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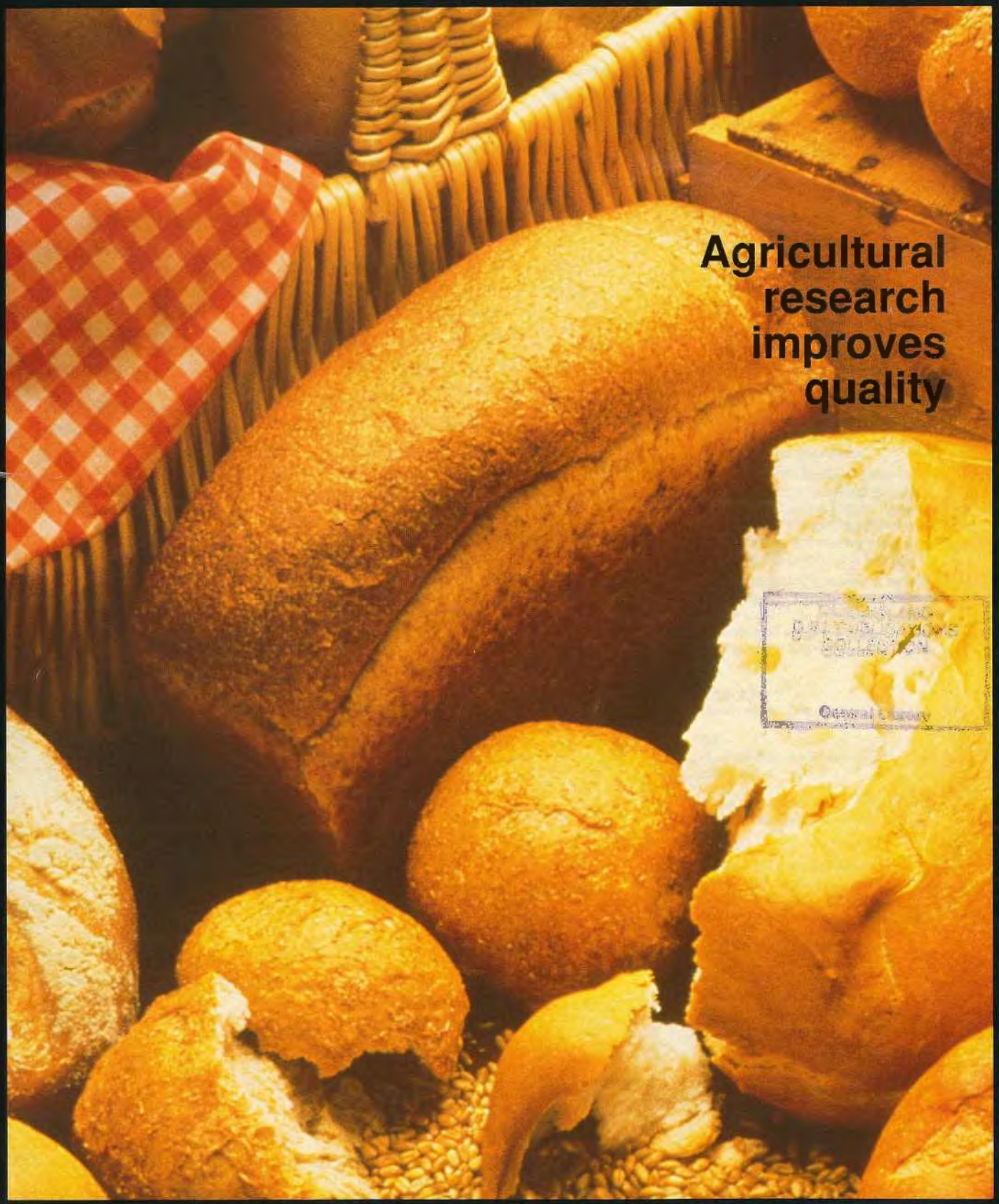

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This issue's cover

The Queensland Department of Primary Industries provides land and facilities for much of the State's agricultural, horticultural and animal production research and development. Research Stations and other institutions provide headquarters and facilities for off-station trials and serve as centres for the exchange and distribution of information from departmental trials, district experience and research from interstate and overseas.

Most research facilities cater to the agricultural, horticultural and pastoral industries in their region of influence. Others, such as the Queensland Wheat Research Institute at Toowoomba, are strategically located to fulfil a Statewide function for a specific industry.

The department's research facilities are a big investment in Queensland's agriculture. They play a major role in enhancing the economic growth, and sustaining the productivity and quality of the State's food and fibre industries.

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Cattle

Pasture

Food

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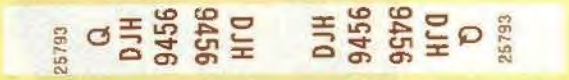
Marketing

Research

QUEENSLAND TAIL TAGS

1 

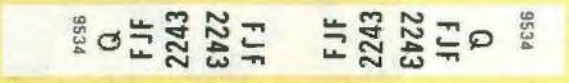
Red print Denotes a CLEAR pesticide residue status

RANDOM SAMPLING ONLY

2 

Black print denotes cattle from a holding which requires either

RANDOM or LOT sampling depending on herd history

3 

Tags 1,2 and 3 are property tags used by owner when cattle moved to sale or slaughter

Either horizontal or vertical format is permitted

4 

TB quarantine tag – used on cattle from herds under TB quarantine

RED on GREEN denotes a CLEAR pesticide residue status

5 

District tag – used when a herd has less than 11 head and is not registered

6 

Saleyard tag – used on cattle at a saleyard which are not otherwise identified

7 

TB testing tag to NSW – used at saleyards close to the border

8 

Blood testing tag

NOTE application of tags 7 and 8 do not preclude the requirement to use property tags

9 

Aus-meat feedlot tag

Veterinary Services Branch

'putting stock in your future'

Department of Primary Industries

Queensland Government

Figure 1. A poster explaining Queensland tail tags.

Protecting the beef industry: a tale of tell-tail tag

D. Daniel, Veterinary Services and **B. Anderson**, Veterinary Public Health

A simple strip of self-adhesive plastic attached to the base of the tail of each head of cattle bound for market and slaughter has proved the best thing since barbed wire for the Australian beef industry.

The 'tail tag' has become to the cattle industry what the 'finger-print' is to forensic science. Each head of cattle, by carrying an identification number unique to its property of origin, can be traced through all stages of the transport, marketing and processing chain.

Several manufacturers are currently approved to print tail tags in Queensland. Although their format may vary, the message always remains the same.

The first number on the tag, after the Q for Queensland identification, is the computer check digit which ensures that properties cannot be confused. The second and third numbers represent the shire code and the following four numbers identify the individual property within that shire.

The idea arose in 1976 during the early days of the national brucellosis and tuberculosis campaign (BTEC), when a system was needed to rid Australia of these two costly diseases by tracing them to their property of origin. Valuable export meat and dairy markets were at stake, as well as human health, since both diseases can be contracted by humans.

The task was impressive: to test and monitor over 10 m animals on 35,000 properties where 80% of cattle are found on extensive runs on vast streches of open range.

The system had to be quick, easy, inexpensive and flexible enough suit a fast-moving chain of operations in the meatworks. Information coming to light at slaughter would mean enormous savings in mustering and yarding costs on the property.

And so the tail tag was born, the preferred option over the stressful ear tag and awkward back tag.

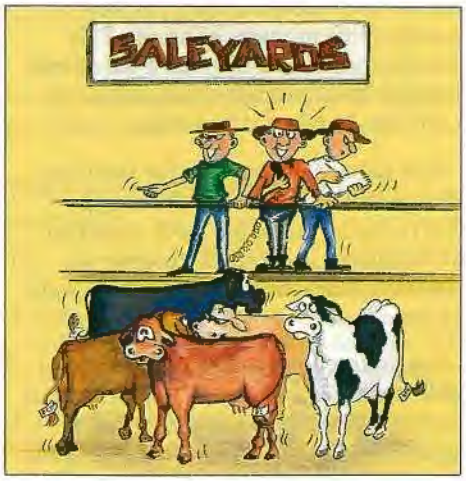
Now, 15 years later and some 15 million tests down the track, Queensland is brucellosis free and on target for tuberculosis freedom by 1 January 1990. This feat is attributable in no small part to the humble tail tag.

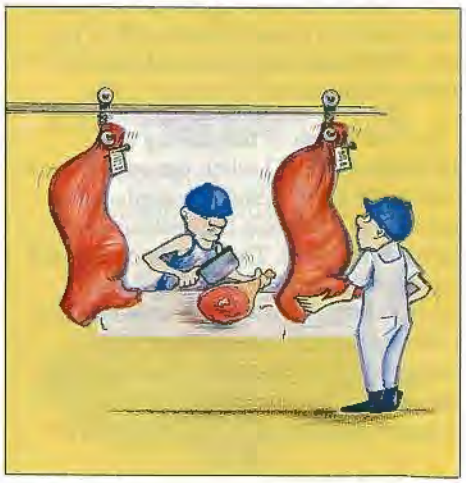
During those years, the tag has been developed and adapted to a variety of tasks. For example, it can be nsed in routine disease surveys for many conditions. If an exotic disease outbreak was detected, identification of property of origin would be an immediate priority and the tail tag would be indispensible.

The flexibility of this is demonstrated by its colour coding. For instance, in the BTEC programme, clean stock can be separated from suspect stock by the colour of the tag: white for TB clean properties and green for TB quarantined properties.

This feature has proved its value in the enormous distances that stock are transported in Queensland, often over poor roads and in bad weather. Rollovers do occur, spilling green tagged cattle onto clean properties. But the distinctive tag colour permits easy identification and a quick roundup.

Another feature of the tail tag, and one exclusive to Queensland, is the inclusion of a serial number which allows the owner to record specific areas and individual animals on his meatworks drafts. Any condition recorded at slaughter can then be quickly correlated to a paddock or area.





The tail tag can also be selective to a particular type or class of stock, for instance to denote feedlot cattle.

The process combines the expertise of the staff of the QDPI's Veterinary Services Branch, Veterinary Public Health Branch and the diagnostic laboratory staff (BTB, Pathology, Pesticide, Biochemistry).

The latest advance in the tail tag story is the introduction of a colour coded tag to show the pesticide residue status of a property. The distincitve red print on white tape means a clear pestide status as well as a clean brucellosis and tuberculosis status.

The advantage in achieving this tag status speaks for itself in a market that demands a pure, healthy product.

There are currently six distinctive colour coded tail tags approved for use in Queensland to monitor the health of the state's herd and help produce stock to market requirements (see page 274).

The real worth of the tail tag was highlighted in 1987 when our export meat trade to the United States was placed in the balance following the detection of chemical residues. The assurance that our traceback system could identify and isolate offending properties was essential to allow shipments to continue. The recent visit of a European Community team futher endorsed the system as adequate to monitor for the presence of hormonal growth promotants (HGP's), which are now banned in EC countries.

The tail tag works because it accompanies the animal from property through the various stages of marketing until it becomes a product marked 'fit for human consumption'.

It travels with the carcass during the inspection process and is correlated to the various parts such as the head, intestines and hide. In the event of a disease condition being discovered, all parts of the animal can be traced.

Carcasses which are fat sampled for pesticide residue testing or blood sampled for brucellosis are individually identified by recording or attaching the tail tag number to the sample container.

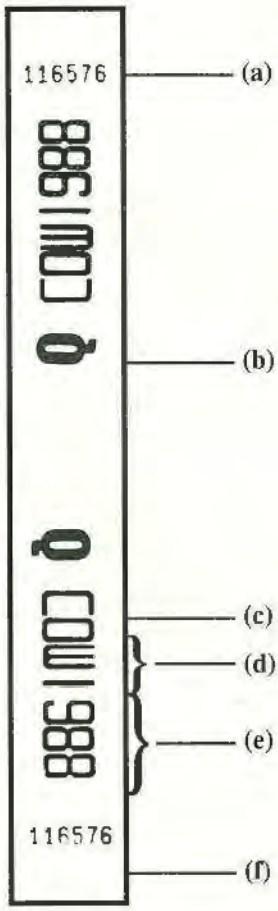
After laboratory analysis, information on the sample, together with the tag number, are entered on the computer records of the property of origin. This ensures a continuous record of the disease situation on all properties and follow up action can be taken if necessary.

As a futher safeguard for the producer, tail tags can only be ordered through QDPI offices, where the stock inspector for the district in which the property is located certifies the tag number and status is correct.

Any further information about the cattle identification system in Queensland can be obtained from your local stock inspector.

To the beef industry—the producer, the agent, the processor, the exporter and the retailer—the tail tag is a simple, effective protection symbol. For the consumer, it is an assurance of a true quality product.

A 10 minute video on the tail tag story is available from Veterinary Services Branch and Veterinary Public Health Branch.



(a) serial number

(b) Queensland

(c) computer check digit

(d) shire code

(e) property number within shire

(f) colour code

Property planning boosts production

D.G. Chapman, Soil Conservation Services Branch

Property planning techniques have helped graziers in the Capricornia region to sustain production without land and pasture degradation. The techniques match management practices with land resources. Productivity is boosted as the full land potential is required.

QDPI officers at Rockhampton have developed a system to develop property plans using the landholder's knowledge of the property and ideas on management.

QDPI staff have found that although landholders often begin by making enquiries on a single topic, that issue may be related to other factors on the property. For example, on one district property it was found that an erosion problem was the result of pasture degradation caused by overgrazing. For this reason, staff often encourage graziers to use a property plan and management package.

The photomosaic plans drawn up by Soil Conservation Services Branch are based on the most recent aerial photography available. Existing features such as creeks and ridges, timbered areas, dams and buildings are easy to identify. Access tracks and fences are highlighted on the plan. Areas of different soils or landscape features are shown and an accompanying legend records recommended land use and land management options.

Property development and management are considered with the landholder's aspirations and the capacity of the land resources. The plan then becomes a catalyst for increased production, as property potential is tapped.

The next logical step in planning is the 'whole property plan' approach. Graziers may decide to use the plan to help make management decisions. The plan is augmented by officers in other QDPI branches.

The whole property plan is a information package that consists of a photomosaic property plan, a report and specific extension pamphlets. The report is based on the property plan and landholder resources, and contains:

- a property description
- erosion statement – timber, regrowth and weed control information
- pasture and herd management advice – fencing and water recommendations
- other land use and land management advice
- cash flow budgeting (if required)
- a programme listing the priority of development works.

The other part of the package is the excellent range of prepared farmnotes or central Queensland agnotes that are produced by QDPI officers. These notes relate to property needs and complement the plan and report. For example, a Mornish grazier was provided with agnotes on the establishment of stylos and wynn cassia on his granite country.

By the time the report is finalised, a lot of the recommendations are being put into practice.

The advantages of the planning approach

The advantages of this approach are:

- property development and management are matched to the landholder and to the land resource
- cash flow budgeting based on the resources and possible enterprise options comes up with the best fit
- the grazier gains a greater insight into the potential of property resources
- contact is established with extension officers and continuing contact is encouraged
- a blueprint for future development is provided that allows the property to be used to its potential within the sustained capability of the land resources.

Landholder interest

Rockhampton QDPI staff are finding graziers show a keen interest in this new extension approach. It allows a flexible response to individual needs. Some landholders want only a detailed property plan from which they can identify land types, while others request a development plan which includes a cash flow budget. The complete package comprises a property plan, enterprise budgets and technical management information. It is particularly suitable for the new landholder who has made a recent purchase of property in the area and is seeking local knowledge.

Food analysing services of QDPI

G.E. Mitchell, Food Research & Technology Branch

Plate 1. Some of the range of dairy products regularly monitored by Food Research and Technology Branch.

Encouraging the production of high quality foods, efficiently and consistently across local and export markets, is the function of the Food Research and Technology Branch of QDPI. No food is outside the range of the branch and consideration is given to all requests for assistance from food industries.

Analytical Services section

The branch provides an expert, comprehensive and confidential analytical service. The Analytical Services Section has four laboratories at Hamilton in Brisbane and one at Malanda in north Queensland.

The five laboratories provide a wide range of chemical and microbiological analyses for the food industry and the section maintains its position as a leader in food analysis by constantly improving existing methods and establishing new techniques.

The service is available to the food industry on a fee-for-service basis. Services available to industry include:

- NATA-accredited laboratories for a wide range of food analyses
- comprehensive microbiological testing, including coagulase-positive staphylococci, coliforms, *Listeria*, *Salmonella*, *Vibrio* and *Yersinia*
- compositional analysis (including moisture, fat, protein, carbohydrates, ash, pH, acidity, fatty acid profiles) of major food groups (meat, fish, cereals, fruit and vegetables and dairy products)
- evaluation of product quality
- sensory evaluations
- advice on food analysis methodology
- evaluation of new instrumentation
- extensive library and literature searching facilities.

This service is supported by a high level of analytical proficiency verified through regular internal quality assurance programmes and independent audits by the National Association of Testing Authorities (NATA).

NATA-registered testing

NATA registration specifies areas of laboratory competence necessary for accreditation. Terms of registration give an indication of the scope of work and types of methods the laboratory is able to carry out. Because granting of registration is subject to regular assessment, usually every two to three years, a laboratory must maintain a high level of analytical proficiency. It follows that not every laboratory is able to perform NATA-certified work and those laboratories which do have NATA registration enjoy prestige among their peers.

Analytical Services Section has held NATA accreditation for over 30 years and holds registration for chemical and microbiological tests on the following food groups:

- nuts and nut products
- dairy products
- meat and meat products
- fish, crustaceans and molluscs
- fruit, jams and other fruit products
- vegetables and vegetable products
- alcoholic beverages
- edible fats and oils
- margarine, and
- eggs and egg products.

NATA certificates provide manufacturers, agents, importers, exporters and government with independent test results obtained by strict adherence to recognised procedures.

Dairy industry service

The branch (formerly the Dairy Research Branch) has been associated with milk quality testing for the dairy industry since the first dairy research laboratory was set up in 1935. However, this role has changed over the last few years and more reliance on statewide liquid milk quality monitoring has been placed on information from industry laboratories.

To assist in this regard, the section operates a number of programmes for the dairy industry.

Product testing

Chemical and microbiological tests are carried out on a wide range of dairy products including milk, cream, butter, yoghurt, ice-cream and desserts. Last year, some 12 000 tests were performed on 3400 samples.

As part of this programme, all Queensland dairy products are regularly monitored for pesticide residues.

Plate 2. An infra-red analyser used for the simultaneous determination of fat, protein and lactose in dairy products.

Plate 3. Analysis of sugars in food by high performance liquid chromatography.

Collation of factory test results

Results of milk testing by industry laboratories are received monthly and processed on the branch computer, then distributed to field staff and statutory authority personnel for follow-up action and advice to industry.

Interlaboratory proficiency testing

Over 20 dairy laboratories participate in this programme in which the laboratories are asked to test identical samples prepared by the section. Their results are statistically analysed to compare each laboratory's result with all others. This checks the testing accuracy of each of the laboratories.

Standards for milk testing

A range of standards are prepared, analysed and distributed to dairy industry laboratories to calibrate milk-testing instruments which test dairy farmers' milk. Standards provided include fat, protein, lactose, freezing point and iodine.

The aims of the last two programmes are to improve and standardise the testing done by dairy industry laboratories.

Research

The section assists the research work of other sections of the branch. It also undertakes research activities in its own right. Recent research projects have included:

- the development of methods for the detection of antibiotics in meat
- studies on sources of heavy metal contamination in seafood
- surveys on the microbiological quality of cheese and poultry
- the development of methods for the detection of irradiated food
- studies on the correct use of sulphur dioxide for treatment of prawns.

Equipment

The Food Research and Technology Branch laboratories are equipped with an extensive range of scientific equipment including a Malthus microbiological growth analyser, spiral plater, automatic colony counter, high performance liquid chromatographs, gas chromatographs, computerised densitometer, Iatroscan TLC analyser, ultracentrifuge and food texture testing machine.

Plate 4. Examination of blood agar plates for the presence of the food-poisoning microorganism *Listeria*.

Computer support

Computer support is a key element in laboratory management and the section has access to personal computers and a VAX 11/730 minicomputer for compilation of dairy factory test results. Future developments call for the acquisition of a special powerful software package which will deal with all sample details and print the analytical results and invoices. This also has a powerful 'query' facility for phone enquiries.

Sown grass productivity: run down but not run out

J.M. Cavaye, Beef Cattle Husbandry Branch, and **T.W.G. Graham** and **G.B. Robbins**, Pasture Management Branch

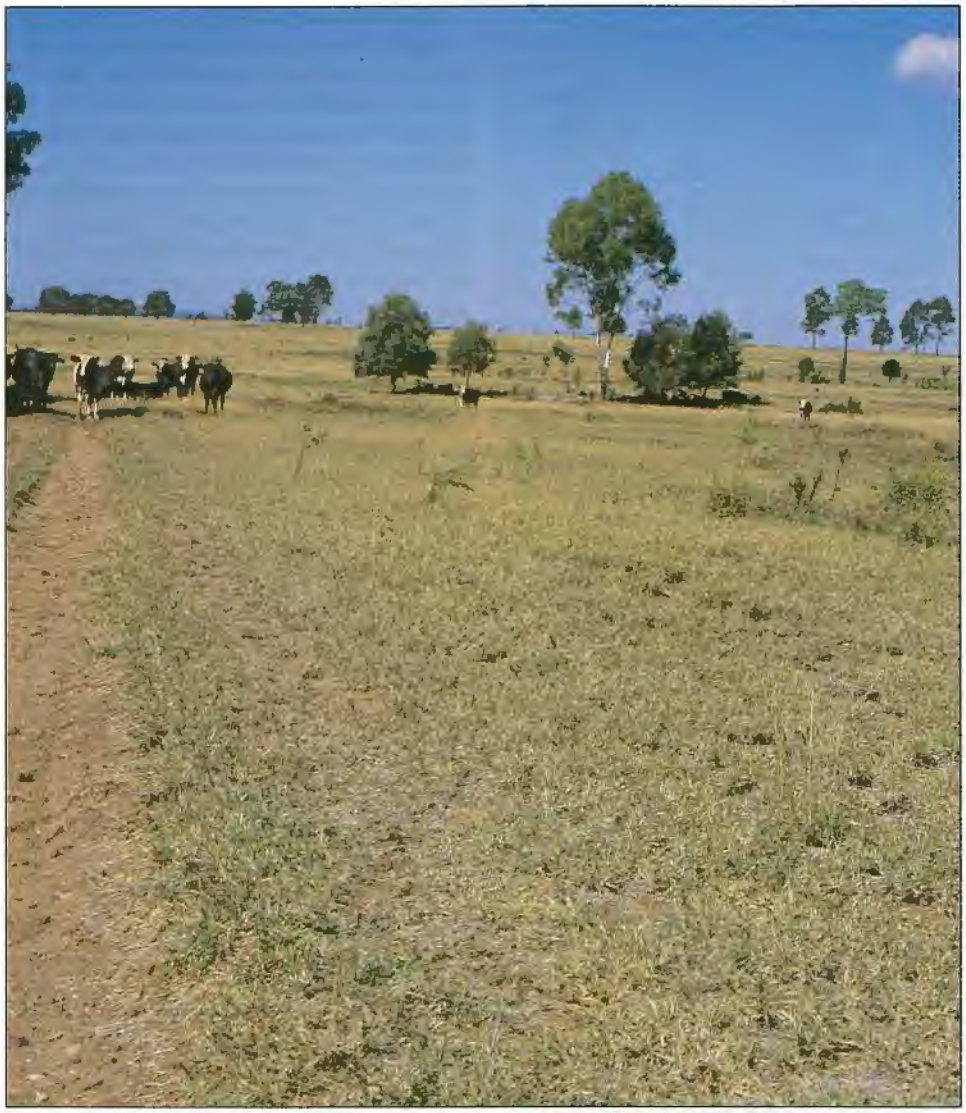


Plate 1. A run down buffel grass pasture in central Queensland showing signs of nitrogen deficiency.

Paddocks covered in tall green pastures of buffel grass, rhodes grass or green panic are a common sight in Queensland. These pastures are productive and profitable. But the high productivity does not last long, as the pastures run down with age.

Graziers have long recognised that sown grass pastures run down. They see thinning of the sward, declining vigour, pale green or yellow leaves, declining seed production and, most importantly, declining cattle production and profit.

Trial results have shown cattle liveweight gain to decline at the rate of 9 to 13 kg/head for each year the pasture ages. This means that cattle which gain 180 to 200 kg/head a year on young pasture will gain only 130 to 150 kg/head on old pasture. Steers could take an extra year to reach sale weight. Alternatively, a grazier may be able to maintain production for each head but have to reduce the stocking rate.

In this article we are going to discuss why sown grass pastures run down and possible solutions, including:

- accepting lower productivity
- sowing legumes
- using a short fallow
- cropping for one or more years
- renovating with a single cultivation
- fertilising with nitrogen.

Why sown grass pastures run down

Simply, sown grass pastures run down because the amount of soil nitrogen available to the plants reduces as a pasture ages. Nitrogen accumulates in forms that are unavailable to the plant, the pasture becomes nitrogen-deficient and productivity falls.

The irony is that most soils contain a large amount of nitrogen; it's just that most of this nitrogen is unavailable to the plant. For example, many soils contain as much as 3000 kg of nitrogen in 1 ha to 50 cm depth, equivalent to the nitrogen in 130 bags of urea (and some soils contain much more than that). However, of that 3000 kg, only about 60 kg (equivalent to the nitrogen in just 2.6 bags of urea) may be available to the plant.

Most nitrogen is tied up in the organic 'pool' in the soil, in organic material such as humus (figure 1). Soil microorganisms break down the relatively complex forms of nitrogen in the organic pool, converting nitrogen into simpler forms that make up the mineral pool. This process is called 'mineralisation'. Grasses can take up only the simple forms of nitrogen in the mineral pool.

As pastures age, nitrogen accumulates in the organic pool (plant litter, animal residues and the like) and in the soil microbes themselves. The mineral pool becomes depleted, limiting the growth of the pasture.

Interestingly, run down pasture is not caused by loss of nitrogen from the paddock, since only a small amonnt of nitrogen is removed in animal products.

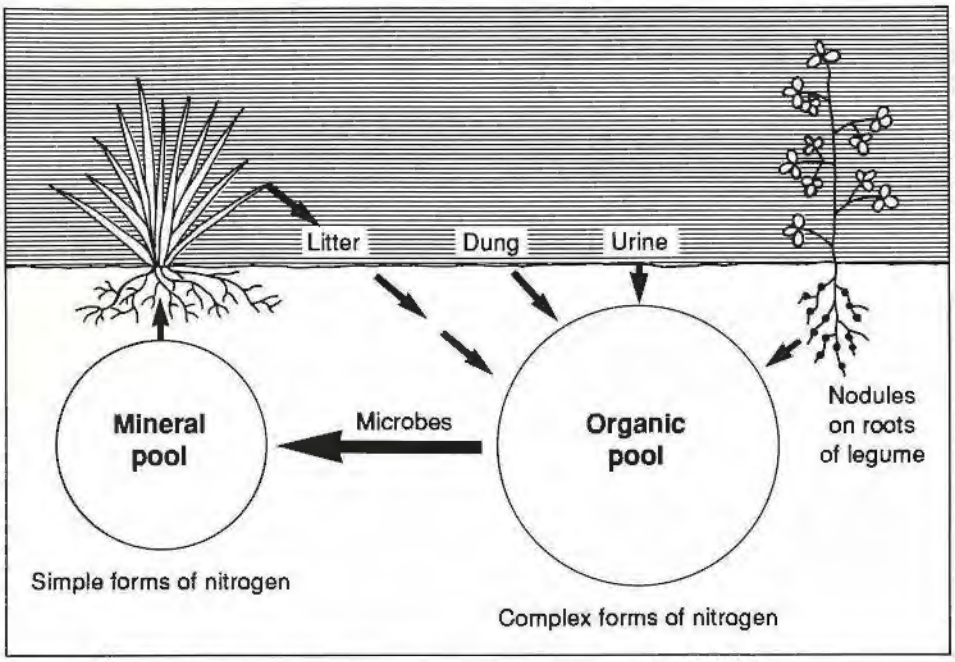


Figure 1. Flow of nitrogen from organic to mineral pool.

Almost all the nitrogen consumed by the animals is recycled in the paddock. Nitrogen deficiency, the tell-tale sign of pasture rundown, is induced by changes that occur in the form of nitrogen present in the soil.

What makes new sown pastures so productive?

During property development, the removal of plant cover and the disturbance by clearing and stickraking stimulates nitrogen mineralisation. There is a large increase in the flow of nitrogen from the organic to the mineral pool (figure 1). The resulting run up in available nitrogen causes rapid pasture growth, high pasture quality and good cattle growth in the first few years.

This is followed by a gradual run down in pasture and animal production, as nitrogen accumulates in the organic pool. Eventually an equilibrium is reached where available nitrogen limits improved grass production to a level similar to that of native pasture. Unfortunately, run down takes only a few years on many soil types.

Possible solutions

Accepting lower productivity

Accepting a lower level of production is a simple way of dealing with run down of sown grass pastures.

As mentioned earlier, there is a run up in pasture growth after development and this can give an unrealistic expectation of production. Some graziers become worried when pasture production returns to a more sustainable level. However, pasture decline is normal and predictable. Perhaps expectations should be based on a lower level of production since it is unrealistic to expect pasture production to continue at run up levels.

Sowing legumes

Legumes are high in nitrogen. If there is enough legume present in a sown pasture, the rate of decline should slow and the eventual equilibrium level of pasture production should be greater than without a legume. The main benefit from a legume is the boost in animal production that results when cattle eat high quality legume leaf. A lesser benefit comes from the boost in grass growth resulting from the nitrogen fixed by legumes.

Legumes can benefit associated grasses, but not as directly as fertiliser can. Over a long period, legumes increase the amount of nitrogen available for mineralisation. Decomposition of the legume plant and of the nitrogen-rich

Plate 2. Cultivating pastures and maintaining a fallow for at least three months is one option to improve production from run down pastures.

nodules on the roots feed nitrogen into the organic pool and not into the mineral pool (figure 1). This material must be broken down further by microorganisms to make nitrogen available to plants.

However, every bit of extra nitrogen helps. If a legume can be established successfully into a pasture, and its production maintained, then pasture productivity will benefit. Of course, different legumes are adapted to different localities and soils throughout Queensland. For advice as to the best legume or legume mixture for a particular site, contact your local QDPI extension officer.

Using a short fallow

A successful way to improve the productivity of run down sown grass pasture is to plough out the pasture and re-sow after a bare fallow lasting at least three months. In trial work on old buffel grass pastures, a three month fallow increased the yield of resown grass by 60% over two years.

Advantages of the short fallow include boosting nitrogen mineralisation and recharging the mineral pool. Disadvantages include an erosion risk on the bare fallow and the need to re-sow a new pasture, with the associated risk of establishment failure and high costs of re-establishment. Whether the advantages outweigh the disadvantages will depend on the situation.

Cropping for one or more years

This option is really an extension of the short fallow idea. However, cultivation and cropping are extended over at least one year. The large number of cultivations means that more nitrogen is likely to be mineralised than in a short fallow, although at least some of this would be removed in the crop. In a current trial, the impact on re-sown pasture of different crops, of different durations of cropping and of different degrees of soil disturbance is being assessed.

The cropping option is also likely to have advantages and disadvantages. Advantages include a larger boost to nitrogen mineralisation than from a short fallow, and a return from the crop to help pay for the operation. Disadvantages include the cost of cropping and the need to re-sow a pasture, with associated costs and risks. The relative returns from cattle and crop will influence the decision at any time.

In addition, not all cattle producers have the inclination, machinery, suitable land to embark on a cropping enterprise. Nevertheless, the ultimate application of a cropping phase is to set up a system of crop–pasture rotations, ensuring sustained high production from both crop and pasture.

Renovating with a single cultivation

This is the most controversial option of all, since the responses to renovation have often been inconsistent. Many graziers have had a lot of success by renovating old grass pastures. However, there is a good chance that many of the benefits are more illusory than actual. Grass grows greener and taller but, if the sward is more open than it was before renovating, there may be no increase in pasture yield.

Unfortunately, the results from research have also been inconsistent. Some have shown that a temporary increase in feed quality for up to three months but no increase in pasture yield. In other research, pasture dry matter yield and pasture nitrogen yield were increased by 30% and 50% respectively after a single cultivation, compared with uncultivated pastures. In the latter, cattle liveweights were increased by 35 kg/head for one year. However, this finding has no yet been repeated.

Renovating with a single cultivation has the advantages of being a relatively cheap option, not dependent on the need to re-sow a new pasture. However, it is not yet clear whether any extra liveweight gain will consistently pay for the cost of renovating.

Fertilising with nitrogen

This is one option that we know can maintain high levels of grass productivity. However, high rates of fertiliser are needed and these are costly. Furthermore, the older the pasture, the more fertiliser that is needed to boost productivity. Fertilising with nitrogen is likely to be prohibitively expensive for most pastures at present.

The best solution

There is no 'best solution' which suits all situations. The options we have presented here range from accepting a lower level of productivity through to cropping or fertilising with nitrogen. The most appropriate solution will depend on individual circumstances.

Sown grass pastures are a valuable resource in Queensland which must be sustained. Current and future research, together with valuable producer experiences, are necessary to achieve that goal.

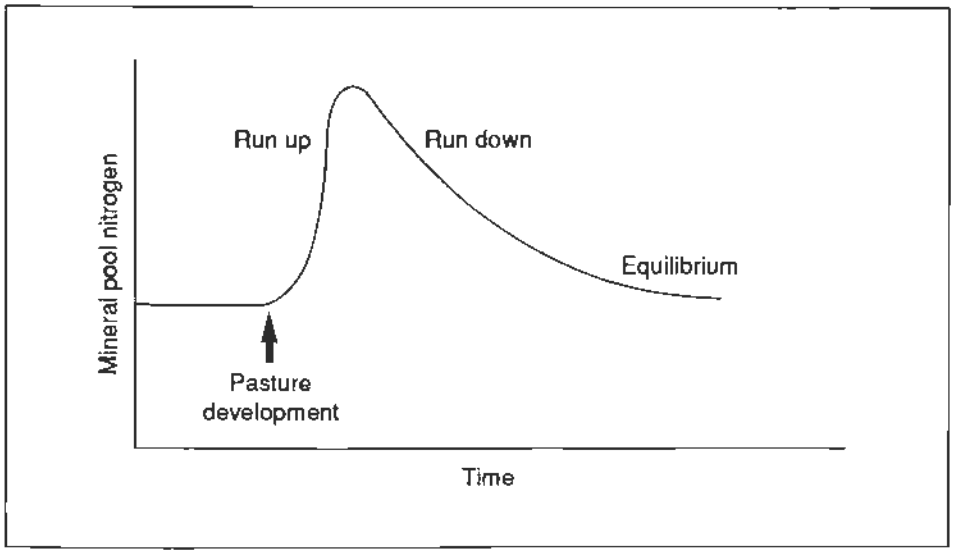


Figure 2. Nitrogen levels in pasture over time.

Yellow spot of wheat:
a conservation cropping dilemma

G.J. Platz and **R.G. Rees**, Plant Pathology Branch

Plate 1. Severe yellow spot debilitates plants, substantially reducing grain yield. The heads to the left are from healthy plants, those on the right are from infected plots.

Plate 2. Severe yellow spot can defoliate crops, leaving green heads and stems.

Introduction

Soil erosion is probably the greatest problem facing stable agricultural production in Queensland with virtually all our crop land vulnerable. Retaining crop residues on the soil surface (conservation cropping) is a very effective means of increasing water infiltration into soil and so reducing erosion. Unfortunately, some crop diseases survive in crop residues and increased levels of residues on the soil surface may aggravate disease problems. It is, however, possible to minimise diseases in conservation cropping systems.

In the past, it was accepted practice to burn stubble shortly after harvest. This disposed of the large bulk of stubble and any pathogens it contained. Under these conditions yellow spot was not a problem but our wheat lands were frequently exposed to severe erosion. The trend to surface retention of crop residues has resulted in yellow spot becoming the most conspicuous disease of wheat in Queensland.

Does this suggest that we should return to the 'bad old ways' of burning crop residues soon after harvest? No! Quite the opposite! Conservation cropping has proven its worth and is vigorously encouraged. However, stubble-borne diseases can be a problem under these systems and control measures are required. Since yellow spot is typical of several diseases that survive in stubble, an understanding of the pathogen and how it may be controlled can be applied to other crop/disease complexes.

The disease

Yellow spot is caused by the fungus *Pyrenophora tritici-repentis*. It was first recorded in New South Wales and Queensland in 1950 and is now a major problem in these areas as well as parts of Western Australia. It has also become a serious problem in other countries where conservation cropping has been adopted.

The disease initially appears as brown flecks on leaves and these soon expand into lens-shaped, light brown areas of diseased tissue (lesions), often with yellow surrounds. The lesions can be up to 10 to 15 mm long and may coalesce to kill the leaf blades and sheaths. The fungus can infect all above-ground parts of the plant. However, lesions on the stem and head are usually confined and remain dark brown to black. Infection of the grain can result in a 'pink grain' symptom and will lead to downgrading at receival depots.

Survival and development

The yellow spot fungus survives in wheat stubble or, at times, stubble of triticale. In very rare cases the fungus may survive in barley stubble, but it is not generally an effective source of initial (primary) inoculum. Wet spores (ascospores)

develop in spore producing structures (ascocarps) on wheat stubble. Ascospores are spread under wet conditions and when deposited on living wheat tissues under wet conditions, infection may occur. Ascospores are generally not spread far and so there is usually a strong association between yellow spot and wheat stubble.

As the crop develops, masses of a second type of spore (conidia) are produced on old lesions and dead tissues. Wet conditions promote the development of conidia and are necessary for infection to occur. Unlike ascospores, conidia may be distributed widely by the wind. Conidia result in rapid development of the epidemic within a crop and spread the disease to other crops and areas. Figure 1 illustrates the disease cycle for yellow spot.

Plate 3. Typical yellow spot lesions showing light brown areas of dead tissue with yellow surrounds.

Since the two important requirements for severe yellow spot are infected wheat stubble and a wet growiug season, it is seldom a problem in dry years.

Effects of the disease

In severely diseased crops, most of the leaves present at any given time will be dead. This results in short, spindly plants with reduced tillering and root development. Where conditions favour continued development of the disease, plants may lose all their leaves soon after flowering.

Grain yield can be substantially reduced and losses of more than 50% may occur in extreme situations. Where wheat crop follows wheat crop and some stubble remains on the soil surface, losses would commonly be around 10 to 15% and nearer 30% in wet growing seasons.

Managing the problem

Crop rotation

Crop rotation is the best means currently available to reduce the impact of yellow spot. This is because other crops, except for some triticales, are resistant to the disease. In addition, ascospores are generally not dispersed far from wheat stubble and management practices in a field have a strong influence on the level of yellow spot in wheat planted in that field.

Stubble incorporation

Once buried below the soil surface, stubble plays no further role in the development of yellow spot. Hence a useful procedure is to retain stubble on the soil surface through most of the summer before incorporating it into the soil. The degree of yellnw spot control achieved largely depends on the amount of stubble remaining on the soil surface. The more stubble remaining, the greater the chance of severe yellow spot developing.

Stubble grazing

Removing wheat stubble by grazing will also reduce the severity of yellow spot.

Plate 4. Dark fruiting bodies (ascocarps) on wheat stubble produce spores (ascospores) under wet conditions, initiating yellow spot in wheat planted through the stubble.

Stubble burning

Burning wheat stubble will generally give good control of yellow spot. However, because retention of stubble on the soil surface is an excellent means of improving water storage and reducing soil erosion, early burning is undesirable. A compromise solution to this dilemma is to delay burning as long as practicable. While there may be practical problems in achieving a good burn in autumn, burning stubble before planting can be beneficial in terms of yellow spot control. In trials, this practice has resulted in considerable yield increases under conditions suited to severe yellow spot.

Future control options

Resistant varieties

All wheat varieties recommended in Queensland are very susceptible to yellow spot and resistant varieties are not a control option at present. Small differences in susceptibility can be detected between varieties, but these are of limited practical value. Useful sources of resistance have been located in wheats which are unsuited to Queensland conditions and a major programme is underway to develop adapted varieties resistant to the disease. Advanced lines from this programme have reached the field evaluation stage and some have performed extremely well in trials during the past three years. Hopefully, varieties resistant to yellow spot will become available within a few years. This program is funded by the Wheat Research Committee for Queensland and the Wheat Research Council.

Fungicides

No fungicides are currently registered or recommended for control of yellow spot in Queensland. It is doubtful whether any currently available fungicides would give economic control of the disease.

Summary

Yellow spot can be a major disease problem in wheat crops where wheat stubble has been retained on the soil surface. The impact of the disease can be reduced by avoiding planting wheat through wheat stubble. This can best be achieved by crop rotation. Effective control is also obtained by incorporating stubble into the soil or grazing or burning stubble after the erosion risks from high intensity summer storms have lessened. Yellow spot will be a problem only in wet years. Resistant varieties will greatly improve our ability to control yellow spot.

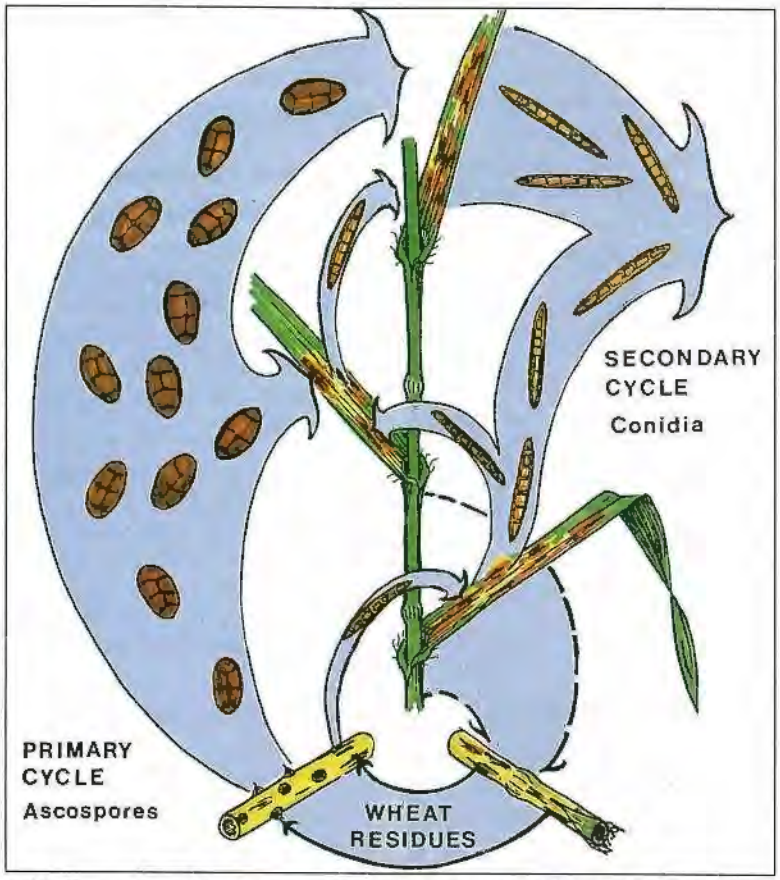


Figure 1. Yellow spot disease cycle. Ascospores of the fungus produced on wheat residues start the epidemic while conidia produced on diseased plant tissues promote its rapid development and spread to other crops.

Farm garden medicine chest

Dick Franklin, Information Services

Some people prefer not to use chemical sprays for pests but it is a case of *them or us*. Pests, insects and diseases compete directly with us humans in the food chain. The idea of a chemical that is harmless to us and deadly to insects is so far a dream. Most if not all chemicals that kill insects are also harmful to us. Years ago I grew commercial garlic. Grubs ate it. These grubs may not have had much of a social life but they were healthy. Many household chemicals are toxic. These include kerosene, oven-cleaner, dry cleaning fluids and even salt, if enough is eaten.

It is a fact of life that in most years the following crops will not be successful unless sprayed — rose, grape, papaw, avocado, peach, melons, citrus, strawberry and others. No spray, no crop.

The following programme has been greatly simplified. While it is not perfect it should give around 80% efficiency. The odd grub or grub hole is a sign there is little or no chemical left on the food. Insects should be sprayed only when they are actually on the plant that is on sight. Small numbers of insects can get the completely biodegradable treatment of hand picking or throwing on the ground and stomping to death. Aphids can be hosed from the plants. The aim is to have the minimum number of sprayings, each with the maximum effective kill. Resistance to insecticides is easily acquired by insects.

Insecticides used are diazinon, which can be sold under many brand names, and fenthion, sold as Lebaycid®. This is a made up word, 'Le' meaning 'the', 'bay' short for Bayer (the company that makes it) and 'cid'(e) meaning 'kill' as in suicide, homicide, etc. I use diazinon for fleas and ticks on my dogs, buffalo fly on the cows and, cockies in the laundry as well citrus leaf miner, aphids, some cabbage grubs, corn ear worm, bronze orange bug scales, mealy bug, and others. It will control most insects except fruit flies. Lebaycid controls fruit flies.

Fungicides must be used for prevention. If you can see the diseases, it is too late. Mancozeb, sold as Dithane®, is a powder used at the rate of 2 g/L water. It can be used on all plants. I regard it as a 'soft' chemical, one that is kind both to the user and the garden. It is also a source of manganese and zinc, which are required by the plant in small amounts. In other words, manganese and zinc are micronutrients or trace elements.

Copper oxcychloride, or green copper, is an old fashioned spray that has good weather resistance. It should not be used on early peaches which are copper shy. I use it at 3 g/L. Copper was the second chemical used in agriculture for disease control. During the Irish potato blight years of the mid-nineteeth century, it was noticed that potato plants near copper smelters did not have the disease.

Sulphur originally came from volcanoes, so people thousands of years ago believed it was from the gods. They used it on plants and controlled some diseases such as a powdery mildew. It is one chemical that is a fungicide, an insecticide and also a fertiliser. In my boyhood days, sulphur and treacle was a spring tonic administered by parents to reluctant children. Use wettable sulphur at 3 g/L. Stop when the temperature is over 30°C. Do not use on rockmelons, cucumbers or sulphur shy plants.

Most of Queensland, which is a great state for people but not plants, is deficient in micronutrieuts such as zinc, boron, copper, manganese, molybdenum and others. A foliage or leaf fertiliser is the way to go. I use mine at slightly under-strength to avoid burning. About 15 g/5L or 3 g/L usually does the trick.

It is never safe to mix two or more chemicals unless the labels on the container recommend it. If in doubt contact the manufacturer. Do not mix in the spray container and mix each chemical with a little water first. Water allows us to spread the chemical evenly over the plants. Two plastic buckets of known volume is the way to start. Then mix by pouring from bucket to bucket.

If I want to spray a whole range of garden plants which includes peaches (copper shy) and rockmelons (sulphur shy), I make up the mix without these. Spray the peaches and rockmelons first, then add copper and sulphur.

Take one crop as an example — tomatoes. When young, from day old to six to eight weeks, they can be sprayed with a half strength mixture at weekly intervals. Sprays include diazinon, mancozeb, sulphur, copper oxy and leaf fertilisers. When the fruit are half-grown (golf ball size) fenthion can be added. These treatments are applied fortnightly. When the plants are being harvested, pick hard, then spray and wait three to four days for the next spray.

Always clean out equipment after use. Do not use weedicides in your spray equipment and always read directions on the packet *several times*.

Good spraying and good gardening.

Trap rock boosted by contour chisel ploughing

T.Crossley, S. Glanville and D. Orange, Soil Conservation Branch

Plate 1. Legume plots recover after crash grazing in early May.

Plant cover is arguably the single most important factor in reducing erosion from water runoff.

Where plant cover has been redneed by drought or overgrazing, contour chisel ploughing can help retain water and re-establish pasture. It can also be a useful aid to successful establishment of inproved pastures. This article looks at the benefits of contour chisel ploughing on traprock soils shown by early results from a trial set up at cement mills at 'Brooklyn', an hour west of Warwick, near Karara.

Trap rock country (figure 2) is probably best known for its fine wool production. Traprock graziers purchase western Queensland fully grown wethers and keep them for about five years. Nutritional problems associated with long hard winters are the main limiting factors to sheep breeding enterprises and beef cattle production.

The traprock country has the most reliable rainfall of all the main wool producing areas in Queensland. But the effectiveness of rain, particularly the intense spring storm rain, is limited because of the very slow infiltration, consequently most of the rain runs off.

Plants help because they shelter the soil from the impact of raindrops and allow water to penetrate through their root channels. When plant cover is removed by drought or overgrazing, this access of water is also removed, leaving the soil surface to become dry and crusted.

Management of traprock should therefore be tailored towards keeping adequate plant cover at all times.

Contour chisel ploughing is regarded as a useful management technique to improve the soil infiltration and subsequent pasture regeneration. However, its benefits had not been quantified, which prompted soil Conservation Services Branch to set up the Cement Mills trial.

Because traprock soils soak up water slowly, keeping the water on the soil surface, rather than allowing it to run off, will help infiltration. Chisel ploughing on the contour lets each tyne furrow act as a small dam and allows the water more time to soak into the ground. We estimated that chisel furrows would hold about 30 000 L of water over 1 ha of ground.

Chisel ploughing on traprock is ideally done after rain, as the ground is softer. Spring chisellings are likely to produce the best results. However, if the operation is done in conjunction with seeding of winter legumes, an autumn chiselling would be more appropriate.

Chiselling down to 75 mm is all that is necessary. Any deeper than this can be undesirable as it may bring up subsoil. A minimum tine spacing of 300 mm is recommended to minimise destruction of existing plants.

Results

Runoff

Small plots, both in the chiselled and control areas, were sprinkled with water, at about 60 mm/hour intensity (plate 4). Runoff measurements were taken every 2 minutes until a fairly consistent runoff rate was reached. On average, runoff began after only 4 minutes of rain on the control plots, but not until 10 minutes on the roughened surface of the chisel plots. They reached a constant runoff rate after about 30 minutes, compared to about 15 for the control plots. By then, 40% of the rainfall was still infiltrating the chiselled soil, but only 10% was infiltrating the control plots.

Total infiltration was calculated for each plot after 20 mm of rainfall. The

chiselled plots contained twice as much water.

All the plots had a 70% covering of clipped grass, so the results apply to well-grassed country. Other tests show infiltration to be lower without grass cover.

Projection of runoff were calculated for the chiselled and control plots using daily rainfall figures for 1987 and 1988. The USOA curve number equation was used to estimate runoff:

$$\frac{R = (P - .2\,S)^2}{(P + .8\,S)}$$

where R is total runoff and P is total rainfall. For our purposes, rainfall was accumulated until there were more than 5 dry days between rain days. This accumulated rain was then used in the equation to calculate runoff from each rain period in those two years.

The factor S was calculated by subtituting total runoff and total rainfall from the rainfall simulator plots into the above equation. The values of S were 39.5 and 11.7 for the furrowed and control plots respectively.

Evaporation was not considered and furrows were assumed to remain all year. One millimetre was subtracted from each rainfall event as surface storage on the control plots, while 5 mms were subtracted from the furrowed plots. 1987 was taken to represent a dry year in the traprock and 1986 represented a very wet year.

Figure 2 shows the hypothetical runoff from chiselled and unchiselled sites. In chiselled sites, in 1987, runoff only occurred 11 times with 31% runoff. In unchiselled plots, runoff occurred 17 times, with about 68% lost as runoff. Runoff for 1988 was 49% and 76% respectively, mostly from record rains in April, when 235 mm fell in the traprock area. Of this, about 188 mm would have runoff form chiselled sites, and 220 mm for unchiselled sites.

Native pasture production

For contour chisel ploughing to be viable, the extra water conserved has to be turned into extra grass production. Increases in production of up to 100% were shown (mainly on Queensland blue grass (*Dicanthium sericeum*) and pitted blue grass (*Bothriochloa decipiens*)). Areas that were completely bare before chiselling also regenerated well compared with non-chiselled sites.

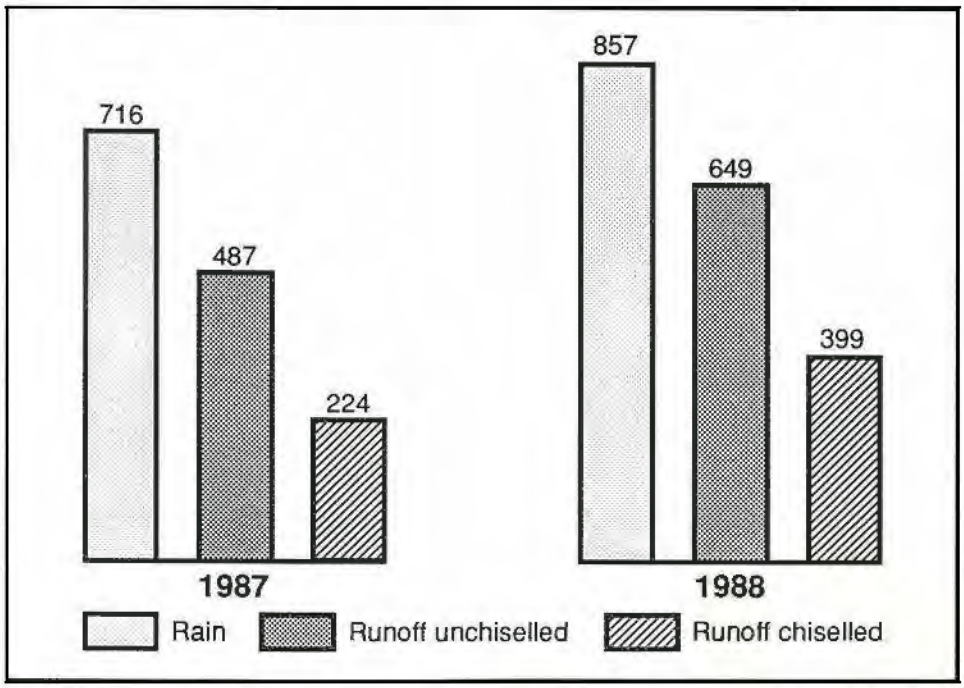


Figure 1. Rainfall and runoff from chisel furrows.

Plate 2. Setting up for the rainfall simulator—the hard soil conditions make a jackhammer necessary.

Plate 3. Operating the simulator.

Pasture improvement

Native pasture in cleared country carries on average 2 dry sheep equivalents/ha. It is good summer grazing, but its dormancy in winter produces a major feed gap. Improved pastures are essential supplements to winter grazing, but are generally very difficult to establish using low cost techniques. Attempts at surface seeding into undisturbed ground have generally failed.

Contour chisel ploughing can give plants a better chance of germination. The chisel furrow protects seedlings from the sun and wind, and traps water providing moisture for longer periods. Chiselled sites sown with a mixture of clovers, medics and lucerne and 250 kg/ha Mo 200 superphosphate germinated very well. Seedling survival rates were also high, especially in the chisel furrow (plate 5).

Dry matter production on these sites was also impressive (table 2). Production in the crucial winter feed gap period was five times greater than the control plots. Pasture quality was also better with legumes making up between 30 and 60% of the pasture sampled.

A useful, low-cost method of pasture establishment can be achieved by mounting a planter box on a chisel plough. Seeding and contour chiselling can then be done in one cheap operation.

Reduced erosion

Traprock, like most grazing lands, has a thin layer of top soil. Top soil is the main source of nutrients and seeds for pasture regeneration so it is important that this layer is maintained.

Two types of erosion are common on traprock country, gully and sheet. Both are caused by too much water runoff (plate 6). Sheet erosion usually occurs at such a low rate it is unnoticed. But its long-term effect, particularly when occurring on shallow topsoil, will be pasture degradation.

Contour chisel ploughing will reduce total runoff and sheet erosion, particularly in overgrazed pasture. The speed in which gullies cut back will also be slowed and the chance of them regenerating through simple techniques

Plate 4. Chisel furrows holding runoff after simulated rainfall.

Table 1. Native pasture production.

Treatment	(Dry matter kg/ha for 1988-89) Oct–May	May–Oct	Total
Control (no chiselling)	513	46	559
Chisel furrows (1 year old)	1118	68	1186
Chisel furrows (2 years old)	951	70	1020
Chisel furrows (3 years old)	*	*	*

* Data not available yet

Table 2. Improved pasture production.

Treatment	(Dry matter kg/ha for 1988-89) Oct–May	May–Oct	Total
Chiselled plus legume seed and Superphosphate (1 year old)	1204	248	1452
Chiselled plus legume seed and Superphosphate (2 years old)	*	*	*

* Data not available yet

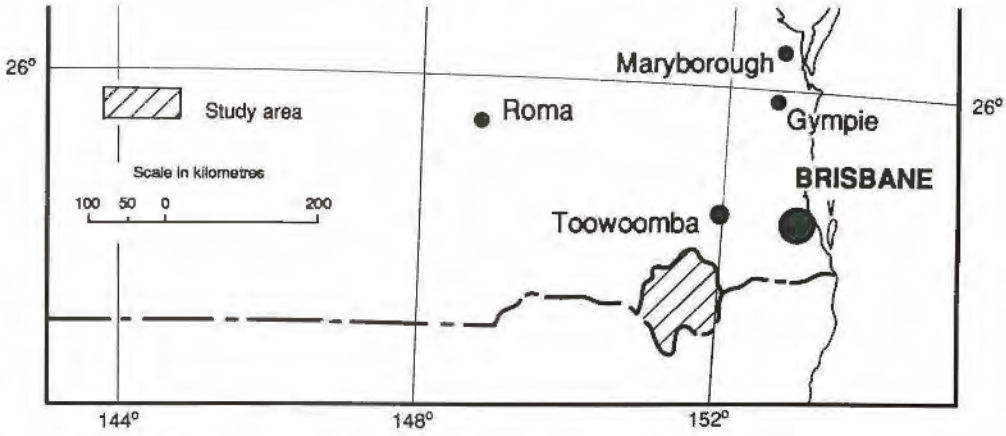


Figure 2. Location map: trap rock country.

such as destocking will be much improved.

Economics

It costs about $10/ha to chisel plough. But the returns in terms of improved wool production are not easy to measure. However, by being able to establish improved pastures that provide good quality feed through winter, financial benefits are obvious.

Method

Treatments

An even slope was selected for the trial site. Five plots were replicated six times to remove any bias. Plot treatments follow.

1 Contour chiselling in the first year

2 Contour chiselliug in the second year

3 Contour chiselling in the third year

4 No chisel ploughing (control group)

5 Contour chiselling, followed by 250 kg/ha MO 200 superphosphate with 0.5 kg/ha 581 lucerne and 0.5 hg/ha trifecta lucerne, 0.5 kg/ha Parragio and Gemalong medic, 1 kg/ha cluster clover and 0.5 kg/ha Haifa Clover.

The reason chiselling is to be done over three years is to compare chiselled plots done in the first year of the trial with those in the second and third. This will then give an idea as to how long the benefits of chiselling will last.

Measurements

Dry matter (kg/ha), depth of soil wetting (cm), % soil moisture, runoff (m) and species composition were measured on each plot.

Dry matter was measured by clipping the plots at the end of each growing season. Runoff was measured using a rainfall simulator (plate 3). Depth of infiltration and the amount of soil moisture were measured after simulator mns and after natural rainfall events.

Mango marketing potential for profit

Joanna Kane, Marketing Services Branch

The fresh sector of the Australian mango industry could work more closely with the processing sector to fill untapped demand from domestic and international markets.

Industry problems are often wrongly explained as oversupply caused by increased plantings. Consequential solutions have been to process the leftovers, export to decrease domestic supplies and discourage plantings of new mango trees.

But the problem could be redefined as untapped demand with potential profits left unrealised.

If a problem and its cause are incorrectly defined, incorrect solutions will probably be developed. The industry's concern about oversupply may very well become reality if attitudes don't change. Untapped demand for fresh and processed products on both the domestic and export markets have been identified but, unless the industry develops these markets and makes a commitment to them, they may be lost in the dynamic international environment.

To achieve this, suggest, a 4 C approach — a strategy of coordination, commitment, capacity and concentration on competitive advantage. I first delivered this concept to the 3rd international mango symposium in Darwin at the end of September.

Coordination

Coordination among growers, processors and other industry bodies will help by sharing information, research, promotion and problem solving.

The industry needs to see itself as an Australian mango industry with a fresh and a processing sector, not as a fresh mango industry with a separate mango processing industry.

Commitment

Increased commitment is needed from both growers and processors to each other and hence to the markets . One option is to set up grower cooperatives for processing.

Once the consumer market is developed, consumers quickly forget their product loyalty with continual new products and high competition in the food market. Rebuilding this product loyalty every time extra mango supplies are available is very expensive. Large retail chains charge a fee e.g. $10 000, for shelf space. If supply is irregular, this fee has to be repaid each time the product becomes available. As a result, processors need committed supplies of mangoes.

Irregular supply gives the company and its product a bad reputation and eventually leads to the refusal by the distributors, e.g. supermarkets, to display the product. Processors need to make a commitment to their retailers and exporters.

Processing operations can not be set up on demand. They need research, capital investment, plant set ups, trial runs etc. And because processing plants need to plan ahead and commit capital, they need to be assured of throughput and returns.

All these points hold for the fresh export market as well, especially the importance of a reputation as a reliable supplier.

Capacity

The industry is so worried about having a potential oversupply it may actually miss out on markets by not having the capacity to satisfy them.

Export markets are good examples which often require large quantities. Mango processors have had overseas requests and orders for mango products

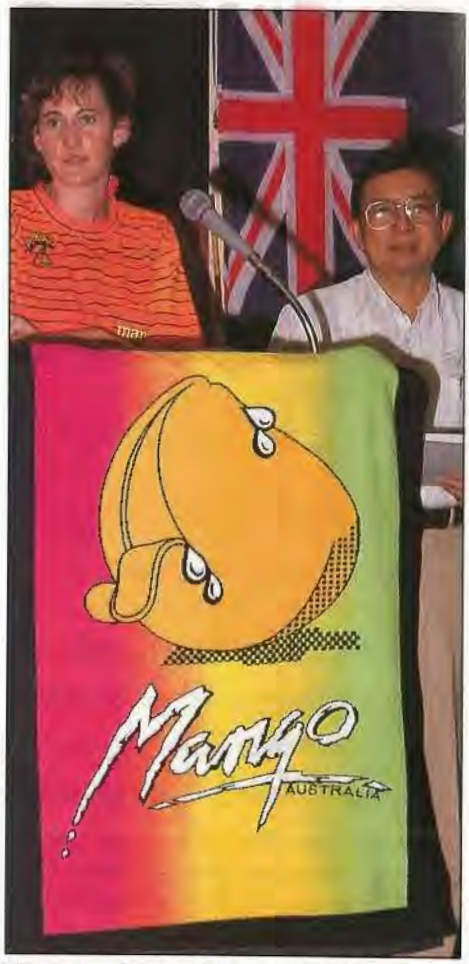


Plate 1. Joanna Kane speaking at the 3rd International mango symposium 'Australian outlook' session, with Laurence Ah Toy (chairperson).

which were greater than the overall quantity processed in Australia, without any major marketing being undertaken overseas.

These requests were turned down, due mainly to lack of capacity.

The industry needs to look more closely at the demand potential and match this with forecast supply for both domestic and export markets.

Competitive advantage

With the potential to still expand demand further, a price advantage is not yet necessary to sell more mangoes. A suggestion is promotion along the lines of a 'Tropical/unique/special/Queensland/ Australian' image.

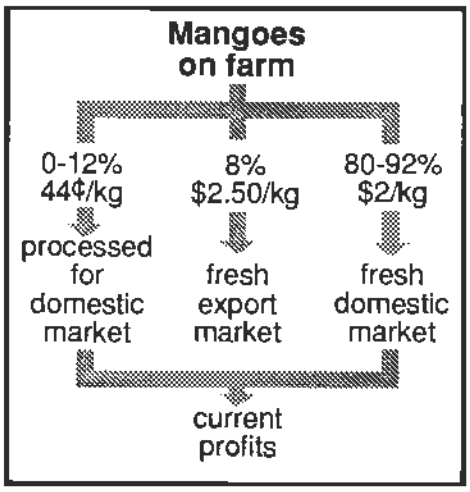


Figure 1. Current industry structure.

The Australian mango industry has defined itself as a 'fresh mango industry'. What has happened to mangoes over the decade as a result of this, is shown in figure 1.

Over this decade, 80-92 % of Australia's mango production has been supplied to the fresh domestic market. This market gives the best price for the least effort, currently averaging $2/kilo.

About 8% is sent to fresh export markets mainly arranged by growers who have grown mangoes specifically for them.

Leftovers are either forgotten about or sent to processing. The quantities processed have varied over this decade, the maximum reaching up to 12% in one season. Returns from processed fruit are much lower, averaging 44c/kilo last season, but are offset some what by the reduced costs and quality necessary.

Overall, the industry is currently considered profitable.

Some solutions the industry has developed to overcome this perceived oversupply include:

- developing the mango processing industry for 'leftover' mangoes
- developing export markets for fresh mangoes, so that fewer mangoes are left on the domestic fresh market
- suggesting fresh mangoes be marketed as 'common everyday' fruit on the domestic market, to be able to sell as much as possible to the mass market
- discouraging the planting of new mango trees.

Coordinating the Industry

Redefining the industry as one mango industry identifies the need for coordination among growers, processors and industry bodies. This would affect the attitude towards solutions and actions undertaken in the industry.

Coordination could allow information sharing, research, promotion, etc.

It can be developed through formal or informal methods e.g. forming a processor and grower body, or marketing cooperative or board. There are numerous types of coordinating bodies that could be arranged and the industry must research into this area and decide on the optimal type of coordination.

Commitment to markets

As explained earlier, consumer markets and distribution networks cannot be used just for convenience. The markets currently lacking commitment from the mango industry include the domestic and export markets for processed mango products, and the export market for fresh mangoes. The principles of commitment to processed products also apply to the export market for fresh mangoes.

Commitment is not being made by growers to supply mangoes to the processing sector, so the processing sector cannot make a commitment of supply to the markets.

But the need for commitment is not just the responsibility of the growers. Just as much responsibility lies with the processors to make an effort to access committed supplies of mangoes. Most processors who considered the lack of

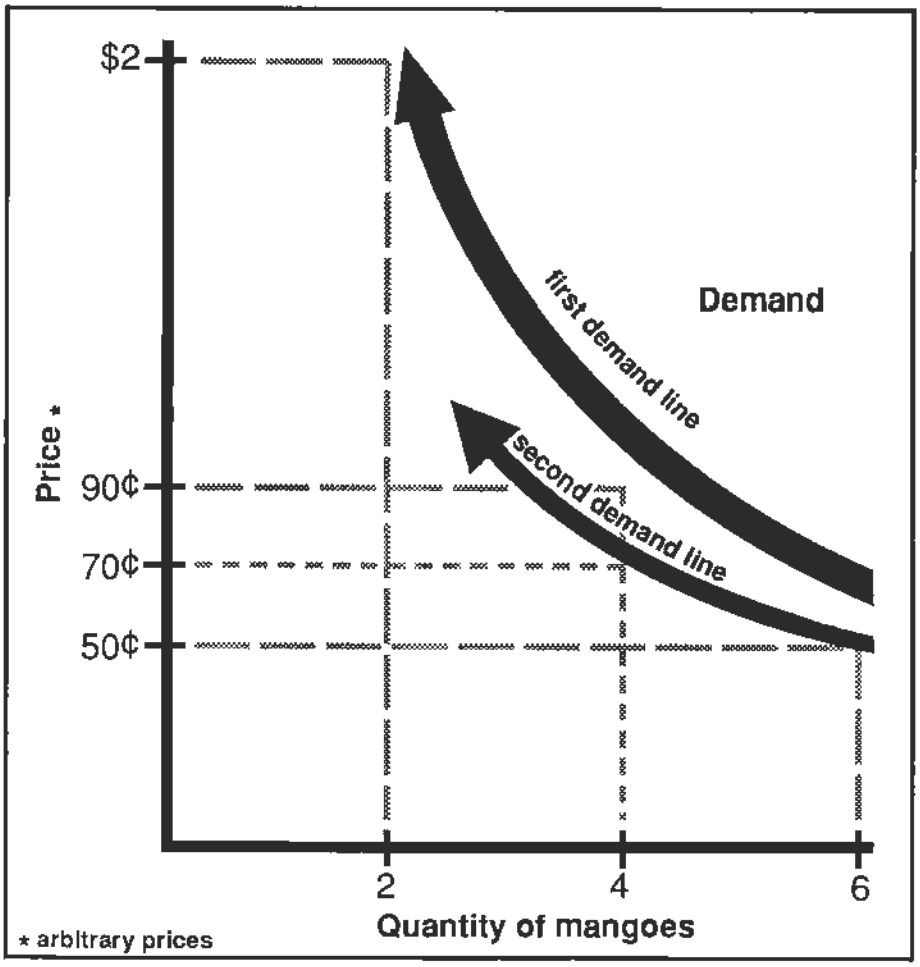


Figure 2. Demand for fresh mangoes on the domestic market.

commitment by growers as their major problem put little effort into sourcing mangoes were are prepared to wait until the growers had flooded the domestic fresh market and were desperate to sell to processors.

Industry future

Supplies of mangoes are increasing and fresh mangoes sold domestically are still the major market. In the current situation, these increases in supplies are expected to lower prices, force more mangoes into fresh exports and more leftover mangoes into processing, decreasing dollar returns overall.

This situation could produce even lower profits than the industry expects, and maybe even financial losses.

Developing a market for the processed product will take time and money. A developed market can not be expected to be ready and waiting for the first season of extra supplies of mangoes. Processors need to be able to make a commitment to consumers to be able to develop the market. Just sending 'leftovers' to processing is not good enough.

By trying to sell as much as possible on the fresh domestic market, poor quality mangoes find their way on to this market. Low quality fruit is particularly damaging to a market when the fruit is 'new' to the consumers. If you eat an apple that tastes awful you won't stop buying apples for a year or two because you know apples don't normally taste like that. But if a consumer in Sydney or Melbourne buys a bad mango they may come to the conclusion that they don't like the taste of mangoes and never buy one again.

Numerous research reports have indicated the strong effect of quality on demand. Keith Chapman's research is one example. As a senior horticulturalist with QDPI, he looked at the new and tropical fruit lychee, and concluded that quality has 2 to 5 times the effect on price in an unglutted market, as quantity.

As a result, strict quality standards are necessary in the fresh sector. This problem has been recognised in some industry bodies by the adoption of grade standards, but not by enough growers.

Marketing mangoes as an 'everyday' and 'common' fruit to the mass market is likely to result in a price that is consistent with this image — a low price. But mangoes do not have a competitive advantage of low costs of production to support low pricing, e.g. the cost of production for mangoes is approximately twice that of bananas and over four times the cost of apples or pears.

As a result, the selling price could end up lower than the cost price, unless the industry develops a realistic competitive advantage.

Once fresh mango supplies have saturated the market and consumers have experienced low prices, any future decreases in supply will not result in the higher prices previously attained. To explain this using arbitrary numbers — when 2 mangoes were available, the consumer was willing to pay $2/mango. When the supply increased to 4 mangoes the consumer was only willing to pay 90c/mango. When the supply eventually increased to 6 the consumer would only pay 50c for each of the 6 mangoes. Now if the industry then tried to process more and decrease the quantity of fresh mangoes back to 4, the consumer, having experienced the cheaper price, will now not pay 90c/mango but only, say, 70c/mango. Demand is lower when quantities decrease (figure 2).

So if the industry waits until the fresh market is flooded before processing and exporting more mangoes, and if they promote mangoes as a common everyday fruit, demand for mangoes could be permanently lowered.

So there are some major reasons why the solutions and direction of the industry may not be possible to achieve and may result in poor financial returns to growers and processors.

But should an industry so often talked about as having good consumer potential as the mango industry, have such a poor future outlook?

If 'oversupply' is seen instead as 'latent demand', the problems in the industy could be said to have resulted not from extra plantings but from the attitudes in the industry—the non-strategic attitudes.

Strategic thinking is the type of thinking that redefines the game, that is not limited by the obvious and the measurable. It is an imaginative approach towards a goal.

Developing a the solution for the redefined problem requires an attitude change within the industry.

The main areas that need to be developed accordingly are the 4 Cs.

The first step is to say "CC's" (Throw out pre-packaged perceptions).

Some strategic thinking solutions that could be implemented by growers, processors and industry bodies are:

- arranging orchards specifically for processing to lower the costs of production
- contracting orchard supplies directly from growers
- arranging the collection of mangoes from growers not bothering to pick
- setting up grower cooperatives for processing so that growers get a proportion of the returns of the end product and not just the raw material
- buy large quantities of fruit and sell it on the fresh market themselves, as well as process. This way a commitment to the processed market can be kept and the supply and quality of fruit on the fresh market controlled to ensure good prices.

Reaching capacity

The industry is so worried about having a potential oversupply it may actually miss out on markets by not having the capacity to satisfy them.

Export markets for both fresh and processed products are a good example. Australia's domestic market is very small in comparison to overseas markets, and exporting often requires quantities greater than the quantity produced by all the processors in Australia to fill just one order.

For example:

- one Japanese ice cream manufacturer enquired about buying over ten times

the quantity of mango slices produced in Australia

- one Canadian company ordered over 6 times the quantity of frozen mango slices that are produced in the whole of Australia
- a tenth of Australias mango puree was requested by one European juice manufacturer, just for trial purposes
- one order from Japan for dried mango was for the total quantity of mango produced by Australia's biggest mango drying company.

These examples only begin to indicate the massive potential export markets.

The industry needs to look much more closely at the demand potential and match this with the forecast supply to determine whether it will be able to supply fresh and processed mangoes to both domestic and overseas markets.

Concentrating on a competitive advantage

Any product being sold in a competitive market needs a 'competitive advantage'. The cost structure of the mango industry doesn't lend itself to a price advantage. Each product within the market may need a different competitive advantage to be developed. One example is fresh mangoes, and even many processed mango products on the domestic market, that could bave a competitive advantage by being promoted for example as 'tropical/unique'.

The 'tropical/unique' image of anything mango is supported by the natural characteristics of the mango; perceived as such by the consumers; consistent with what is in vogue (and not expected to be just a 'fad') in the domestic market; consistent with receiving a high price; and with the potential to be further marketed.

Summary

The Australian mango industry needs a new direction — to change its attitudes, think strategically and redefine itself as single industry.

Coordination, commitment, capacity and concentration on a competitive advantage are recommended.

Stylos in the dry tropics

P. Anning, Agriculture Branch

The old and the new

Townsville stylo has inspired pasture scientists searching for improved pastures for Australia's dry tropics. In the 1960s, QDPI and CSIRO began a programme of introducing stylos from central and south America, where they occur on infertile tropical soils.

Years of collecting and testing led to the release of stylo cultivars for both the wet and dry tropics in the 1970s. The most successful of these are verano and seca. Verano looks much like Townsville stylo, while seca is a small shrub.

The QDPI and CSIRO are now developing a wider range of pasture legumes for the dry tropics. Recently a new cultivar of stylo was released (amiga), which may have a wider climatic range and yield more than verano.

Mixtures of a number of shrubby stylos are being compared with seca from Mareeba to Rockhampton in the search for genetic variation. This is likely to lead to locally adapted shrubby stylos. A similar natural selection has occurred with other pasture plants – the Georgetown strain of Townsville stylo flowered a month earlier than the Mareeba one, matching the rainfall pattern.

An international watch is kept on the progress of both stylo species selection and stylo diseases. Strict quarantine may prevent the introduction of more virulent forms of anthracnose from South America.

Protected hard seed

Like many legumes, stylos have seeds which are protected from the weather by a hard coat. The advantage of this is that at any one time only 10 to 40% of stylo seed on the ground germinates after rain. An established stylo pasture may have more than 100 kg/hectare of seed reserves in the soil.

Stylo seed should be scarified to reduce hardness if immediate germination is required. This applies where seed is being sown into a cultivated seedbed during the wet season. Mechanical scarification with abrasive surfaces or hammermills is used for stylo.

Hard seed is also the basis for rapid spreading and thickening of stylo pastures. Stock do not digest much hard seed, so it is both spread in dung and provided with a fertile seedbed. Stock tend to avoid dung patches, so the stylo plants which come up are temporarily protected from grazing.

Townsville stylo was spread in the dry season when country was grazed bare. The legume established before grass and, became dense and competitive. Similarly, the new stylos do not require cultivated seedbeds, although cultivation is an advantage. Beef producers in north Queensland have sown many tonnes of stylo seed, usually in October and November when the country is bare from grazing and in the dry season. Aerial sowing is popular for areas of more than 100 ha, but a tractor-mounted broadcaster is usually used for smaller areas.

Cultivation may be used before sowing on fertile country supporting a thick body of grass. It is also required when a grass is sown. Deep ploughing is not necessary except for woody weed control.

Clearing open timber is not necessary for oversowing stylos. The largest areas of sown stylo in north Queensland have been developed on uncleared country. Dense timber (for example tea trees) can be removed. Local experience is that verano recovers from treatment with Graslan pellets after two years but seca is more sensitive.

The rate of return on the investment in pasture depends on the amount of legume available to turnoff stock. Seed is surface sown at 3 kg/ha. It can be spread and mixed with fertiliser. However, granulated fertiliser is broadcast further than the seed, so overlapping is necessary.

Seed does not usually require inoculation, as the natural soil rhizobia (microorganism which fix nitrogen) are effective. However, Oxley fine stem stylo needs a specific inoculum.

Lenient grazing during the main flowering and seed filling periods leads to rapid thickening of stylo pastures.

Balancing a stylo diet

Stylos are adapted to Australia's low phosphorus soils. The majority of their yield is produced at available soil phosphorus levels of 10 ppm, too low for most sown pastures. However, the fodder does not contain much phosphorus for cattle.

The key is either to grow stylos on fertile soils such as alluvial river frontage, or supply phosphorus as fertiliser or directly to the animal. Phosphate licks for animals are a cost effective remedy.

In a wide range of grazing trials, stylos have increased annual liveweight gain of cattle by an average of 30 kg/head where phosphate was not limiting.

Stylo, a permanent protein supplement, is much more cost and time efficient than either applying nitrogen fertiliser or feeding protein supplements. As well, pasture legumes add available nitrogen to the soil and improve grass vigour. Thus, a sown legume is an essential basis for sustainable long-term pasture vigour and beef production.

Most of the early research and development with stylos occurred in northern Australia. More recently seca has been sown into brigalow pastures to lift declining protein levels in older buffet grass pasture.

Seed production

After the severe drought and overgrazing in 1987, stylo pastures recovered fully. A further indication of the success of seca and verano is that in 1989 over 100 t of seca seed was sold, and perhaps twice as much verano. The market absorbs all the seca seed which is produced. Seed crops are also being grown on a number of cattle properties to supply seed for pasture development.

Radical weaning in north-western Queensland

B.M. Burns, and **R. Sneath**, Beef Cattle Husbandry Branch,

Plate 1. Radically weaned heifers 396 days after completion of the trial .

Two radical weaning demonstrations using calves between two and eight weeks were organised on properties in the Richmond area of north-western Queensland during the drought of 1988. Following these demonstrations, funded by Australian Meat Livestock Research and Development Corporation a number of other properties throughout the area successfully weaned very young calves.

Demonstration one

On the first property, some cows had stopped lactating, and cows and calves were already dying when the decision to wean was made.

For the first demonstration, 90 Brahman crossbred calves ranging from two to six weeks of age and weighing between 36 kg and 70 kg were used. These calves were divided into two groups on body condition and strength. Each group was fed a different ration in the yards for 56 days. At the end of this period the calves were supplemented for a short period, and were then sent away to agistment.

The strong calves were fed 1.5 kg/head/day of Burval Calf Weaner Pellets and 1.4 kg of good quality sorghum hay. During the feeding period, they gained 25 kg liveweight at a cost of $29.68/head.

The weak calves were fed Burval calf weaner pellets at the rate of 1.1 kg/head/day, but the roughage was a mixture of good quality sorghum hay and grassy lucerne hay fed at the rate of 1.4 kg/head/day. This feeding regime cost $26.69/head and the calves gained 17 kg over the 56 days.

Weaning prevented further cow deaths, but five of the calves died from coccidiosis during the course of the demonstration.

Demonstration two

On the second property, calves between four and eight weeks of age were weaned. The reasons for weaning these calves were:

- to remove the stress of lactation from first calf heifers and older cows which could not have survived while supporting a calf
- to allow older cows to improve in condition before sale. The sale of older cows reduced stocking pressure, making more country available for younger cattle
- to give young breeders a better chance of getting back in calf
- to convert the single stomached digestion of the calves, with a limited chance of surviving under drought conditions, into a ruminant animal with a good chance of surviving on a roughage and molasses based ration
- to remove the need for one weaning muster of breeders on agistment, therefore reducing costs.

The cows were pregnancy tested and drafted according to age and pregnancy status. Old cows were tail tagged according to whether they were empty, six weeks to four months in calf, or over four months in calf. All old cows and young cows were sold. The older pregnant breeders brought premium prices on southern markets.

The remaining breeders were sent to agistment. As a result of the radical weaning before they left, it was only necessary to muster these cows once for weaning while they were away. Without the radical weaning, at least two musters would have been required. Therefore, weaning muster costs were cut by at least half.

For the second weaning demonstration, 60 Brahman crossbred calves weighing between 62 kg and 105 kg, and ranging in age from four to eight weeks, were divided into two groups.

Each group was fed 1.4 kg/head/day of Burval calf weaning pellets and 1 kg/head/day of grassy lucerne hay. The rumen modifier Rumensin was incorporated into the pellets fed to one group.

Rumensin, in addition to modifying the way in which the rumen works and making it more efficient, is also a coccidiostat. Coccidiosis, the disease which Rumensin controls, is usually seen as a black scour which develops about 1 month after calves are weaned. The organisms which canse coccidiosis are called coccidia, and they are carried in the intestines of all cattle. However, healthy strong calves are nsually resistant to this organism, and it is only when calves suffer stress at weaning that coccidiosis develops. Severely affected

calves lose weight rapidly and may die. Those that do not die remain in poor condition until the break of the season.

A third property of Rumensin is its ability to control intake of feed. It appears to be quite unpalatable to cattle and therefore it prevents gorging of feed by older or stronger animals at the expense of weaker ones.

The demonstration ran for 62 days. At the end of that time the calves on the ration containing Rumensin had gained 39 kg, while the calves on the ration without Rumensin had only gained 30 kg. There were no deaths in either group and gorging was reduced in the Rumensin group.

After the demonstration concluded, the calves were run together in a paddock on short, dry mitchell grass. Calves which had been fed Rumensin developed scouring with a few spots of blood present. This probably occurred because the coccidiostat effect of Rumensin suppressed the coccidia and prevented natural immunity from developing.

When the Rumensin was removed from their diet they were susceptible to the organism. This situation could probably have been avoided by gradually weaning the calves off the pellets, or by gradually introducing them to a molasses supplement containing Rumensin before turning them out of the yards and then gradually reducing the quantity of Rumensin in the molasses. This would have given the weaners the opportunity to develop their immunity to coccidia before removing the molasses supplement.

Recommendations

The following recommendations can be made about weaning calves under three months of age as a result of the Richmond demonstrations:

- Calves should be weaned while they are still in good body condition
- Segregate smaller or weaker calves and bigger or stronger calves and feed each group separately
- Begin feeding a high quality ration on the day that the calves are weaned. This reduces the stress of weaning
- Keep feeders up off the ground

Plate 2. Early weaned calves fed from homemade feeders designed to prevent spoiling and waste and increase hygiene.

- Calves can be fed every second day without ill effects
- Ensure clean water is always available
- Two-week-old calves should be fed a meal, rather than pellets, containing at least 18% crude protein. The protein should be in a highly digestible form, for example soybean or milk powder
- Calves four to 12 weeks old should be fed a ration containing at least 16% crude protein
- Rumensin can be added to the ration to control coccidiosis, but it may not be necessary if the calves are weaned before they begin to lose condition, if they go straight onto an appropriate high quality diet when weaned
- If prevention fails, scours can be treated with sulphonamide based products which are effective against coccidiosis.

If radical weaning is to be considered as a management practice during severe droughts, producers should be aware of the costs and husbandry practices involved in feeding calves under three months of age. They should also recognise that after the calves reach three months of age they will require further supplementation with a true protein supplement fed alone or with molasses.

The cost of feeding calves in these demonstrations until they reached three months of age varied from $26 to $30/head, a cost the producers involved considered very reasonable.

A sample of animals (steers and heifers) was recently weighed 396 days after the completion of the trial. No significant difference in liveweight was found between the two different ration groups, with steers and heifers gaining approximately 0.54 kg/head/day and 0.45 kg/head/day, respectively. At a further non-trial site, calves averaging 62 kg at weaning gained 0.35 kg/head/day over a 316 day period.

Producers in north-western Queensland who adopted radical weaning as a management strategy during the severe drought conditions of 1988 are more than happy with the premium prices that these store cattle are now attracting.

Early weaning improves breeder performance in north-western Queensland

B.M. Burns, and **M.T. Sullivan**, Beef Cattle Husbandry Branch

Plate 1. Early weaned calves less than 150 kg supplemented with cottonseed meal.

The highly seasonal rainfall in north-western Queensland is responsible for an annual period of decline in pasture quality and quantity in low fertile areas during winter. Drought conditions prevail on an annual basis from April/May to October/November. This period of poor nutrition is reflected in low breeder fertility, poor growth rates, high breeder death rates and low female cattle sales. Poor nutrition during lactation tends to suppress reproduction of Brahman and Brahman crossbred breeders. This condition is known as lactation anoestrus. British breed cattle can often die. Breeder performance can be improved by improving breeder body condition through weaning.

Traditionally, the practice in breeder management in north-western Queensland has been to wean calves to six to 10 months of age. Recently, weaning calves, at three to five months (100 to 150 kg), at the start of the dry season in April/May, and the peak of the dry season in August/September, has been recommended by beef cattle husbandry officers to overcome this period of nutritional stress in breeders. This strategy has been adopted by Evan Acton, who owns and manages a forest–downs country block at 'Millungera Station', Julia Creek. He sees it as a way to remove the lactation stress from his breeder herd, to increase conception rates at the first muster and to increase breeder survival at the second muster. Lower breeder death rates and the culling of sub-fertile and cast for age breeders increases his net property income. Further, the increased weaning rates allow him to transfer more weaner steers to his family's properties in the brigalow country for fattening as Japanese ox.

Plate 2. Early weaned non-lacting breeders maintain good body condition throughout the dry season.

The benefits of weaning calves down to three months at a minimum of two musters a year are: improved breeder condition, reduced breeder death rates, reduced drought stress, improved branding rates, increased cull female sales and hence increased net property income.

However, there is a cost to an early weaning management strategy. Early weaned calves must be fed a high quality supplement and sound husbandry practices must be employed for three to four months post-weaning to ensure the growth and survival of these young weaners. Evan Acton feeds these early weaned calves cottonseed meal at the rate of 0.5 kg/head/day twice weekly to ensure a daily liveweight gain of 200 g/day until the calves reach 150 kg liveweight, at which time they are depastured with the older weaners. For the initial 10 to 14 day period of weaner education, these calves are fed good quality Flinders grass hay at the rate of 1 kg/head/day, after which they are placed in a weaner paddock and further supplemented with cottonseed meal.

The benefits of an early weaning management strategy far outweigh the costs.

Custard apples: sweet taste of success?

G.M. Sanewski, Horticulture Branch and **S. Turner**, Marketing Services Branch

Why haven't custard apples grown into a multi-million dollar industry to rival apples and oranges?

They have been grown in Australia for over 100 years. At present, approximately 128,000 trees are planted, producing about 2000 t of fruit a year. Even at this relatively low level of production (as a comparison, there are about 300,000 t of apples produced in Australia every year), the custard apple market is easily oversupplied. That is, prices decline over the season to unprofitable levels.

A comprehensive market survey throughout Brisbane, Sydney and Melbourne was carried out by Marketing Services Branch and Horticulture Branch of QDPI to examine the custard apple industry and suggest some strategies for its development.

The ingredients for success

Successful horticultural products have several attributes in common. They are:

- convenient to use
- readily available
- appealing
- reasonably priced and economical to produce.

How do custard apples measure up? They measure up rather poorly in all departments except, perhaps, some aspects of appeal.

Appeal

Taste tests using people from a broad cross-section of locations in Australia indicated that 90% of people liked the taste of custard apples. However, while it appears appealing in taste, it does not seem appealing to the eye. Blemish was rated by over 50% of retailers and 58% of wholesalers in Brisbane, Sydney and Melbourne as the most serious impediment to increasing sales of custard apples. In Brisbane, 30% of consumers considered it the most serious problem.

Being realistic, custard apples blemish easily. Some major causes are:

- cold, windy sites
- limb rub
- rough handling
- incorrect storage
- pest and disease.

Some key strategies to avoid blemish are:

- avoid cold, windy sites
- use windbreaks
- don't hang fruit longer than necessary
- prune carefully
- pre-cool
- store correctly
- monitor regularly for insect activity
- mulch for disease control
- use grade standards consistently.

All these points are important.

In the long run, thicker-skinned cultivars with a greater tolerance to cool weather, better pruning methods and more efficient harvesting, storage and handling systems are needed. Some research towards this has already been completed. All this work is basic product development. The custard apple has potential to be a very appealing product. Let's look at some of the other necessary attributes for success.

Plate 1. Well-presented African Pride custard apples.

Convenience

Convenience of eating was not found to be a major problem although it is considered necessary to educate consumers on how best to store and prepare custard apples.

Availability

Production in Australia extends from March to September. This is a reasonably good spread. Newer hybrids and selections of cherimoya being tested may extend the season both earlier and later. The development of processed products is

Plate 2. Poor quality custard apples, which present poorly when displayed next to other uniform, highly coloured fruit.

another way of artificially extending the season.

Price

On average 30% of consumers interviewed thought custard apples were too expensive. In Brisbane where people were more familiar with the fruit, 50% said they were too expensive. In Sydney, and more so in Melbourne, price was of less concern. This can be explained by using the product life cycle concept shown in figure 2.

Every product goes through a well defined life cycle. This life cycle consists of an introduction phase, a growth phase, a maturity phase and finally a phase of decline. In the introduction phase, there is little competition and high prices are received. In the growth phase, there is increased demand, sustained or slightly lower prices and more competition. At some stage, the rate of sales growth slows down, and the product enters a stage of relative maturity. This stage is characterised by oversupply and price competition which often leads to lower prices.

The final stage is decline, where continued oversupply and price competition lead to a serious erosion of profits. The market study mentioned earlier suggests that the custard apple is in different stages of the product life cycle in different markets.

The following table demonstrates differing levels of market awareness and progression through the product life cycle.

In southern states, the fruit has more of an exotic image and hence price is of less concern. In fact, a high price helps promote the image. It must be emphasised that this is a small market. In Brisbane, custard apples are better known and considered more of a common consumption fruit. Price is therefore more important in Brisbane. Figure 1 shows the price and throughput trends for custard apples on the Brisbane wholesale market over the last seven years. Volume is increasing but price has levelled. Should volume continue to increase, without any new marketing initiatives, price can be expected to drop.

Plate 3. Examples of mild and severe chilling injury.

Market strategies

The domestic market

The market study identified the existence of a market segment which required high quality custard apples and was willing to pay a high price for them. With limited resources and limited quality product, it is probably best in the short-term for growers to form small groups and position their product as a speciality line for targeting the top end of the market. This requires top quality fruit. Strict quality standards would be necessary with a brand name so the product is easily identifiable for repeat purchasers.

These marketing groups should then target consumers who will pay for this special product. Examples are tourists, restaurants, consumers with a high disposable income and some segments of the south-east Asian population in Australia.

Plate 4. Russet from cold, dry winds.

Unfortunately, these market segments would initially absorb only small quantities of custard apples. In any case, only a small proportion of custard apples produced would be of sufficiently good quality, probably less than 100 t.

Markets need to be found for the remainder of production. Significant markets might exist for slightly blemished or misshapen fruit. This fruit,

while retaining the exotic image, could be positioned at a lower price. Market segments worth targeting initially would be the majority of south-east Asian communities in Australia and to a lesser extent older people in Brisbane. These market segments are already familiar with custard apples so less promotion is required.

To move into the 'average consumer' market segment would require more effort, especially in southern cities. It may be possible to educate these potential consumers that some blemish is 'okay'. Tastings should be an integral part of this promotion.

The market for processed custard apple products could be significant. As well as providing a return for previously unmarketable fruit, it also increases the availability of custard apple. Have you ever tried custard apple ice-cream? This and many other custard apple products will hit the shelves if current research and development in NSW is successful.

Export markets

The export of custard apples has been sporadic but significant. In most cases, only top quality fruit is required.

Table 2. Australian exports of custard apples for 1989

Country	Tonnes*
Singapore	17.12
Hong Kong	12.64
UAE	7.18
Kuwait	5.13
Philippines	0.68
Malaysia	0.43
Saudi Arabia	0.39
Bahrain	1.84
Miscellaneous	1.30
TOTAL	46.71 tonnes

* These are approximate tonnages compiled from figures supplied by the Victorian, New South Wales and Queensland Departments of Agriculture.

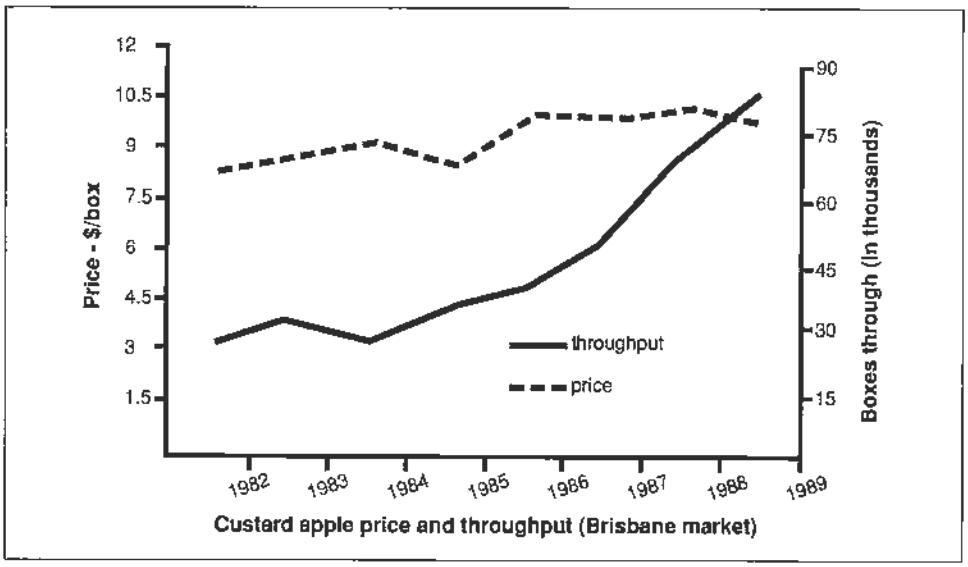


Figure 1. Custard apple price and throughput at the Brisbane wholesale market.

Table 1. Market awareness of custard apples

Knowledge of custard apples	Brisbane %	Sydney %	Melbourne %
Heard of custard apples	99	82	68
Tasted custard apples	93	47	43

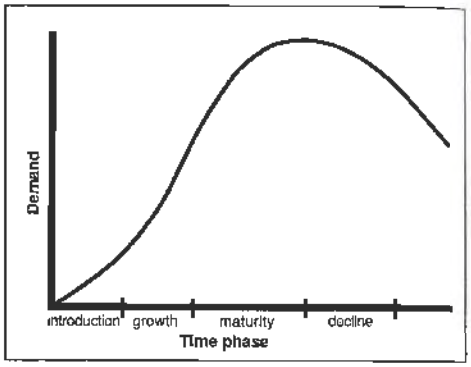


Figure 2. Product life cycle.

Experiences so far indicate the south-east Asian markets offer small scale potential, probably no more than 100 to 150 t.year. Nevertheless these markets can be worthwhile with more development.

The Japanese market, while currently inaccessible due to quarantine barriers, is considered a very high priced market. Development of disinfestation procedures is necessary to gain access.

Small consignments have been sent to Vancouver in past years. While returns were worthwhile, the long-term future of this market is in doubt. This is due to the closer trading ties being formed with the USA which introduce quarantine barriers for fruit from Australia.

A breakdown of the exports for 1989 is shown in table 2. A thorough study of potential markets, including the European market, is warranted.

The adoption of market strategies will go a long way towards organising the industry. In the long run, however, many of the cultural practices used to grow this crop need to be reviewed. The objective is to maximise the production of top quality fruit at low cost and little difficulty. This includes transport and storage technology becoming a top priority. Growing systems also need to be revised.

Instant successes don't just happen in the horticultural world. There are good reasons why crops fail to develop into large industries. Custard apples have a long way to go, but already the seeds for success are growing.

Where wheat is made

G. Scott, Queensland Wheat Research Institute

Plate 1. Ruth Dill-Mackay, pathologist, prepares a barley plant for cross-breeding

Many people think of Toowoomba as a city of gardens, a cool comfortable haven for retirement after a hard life on the hot dry land. Such it is, but it is also a considerable centre for education and agricultural research.

Sitting atop the Great Dividing Range, 130 km west of Brisbane, it services both the Lockyer Valley and the rich agricultural Darling Downs to the west. Because of its location it is well suited to accommodate the Queensland Wheat Research Institute (QWRI).

QWRI is the centre for research about wheat and the problems about wheat growing in Queensland. It was started by and is still largely funded by the Wheat Research Committee for Queensland, representing the wheat growers themselves. Other sources of funding are the Australian Wheat Research Council, the Barley Research Committee for Queensland, the Australian Barley Research Council and the National Soil Conservation Program.

High on the list of priorities at QWRI is the development of new wheat varieties suited for the subtropical climates of Queensland and northern New South Wales. Variety names such as Oxley, Cook, Banks, Flinders, Hartog, Torres, Bass, King, Vasco and Diaz are familiar to anyone involved with agriculture; all of these, plus 1989 releases, Janz and Perouse, were developed by the wheat breeding team at QWRI.

The need for new varieties arises because diseases and other growth problems are constantly changing. Varieties are bred to resist these problems and maintain the value of the wheat industry. Farmers are always eager to have higher yielding varieties that will help in their battle against rising costs.

These and many other issues are studied by 22 scientists supported by skilled technical and field staff.

Besides variety improvement, areas of study include pathology, microbiology, soil fertility management, crop nutrition, weeds, water and erosion control and grain quality assessment. These activities are well supported by an excellent analytical laboratory. Although still called the Wheat Research Institute, quite a lot of work concerns barley, the other major winter crop in Queensland. Barley quality and pathology are especially important areas of research, and this work is done in close collaboration with the barley breeders at Hermitage Research Station, Warwick. In addition, much of the work on weeds, soil fertility and erosion benefits other crops.

Because many problems in agriculture are complex, cooperation between scientists is the key to success in solving them. Producing a new wheat variety, for example, requires cooperation between breeders (geneticists), cereal chemists and plant pathologists.

Also, recommendations for solving one problem may conflict with those for dealing with another. For example, fungal infections on leaves can be controlled by burning off, but if the stubble cover is removed, its value in controlling soil erosion is lost. Conservation tillage procedures enhance water retention and erosion control, but create problems in weed control.

Soil fertility restoration

The heavy black earths of the Darling Downs have been used continually by farmers for up to a century now. The rich soil once produced grain with 15% protein — now they can only give 11 to 12%. The nitrogen and other elements essential to produce top quality grain are no longer abundant in the overworked soil.

A soil fertility restoration program has been running at Warra, west of Dalby, for four years. Pasture leys, legume crop rotations and fertiliser trails are all giving results and recommendations that are relayed to farmers at popular field days.

Conservation tillage

Water is the scarcest nutrient in Australian farming soils. Various conservation tillage practices have shown to have important effects in storing soil water and recycling nutrients in the soil.

Soil microbiology

Root lesion nematodes (and fungi that can catch them), long fallow disorder and trace element nutrition occupy the attention of the soil microbiologists. So too, do the friendly VAM fungi which are important in the nutrition of many plant families, including cereals. It is surprising how many plants depend on special fungi that live in their roots and extend out into the soil, bringing scarce but essential chemicals into the plants.

Foliar diseases

The ravages of foliar diseases can be spectacular. Since it is impossible to prevent the highly coloured but devastating effects of airborne fungal diseases, the team tries to keep ahead of new fungal types by breeding resistant wheat and barley varieties.

Wheat-breeding

The wheat-breeding group prepares new crosses from selected parents. New lines are carefully nurtured from small grain samples, grown and tested in the large glasshouse complex and in nearby field trials. Eventually a few select lines are tested in trials across the wheat belt and one or two may be released as commercial varieties.

Everything can be lost in field trials if rain does not fall, or if too much rain comes at the wrong time — or the local birds home in on a ripe crop early one morning. Some ingenious devices are used to overcome these threats.

Enormous bird-cages cover hectares of trial grounds at QWRI. Inside some of them are huge plastic 'rain-out' shelters, used to prevent unwanted rain damaging the crop. There is also a truck and trailer which can carry a large, portable 'rainulator' to provide controlled, simulated rainfall wherever it is needed.

Machinery and equipment are housed, cared-for and modified as needed by a support team of field workers.

Some extremely sophisticated and sensitive equipment is to be found in the Analytical Chemistry section. It is used by a team of expert technicians for testing soil and whole plant materials.

The Cereal Chemistry section is especially equipped to deal with grain quality. Flour from the breeders wheat lines is produced by a test mill and rigorously tested for its suitability for making bread and noodles, the end-product of much of Queensland's wheat crop.

Barley samples from Hermitage Research Station are also examined, in particular for malting quality. Sad to say, QWRI has not yet acquired a test brewery!

Plate 2. 'Bird-out' cage and the new 'rain-out' shelter inside it at QWRI.

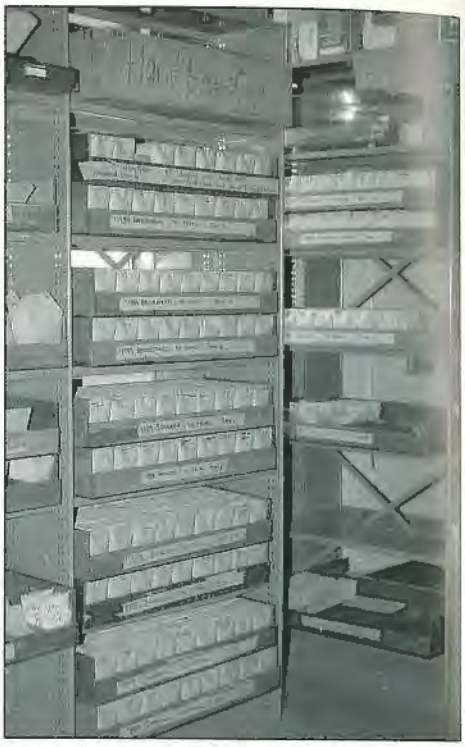


Plate 3. Part of the seed store for cross-breeding.

Developing new breeds of wheat to suit new market needs has led to interaction with Asian and Middle Eastern countries in recent years, with exchange visits by QWRI staff and Asian agricultural scientists.

Visiting scientists are always present — the common room is a miniature United Nations. Last year most visitors were Chinese, Canadian or American. This year Indian visitors predominate, due to the large international project on zinc deficiencies in vertisols, sponsored by the Australian Centre for International Agricultural Research.

QWRI not only has a good mixture of nationalities but also has a goodly proportion of females on the staff. Three are in the highly efficient front office. while three research scientists, several of the leading technicians, the librarian and information officer are women.

All up, the staff at QWRI are an harmonious and successful group led with care by director, Allan Clarke.

Toorak Research Station

A.R. Bird, Sheep & Wool Branch

Plate 1. Dry winter pasture at Toorak Research Station.

The Toorak Research Station was established by the State Government in 1951 to research sheep production problems in the region.

The station comprises 15 000 ha of open Mitchell grassland characteristic of the vast clay soil plains of the semi-arid north and central west.

It is situated approximately 50 km south of Julia Creek and has an average annual rainfall of 400 mm. Droughts are common. Sheep numbers in the north-west fluctuate greatly as a result of the extreme variation in seasonal conditions. Currently there are 1.5 million sheep in the north-west region — 10% of Queensland's sheep population.

During the last three decades, research has been conducted at Toorak to define factors which limit sheep and wool production in this harsh environment. Sound, practical husbandry recommendations that can overcome these limitations benefit sheep producers both locally and nationally.

Current research aims to improve nutrition and management of sheep flocks.

Examples of research projects

Improving sheep nutrition

- Improving the way sheep digest feed in the dry season and increasing the amount of nutrition they gain from supplements.

Increasing lamb survival

- Identifying those wet season herbs which, when grazed by the ewe, have a harmful effect on her foetus. Attempts are being made to isolate the responsible substances (foetotoxins) contained in the plants(s) and identify practical management strategies to minimise the effect of these toxic plants on lamb survival.

Improving pasture

- Native pasture quality and grazing animal production is improved by introducing exotic perennial legumes. Many plant species are being evaluated, including those of the genus *Desmanthus* which are important fodder plants in other parts of the world, for their ability to survive, grow and reproduce in harsh climates. Leguminous plants successfully incorporated in the native pasture will enhance its nutritive value for sheep as well as the fertility of the soil.

Plate 2. Jetting ewes.

Increasing production

- Demonstration flocks are used to evaluate sheep management guidelines resulting from this work. For example, providing shade for pregnant ewes and access to drinking water for young lambs has been shown to improve lamb survival and hence profitability of a breeding enterprise. Early results from the ewe demonstration flock show that much higher levels of productivity can be achieved by adopting basic practical recommendations, found through research.

In addition to its main research role, the station is an important resource base for this remote area of the State. Staff presently number 12, half directly involved in research or extension activities and the remainder involved in the management and upkeep of the station. These people extend new technology and provide advice and assistance to local graziers through field days, scientific publications, rural press and radio.

How to identify and control mung bean pests

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Plate 1. Heliothis larvae.

Plate 2. Bean podborer larvae.

Many insect pests are found in mung bean crops in Queensland. The most serious are the larvae of heliothis, the larvae of the bean podborer and the sapsucking bugs (brown bean bug, green vegetable bug and pod sucking bug).

These insects reduce yield and quality by damaging flowers, pods and seeds, and control is necessary to produce high quality seed.

Heliothis larvae (*Helicoverpa* spp.) feed on leaves (plate 1) and terminal buds as well as developing seeds. During the first month of emergence, feeding on the terminal buds will cause the plant to branch from the axillary buds, but these will grow and yield normally if soil moisture levels are high and plants are able to make compensating growth. However, if the terminal buds are attacked after the first month, only small stunted branches will grow and the pods produced will lie too close to the ground to be harvested. Heliothis larvae will also eat flowers, effectively preventing pod set, or feed on the developing seeds. More importantly, holes chewed in the pods expose uneaten seeds to the weather. During rainy periods, germination may occur, or fungal and bacterial pathogens may infect damaged pods and destroy the remaining seeds.

Plate 3. Pod sucking bug

Larvae of the bean podborer (*Maruca testularis* plate 2) bore into unopened flower buds, leaving a 'pin hole' in the petals as the only external evidence of infestation. They feed on the developing seed pod within the buds and require nourishment from several flower clusters for full development. As the larvae move between flowers and developing pods, they bind them together with frass-covered webbing.

Controlling both heliothis and bean podborer larvae in flowers is essential for pod set.

The adults and nymphs of pod sucking bugs, (*Riptortus serripes*, plate 3), brown bean bug (*Mirperus scutellaris*, plate 4), redbanded shield bug (*Piezodorus hybneri*) and green vegetable bug (*Nezara viridula*, plate 5), feed by piercing and sucking the developing bean seeds. This causes young seeds to abort and partly grown seeds to shrivel. Fully expanded seeds show discoloration surrounding the depressed puncture point.

As the value of mung bean seed depends on quality, especially its ability to sprout evenly with high percentage germination, bug control is important.

Plate 4. Brown bean bug.

Plate 5 (top left). Green vegetable bug.

Plate 6 (top right). Soybean moth.

Plate 7 (centre). Soybean looper.

Plate 8. Cluster caterpillar

Plate 9. Green mirrid.

Other pests

Bean fly (*Ophiomyia phaseoli*) is usually a minor pest of mung beans. It is rarely seen in spring planted crops inland, hut can appear in summer planted crops where successive plantings of susceptible crops have allowed large populations to build up in an area. Female bean flies lay very small eggs into the upper side of the leaf. The oviposition sites are marked by small, light-coloured punctures. A severe attack on young plants may cause them to wilt and die. After hatching, larvae tunnel down into the stem and, on older plants, the surface of the stem may split open near ground level. Yield and vigour of the plant is reduced and affected plants are susceptible to lodging (falling over) and mecbanical damage, exaggerated by wind. This is rare and damage is usually restricted to scarring. Although this has been a minor pest in inland areas, it has been found to be a major pest overseas and may need to be controlled if mung beans are grown in the coastal areas of Queensland.

Bean blossom thrips (*Megalurothrips usitatis*) and jassids (*Austroasca viridigrisea*) attack seedlings. Both cause white stippling of the leaves. Thrips rasp the leaf surface and lap tbe exuding plant sap while jassids (or leafhoppers) pierce and suck sap. As seedlings grow, they become less susceptable to attack. Thrips also feed within flowers and can cause severe twisting of the pods and scarring of the pod surface. Such damage is of no economic concern.

The larvae of soybean moth (*Stomopteryx simplexella* plate 6), roll leaves to form a shelter from within which they feed on the leaf surfaces. Although this reduces the photosynthetic area of the plant, it is rare for populations to build up to levels that significantly affect plant growth.

Larvae of the soybean looper (*Diachrysia orichalcea*, plate 7) and cluster caterpillar (*Spodoptera litura*, plate 8) are occasionally found on foliage but it is unusual for populations to become large enough to cause economic damage.

A number of species of small bugs may be found in mung bean crops, the most common being Rutherglen bug (*Nysius vinitor*), green mirid (*Creontiades sp.*, plate 8 and apple dimpling bug (*Campylomma livida*,). The Rutherglen bug is a plant feeder but the others may be both plant feeders and predators of other pests. A research program is presently being conducted at Biloela Research Station to investigate the relationship between these bugs. The damsel bug (*Tropiconabis nigrolineatus*) and the bigeyed bug (*Geocoris lubra*) are both predatory on small insects and should be regarded as beneficial.

Ladybirds (*Micraspis frenata*), commonly called the stiped ladybird, can occur in large numbers are are usually seen feeding at the nectaries. They are predators of other insects such as aphids and do not canse damage to crops.

Control

Heliothis is a major pest of several field crops in Queensland and an insecticide strategy, designed to slow the development of insecticide resistance in heliothis populations, needs to be observed when control is being considered.

Crop monitoring

Sampling methods and economic injury levels have not been determined for mung beans. The following procedures, used for navy beans and soybeans, can be used as a guide.

Mung bean crops should be inspected weekly while in vegetative growth and twice weekly from flowering to completion of pod fill, so that informed judgement of whetber to spray or not can be reached.

Vegetative stage

Seedlings should be inspected for heliothis or thrips damage to terminals. If most plants show leaf distortion from thrips damage and early crop growth is slow due to cool conditions, a spray will boost early growth. If more than 25% of terminals show heliothis damage, an insecticide should be applied.

Flowering and pod-fill stages

During the flowering and pod-fill stages, 5 m lengths of row at six locations, widely spaced throughout the crop, should be examined. Insecticide application should be made if heliothis numbers average more than 2/m, or bean pod borer larvae average more than 3/m.

Sapsucking bugs can be sampled by shaking plants onto a white sheet, such as an opened up fertiliser bag. Examine 5 m lengths of row at six widely spaced locations throughout the crop, at least twice weekly from early flowering until the completion of pod-fill. Many species of bugs move to the top of the canopy and bask in the sunlight between 7 and 9 a.m. and are more easily seen and dislodged at that time. If bug numbers average 1/5 m of row, spraying is warranted.

Table 1. Chemicals recommended.

Pest	Chemical control
heliothis	endosulfan, methomyl, thiodicarb, deltamethrin and synthetic pyrethroids, in accordance with the pyrethroid strategy. (Growers are referred to QDPI farm note *Summer crop insecticide management strategy* EN 8904002)
bean podborer	methomyl
soybean looper	endosulfan, deltamethrin
pod sucking bug	endosulfan
brown bean bug	endosulfan
redbanded shield bug	endosulfan
green vegetable bug	endosulfan
thrips	dimethoate

Research for Queensland's 'wet belt'

W. Mellor, Technical Services, South Johnstone Research Station

The South Johnstone Research Station (SJRS) near Innisfail is one of Australia's few agricultural research centres in a humid, tropical, lowland environment. The station's research is directly applicable to some 800 000 ha of coastal lowlands between Bambaroo and Cape Tribulation (15-19°S). Indirectly, the work is applicable to other warm, humid areas of Queensland, the Northern Territory and tropical countries overseas.

The station services Queensland's 'wet belt', areas with average annual rainfalls from 1500 to 4000 mm, falling mostly between December and May. However, for significant periods between August and January, plants are stressed by too little water and so high-value crops are often irrigated. Temperatures seldom drop to frost level, but cold stress can still sometimes affect sensitive crops and pastures.

South Johnstone's research history goes back to 1917, when it was established for sugar cane experimentation. However, the northern headquarters for such work was moved to Meringa near Cairns in 1934, and over the succeeding decades sugar research at South Johnstone dwindled. No cane has been grown here since the 1950s. Since 1935, firstly as the Bureau of Tropical Agriculture, then the Tropical Agriculture Research Station (1962 to 1969) and now as the SJRS, many plants have been introduced and grown, including fruits, oil, root, medicinal, beverage, grain and fibre crops, as well as thousands of pasture plants.

Headquarters and major facilities for the 17 full-time staff are on a 49 ha site bordering the South Johnstone River, and two there are sub-stations. One of 267 ha is at Utchee Creek where much of the world famous grazing trial work of the past four decades has been conducted. The other is smaller (11 ha), on naturally infertile and poorly drained soil near Silkwood and used only for small plot work.

Research associated with fattening beef cattle on tropical pastures has been a consistent major activity at South Johnstone for over 50 years. This reflects an appreciation of the potential productivity (recently estimated at up to 400 000 head annual turnoff) of the climatically favoured and strategically situated beef industry of this region. The present research program is giving emphasis to the integration of all available information on climate, soils, plants and animals to develop more profitable and stable farm production systems. Special priority areas include research into more precise fertiliser programs, pasture systems that require lower management requirements and better pasture species for poorly drained land.

Horticultural research has expanded significant over recent years. This growth is partly due to development of the $100 m banana industry (1989) and partly in an attempt to provide further diversification options for the periodically embattled sugar cane industry. Work on bananas includes improving production methods, evaluating imported varieties for agronomic suitability and resistance to some serious diseases (e.g. Black Sigatoka, Panama Disease Race 4), screening new fungicides for controlling leafspot, developing integrated pest management programs (e.g. for scab moth, weevil borer and spider mites) and researching maturity bronzing, a fruit disorder.

Exotic tropical fruits are becoming important with increasing numbers of producers in the area, and variety evaluation trials on three of the most promising ones (rambutan, durian and longan) have been established.

Plantation beverage crops are also researched. Tea has been grown on the station since 1936, and recent expansions in the commercial industry (both near the coast and on the nearby Atherton Tableland) have led to renewed interest in clonal selection. Coffee cultivars Arabica and Robusta are being evaluated for suitability for mechanical harvesting.

Soil erosion is a major concern on the sloping cultivation land in this high rainfall area. Research on local cane farms has proven that changing to minimum or zero till farming systems which involve green cane harvesting can dramatically reduce soil erosion. A soil conservation advisory service operates from the station.

Land resource assessment of 600 000 ha of the wet tropical coast is based at SJRS. This assessment involves describing and mapping all the different soil – land form types, using air photographs and field survey information. This phase is being carried out in collaboration with the CSIRO Division of Soils. It also involves determining the suitability classification of each map unit for all appropriate land uses. Some 25 land uses encompassing arable crops, horticultural tree crops and grazing have been classified.

South Johnstone's environment is somewhat unique in Australia. Because of the quality and sometimes pioneering nature of their research, officers based here have often achieved international recognition with agricultural research and teaching institutions. Our specialists are often called upon for consultancy and training at home and abroad — a significant feature of the stations' activity.

Hermitage Research Station

R.N. Amos, Technical Services Branch

Plate 1. Breeding sorghum in a glasshouse.

Introduction

Hermitage Research station has made many major contributions to commercial agriculture in south-east Queensland by improving varieties of the major crops grown in the region and evaluating new techniques in crop and animal production.

Established in 1897, when the large selections of the first European settlers were being subdivided for closer settlement, Hermitage is one of the oldest research stations in Queensland.

Situated six kilometres east of Warwick, Hermitage occupies 228 ha on the west bank of Swan Creek, a tributary of the Condamine, on the eastern Darling Downs. The station carries out plant breeding as well as agronomic and animal studies relevant to commercial farming on the Darling Downs and adjacent regions, one of the most fertile and productive areas in Australia.

With an average annual rainfall of 725mm and a normal distribution of high summer rainfall with frequent storms, moderate spring rain, and relatively dry autumn and winter, the region is a major production area for winter and summer grain crops. Dairying is still important on the eastern Downs, and beef production (both free-range and feedlot) is a major income earner. Pig raising, wool and prime lamb production, apiculture, and a developing cashmere industry are also suited to this diverse and rich agricultural region. Wide seasonal temperature variations are experienced at Hermitage, from a high of 38°C in January to a low of –4°C in July. Frequent frosts occur between late April and mid-October, and the grass temperature can sink to –10°C. This general pattern is common to the Downs and crop varieties and production techniques have to be tailored to suit the conditions.

History and development

Discovery and exploration of the Darling Downs by Allan Cunningham during 1827–28 led to settlement by graziers from the colony of New South Wales, initially by the Leslie brothers. They established 'Toolburra', the first sheep station in Queensland in 1840, and subsequently the historic 'Canning Downs' station near the present town of Warwick, which is celebrating 150 years of European settlement in Queensland next year.

Other squatters soon followed and selected large pastoral holdings, however from around 1870 these were resumed by the Government and subdivided for closer settlement. The State Farm, as it was then called, comprised part of Canning Downs Station and was established to provide information for farmers on these new subdivisions. During this early period a variety of experimental work was conducted on a wide range of crops and livestock enterprises.

During the Depression years, the State Farm was leased for commercial use but in 1946 the lease was terminated and the farm resumed operations, as a Regional Experiment Station with wheat breeding as a major activity. This work, initiated by the late R.E. Soutter who developed Queensland's early commercial varieties, was transferred to Hermitage under the guidance of David Rosser until the establishment of the Queensland Wheat Rersearch Institute at Toowoomba in 1962.

Station staff in 1946 comprised the station manager, three technical officers and two farmhands. The number of

Plate 2. Harvesting wheat trial plots in 1955.

permanent staff at the station has now grown to 40; 11 graduate officers, 17 technicians, nine farm staff and three administrative personnel.

Initially trials were established with the smallest available seed combine or a range of hand planters. Harvesting was done with a commercial header which was impossible to thoroughly clean and resulted in considerable mixing of seed between plots. Nursery rows were harvested by hand.

From 1965 a range of hand planters and harvesting equipment became available, some commercially manufactured and others developed by station staff. This equipment made possible comparatively fast and accurate planting and harvest of trial plots and from about 1970 onwards this machinery was also transported to various properties in the region to replicate station trials, improving the accuracy and relevance of the results.

The steady improvement in specialised equipment for plot planting and harvesting, and in the transport units, has produced a dramatic expansion in the number and extent of off-station trials. This ability to plant trials with large numbers of entries at wide ranging sites throughout the region has greatly increased both the quantity and quality of data obtained from the research programme, and the advent of computers has facilitated the collation and analysis of this data. The result is an ability to carry out thorough and reliable testing of very large numbers of trial entries over a wide range of representative sites.

Research programme

Plant breeding and testing has always been a major component of the research programme at Hermitage and the station has made many significant contributions to primary production by developing improved varieties of commercial crops.

Sorghum breeding

Sorghum breeding began in 1958 and concentrated on identifying superior hybrids from American parent material and marketing them through the seed certification scheme. Between 1962 and 1972, eight major commercial hybrids were released. More recently the breeders have concentrated on developing improved parental lines for release to the seed industry, allowing improved commercial hybrids to be provided. The 39 parental lines developed since 1972 have included varieties with resistance to sugarcane mosaic virus, smut and midge. These parents have been released for use by commercial seed producers and have produced many of the improved hybrid grain sorghums grown by Downs producers today. A late-maturing hybrid forage sorghum variety produced from Hermitage bred parents produces green feed over a much longer period.

Barley breeding

The barley breeding programme, established in 1973, has contributed to the rapid expansion of barley production in Queensland. The feed variety Corvette, released in 1973, was widely accepted; and Grimmett, a malting quality variety released in 1976 has become the main commercial variety in Queensland. A new malting variety with improved yield and disease resistance is currently undergoing major seed increase and will

Plate 3. Harvesting barley trial plots in 1989.

be available for planting by farmers in 1991.

Barley agronomy

Other aspects of the barley research programme include studies on planting much earlier than the traditional sowing time and investigations into the effect of climate and soil variability on the development of particular varieties. The programme is also studying growth patterns of barley varieties to prepare computer model predictions. These models will help growers select varieties and management practices.

Soybean breeding

Soybean breeding began at Hermitage in 1970 and the early work resulted in the release of locally-adapted high yielding American varieties. Subsequently eight new varieties have been released from Hermitage: Collee, Flegler, Canopolis, Nessen, Dragon, Centaur, Triton and Manark. The initial aim was to produce well-adapted, high yielding varieties with good height and resistance to lodging, shattering and leaf diseases. With the advent of phytophthora root rot in 1980, emphasis is now placed on producing varieties which are immune or resistant to this disease and results to date indicate a steady advance in yield increase as well as improvements in resistance to phytophthora, shattering and lodging.

Sunflower breeding

The development of a Queensland sunflower oilseed industry led to the establishment of a breeding programme at Hermitage in 1970, based mostly on high oil content Russian introductions. Since then germplasm has been introduced from South Africa, Argentina, Europe and America. The breeding programme has released germplasm resistant to present races of rust, with improved resistance to blight, and lines which are 10% higher in linoleic acid content and suitable for polyunsaturated oil and margarine.

Navybean breeding

Navybean breeding began in 1982 with final yield assessment of lines developed in the 1970s and the assembly of a germplasm collection which now totals over 2000 entries. The systematic evaluation of this collection has provided material for both culinary and navybean trials, and parents for crosses to develop lines with improved yield, height and disease resistance.

New crops

The experimental programme has always included introductory trials and varietal screening of potential new crops for the region. Recent introductions tested at Hermitage include chickpea, sesame, guar, lupin, pigeonpea, fenugreek and amaranthus. Hermitage played a major role in assessing the potential of chickpea on the Darling Downs and its subsequent development as a significant commercial crop in the region.

Weed control

The weed control research programme conducted from Hermitage aims to minimise losses in cropping systems in the region. Major contributions include detailed investigations on the use of residual herbicides in conservation cropping systems and evaluation of herbicides for use in minor crops and for limited weed problems.

Pasture research

The station has participated in varietal assessment programmes for grasses and pasture legumes which provide information to help farmers select pasture mixtures. Since the early 1970s, Hermitage has conducted a major evaluation of annual medics as a winter grazing legume and a source of soil nitrogen, highlighting the value of legume-based pasture in cropping rotation.

Animal studies

The Hermitage research programme has always included an animal studies component. During the 1970s, the use of economic criteria for the selection of pig herd replacements was demonstrated, resulting in wide acceptance by the local industry, and a valuable store of data was compiled on the use of forage crops and supplements in feedlotting of cattle and sheep. More recently animal research has focussed on increasing prime lamb production efficiency and fine fibre production in cashmere goats.

Weather recording

A weather station has operated continuously at Hermitage since 1946. As well as supplying daily readings to the Bureau of Meteorology as part of its statewide recording network, the climate data is useful to station research staff as it is a major factor affecting plant growth. Computers have greatly simplified and accelerated the collection, collation and analysis of experimental data.

Other activities

An experimentral solar collector and rock beat-storage bank has demonstrated a potential use for cheaper glasshouse heating.

Extension and Industry liaison

Regular meetings of the Industry Consultative Committee, made up of senior research staff and representatives from the major primary industries in the region, ensures that the research programme remains relevant to industry needs.

Extension activities include field days, collaboration on varietal planting recommendations, talks to growers, show exhibits and a range of presentations on radio, television, and in rural press and scientific journals.

School groups visit the station to learn about agricultural research. Hermitage also helps train college and university students in plant breeding and testing.

Regular seminars at Hermitage feature speakers from station staff, as well as visiting Australian and overseas scientists.