwhile savings on capital outlay. There is no likewise scope for reducing the connection charges that go with electricity.

Lesser advantages with diesel include freedom from blackouts (either industrially or mechanically induced) and greater site mobility than electricity, the latter being strictly confined to the point of power connection.

The analysis of diesel and electricity given in this paper was based on data relating to the Goondiwindi area where electricity is supplied by the North-West County Council. Therefore, the findings apply specifically to the Goondiwindi area but could also apply to areas serviced by generating authorities using similar rates and methods of charging.

State Wheat Board election result

THE by-election conducted in District No. 2 of the State Wheat Board to fill the vacancy caused by the death of Mr V. J. Coggan has resulted in Mr B. E. D. Cameron of The Gums being elected to the Board.

Announcing this, the Minister for Primary Industries (Mr Mike Ahern, M.L.A.) said that Mr Cameron would represent District No. 2 which comprises the Western Downs and South West areas until the 31 August 1983.

Details of the voting released by Mr Ahern were:—Cameron, Bryan Edward Dixon (The Gums) 294 votes; McCosker, Anthony John (Meandarra) 282; Norman, Arthur George (Bungunya) 145; Shand, William Neil (Hannaford) 63; Taylor, Donald Clarendon (Moonie) 285; Thompson, Max Laidlaw (St. George) 182; Informal 3.

Congratulating Mr Cameron, Mr Ahern said he was confident that wheatgrowers in District No. 2 would be well served by Mr Cameron's appointment.

South Queensland grain sorghum yields

compiled by R. G. Henzell, D. S. Fletcher and E. C. Gallagher, Agriculture Branch

The table of yield data in this article is a summary of data collected from the Department of Primary Industries' grain sorghum hybrid testing program in southern Queensland.

The data have been separated into five groups: Eastern Downs (Shires of Glengallan, Rosenthal, Allora, Clifton, Cambooya); Central Downs (Shires of Jondaryan, Pittsworth, Millmerran, Crow's Nest, part Rosalie); Northern Downs (Shires of Wambo and Chinchilla); South Burnett; and Boonah.

Most trials in the Eastern Downs, Central Downs and South Burnett have been grown at the

Hermitage Research Station, Bongeen, Jimbour and the Bjelke-Petersen Field Station respectively.

In previous years, the yield of particular hybrids has been expressed as a percentage of Texas 610SR's yield. This has been continued but in addition a hybrid's yield as a percentage of the mean yield of three hybrids (Texas 610SR, Pride and E57) has been presented.

Using a mean may help to overcome situations where a single reference hybrid (for example, Texas 610SR) may be affected (adversely or beneficially) by a set of conditions which may specifically affect that hybrid. The yield figure expressed as a

percentage of the mean of the three hybrids is the most reliable.

As has been pointed out previously, hybrids (and indeed varieties of any crop) vary in performance relative to one another both from location to location and year to year. For this reason, these yield data become more reliable as more trials are grown and this should be noted when examining the data.

These types of data should be used only as a guide but should help in conjunction with the guide of grain sorghum characteristics chart when grain-growers are making their hybrid selection.

Mean yield as % of Texas 610SR and % of mean of Texas 610SR, Pride and E57. 1974-75 up to and including 1980-81 trials.

SEED COMPANY	HYBRID	EASTERN DOWNS				CENTRAL DOWNS				NORTHERN DOWNS				BOONAH				SOUTH BURNETT			
		Yield % Texas 610SR	No. of trials	Yield % of 3	No. of trials	Yield % Texas 610SR	No. of trials	Yield % of 3	No. of trials	Yield % Texas 610SR	No. of trials	Yield % of 3	No. of trials	Yield % Texas 610SR	No. of trials	Yield % of 3	No. of trials	Yield % Texas 610SR	No. of trials	Yield % of 3	No. of trials
ASGROW	Dorado	112	5	109	5	96	6	96	6	98	12	95	12	105	4	109	4	90	14	97	14
	Dorado E	97	5	95	2	103	8	100	4	108	12	102	9	89	4	93	4	94	11	90	6
DEKALB	C42t	94	4	92	4	86	4	97	4	92	7	94	7	..	..	..	..	96	5	90	5
	C43	97	3	97	2	103	5	100	5	101	10	96	10	95	4	99	4	95	12	94	12
	E55e	94	4	92	4	75	4	85	4	86	4	93	4	..	..	..	..	89	9	95	9
	DK55	94	2	94	2	100	3	95	3	104	6	97	6	102	2	112	2	87	3	89	3
	E57	110	5	107	5	96	8	98	8	97	13	95	13	95	4	99	4	100	17	101	17
	F64a	101	5	98	5	68	6	68	6	78	12	76	12	87	3	91	3	91	10	88	10

Mean yield as % of Texas 610SR and % of mean of Texas 610SR, Pride and E57. 1974-75 up to and including 1980-81 trials.

SEED COMPANY	HYBRID	EASTERN DOWNS				CENTRAL DOWNS				NORTHERN DOWNS				BOONAH				SOUTH BURNETT			
		Yield % Texas 610SR	No. of trials	Yield % of 3	No. of trials	Yield % Texas 610SR	No. of trials	Yield % of 3	No. of trials	Yield % Texas 610SR	No. of trials	Yield % of 3	No. of trials	Yield % Texas 610SR	No. of trials	Yield % of 3	No. of trials	Yield % Texas 610SR	No. of trials	Yield % of 3	No. of trials
NORTHROP KING	NK006	87	2	86	2	92	2	86	2	106	6	99	6	81	2	89	2	88	2	..	..
	NK150	87	2	87	2	102	2	95	2	108	6	101	6	74	2	81	2	95	2	..	..
	NK250	100	2	99	2	102	2	95	2	105	6	98	6	83	2	90	2	94	3	95	2
	NK280	..	..	..	..	99	2	93	2	114	6	107	6	95	2	104	2	85	2	88	2
	NK350	..	..	..	..	..	..	..	..	87	3	81	3	..	..	..	..	..	..	..	..
PACIFIC SEEDS	Goldfinger	98	5	102	2	94	6	92	6	104	10	97	7	99	3	104	3	96	15	86	10
	Goldrush	90	5	88	3	94	8	96	5	106	12	107	9	91	4	95	4	91	19	95	15
	Pac 710	100	3	98	3	104	5	101	5	108	9	103	9	96	3	101	3	98	3	85	3
	Nugget	86	2	83	2	101	3	95	3	115	8	109	8	86	3	90	3	84	11	80	8
	Sundowner	112	2	112	2	103	3	97	3	101	8	93	8	93	2	101	2	100	10	99	10
Pioneer	Leader 1	101	5	99	5	88	7	90	7	92	13	90	13	103	4	107	4	104	14	102	14
	Pride	99	5	96	5	99	8	100	8	108	13	106	13	93	4	97	4	98	17	99	17
	Sunlover 1	98	5	95	5	106	5	100	5	95	11	95	11	95	2	101	2	103	15	99	15
	Big Red	109	5	106	5	90	4	91	4	94	8	93	8	99	2	108	2	96	11	95	11
	Gem	90	3	..	..	105	4	99	4	110	9	103	9	92	3	98	3	92	9	91	7
	Solo H	..	..	..	..	..	..	..	..	84	3	78	3	..	..	..	..	101	2	105	2
	Trump	..	..	..	..	106	2	101	2	115	3	107	3	..	..	..	..	97	2	97	2
YATES	Yates 212	95	4	93	4	94	6	99	6	89	9	90	9	..	..	..	..	93	7	94	7
	Yates 233	93	4	..	..	93	4	..	..	90	3	..	..	..	..	..	..	100	5	..	..
	Yates 266	99	4	97	4	82	4	93	4	86	4	93	4	95	2	94	2	104	10	102	10
	Yates 275	101	2	97	2	81	2	97	2	79	2	82	2	..	..	..	..	104	2	91	2
	Yates SM5	110	5	107	5	101	2	94	2	109	6	102	6	93	2	102	2	113	5	102	5
	Yates SM8	102	5	100	5	103	5	101	5	105	10	100	10	97	4	101	4	102	14	103	14
	Yates SM9	107	4	104	4	98	2	92	2	99	6	93	6	99	2	108	2	95	3	92	3
	Yates SM10	101	4	99	4	87	2	82	2	81	7	78	7	93	4	96	4	98	7	95	7
HYLAN	Star	98	2	98	2	105	2	98	2	100	6	94	6	..	..	..	..	95	2	97	2
	Trojan 1	..	..	..	..	102	2	95	2	103	6	97	6	96	2	105	2	90	6	96	6
	Hylan 4 x 8	..	..	..	..	110	2	102	2	109	6	102	6	96	2	105	2	104	6	106	6
	Texas 610SR	100	..	97	2	100	..	102	8	100	..	99	13	100	..	104	4	100	..	101	17
	Texas 626	97	4	95	4	94	4	99	4	92	4	96	4	..	..	..	..	90	3	92	3
	Texas 671'	101	2	98	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Q5161	98	5	96	5	103	6	107	6	101	12	99	12	93	3	97	3	101	17	102	17

Grey kangaroo survey in southern inland Queensland

by G. J. E. Hill, Geography Department, University of Queensland

Over the last 10 years, kangaroo conservation has been a controversial issue.

One of the major obstacles to effective public education on the kangaroo situation has been the lack of any quantitative data on population totals. Conflicting interpretations of available evidence by scientists, landholders and conservationists have made objective assessments of the status of kangaroos extremely difficult.

One direct result of this that has had repercussions for the kangaroo industry and landholders was the imposition of bans on the import of kangaroo products by the United

States government in 1974. At the present time, this embargo is still in force.

This article outlines the results of an aerial survey of grey kangaroo density for a section of southern, inland Queensland. The survey, conducted during 1979 sampled a variety of habitat types and covered that part of the State supporting the highest harvest rates for grey kangaroos.

The survey

So that results would be comparable with similar work, survey mechanics were standardized against those of New South Wales' research.

The basic flight plan is illustrated in figure 1. A Cessna 172 aircraft was used, the survey crew consisting of a pilot/navigator and two observers, one for either side of the plane.

Results

The survey covered an area of 47 000 km² and returned a population estimate of 694 000 $\pm$ 7.6% ($\bar{Y} \pm SE$) grey kangaroos. This represents an average density of 14.7 kangaroos per km² for the area as a whole.

Figure 2 illustrates the results obtained in map form using the

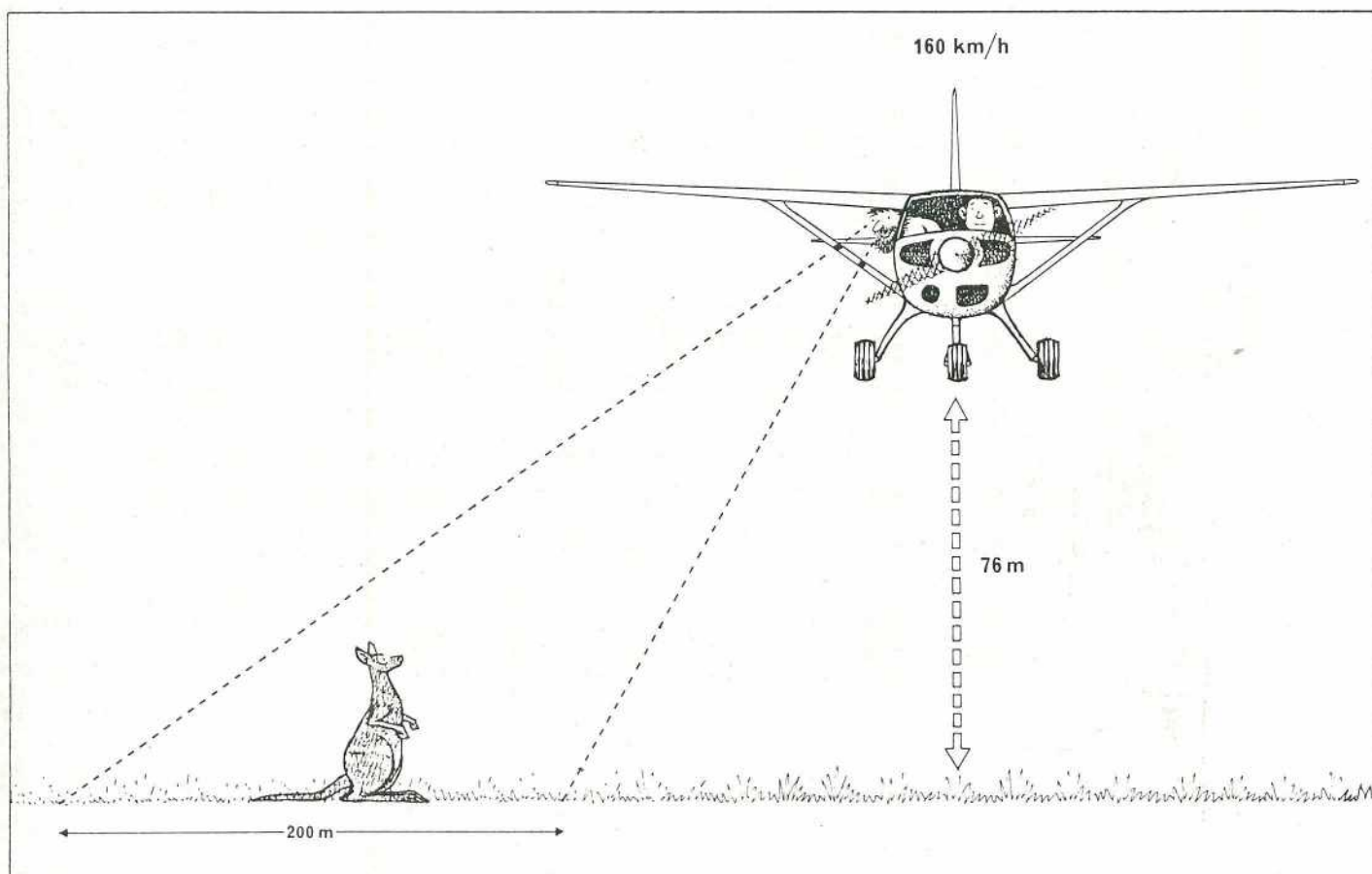


Figure 1. Flight plan for aerial survey of grey kangaroo density.

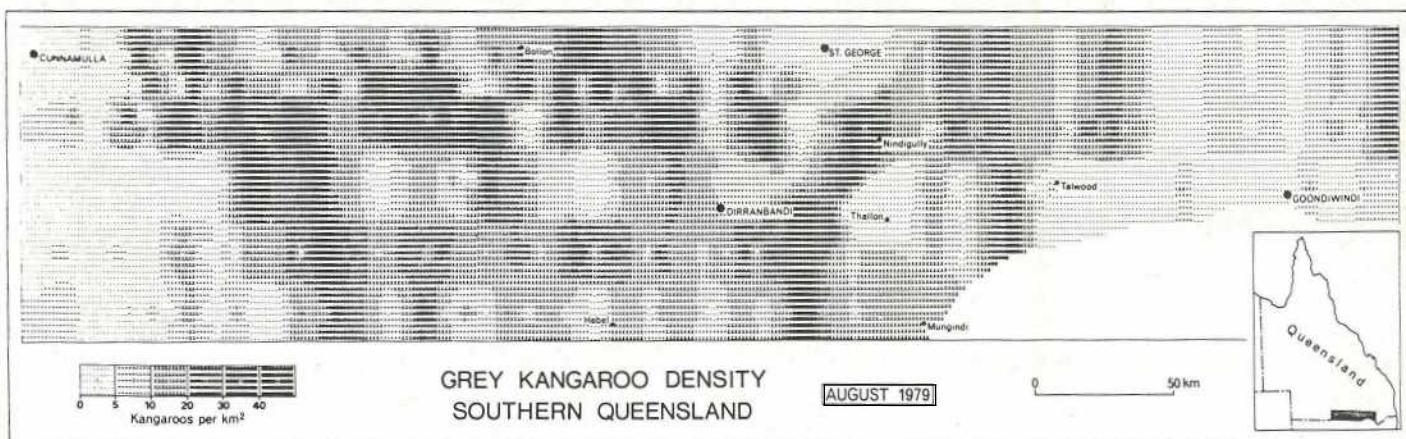


Figure 2. Distribution map of grey kangaroo density August 1979.

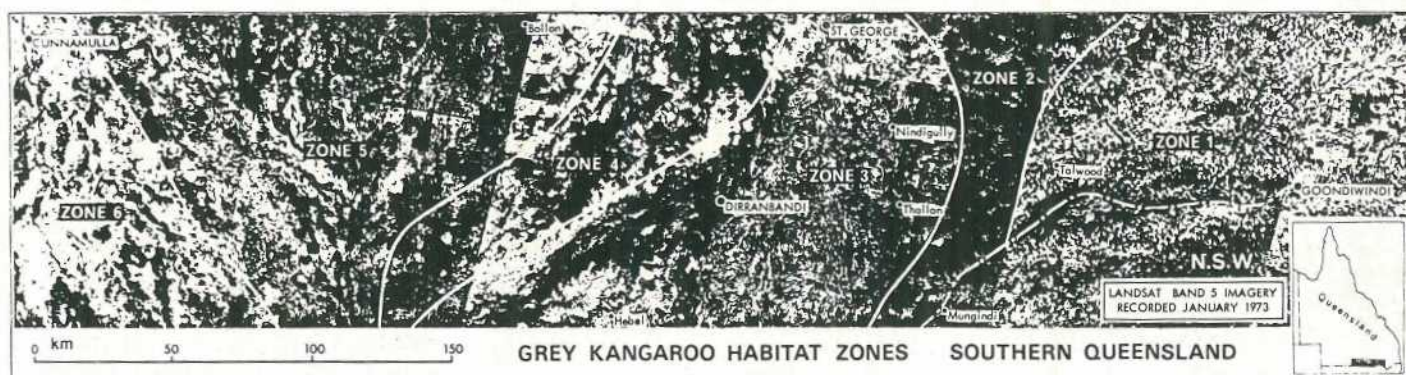


Figure 3. Habitat zones mapped from LANDSAT imagery.

SYMAP computer mapping programme. As the map is based on a sampling intensity of only 1.6% it should not be taken as an accurate guide to kangaroo density. It does, however, establish the generalized distribution of grey kangaroos for this section of the State.

Figure 3, a LANDSAT mosaic of the area, defines regional habitat types that can be related to the density patterns of figure 2. The highest numbers were recorded in zone 5, which is predominately mulga country. This region returned an average density of 23 kangaroos per km². Zones 2, 3 and 4 also supported high densities averaging approximately 17 kangaroos per km². Zone 1 (6.7 kangaroos per

km²) and zone 6 (4.6 kangaroos per km²), areas with limited woodland and scrub cover, carried significantly lower populations.

While it is doubtful that aerial counts supply truly accurate estimates of kangaroo numbers, this type of survey does represent the only method available for gauging kangaroo density across large areas. As far as management of kangaroos is concerned, accurate counts are not a necessity. Providing surveys can monitor trends in the population, the impact of commercial harvesting or other factors governing kangaroo abundance can be assessed.

The survey established that grey kangaroos are abundant in southern, inland Queensland. As the areas of

highest kangaroo density also support the highest harvest rates for the animal, results suggest that commercial harvesting poses no threat to the conservation of grey kangaroos in this part of the State.

Further reading

Hill, G. J. E. and Falconer, A. (1978) Relevance of LANDSAT to Kangaroo Management in Queensland, Australia *Proc. Pecora IV: Symp. Appl. Rem. Sens. Data to Wildl. Manage.*, Sioux, pp. 287-293.

Caughley, G., Sinclair, R. and Wilson, G. (1977) Numbers, Distribution and Harvesting Rate of Kangaroos on the Inland Plains of New South Wales, *Aust. Wildl. Res.*, 4(2): 99-108.



Maize planting guide 1981-82 season

compiled by I. F. Swann, Agriculture Branch

Maize hybrids recommended for planting in the 1981-82 season are listed below.

The hybrids have not been ranked in order of preference. Those listed 'for trial' should only be sown in limited areas to evaluate their performance.

To minimize the risk of loss through adverse seasonal and other conditions, it is suggested that two or more hybrids should be sown.

Plant populations

The planting rate will be governed by such factors as soil type, variety, climatic conditions, district, planting time and soil moisture.

The plant population for rain-grown crops will vary between 20 000 and 30 000 plants per ha but should be 40 000 plants per ha on the Atherton Tableland. The rate should be increased to establish about 50 000 plants per ha when the crop is grown under irrigation.

Seed is available commercially in a range of shapes and sizes. Selection from this range can be made to suit the type of planting machinery being used.

The size usually ranges between 2 600 to 4 500 seeds per kg.

Most commercial seed companies mark the seed count per kg on the container.

Disease

The main diseases affecting maize are illustrated in the *Handbook of Plant Diseases*, Volume 2, published by the Queensland Department of Primary Industries.

The following summary of the more important diseases has been extracted from that publication.

Maydis leaf blight—may be serious in north Queensland, but is not a problem in south Queensland.

Turcica leaf blight—may be serious in susceptible hybrids.

Common rust—common but minor.

Maize dwarf mosaic—major in susceptible hybrids.

Wallaby ear—major in late coastal crops.

Head smut—may be serious in susceptible hybrids in north Queensland; minor in south Queensland.

Diplodia rots—ear rot may be serious in north Queensland.

Gibberella rots—may be serious in north Queensland, moderate in south Queensland.

A number of other stalk and ear rots has been recorded; the infection is usually minor but may vary in intensity between districts and seasons.

A brief description of the more common diseases is given below:

Common leaf blight The fungus *Drechslera turcica* produces grey or light-brown, large, spindle-shaped leaf spots commonly up to 15 x 2 cm in size.

Maydis leaf blight Maydis leaf blight (*Drechslera maydis*) is restricted to north Queensland. The change by seed producers from T cytoplasm to N cytoplasm has effectively controlled this disease in south Queensland.

Head smut In north Queensland and certain areas of the South Burnett region, head smut caused by *Sphacelotheca railiana* is prevalent. Grain yields may be seriously reduced in crops with a heavy infection because the grain is replaced by a mass of fungal spores.

Seed treatments may destroy externally-borne spores on the seed

but will not protect a crop against infection from smut in infested soil. Resistant hybrids should therefore be used.

Maize dwarf mosaic This disease can be present in many south Queensland maize crops if susceptible hybrids are grown. Maize dwarf mosaic is caused by infection with the Johnson grass strain of sugarcane mosaic virus which is transmitted by aphids.

Infected plants of susceptible hybrids show conspicuous stripes or mosaic and ringspot patterns. Severe stunting may result, particularly when plants are infected early. The virus is maintained between seasons in Johnson grass and stand-over fodder sorghum.

Disease control cannot be effectively achieved with insecticides and Johnson grass cannot be economically eradicated in all situations. Control of the disease is achieved by sowing resistant hybrids.

Wallaby ear This disease is associated with infestation by a small, pale-coloured leafhopper and is generally more severe in late plantings in coastal districts.

Affected plants are dark green and stunted. The leaves stand out stiffly at sharp angles to the stalk and the veins on the under surface are very prominent. Ear development on severely affected plants is very poor.

Maturity

Hybrids may vary in maturity depending on the environment in which they are sown.

The recommendations are basic information only and further details should be sought from your local Agricultural Extension Officer.

A summary of the characteristics of maize hybrids is shown in the guide.

VARIETAL PLANTING GUIDE

Region	Planting Time	Hybrids
Far Northern Cook, Mareeba, Atherton, Eacham, Herberton, Mulgrave, Johnstone, Cardwell, Douglas, Etheridge, Hinchinbrook Shires	Dec.-mid Feb.	S : QK657, QK690, QK694
Northern Dalrymple, Thuringowa, Ayr, Bowen, Proserpine Shires	<i>Irrigated</i> Mar.-July <i>For trial</i> Mar.-July	MS: XL399 M : Sergeant, XL81 M : PX74
Capricornia Livingstone, Fitzroy, Calliope, Broadsound Shires	Dec.-Jan. end Dec.-end Jan.	M : Major, Sergeant, XL81
Burnett Miriam Vale, Kolan, Gooburrum, Woongarra, Isis, Perry, part Biggenden, Hervey Bay, Woocoo Shires Gayndah, Mundubbera, part Biggenden Shires Eidsvold, Monto Shires	late Aug.-Dec. mid Nov.-early Jan. mid Nov.-early Jan.	S : GH128, GH390 MS: XL99 M : GH5004, Sergeant, XL81 After Dec. sow only GH5004 or Sergeant M : GH5004, Sergeant MS: Major, XL99, XL399 M : GH5004, Sergeant, XL81
South Burnett Kingaroy, Nanango, Wondai, Murgon, part Kilkivan, part Rosalie Shires	mid Nov.-Dec. <i>For trial</i> mid Nov.-Dec.	MS: Major M : Sergeant, XL81, GH5004 M : XL72aa, PX74
Near North Coast Widgee, Noosa, part Tiaro, Maroochy, Landsborough, part Kilkivan Shires	Nov.-Jan.	S : GH390 MS: Major, XL99, XL399 M : GH5004, Sergeant, XL81
Moreton Caboolture, Pine Rivers, Redlands, Albert, Beaudesert, Moreton, Esk, Kilcoy, Boonah, Gatton, Laidley Shires	Sept.-Dec. <i>For trial</i> Sept.-Dec.	S : GH128, GH390 MS: XL99, XL399 M : GH5004, XL81 Sergeant for early sowing only Q : PX48
Darling Downs Wambo, Chinchilla Shires Pittsworth, Millmerran, Jondaryan, Crows Nest, part Rosalie Shires Clifton, Allora, Cambooya, Rosenthal, Glengallan Shires Stanthorpe Shire Irrigated—All Shires Inglewood	Sept.-Nov. Dec. Oct.-Dec. <i>For trial</i> Oct.-Dec. Oct.-Dec. <i>For trial</i> Oct.-Dec. Nov.-Dec. Oct.-Dec. <i>For trial</i> Oct.-Dec. Oct.-Dec.	MS: XL99, XL399 M : XL81, Sergeant M : XL81 MS: XL99, XL399 M : XL81, Sergeant Q : XL66 MS: XL99, XL399 M : Sergeant, XL81 Q : XL66 M : Sergeant, XL81 MS: XL99, XL399 M : Sergeant, XL81 M : GH5004 MQ: XL77 Q : XL66 M : Sergeant, XL81 Q : Colonel
Near South-west Balonne Shire	<i>Irrigated only</i> Oct.-Dec.	M : Sergeant, XL81

GUIDE TO MAIZE CHARACTERISTICS

	Maturity (sown Oct.-Nov.)	Plant height	Cob height	Suckering	Number of cobs	Husk Cover	Reaction To—				
							Turcica leaf blight	Maydis leaf blight Race O	Head smut	Maize dwarf mosaic	Wallaby ear
DeKalb Seed Co											
XL66	Q	MS	MS	N	S	L	NA	NA	NA	S	S
XL361	MQ	MS	MS	N	S	L	S	S	NA	S	R
XL77	MQ	M	M	N	S	L	I-MR	I	NA	R	I
XL77a	M	M	M	N	S	NA	NA	NA	NA	MR	R
XL81	M	M	M	N	S	T	*I-MR	I	MR	MR	R
XL82	M	M	M	L	S-M	NA	NA	NA	NA	MR	I
XL99	MS	MT	MT	L	S	T	R	MR	MR	HR	S
XL399	MS	MT	M	L	S	T	HR	I	MR	MR	I
XL72aa	MQ	M	M	NA	S	L	R	MR	NA	MR	R
XL94	MS	MT	M	L	S-M	NA	NA	NA	NA	MR	I
Northrup King											
PX48	MQ	M	M	L	S	T	NA	NA	NA	R	I
PX74	M	MT	M	L	S	T	NA	NA	NA	MR	I
Pioneer											
Colonel	Q	S	M	N	S-M	L	NA	NA	NA	MR	I
Sergeant	MQ	M	M	L	M	L	R	S	MR	R	S
Major	MS	M	M	N	M	L	R	NA	MR	R	S
QK Groups											
QK657	S	T	T	L	S	T	R	MR	HR	MR	I
QK690	S	T	T	L	S-M	T	R	MR	MR	R	I
QK694	S	MT	MT	L	S-M	T	R	R	MR	R	I
GH Group											
GH128	S	T	T	L	S	T	R	I	R	HR	I
GH390	S	T	T	L	S	T	R	I	S	MR	I
GH5004	M	M	M	M	S	M-T	HR	R	NA	HR	R

KEY

Maturity: Q = quick; MQ = medium quick; M = medium; MS = medium slow; S = slow.

Plant height & cob height: T = tall; MT = medium tall; M = medium; MS = medium short; S = short.

Suckering: N = nil; L = light; M = medium; H = heavy.

Number of cobs: S = single; M = multiple; S-M = single, some multiple.

Husk cover: T = tight; M = medium; L = loose; NA = no information available.

Reaction to disease: HR = highly resistant; R = resistant; MR = moderately resistant; I = intermediate; S = susceptible; HS = highly susceptible; NA = no information available.

* XL81 contains the Hooker gene resistance and was previously resistant to the common race of turcica leaf blight. A new race which has overcome this resistance is now found in south-east Queensland. This loss of resistance may not seriously reduce yields in all circumstances.

Grain sorghum planting guide for central Queensland in 1981-82

compiled by J. W. Foreman and I. Romano, Agriculture Branch

GRAIN sorghums recommended for planting in central Queensland in the 1981-82 season are listed in table 1. These hybrids have been selected because of their yield, consistency of yield over time, standability and head type.

The sorghum-growing areas for which these varieties are recommended in this guide are the Shires of Livingstone, Fitzroy, Calliope, Nebo, Broadsound, Banana, Duaringa, Emerald, Peak Downs, Belyando and Bauhinia.

In some years all of these factors listed above may not come into consideration and a large number of hybrids may equal or even outyield recommended hybrids. However, for recommendation, all hybrids are required to have performed consistently well over at least 3 years and in a minimum of 18 trials.

Those listed for trial have also performed well but in fewer years and in fewer trials. These hybrids should be planted on a smaller area and be fully evaluated on the property. Certainly, as new hybrids become available they should be tried on small areas to test their reaction to local conditions.

Plant populations

Plant populations for rain-grown crops should range from 50 000 to 90 000 plants per hectare. It is important to have an even plant distribution particularly when populations are below 75 000 plants per ha.

Under irrigation, up to 250 000 plants per ha may be used. A maximum of 175 000 plants per ha is recommended for early planted ratoon sorghum.

The planting rate will vary according to—

- The plant population required.
- The seed quality. Grain sorghum seed sold by major seed companies is of high quality and must have a germination of at least 70%. Seed test results can be obtained from retailers. Good seed has a germination of around 90%.
- The number of seeds per kilogram. Seed size varies but generally the number of seeds is

from 20 000 to 40 000 seeds per kilogram. Seed size is usually on the label.

- The expected emergence in the paddock. This depends on available soil moisture, efficiency of planting equipment and soil type.
- The amount of soil moisture likely to be available during the growing period.

$$\text{Seed required per ha} = \frac{\text{desired plant population} \times 10\,000}{\text{no. of seeds/kg} \times \% \text{ germination} \times \% \text{ emergence}}$$

Use the following table as a guide—

APPROXIMATE PLANTING RATE FOR GRAIN SORGHUM PLANT POPULATIONS

Plants/ha	Planting rate kg/ha
50 000	2.5–3.0
75 000	3.75–4.0
100 000	5.0–5.5
150 000	7.5–8.0

Hybrid characteristics

Important characteristics of a wide range of hybrids are given in table 2. The hybrids included are those which are commercially available or are showing good potential in central Queensland.

When selecting a hybrid, the most important characteristics are yield, resistance to lodging (rain-grown crops only), and resistance to leaf diseases. Factors such as maturity, plant height, head characteristics and reaction to insecticides should also be considered.

Maturity. Differences between hybrids in time to flowering are not as great in central Queensland as in

southern areas because of the later planting time and higher temperatures. The differences between slow maturing and quick maturing hybrids are even less in late plantings.

Slow maturing hybrids have a higher yield potential than quick maturing ones. Quick maturing varieties, however, still have a role. They can be used very early or very late in the season. They can also be very effective in main season plantings because of their greater efficiency in moisture usage. If the season turns dry after planting, then a quick variety may escape damage from lodging or disease and still produce an acceptable yield.

Insects. Sorghum midge is more likely to be a problem in hybrids which have an extended flowering period. Heliothis and sorghum head caterpillars are most likely to cause yield reductions in intensive cropping areas and in varieties with compact heads. Heads of open-headed hybrids dry more rapidly and make insect control easier.

Leaf diseases. These can be severe in wet seasons and in coastal areas, and may reduce yield.

Resistance to lodging. This may be advantageous, particularly in more marginal situations or where harvesting is likely to be delayed after maturity.

Yield index. The yield index is only a guide to relative yield. A particular yield index is regarded as reasonably reliable when the hybrid has been in at least 16 trials over three seasons.

TABLE 1
Grain sorghum guide 1981-82

Situation	Planting Time	Recommended Hybrids
Rain-grown (All Shires)	mid December– mid February	E57, F64a, Leader 1, Pride <i>For trial</i> Sundowner, SM8 Trojan I, DK55, Solo H
Irrigated (All Shires)	September (ratoon sorghum) mid December– late January	Limited trial data available but there appears to be little varietal difference between a number of sorghum varieties under ratooning For irrigated sorghum the medium to late maturing varieties are best suited

NOTE—There are limited trial data for irrigated sorghums in central Queensland. For further details consult your local Agricultural Extension Officer.

TABLE 2

Guide to grain sorghum characteristics central Queensland 1981

Seed Company	Hybrid	Time of flowering	Height	Head	Grain colour	Reaction to				Mean yield as % of (Texas 610 SR, E57, Pride		Number of years in trials
						S.C.M. virus	Rust (<i>Puccinia purpurea</i>)	Leaf blight (<i>Drechslera turcica</i>)	Stand-ability or resistance to lodging	central Queensland		
										Yield %	No. of trials	
Asgrow	Dorado Dorado E	MS MQ	M MT	semi-open semi-open	bronze bronze	M Red Stripe	S R	R S	** **	104 97	28 15	8 5
DeKalb	C43	M	MT	open	bronze	M	S	S	****	110	5	2
	E57	MS	MT	open	bronze	M	R	S	*****	102	33	8
	F64a	S	T	open	bronze	M	R	R	*****	100	30	8
	DK55 tt	MS	MT	open	red	M	R	R	****	104	14	3
	DK38 t	MQ	S	open	bronze	M	S	S	NA	NA	..	..
Hylan	Trojan 1	MS	M	semi-open	bronze	R	R	NA	*****	100	15	3
	4 x 8	MS	M	semi-open	bronze	R	R	NA	****	105	9	3
	Q5161	MS	M	compact	bronze	Red leaf	R	HR	*****	92	31	8
	Texas 610 SR	M	M	compact	red	M	S	S	**	97	33	8
	Star SR	M	M	compact	red	R	S	S	**	NA	..	..
Northrup King	NK006	Q	MS	open	red	M	R	S	**	102	10	3
	NK150	Q	MS	open	bronze	M	NA	HR	**	93	12	4
	NK250	MQ	M	semi-open	bronze	M	R	NA	**	82	10	3
	NK280	M	M	semi-open	light red	M	R	NA	**	96	9	2
	NK310	MS	M	semi-open	bronze	R	NA	NA	NA	97	5	1
	NK350	S	M	semi-open	bronze	M	S	NA	NA	91	5	1
	Golddigger	Q	MT	semi-open	red	M	R	R	NA	92	2	1
Pacific Seeds.....	Goldfinger	Q	T	semi-open	bronze	M	S	R	**	100	15	6
	Goldrush	Q	MT	semi-open	red	M	R	R	***	94	31	8
	Nugget	Q	S	open	red	M	R	S	****	95	20	4
	Sundowner	MS	M	semi-open	bronze	R	R	NA	*****	106	16	3
	New Tropic	S	T	semi-open	bronze	M	R	NA	NA	NA	..	..
	Pac 710	M	MT	compact	red	M	R	HR	**	102	2	2
	Monsoon	VS	T	open	red	M	NA	NA	**	104	2	2
Pioneer	Big Red	S	M	semi-compact	bronze	M	S	S	**	101	19	4
	Gem	MQ	MS	semi-compact	light red	M	HS	S	***	101	17	5
	Leader 1	M	MS	semi-open	bronze	M	S	S	****	101	28	8
	Pride	MQ	S	semi-compact	bronze	M	S	S	****	101	29	8
	Solo H	MS	M	open	bronze	R	NA	R	*****	103	14	3
	Sunlover 1	MS	MS	semi-compact	bronze	Red leaf	R	R	*****	91	23	7
	Trump	M	MT	open	bronze	M	S	R	NA	103	7	1
Yates	SM5	M	MS	open	bronze	M	S	R	***	103	11	5
	SM8	M	MS	semi-open	bronze	M	R	R	*****	99	25	6
	SM9	M	M	open	bronze	NA	S	R	*	90	11	4
	SM10	MS	MT	semi-open	bronze	M	R	S	**	101	18	6
Cargill	Todman	MQ	S	semi-compact	red	M	NA	NA	NA	NA	..	..
	Gunsynd	M	M	semi-open	red	M	S	NA	NA	NA	..	..
	Tulloch	M	M	semi-open	red	M	R	NA	NA	NA	..	..
	Hallmark	MS	M	semi-open	bronze	M	R	NA	NA	109	6	1
Open pollinated variety...	Alpha	S	MS	semi-compact	red	M	HS	R	*****	75	12	5

KEY

Time to flowering: Q = quick; MQ = medium quick; M = medium; MS = medium slow; S = slow.

Height: T = tall; MT = medium tall; M = medium; MS = medium short; S = short.

Head type: open; semi-open; semi-compact; compact.

Leaf rust: HR = highly resistant; R = resistant; S = susceptible; HS = highly susceptible.

Sugarcane mosaic virus reaction: R = resistant; M = mosaic; red leaf; red stripe.

Leaf blight: HR = highly resistant; R = resistant; S = susceptible.

Standability or resistance to lodging: * poor standability; ***** very good standability.

Average yield index: The average yield of the variety as a percent of the average of three hybrids (Texas 610 SR, E57 and Pride).

NA: Sufficient information is not available or the hybrid has not been tested in Departmental trials.

Number of trials: The number of trials in which the reference hybrids and the particular hybrids occurred. The greater the number of trials used to calculate the average, the greater the reliability of the results.

Number of Years: The number of years the particular hybrid was tested in trials since 1974.

t formerly X5467 tt formerly X5065.

South Queensland guide to grain sorghum characteristics 1981-82

compiled by officers of the Department of Primary Industries

Seed Company	Hybrid	Time of flowering	Height	Head	Grain colour	Reaction to				Standability or resistance to lodging
						Head Smut Race 1	S.C.M. virus	Rust (<i>Puccinia purpurea</i>)	Leaf Blight (<i>Drechslera turcica</i>)	
ASGROW	Dorado E	MQ	MT	Semi-open	Bronze	R	Red stripe	R	S	**
	Dorado A	M	MT	Semi-open	Bronze	R	M	S	S	*
	Dorado	MS	S	Open	Bronze	R	M	S	R	***
DEKALB	DK38t	MQ	S	Open	Bronze	R	M	S	S	N.A.
	C43	M	MT	Open	Bronze	R	M	S	S	***
	DK55tt	M	MT	Open	Red	R	M	R	R	****
	E55e	MS	MS	Semi-compact	Red	R	M	S	S	***
	E57	MS	MT	Open	Bronze	R	M	R	S	*****
	F64a	S	T	Open	Bronze	R	M	R	R	*****
NORTHROP KING	NK006	Q	MS	Open	Red	R	M	R	S	**
	NK150	Q	MS	Open	Bronze	R	M	N.A.	HR	**
	Golddigger	MQ	MT	Semi-open	Red	S	M	R	S	N.A.
	NK250	MQ	M	Semi-open	Bronze	R	M	R	N.A.	**
	NK280	M	M	Semi-open	Light-red	R	M	R	N.A.	**
	NK310	MS	M	Semi-open	Bronze	R	R	N.A.	N.A.	N.A.
	NK350	MS	M	Semi-open	Bronze	R	M	S	N.A.	N.A.
PACIFIC SEEDS	Nugget	Q	S	Open	Red	S	M	R	S	***
	Goldfinger	MQ	T	Semi-open	Bronze	R	M	S	R	**
	Goldrush	MQ	MT	Semi-open	Red	S	M	R	R	***
	Pac710	M	MT	Compact	Red	R	M	R	HR	**
	Sundowner	MS	MS	Semi-open	Bronze	S	R	R	N.A.	*****
	New Tropic	S	T	Semi-open	Bronze	R	M	R	N.A.	N.A.
	Monsoon	VS	T	Open	Red	R	M	N.A.	N.A.	**
PIONEER	Gem	MQ	MS	Semi-open	Light-red	R	M	HS	S	***
	Pride	M	S	Semi-open	Bronze	R	M	S	S	****
	Leader 1	MS	MS	Open	Bronze	R	M	S	S	****
	Sunlover 1	MS	MS	Semi-compact	Bronze	HS	Red leaf	R	R	*****
	Solo H	MS	M	Open	Bronze	R	R	N.A.	R	****
	Big Red	S	M	Semi-compact	Bronze	R	M	S	S	**
	Trump	M	MT	Open	Bronze	R	M	S	R	N.A.
YATES	Yates 233	MQ	M	Semi-open	Bronze	R	M	S	R	**
	Yates 212	M	M	Semi-compact	Red	R	M	S	S	**
	SM5	M	MS	Open	Bronze	R	M	S	R	***
	SM8	M	MS	Semi-open	Bronze	S	M	R	R	*****
	SM9	MS	M	Open	Bronze	R	N.A.	S	R	*
	Yates 275	MS	M	Semi-compact	Red	R	M	S	HS	**
CARGILL	Todman	MQ	S	Semi-compact	Red	N.A.	M	N.A.	N.A.	N.A.
	Gunsynd	M	M	Semi-open	Red	R	M	S	N.A.	N.A.
	Tulloch	MS	M	Semi-open	Red	S	M	S	N.A.	N.A.
	Hallmark	S	M	Semi-open	Bronze	R	M	R	N.A.	N.A.
HYLAN	Texas 626	M	M	Compact	Red	R	M	S	S	**
	Texas 610 SR	M	M	Compact	Red	R	M	S	S	**
	Star	M	M	Compact	Red	S	R	S	S	**
	Trojan 1	MS	M	Semi-open	Bronze	S	R	R	N.A.	*****
	Q5161	MS	M	Compact	Bronze	HS	Red leaf	R	HR	*****
	Hylan 4 x 8	MS	M	Semi-open	Bronze	S	R	R	N.A.	****
	Texas 671	S	M	Compact	Red	R	M	S	S	**
	Star SR	M	M	Compact	Red	R	R	S	S	**

Seed Company	Hybrid	Time of flowering	Height	Head	Grain colour	Reaction to				Standability or resistance to lodging
						Head Smut Race 1	S.C.M. virus	Rust (<i>Puccinia purpurea</i>)	Leaf Blight (<i>Drechslera turcica</i>)	
PANORAMA	New Red 610	M	M	Semi-compact	Red	S	M	S	S	**
	VIR-RES 610	M	M	Semi-compact	Red	S	R	S	S	**
	VR 5161	MS	M	Semi-compact	Bronze	S	R	S	S	N.A.
OPEN POLLINATED VARIETY	Alpha	S	MS	Semi-compact	Red	S	M	HS	R	*****

KEY

TIME OF FLOWERING

Q = Quick
MQ = Medium quick
M = Medium
MS = Medium slow
S = Slow

LODGING BEHAVIOUR RATINGS

* Poor standability
***** Very good standability

HEIGHT

T = Tall
MT = Medium tall
M = Medium
MS = Medium short
S = Short

HEAD

Open
Semi-open
Semi-compact
Compact
Compact heads dry less rapidly and are more susceptible to head caterpillars.

HEAD SMUT

R = Resistant
S = Susceptible
HS = Highly susceptible

SUGAR CANE MOSAIC VIRUS REACTION

M = Mosaic
Red stripe
Red leaf
R = Resistant

LEAF RUST

HS = Highly susceptible
S = Susceptible
R = Resistant
HR = Highly resistant
These classes are relative to each other, the dividing line being somewhat arbitrary.

N.A.—Information not yet available or the variety has not been fully tested in Departmental trials.

Savings in approved T.B. schemes

GRAZIERs who undertake an approved tuberculosis eradication scheme will avoid testing fees and stand to obtain worthwhile tax savings as well.

This advice comes from Queensland Department of Primary Industries Veterinary Services Director Mr Ian Wells.

He said that cattle from tuberculosis-infected herds that did not have an approved eradication programme would in future have to be tested before they were consigned for slaughter. The new ruling would take effect from 1 April, 1982.

It would also apply to cattle moving to and from interstate for slaughter.

Mr Wells said the rule had been introduced to protect those graziers who had adopted a tuberculosis eradication programme. Only a small number of herds were out of this category.

He said that, overall, the tuberculosis eradication programme was proceeding well, with only about 200 of

the 34 000 herds in Queensland still infected. However, many of those herds were large ones.

Recent changes to the Income Tax Act had encouraged the eradication programme because, from October, graziers with approved programmes would pay less tax on their incomes.

Mr Wells said this would allow graziers with approved destocking programmes to sell large herds in one year and average the income over a 5-year period. It would also allow graziers to offset the cost of replacement against the profit. This would reduce the amount of tax payable.

In addition, expenses for some improvements considered essential for an eradication programme had become tax deductible. This would enable graziers to erect cattle yards, crushes and internal fences.

Mr Wells reminded graziers that they needed prior Departmental approval of destocking and development programmes for their claims to be considered by the Taxation Department.

South Queensland grain sorghum planting guide 1981-82 season

compiled by J. F. Bourne, Agriculture Branch

Grain sorghum hybrids recommended for planting in south Queensland in the 1981-82 season are listed in this article. The hybrids have not been ranked in order of preference.

There are a number of hybrids offered for sale this season. Some have not been tested in Departmental trials and others have only been tested for a limited period. Some are showing promise of high yields and desirable characteristics but could not be included in the planting guide until further testing has been completed.

The hybrids listed 'for trial' should be sown in smaller areas for evaluation under your conditions. It would be appreciated if farmers would advise their agricultural extension officer of trial plantings as this will enable a wider evaluation of the performance of these hybrids to be made.

Some hybrids show phytotoxic reaction to insecticides, particularly monocrotophos which may be used to control sorghum midge. The severity of the reaction to insecticides varies with the growth stage of the plant. A number of new hybrids released to the market have not been tested for their reaction to the insecticides and growers should be cautious when spraying. If in doubt, a small area should be sprayed first to test for any reaction or advice should be sought from the appropriate seed company.

Open-headed hybrids are desirable in the more humid regions and in areas where sorghum head caterpillars are expected.

Planting rates

The established plant population for rain-grown crops will vary between 75 000 to 100 000 plants per ha. The rate should be increased

to establish about 250 000 plants per ha when crops are irrigated.

The planting rate will vary according to available soil moisture, time of planting, soil type and variety. Your agricultural extension officer will provide further information.

Grain sorghum seed sold by major seed companies is of high quality, but seed size varies. Generally it is in the range of 20 000 to 40 000 seeds per kg.

Approximate planting rate for given plant populations

Plants/ha	Planting rate kg/ha
50 000	2.5-3.0
75 000	3.75-4.0
100 000	5.0-5.5
150 000	7.5-8.0

Adjustments must be made for higher or lower populations and seed size. The efficiency of most planting machines is also variable.

Lodging

Lodging is a major problem in many grain sorghum producing areas in Queensland. The most prevalent type is that which follows moisture stress during the grain filling period. Under extreme conditions, all grain sorghum hybrids will lodge to varying extents.

Lodging can also be associated with conditions other than moisture stress and hybrids relatively resistant to one type of lodging may be more susceptible to other forms.

This year, varietal recommendations have been made for lodging soils and other soils. Varying soil types will occur on each individual farm and growers would be aware of the differing qualities and reactions of their soils.

Trial data and farmer experience have enabled classification of some hybrids as to their lodging resistance.

Only lodging resistant hybrids are recommended for areas where lodging is known to be a problem. Other characteristics, particularly grain yield and disease resistance, determine the recommendations for areas where lodging is usually not important.

Lodging is not usually of importance in fully irrigated crops but can occur in well-grown irrigated crops which experience moisture stress during grain filling.

Crop maturity

The hybrids have been given maturity ratings. However, maturity is governed largely by temperature and to a lesser extent by day length. Hybrids which flower in 60 to 65 days when sown in October in south Queensland could be expected to flower in 50 to 55 days when sown in December. The slow and medium-slow hybrids may therefore react as mid season types when sown later in the season.

Head smut

Head smut, an important soil-borne disease, is favoured by cool soil conditions. It is common in early plantings in south Queensland. Highly susceptible (HS) hybrids should not be sown early in areas where this disease has occurred.

Sugar cane mosaic virus (SCMV)

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

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

The red leaf symptom occurs in infected plants of specific hybrids following cool weather. The mosaic

symptoms develop into red spots, streaks and areas of dead tissue. If severe red leaf disease occurs, substantial yield loss will result.

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

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

Rust

Sorghum rust occurs in most districts throughout the State but is more prevalent in late-sown crops. Severe rust infection in highly susceptible hybrids has been associated with pinched grain and yield reduction. Premature plant death may also occur, predisposing the plant to lodging.

SOUTH QUEENSLAND GRAIN SORGHUM PLANTING GUIDE 1981-82 SEASON

A number of hybrids commercially available have not been fully tested in Departmental trials and are not included in the list of recommendations. However, many have shown promise under very limited commercial experience.

Region and Shires	Planting time	Recommended hybrids
Burnett Miriam Vale, Kolan, Gooburrum, Woongarra, Isis, Perry, part Biggenden, part Tiaro, Woocoo, Hervey Bay Shires	Sep.-Jan.	S:F64a MS:E57, Leader 1, Dorado, Sunlover 1 M:SM8, Pride For trial: MS:Sundowner, Hylan 4 x 8 MQ:Goldrush
Monto, Eidsvold Shires.....	Nov.-Jan. late Jan.-early Feb. (planting rate 100 000 plants/ha)	MS:Dorado, Leader 1, E57, Sundowner M:SM8 MQ:Pride Note: Pride is MQ for Jan. planting only
Gayndah, Mundubbera, part Biggenden ..	Nov.-Jan.	S:F64a MS:E57, Dorado, Leader 1, Sunlover 1, Q5161 M:SM8, Pride MQ:Goldrush For trial: MS:Sundowner, Hylan 4 x 8
South Burnett Kingaroy, Nanango, Wondai, Murgon, part Kilkivan, part Rosalie Shires	mid Nov.-Dec.	All soils: MS:E57, Q5161, Sunlover 1, Leader 1, Sundowner M:Pride, SM8 MQ:Goldrush For trial: MS:Hylan 4 x 8, Trojan 1 Non-lodging soils (additional varieties): S:Big Red MS:Dorado M:Texas 610 SR
Near North Coast Noosa, Widgee, part Tiaro, Maroochy, Landsborough, part Kilkivan Shires	mid Nov.-end Jan.	S:Big Red MS:E57, Sunlover 1, Leader 1, Dorado M:Pride, SM8 MQ:Yates 233, Goldfinger, Dorado E For trial: MS:Sundowner, Hylan 4 x 8
Moreton Caboolture, Pine Rivers, Redlands, Albert, Beaudesert, Moreton, Esk, Kilcoy, Boonah, Gatton, Laidley Shires	late Aug.-mid Jan. (Aug.-Sep. planting preferred)	Irrigated and raingrown: MS:Dorado, Leader 1, E57 M:C43 MQ:Yates 233, Goldfinger, Dorado E (early only) Q:Nugget For trial: S:Big Red MS:Sunlover 1, DK 55, SM9, Hylan 4 x 8

Region and Shires	Planting time	Recommended hybrids
Darling Downs <i>Rain-grown</i> Wambo, Chinchilla Shires.....	Oct.–Jan.	Lodging soils: MS:E57, Q1561, Sunlover 1 M:Pride, SM8 MQ:Goldrush Q:Nugget For trial: MS:Hylan 4 x 8 Q:Gem Other soils: M:Texas 610SR, Pride, SM8, Pacific 710 MQ:Yates 233, Goldfinger, Dorado E For trial: M:SM5, NK280 Q:Gem
Pittsworth, Millmerran, Jondaryan, Crows Nest, part Rosalie Shires	Oct.–early Nov.	Lodging soils: MS:E57, Q5161, Sunlover 1 M:Pride, SM8 MQ:Goldrush Other soils (additional varieties): M:Texas 610SR, Pacific 710, C43 MQ:Yates 233, Goldfinger, Dorado E
Clifton, Allora, Rosenthal, Glengallan, Cambooya Shires	Oct.–mid Nov.	S:Big Red MS:E57, Dorado M:Texas 610SR, Pride, Pacific 710, SM8 MQ:Yates 233, Goldfinger, Dorado E For trial: MS:Sundowner M:SM5
Stanthorpe Shire	Nov.–mid Dec.	MS:E57, Q5161, Sunlover 1, Dorado M:SM8 MQ:Goldrush For trial: MS:Sundowner
Inglewood Shire	Sep.–Oct.	MS:E57, Q5161, Sunlover 1, Dorado M:SM8 MQ:Goldrush For trial: MS:Sundowner
<i>Irrigated</i> All Shires	Oct.–early Nov.	Irrigated: S:Big Red, Texas 671 MS:E55e, Dorado, E57 M:Texas 610SR, Pacific 710 MQ:Yates 233, Goldfinger, Dorado E For trial: S:New Tropic MS:SM9, SM5 M:Star
Near South-west Waggamba Shire	Sep.–Oct. late Dec.–Jan.	MS:E57, Q5161, Sunlover 1 M:Pride, SM8 MQ:Goldrush MS:E57, Q5161, Sunlover 1 M:Pride, SM8 MQ:Goldrush For trial: MS:Sundowner, Hylan 4 x 8, Trojan 1

Region and Shires	Planting time	Recommended hybrids
Near South-west—continued		
Balonne Shire	late Dec.—Jan.	Raingrown: MS:E57, Q5161, Sunlover 1 M:Pride, SM8 MQ:Goldrush For trial: MS:Sundowner, Hylan 4 x 8, Trojan 1 Irrigated: S:Big Red, Texas 671 MS:E57, Dorado, E55e M:Texas 610SR, Pride, SM8, Pacific 710 MQ:Yates 233, Goldfinger, Dorado E
Murilla, Tara, Taroom Shires	late Sep.—Oct. late Dec.—Jan.	S:F64a MS:E57, Q5161, Sunlover 1 M:Pride, SM8 MQ:Goldrush For trial: MS:Sundowner, Hylan 4 x 8, Trojan 1 S:F64a MS:E57, Q5161, Sunlover 1 M:Pride, SM8 MQ:Goldrush For trial: MS:Sundowner, Hylan 4 x 8, Trojan 1
Bungil, Bendemere, Warroo, Booringa Shires	late Dec.—Jan.	MS:E57, Q5161, Sunlover 1 M:Pride, SM8 MQ:Goldrush For trial: MS:Sundowner, Hylan 4 x 8, Trojan 1

KEY

S—slow maturity; MS—medium slow maturity; M—medium maturity; MQ—medium quick maturity; Q—quick maturity.

For further information on varietal performance in your own district, consult your agricultural extension officer.

Small increase in Queensland's rural production

THE Minister for Primary Industries, Mr Mike Ahern, M.L.A., today released his Department's estimate of Queensland's gross value of rural production for 1981–82.

Queensland's total gross value of rural production for 1981–82 is put at \$2,445m. This is only a slight increase over the previous year's production value released recently by the Australian Bureau of Statistics.

Mr Ahern said that the value of production of cereal grains was expected to increase substantially and the value of livestock slaughterings and livestock products would also increase. However, these increases would be largely offset by a significant decrease in the value of sugar-cane produced.

By far the biggest increase for the year was expected to occur in wheat and barley. Overall, the gross value of wheat was expected to increase by 205% to \$226.2m and barley by 110% to \$56.2m.

The gross value of the major summer grains and seeds was expected to be less than in the previous year because of anticipated lower prices.

Mr Ahern said that sugar-cane production had increased by 2.9% over the 1980–81 season but, because of the continuing decline in the world price of sugar, the current year's value of production was expected to decrease by 30.7% to \$535m.

The value of livestock slaughterings was put at \$728.5m, or 3.4% above the 1980–81 figure. Cattle and calves were expected to increase by 1.9% to \$591.5m, sheep and lambs by 59.1% to \$18m, pigs by 4.8% to \$72m and poultry by 7.5% to \$47m.

Mr Ahern added that the value of wool was expected to increase by 15.8% to \$135.5m, dairying by 32.8% to \$128m and eggs by 9% to \$45m.

Sunflower varieties, south Qld, 1981-82

compiled by P. B. Wylie and G. L. Hammer, Agriculture Branch

THE choice of sunflower varieties for oilseed production should be made on the basis of yield performance and rust resistance.

The results of three years' trials in southern Queensland are presented in the accompanying guide. The comparative oil yields for each variety are expressed as a percentage of Sunfola 68 oil yields. (Oil yield is seed yield x oil %). Eight trials have been carried out in each of the last 3 years. Those varieties tested over the full 3 years show results from 24 trials. One and two years' testing show results from 8 and 16 trials respectively.

Rust resistance

Rust is the most serious disease of sunflowers and has been reported to reduce yields by as much as 70%. Until recently, most hybrid varieties were resistant or highly tolerant of rust. However, new strains of rust have developed over the past two seasons and many varieties are now classed as susceptible to rust.

Rust-susceptible varieties should be considered for only early plantings up until the end of October.

Other varieties are rated as having a mixed reaction to rust. They have some tolerance to rust but may still suffer losses in yield if conditions are favourable for the rust to develop. Highly resistant varieties should be selected to comprise the major proportion of late plantings of sunflowers in Southern Queensland.

Maturity

All varieties are of similar maturity if planted between early November and late January and, as development is most rapid at this time, can be classified as very quick.

There are some relative differences among varieties for planting times between February and October.

The duration of the period to maturity becomes progressively longer (that is, each variety becomes slower maturing) when planted between February and April.

Each variety is at its slowest maturity when planted in May and June and differences between varieties are greatest at this time.

When plantings are made between July and October the period to maturity becomes progressively shorter (that is, each variety becomes quicker maturing).

The maturity classification of a number of varieties for plantings between February and October has been determined by experimentation and these are given in the guide. Where the maturity classification of a variety has not been determined experimentally, the maturity is given as NA (not available) in the guide.

A screening technique to enable rapid classification into maturity groups for new releases has been devised and is being implemented this year. In the meantime, the seed companies supplying seed of these varieties should be able to give some information on their maturities.

Plant populations

The planting rate for sunflowers in southern Queensland should be varied according to the district, the soil moisture and the planting time. It should also be adjusted for the expected crop emergence.

Plant population recommendations for rain-grown crops vary from 30 000 to 50 000 plants per hectare.

Sunflowers planted in higher yielding situations of cooler weather and good moisture should be at the upper end of this range. Under marginal conditions or plantings in October to December, it may be preferable to plant sunflowers to give populations of 30 000 plants per hectare. Under irrigation, plant populations of 70 000 to 100 000 plants per hectare should be used.

If the expected emergence is 75% then the seeding rate should be one-third higher than the desired populations; that is, 40 000 to 67 000 seed per hectare for rain-grown crops and 93 000 to 133 000 seeds per hectare for irrigated crops. Under many situations, the emergence is lower than 75% and planting rates will need to be increased to achieve the desired plant stand.

Seed is available in a range of sizes. Selection should be made to suit the type of planting equipment being used. In general, smaller seed sizes should be used for combine-type planters, while precision planters will handle larger seed more easily than smaller seed.

The seed count per kilogram should be shown on the seed label. This should be used to adjust planting rates to achieve the desired plant populations.

VARIETAL RECOMMENDATIONS

Early planting (Aug.-early October)

Suncross 52, Hysun 21, Hysun 30, Hysun 31, Sunace, Sungold, Sunking.

Late planting (Nov.-March)

Hysun 30, Sunking, Hysun 11.

SEED SIZE

ASA seed sizes	Description	Approx. seeds per kg
6/7	Very small seed	18 000-25 000
7/8	Small seed	15 000-22 000
8/10	Medium seed	12 000-16 000
10/14	Large seed	10 000-14 000
14/18	Very large seed	8 000-11 000

GUIDE TO SUNFLOWER VARIETIES

	South Queensland trials 1978-1980 Oil yields as % of Sunfola 68		Height S—Short M—Medium T—Tall	Maturity ¹ VQ—Very quick Q—Quick M—Medium	Reaction to rust S—Susceptible M—Mixed reaction HR—Highly resistant
	Yield %	No. of trials			
Yates					
Suncross 150.....	101	8	S	VQ	HR
Suncross 52.....	132	24	M	M	S
Suncross 51.....	121	24	M	Q	S
Pacific					
Sunfola 68.....	100	24	M	Q	S
Hysun 11.....	112	16	S	NA ²	HR
Hysun 21.....	127	24	T	Q	S
Hysun 21R.....	NA	NA	T	NA	NA
Hysun 30.....	134	24	T	M	HR
Hysun 31.....	140	24	M	M	S
Hysun 32.....	NA	NA	M	NA	NA
Northrup King					
Sunbred 707.....	122	16	M	M	M
Sunbred 727.....	122	16	M	M	M
Sunbred 747.....	79	8	M	NA	NA
Sunbred 505.....	NA	NA	S	NA	NA
Panorama					
Sunburst.....	NA	NA	M	M	HR
Sungirl 2.....	122	8	M	NA	M
Cargill					
Cargill 205.....	134	8	S	Q	S
Sunace.....	128	24	M	M	S
Sungold.....	131	24	M	M	S
Sunking.....	138	24	M	M	HR
DeKalb					
DeKalb 600.....	NA	NA	M	NA	NA
DeKalb 500.....	108	8	M	NA	S
Pioneer					
Lady.....	121	8	M	NA	S
Flora.....	NA	NA	NA	NA	NA

1. Maturity. All varieties are of similar maturity if planted between early November and late January and can be classified as VQ for plantings in this period.
The above classifications apply to planting times between February and October.

2. NA—Not available.

Dairy cryogenics in action

FUTURE generations of superior dairy cattle are being placed in cold storage by the Queensland Department of Primary Industries as part of its A.F.S. breeding programme.

Mr Russell Miller, a D.P.I. husbandry officer at the A.I. Export Centre at Redlands near Brisbane, said an embryo freezing unit was being used by the Department with the aim of breeding more daughters from the top producing cows.

'A cow can be stimulated to produce a great number of embryos every 6 weeks,' said Mr Miller. 'These can be collected and transferred to surrogate mothers which have been artificially brought into line with the donor cow's breeding cycle. This process is quite expensive, however, and it is impossible to determine in advance how many surrogate cows will be needed. The new technique allows the surplus embryos to be frozen for future use when fresh embryos are in short supply for transferring.'

Ten microscopic, 7-day-old A.F.S. embryos had already been placed in suspended animation under cold

storage in liquid nitrogen at -196°C . These embryos could be stored indefinitely but some may be thawed this year and transferred.

Mr Miller said: 'It is quite possible that the State may see its first calf born from a frozen embryo some time before Christmas. Overseas experience suggests that the acceptance rate with frozen embryos is about half that of fresh embryos but this will probably improve in the years to come.'

The new Australian-made embryo freezing unit being used by the Department was computer controlled and had certain technical refinements over overseas produced models. It had the capacity to cool up to 250 embryos from room temperature to -140°C in 3 hours. Different freezing programmes would allow the embryos to be cooled as slowly as 1°C a minute which was very important over the critical stages between -6°C and -39°C .

Mr Miller said the machine also printed out the rate of temperature reduction every minute allowing the operator to monitor the freezing process.

Soybean varietal guide 1981-82 season

compiled by N. J. Douglas, Agriculture Branch

This article lists the soybean varieties recommended for planting in Queensland in the 1981-82 season.

December is the main planting time but in some districts and situations this period may be extended from November to January. The crop has critical requirements for cultivation, nutrition, moisture, and weed and insect control.

Plant maturity and plant height are decreased by shortening day length. To compensate for these factors, the planting rate should be increased and the row width reduced in late sown crops.

The planting rate should aim at establishing a plant stand of 250 000 to 350 000 plants per ha for rain-grown crops. The rate should be increased when sown under irrigation to 350 000 to 450 000 plants per ha.

The planting rate will be governed by the time of sowing, soil type, variety and local conditions; the lighter rates for early sowing and the heavier rates for late sowing. Consult your Agricultural Extension Officer.

Late January plantings in coastal regions should be avoided because of the possibility of rust developing and causing severe losses.

Phytophthora root rot is now wide-spread in the Moreton, South Burnett and Darling Downs regions. There have been isolated occurrences of the disease in the St. George and Goondiwindi areas.

The disease is most severe in areas where soybeans have been grown continuously in heavy soils for a number of years. Avoid planting susceptible varieties where there is a

history of the disease in that particular paddock. There is a marked difference in susceptibility to the disease. For reaction of individual cultivars, see summary of cultivar characteristics.

Semstar is susceptible to bacterial pustule and wildfire; these diseases may cause reductions in yield.

Dodds, an early maturing variety, was released by the N.S.W. Department of Agriculture.

Forrest, introduced through the U.S.D.A. is a quick-maturing variety suitable for sowing in the Moreton and southern Darling Downs areas. This variety is susceptible to zinc deficiency and planting of this variety is not recommended on soils known to have zinc problems (for example, the central Darling Downs).

REGION	PLANTING TIME	VARIETIES
Far North Queensland Cook, Mareeba, Atherton, Eacham, Herberton, Mulgrave, Johnstone, Cardwell, Douglas, Hinchinbrook Shires	Dec.-mid Jan.	Fitzroy, Canapolis
North Queensland Dalrymple, Thuringowa, Ayr, Bowen, Proserpine Shires	Dec.-mid Jan.	Canapolis, Fitzroy, Ross
Capricornia Livingstone, Fitzroy, Calliope, Broadsound, Pioneer, Mirani, Sarina, Emerald, Banana, Duaringa Shires	early Dec.-late Dec. late Dec.-Jan. Rain-grown: not recommended in Emerald Shire	Davis, Flegler, Fitzroy Canapolis Fitzroy, Canapolis
Burnett Miriam Vale, Kolan, Gooburru, Woongarra, Isis, Perry, Biggenden, Hervey Bay, part Tiara, Woocoo Shires Gayndah, Mundubbera Shires Monto, Eidsvold Shires	Dec.-early Jan. for trial: Dec.-early Jan. Dec. early Jan. for trial: Dec.-early Jan. Dec. Jan. late Jan.-early Feb.	Davis, Bragg, Wills, Flegler Canapolis, Forrest Davis, Semstar, Flegler, Bragg Davis, Fitzroy Canapolis Bragg, Davis Davis, Fitzroy, Flegler Canapolis, Fitzroy, Davis
South Burnett Kingaroy, Nanango, Wondai, Murgon, part Kilkivan, part Rosalie Shires	Dec. early Jan. for trial: Dec.-early Jan.	Davis, Bragg, Flegler Davis Forrest

REGION	PLANTING TIME	VARIETIES
Near North Coast Widgee, Noosa, part Tiara, Maroochy, Landsborough, part Kilkivan Shires	late Nov.–late Dec. late Nov.–end Jan. mid Dec.–Jan. for trial: late Nov.–late Dec.	Wills, Bragg, Flegler Davis Fitzroy Forrest
Moreton Caboolture, Pine Rivers, Redlands, Albert, Moreton, Esk, Kilcoy, Boonah, Gatton, Laidley, Beaudesert Shires	mid Nov.–Mid Jan. mid Dec.–Jan. mid Jan.–late Jan.	Davis, Bragg, Forrest, Wills, Collee, Flegler Fitzroy Davis
Darling Downs Wambo, Chinchilla Shires Pittsworth, Millmerran, Jondaryan, Crows Nest, part Rosalie, Cambooya Shires Clifton, Allora, Rosenthal, Glengallan Shires Stanthorpe Shire Inglewood Shire	Irrigated: Nov.–Dec. Jan. Irrigated: Nov.–Dec. early Jan. Rain-grown: Basaltic Uplands Nov.–Dec. for trial: Nov.–Dec. Irrigated: late Nov.–Dec. Rain-grown: late Nov.–Dec. early Jan. Nov. Dec. Irrigated: late Nov.–Dec. early Jan. for trial: mid Dec.–early Jan. Rain-grown: not recommended	Davis, Bragg, Collee, Flegler Davis Davis, Bragg, Flegler Davis Davis, Flegler, Collee Forrest Davis, Bragg, Flegler, Collee Davis, Bragg, Flegler, Forrest, Collee Davis Davis, Wills, Collee Davis, Collee Bragg, Collee, Flegler Forrest
Near South West Balonne Shire	Irrigated: Nov.–early Jan. for trial: mid Dec.–early Jan. Rain-grown: not recommended	Davis, Flegler, Wills, Fitzroy Forrest, Dodds

Soybean Yields Shown as Percentage Mean Yield of Davis, Bragg and Wills

—	DARLING DOWNS				ST. GEORGE		W. MORETON		S. BURNETT		KINGAROY (late planted)		MONTO		C. QUEENSLAND	
	Irrigated		Rain-grown		Irrigated		Irrigated		Rain-grown		Rain-grown		Irrigated		Irrigated	
	%	No. of trials	%	No. of trials	%	No. of trials	%	No. of trials	%	No. of trials	%	No. of trials	%	No. of trials	%	No. of trials
Davis	98.0	42	101.3	30	90.5	9	101.6	28	104.2	31	105.8	8	107.0	8	105.2	30
Bragg	103.3	42	101.2	30	103.0	9	99.3	27	95.0	30	95.7	8	97.3	8	97.4	30
Wills	98.5	40	94.1	27	106.6	9	99.5	28	97.6	30	98.5	8	95.7	8	97.4	30
Semstar	96.3	39	104.0	30	97.0	9	94.2	28	100.7	31	94.7	8	97.8	8	96.9	30
Collee	87.5	33	96.7	20	84.6	8	94.1	22	93.1	28	92.7	8	91.5	4	90.2	13
Flegler	100.5	34	101.7	20	94.5	9	104.0	22	101.6	26	96.2	8	97.9	7	107.0	26
Fitzroy	90.1	22	99.8	10	96.1	6	107.9	13	103.4	20	103.6	5	101.0	4	103.6	20
Canapolis	..	..	..	..	..	..	..	..	..	..	..	..	94.7	5	105.1	20
Forrest	100.6	8	115.6	4	97.8	2	115.2	8	118.6	7	108.0	2	..	..	..	..
Dodds	96.0	13	104.2	6	99.4	3	105.3	6	108.2	13	112.9	3	..	..	..	..

This table provides a comparison of yield performance in the main districts where soybeans are grown.

The yields are shown as a percentage of the yield of the varieties Davis, Bragg and Wills. The greater the number of trials used to calculate the average, the greater the reliability of the results.

This table should be used in conjunction with the guide to varietal characteristics.

Summary of Soybean Cultivar Characteristics

Characteristics	Davis	Bragg	Wills	Semstar	Collee	Flegler	Hill	Ross	Fitzroy	Canapolis	Forrest	Dodds
Maturity rating	6	6	8	7	5	7	5	9	8-9	9	5	5
Growth habit	Erect	Erect	Erect	Erect	Erect	Erect	Erect	Erect	Erect	Erect	Erect	Erect
Resistance to lodging ...	Good	V. Good	Fair	Poor	V. Good	Good	Good	Good	Fair	V. Good	Good	Good
Average height (cm)	75	75	85	90	70	75	70	70	100	90	75	70
Average height to low- est pods (cm)	12	10	16	13	8	12	10	10	12	12	10	8
Flower colour	White	White	Purple	White	Purple	Purple	White	Purple	Purple	White	White	Purple
Pod hairs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pod hair colour	Grey	Tawny	Tawny	Grey	Tawny	Tawny	Tawny	Grey	Tawny	Tawny	Tawny	Grey
Resistance to bacterial pustle †	Yes	Yes	Yes	No	Yes	Yes	Yes	LL	Yes	Yes	Yes	Yes
Seed colour	Straw Yellow	Yellow	Yellow	Straw Yellow	Straw Yellow	Dark Yellow	Straw Yellow	Mottled Yellow	Straw Yellow	Dark Yellow	Yellow	Yellow
Hila colour	Buff	Black	Black	Buff	Black	Black	Brown	Brown	Imperfect Black	Brown	Large Black	Imperfect Black
Plant growth habit *	D	D	D	ID	D	D	D	D	ID	D	D	D
Pod shattering	Yes	No	No	No	No	No	Yes	No	No	No	No	No
Approximate number of seeds per kg	5 500	5 200	6 100	5 900	5 700	5 200	6 000	10 000	5 700	6 000	5 700	5 500
Reaction to Phytophtho- ra ‡	1	2	4	5	3	4	1	6	5	3	3	3

* D = Determinate ID = Indeterminate

Varietal descriptions relate to the district of recommendation

† LL = Low level

‡ 1 Highest field resistance—6 highly susceptible

Maturity rating: These are based on the U.S.A. maturity groups.
The lower the maturity group number, the earlier the variety matures.

Meat inspection fees to rise

MEAT inspection fees in Queensland will rise from 1 March 1982, the Minister for Primary Industries (Mr Mike Ahern, M.L.A.) announced recently.

He said a new schedule of meat inspection fees had been approved on the recommendation of Cabinet.

The fee increase varied approximately from 10 to 20% for livestock slaughtered at slaughter-houses and abattoirs.

Mr Ahern said the increase was necessary to cover rising costs in providing Queensland's meat inspection service and to cover inflation.

The new schedule would include a uniform fee for broken-up meats of various species, which replaced the present system of charging a different rate for each species.

Deer had also been included in the Schedule.

Examples of the new inspection rates, which were still lower than those in other eastern States were:—

Cattle	\$2.00 per head	Old rate	\$1.65
Calves over 36 kg d.w.	\$1.20 per head	Old rate	\$1.00
Calves under 36 kg d.w.	60c per head	Old rate	50c
Sheep or goats	30c per head	Old rate	25c
Pigs	\$1.20 per head	Old rate	\$1.00
Poultry	0.7c per head	Old rate	0.6c
Deer	\$1.20 per head		
Broken-up meats: beef, veal, mutton, lamb, goat, pork and venison: 4.0c per kg			

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Predatory insects and spiders in Queensland crops—part 1

By J. F. Donaldson and D. A. Ironside, Entomology Branch

The insects occurring in a crop may consist of serious pests, occasional plant feeders, casual visitors, pollinators, decay feeders and other beneficial species which assist in the natural control of insect pests.

This series of colour plates is designed to give primary producers the ability to recognize some of their colleagues in the battle against pests.

Oechalia schellenbergii (Guérin-Méneville), Pentatomidae (predatory shield bug)

This useful bug measuring 9 to 12 mm in length is easily recognized by its grey to brown mottled coloration, the pale spot and large lateral spines on the thorax. It feeds mainly on larger caterpillars such as *Heliothis* and *Chrysodeixis* (loopers), impaling them on its short, piercing mouthparts and sucking them dry.

They are commonly found in crops such as potatoes, cotton, safflower, sunflowers, rice, navy beans, lucerne and cowpeas. Bugs tend to congregate near the feeding sites of their prey (for example, the flower heads in sunflowers).

Cermatulus nasalis (Westwood), Pentatomidae (predatory shield bug)

This predatory shield bug measures 10 to 15 mm in length and is considerably broader and darker

than *Oechalia*. It is also distinguished by a shining black patch on each forewing and the absence of spines on the thorax. Feeding habits are similar to *Oechalia* but a much broader prey range has been recorded including armyworms, cabbage white butterfly, *Heliothis*, *Chrysodeixis*, hawk moths and the larvae of the potato beetle (*Lema trivittata* Say).

Crops in which this bug has been found include cabbage, corn, sweet potato, linseed, tomato and pastures in addition to those mentioned for *Oechalia*.

Coranus trabeatus Horvath, Reduviidae (assassin bug)

This red and black species with a length of about 10 mm is more slender than the shield bugs. The well-defined head with its short, curved beak is distinctive of all assassin bugs. It preys on small arthropods including a wide range of insects and has been collected in cotton and sunflower crops.

Geocoris spp., Lygaeidae (big-eyed bugs)

These small insects are mostly shining black, 4 to 6 mm in length and have a pair of large, bulging eyes. Because of their small size, the big-eyed bugs feed mainly on eggs and other small insects. Although their diet also includes plant juices, they are not known to transmit any plant

diseases. They can be found in most crops, often in low numbers.

Chauliognathus pulchellus (Macleay), Cantharidae (soldier beetle)

The adult soldier beetle is soft-bodied with green elytra and a black and orange thorax. It ranges from 11 to 14 mm in length and has the anterior portion of the thorax deflexed so that the head is not visible from above. Both adults and larvae are predatory. In the field, it is thought to prey on a wide range of small arthropods and has been shown to attack *Heliothis* eggs and larvae in the laboratory. The beetle has been recorded from maize, lucerne, sunflowers and mung beans.

Dicranolaius bellulus (Guérin-Méneville), Melyridae (pollen beetle)

This attractive red and blue metallic-coloured beetle measures 4 to 6 mm in length. Typically, it moves rapidly over plants with its antennae extended forwards. It is a regular inhabitant of sunflower crops, although it is rare to find more than one or two beetles per plant. It has also been recorded from lucerne and apple trees, but vegetables do not appear to be as attractive to them as flowering crops.

As the common name suggests, the beetle also feeds on pollen as well as *Heliothis* eggs and larvae and many small arthropods. The immature stages are spent in the soil.





Predatory shield bug (*Oechalia*)



Predatory shield bug (*Cermatulus*)



Assassin bug



Bigeyed bug



Soldier beetle



Pollen beetle