Queensland
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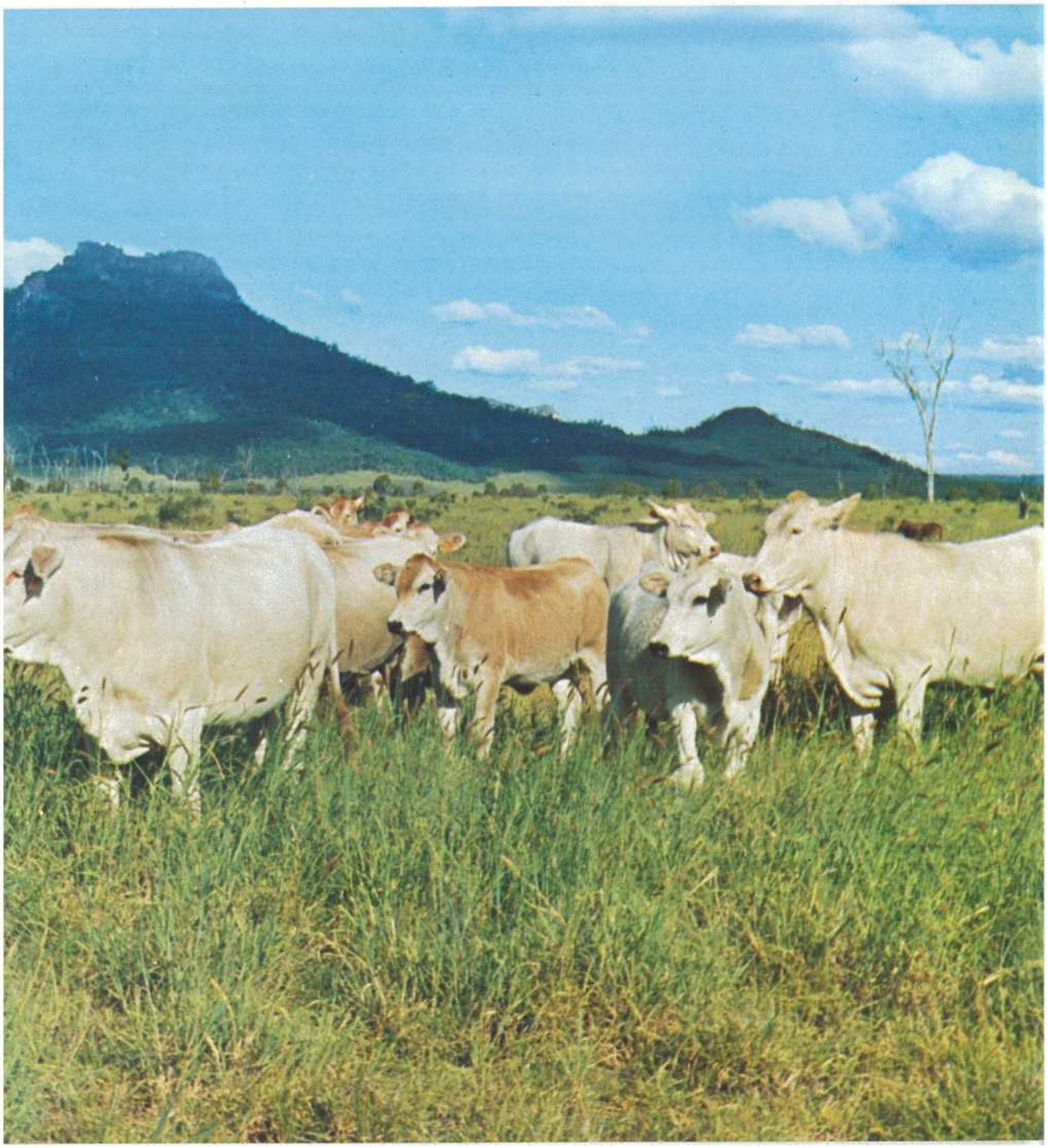

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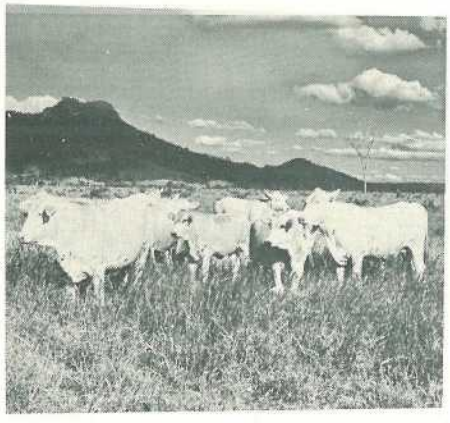

COVER: Chianina cross (Hereford X Brahman) with three-quarters Chianina calves on W. J. Peart's property 'Sunnyholt' in the Arcadia Valley, Injune.

QUEENSLAND AGRICULTURAL JOURNAL

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Contents

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Revolution in spaying cattle

by J. C. BIGGERS, Veterinary Services Branch.

THE development of new instruments and improved crushes shows promise of reducing the cost and improving the efficiency and safety of spaying cattle.

It should be possible for most stockowners to spay their own cattle more easily with a little tuition.

The depression in the beef industry has led to increased stock numbers and highlighted the need for controlled breeding. Spaying of surplus and cull cows has long been part of controlled breeding programmes.

However, not many cattlemen are skilled in spaying. Also, the currently used spaying instruments are expensive and awkward to use.

The stage when any stockowner can spay his own cattle has nearly been reached. Promising developments in new spaying instruments and the use of new squeeze crush designs could make this possible.

The new developments

Auto flank knife

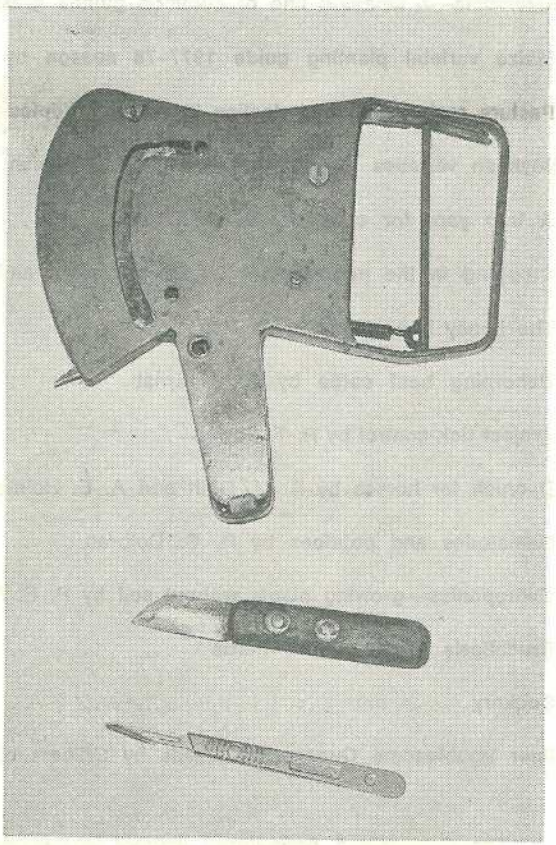
The idea of an automatic incision knife to be used in one hand and operated by pressing a button which releases a pre-set surgical blade to instantly cut through the flank of an animal was originated by the author who is responsible for field testing.

The design and development of the instrument is being undertaken by L. G. and C. A. Toms, Fabricating Engineers of Toogoolawah.

The prototype at the time of writing has been used on over 1 500 cattle during a 10 month period. It has been used by about 60 stockowners and others learning to spay at D.P.I. spaying schools in the Brisbane Valley.

ADVANTAGES

- The instrument allows inexperienced people to confidently make a precise depth of cut and a precise length incision in the **shortest possible time.**

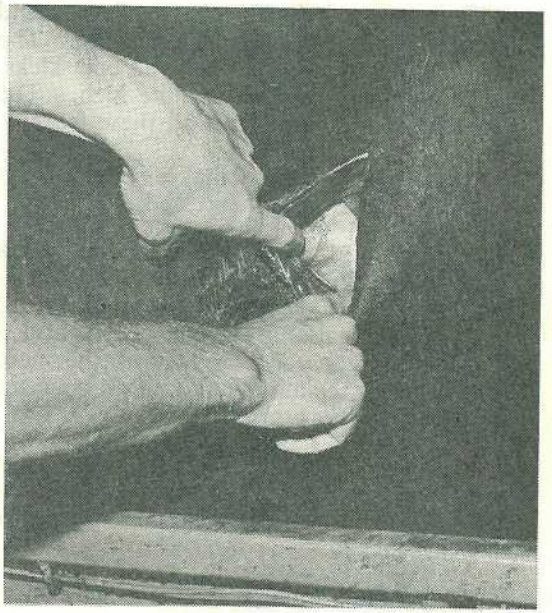


The prototype auto flank knife (top) is shown with its surgical blade projecting after releasing action. The other two knives (bottom) are typical of those currently in use.

This reduces the stress on both the operator and the beast. The clean cut once sutured heals more quickly.

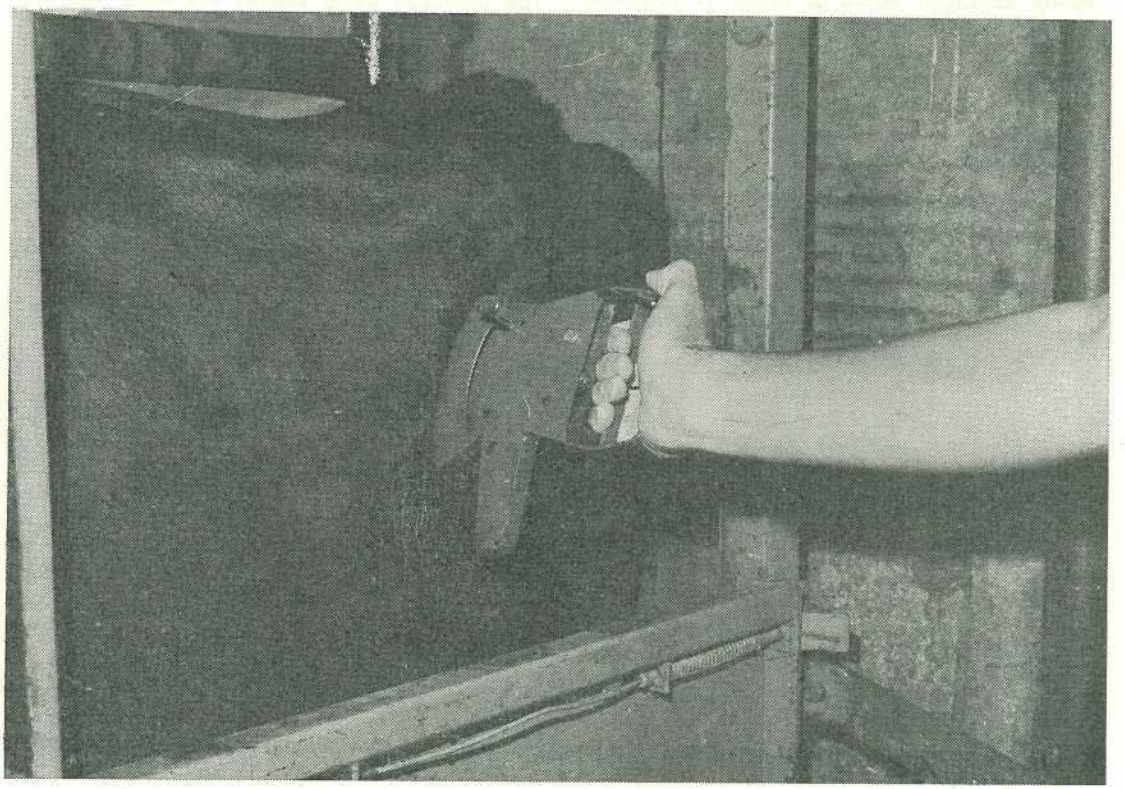
- It eliminates operators' fears of either cutting too shallow, too deep, too short, too long, cutting inaccurately because the cow moves or cutting themselves.

The present method of placing either the scalpel blade and handle or pocket knife or spaying knife between the operator's fingers is the only guide to the depth of cut.



Right. The clean incision opened up with the fingers showing the internal oblique muscle completely parted exposing the peritoneum which is then punctured with the fingers.

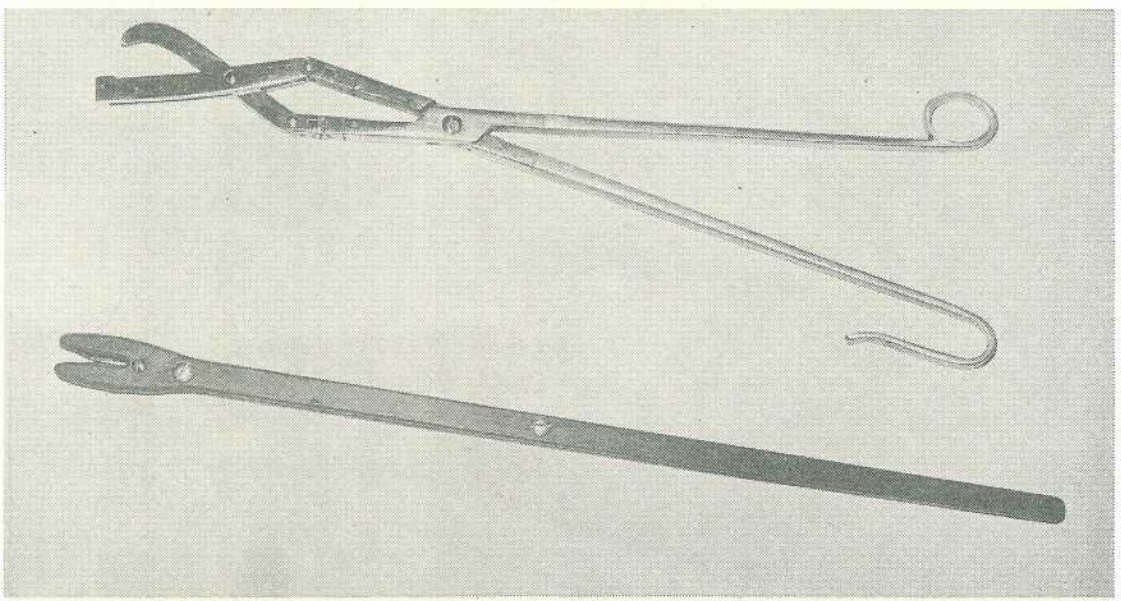
Below. The auto flank knife in position ready to use. This flank position is important so that the knife cuts through the skin, the abdominal tunic of the external oblique and splits the internal oblique muscle in the natural direction of its fibres.



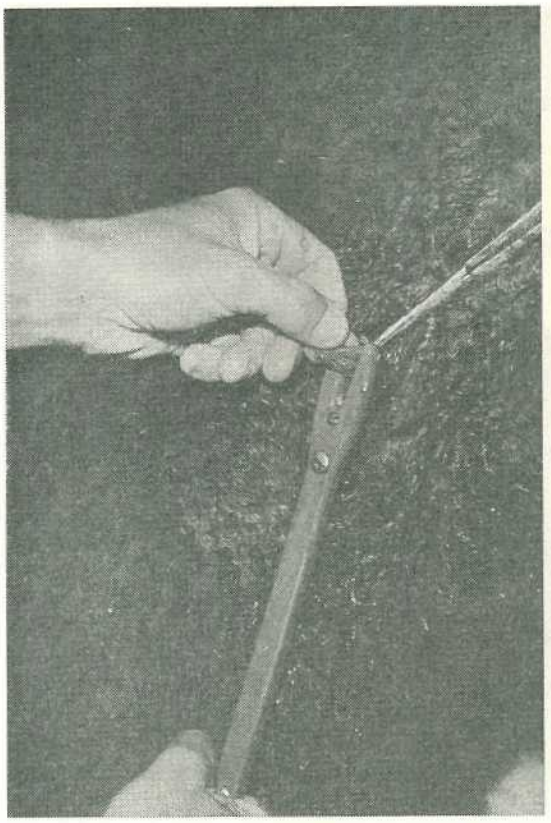
The operator's hands are usually wet and slippery from disinfectants or soap. The risk of being seriously cut if the cow kicks, reefs or falls in the bail is quite high. The auto flank knife eliminates all these fears.

- The auto flank knife makes the incision instantly the trigger is pressed.
- Spaying speed is increased as the auto flank knife is held in one hand only. This allows the operator to keep his entry arm away from contamination. Once his entry arm is thoroughly cleansed, there is no further need to re-wash as the auto flank knife is operated by the non-entry arm.
- The operator can stand a full arm's length from the flank of the cow while using the auto flank knife. This eliminates the risk of being kicked.
- The auto flank knife is compact and simply operated.
- The surgical sterile no. 11 scalpel blade is easily replaced when a blade is required. One blade will usually do 50 or more cattle.
- The auto flank knife will be made from a heavy, durable plastic capable of being sterilized.

The operation being carried out using the ovary extractor.



A prototype bovine ovary extractor (bottom) shown with a pair of conventional spaying scissors currently being used in the industry.

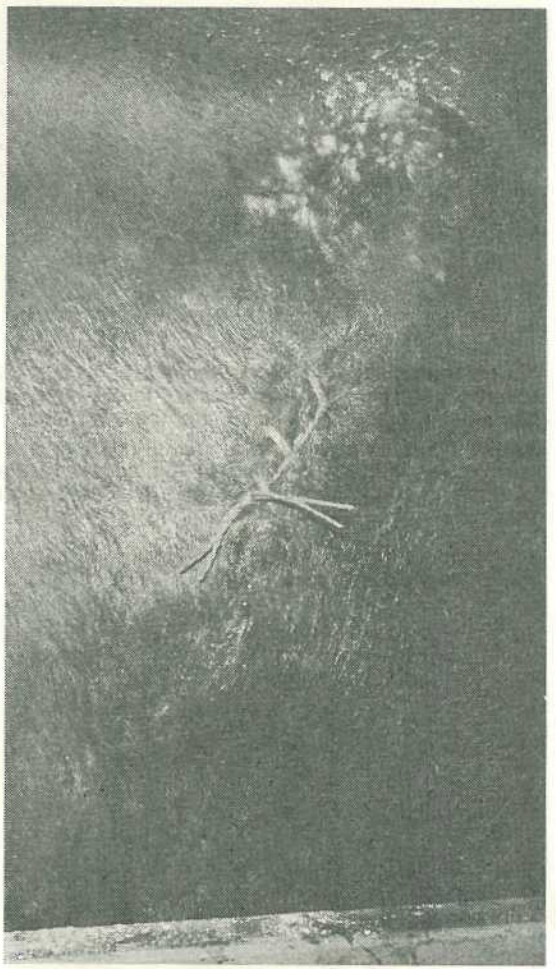


To demonstrate the action of the ovary extractor, an ovary has been pulled outside the animal with the aid of forceps. The ovary is held in the left hand and is pushed into the blades in the mouth of the ovary extractor.

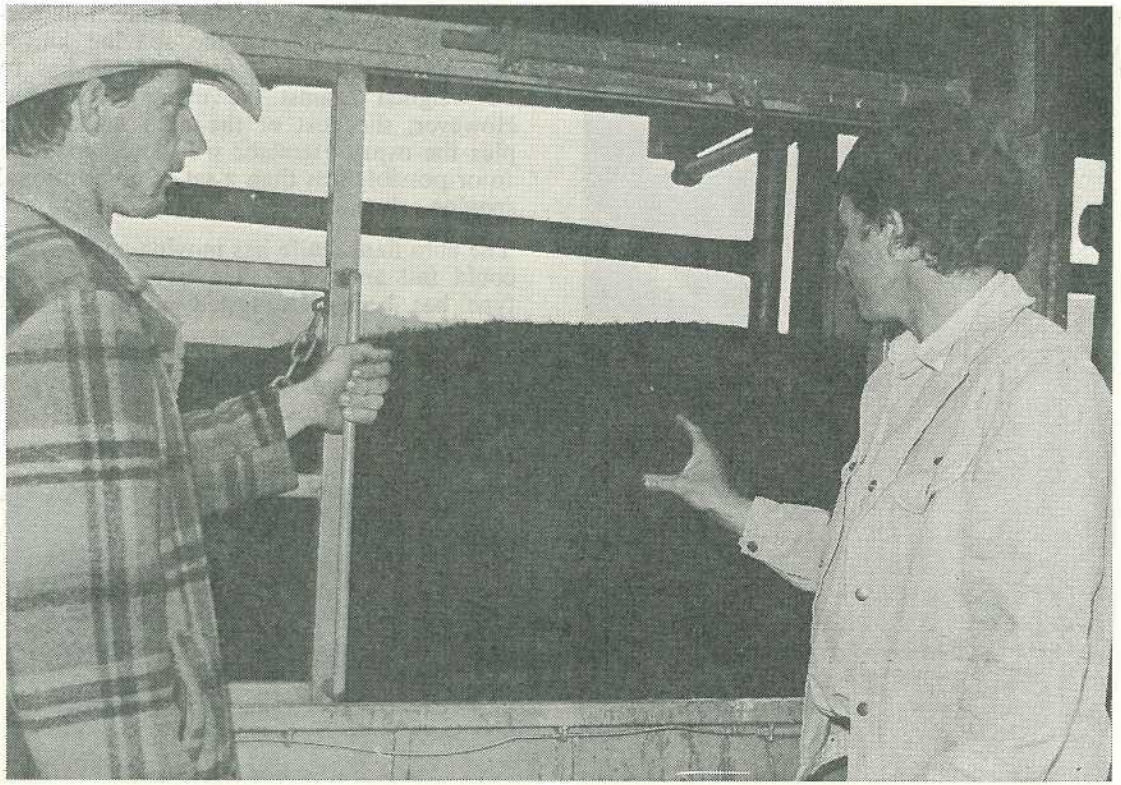
- The instrument's inspection plate can be easily and quickly removed so that all the working parts are revealed.
- The scalpel blade is fully retracted before use. This makes it possible to carefully position the auto flank knife.
- The auto flank knife is easily reloaded by a bolt action mechanism.

DISADVANTAGES

- The experienced flank operator may not want to change as he may feel his techniques are adequate. However, experienced operators who have used or seen the auto flank knife in action so far have viewed it favourably.
- The cost of the auto flank knife will certainly be in excess of the spaying knives currently in use. This disadvantage has to be weighed against the many advantages. However, the cost of the auto flank knife plus the ovary extractor will be comparable to or possibly less than a set of conventional spaying scissors.
- The auto flank knife has moving parts which could fail and wear. However, the prototype has been field tested on over 1 500 cattle so far.

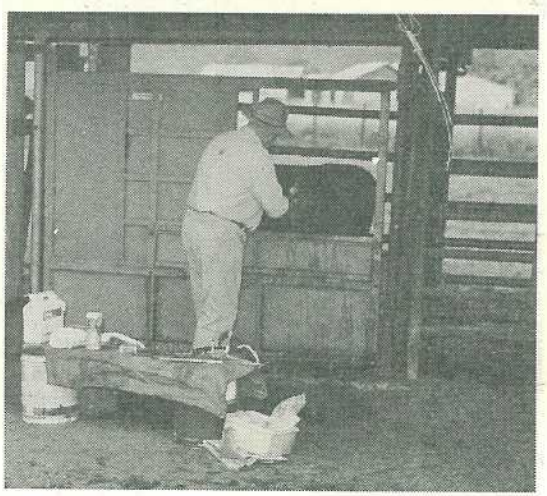


A close up view of the completed stitching.



Above. General view of a well-built near side steel squeeze gate showing easy access to the flank of the animal made by sliding the panels back.

Below. Mr. Jack Howard, a Brisbane Valley grazier, working through the opening in the squeeze gate to stitch up the incision. This is a well-built steel gate.



Bovine ovary extractor

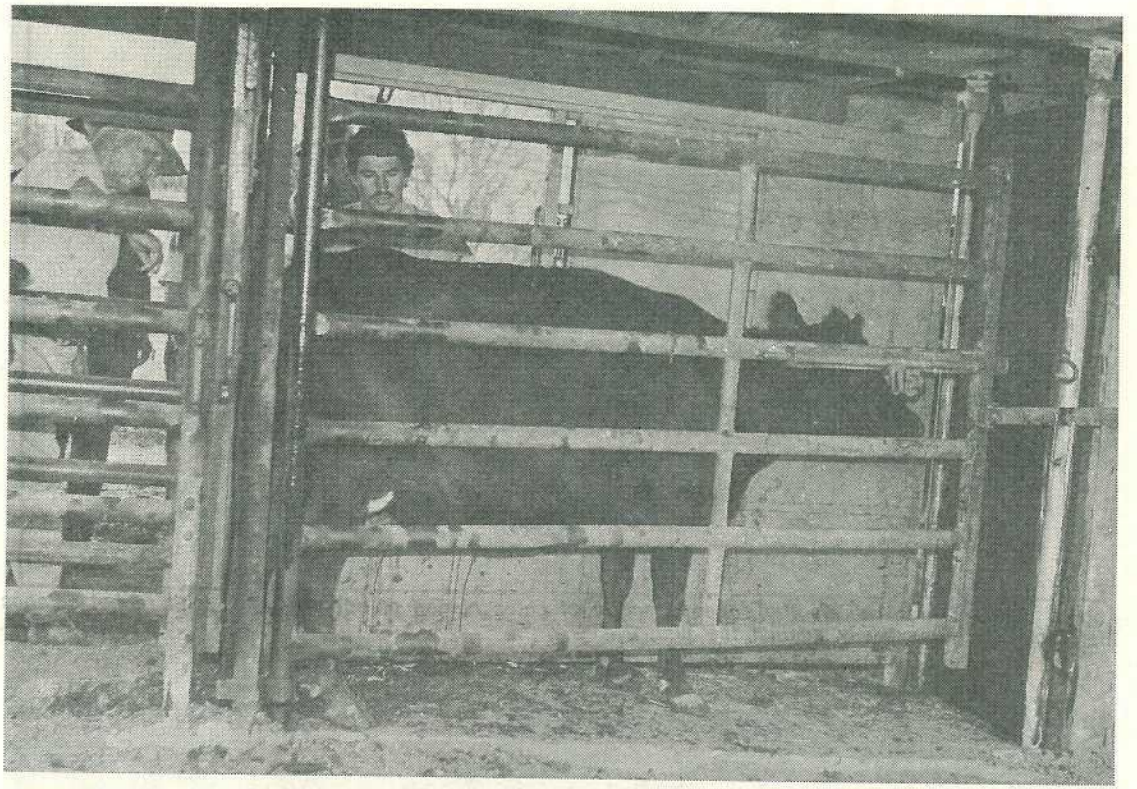
The bovine ovary extractor is a simple instrument, specifically designed to incise the broad ligaments and vessels which attach the ovary.

The cutting section of the instrument or head, consists of two Y-shaped cover protection plates, which house two surgical scalpel blades so that the two cutting edges are just touching together. The top protection plate is removable, so that new blades can be replaced when necessary.

The operator holds the handle section in one hand and with his other hand holds the ovary. The ovary is cut off by the operator gently pushing the instrument forward and manipulating the broad ligaments into the Y opening of the instrument and on to the surgical blades.

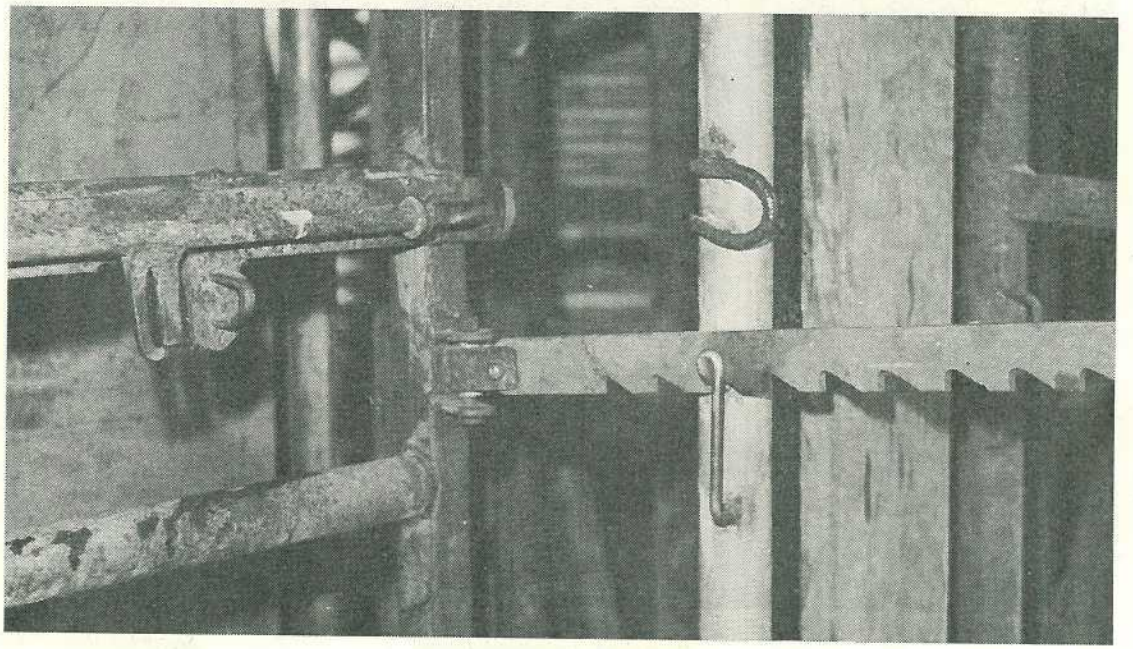
Advantages

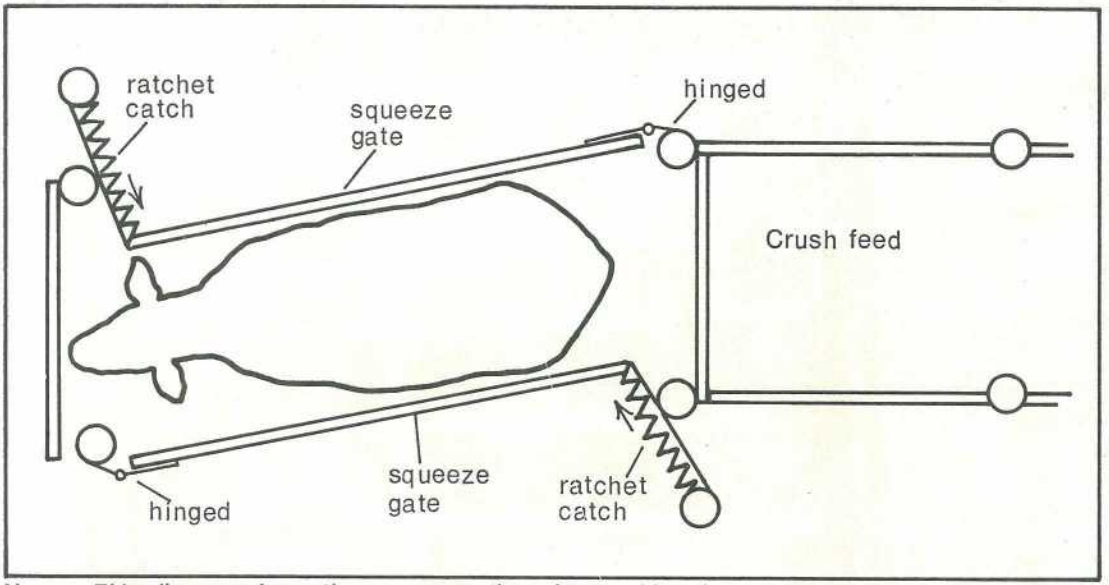
- Initial development shows that the cost of the extractor should be lower than present spaying scissors.



Above. View of the off side squeeze gate with the ratchet latch on the right hand side. The operator can be seen in the rear working through the near side squeeze gate.

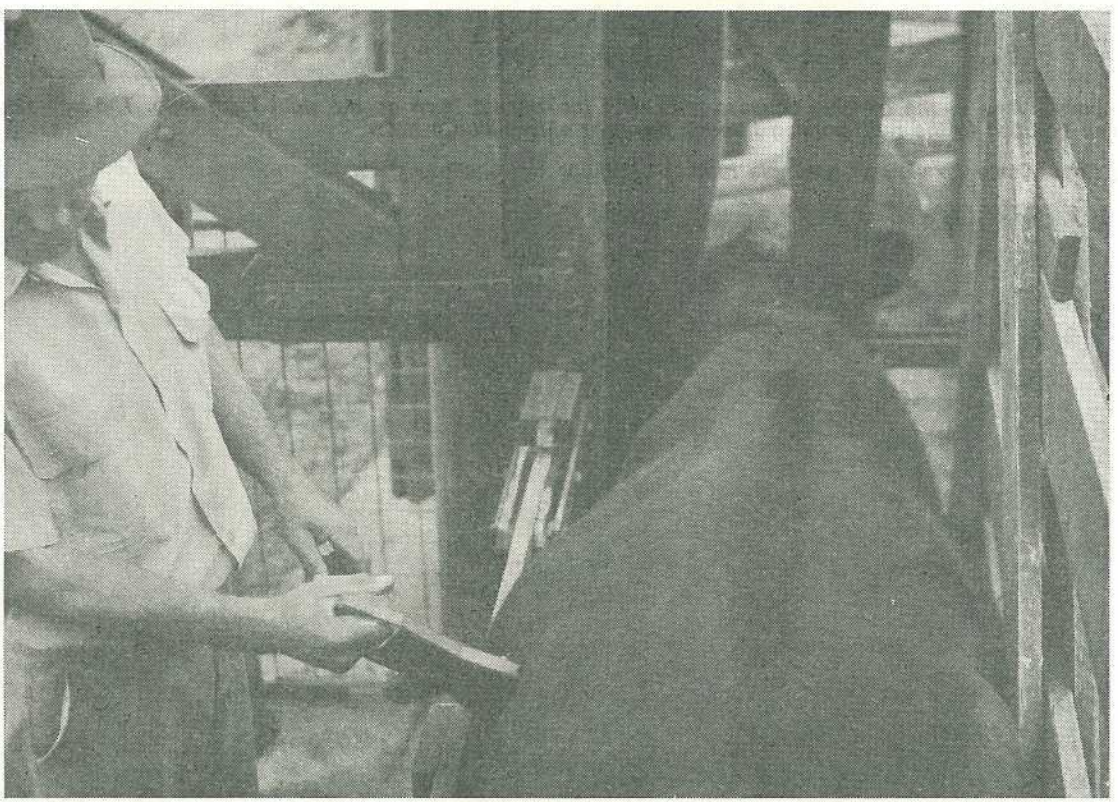
Below. Close up view of a simple ratchet catch for the squeeze gate.

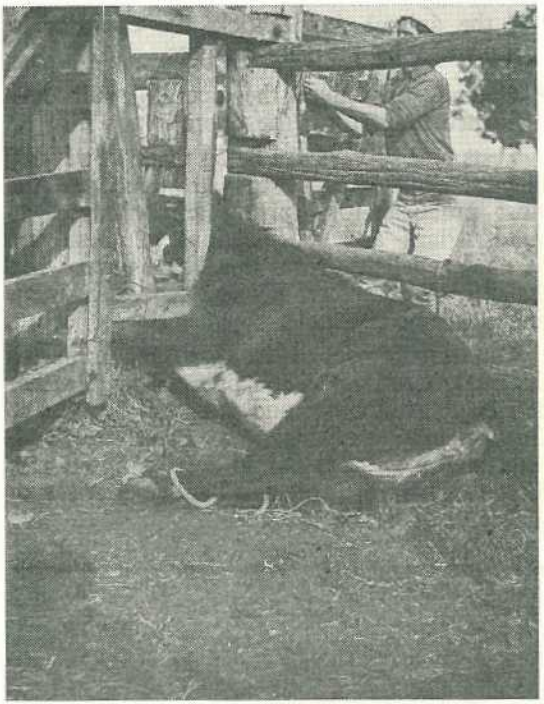




Above. This diagram shows the squeeze action of gates hinged at opposite ends with rachet catches that lock the gates firmly against the animal.

Below. A modified crush with one squeeze gate and a head bail.





A typical head bail and flank rope restraint showing the cow fighting in the bail.

- It also appears from initial enquiries that the instrument can be easily manufactured in fibreglass. The flexibility of fibreglass is useful when locating and cutting off the ovaries.
- The extractor will have no moving parts and therefore no wear.
- It will be easy to keep clean and hygienic and is easily sterilized.
- It can be kept sharp with replaceable surgical blades.
- It will be lighter and smaller than conventional spaying scissors.
- In the field trials, the author has found it to be much quicker and more efficient to use than conventional spaying scissors. To operate the extractor, just one gentle forward movement is all that is necessary. Scissors have to be manually operated from outside the animal.
- The extractor will be safer to use inside the abdominal cavity or vaginal passage, as the only tissues that can be cut are those which the operator feeds into the entrance of the instrument. Intestinal organs can be accidentally cut by the opening and shutting action of scissor jaws.
- Experience with spaying scissors has shown that they have to make several cuts through the ligament. This is so even when spaying scissors are sharp. When using blunt spaying scissors, the spaying operation can become a very tiring effort.
- Less surgical shock should be experienced by the sharp, clean cutting action of the extractor.

DISADVANTAGE

There is no emasculation with the instrument. Bleeding trials are being undertaken to compare the emasculation effects of spaying scissors and the ovary extractor.

Over 200 cattle have so far been successfully spayed with the ovary extractor and bleeding observed. These have been a cross section of cows including different breeds through the various stages of pregnancy, from maiden heifers through to 8 month pregnant animals.

Findings to date show that when using the ovary extractor the same amount of bleeding was observed as when using spaying scissors. This suggests that the use of the ovary extractor does not increase the risk of haemorrhage.

Squeeze crushes

The main features of these are as follows:—

- Squeeze action.

  Gates which form part of the crush are hinged at opposite ends to each other and are fitted with ratchet type catches so that they can be squeezed and locked firmly against the animal. This restrains body movement.

- No head bail.

  The firm restraint of the squeeze gates eliminates the need for a head bail which the animal usually fights against, adding stress to both animal and operator.

- Flank access.

  A drop, removable or sliding panel in the near side gate, or a split gate is necessary to allow easy access to the flank to make the incision.

- Easy conversion.

  Most existing crush facilities can easily be converted to one of the squeeze crush designs.

ADVANTAGES

The advantages of these features are:

- The animal is restrained as quickly and as quietly as possible and stands securely until the operation is completed.
- If the animal should kick, the operator is protected by the squeeze gate.
- Overall, this gives the operator full confidence to perform the operation.

Tests and surveys are being made of various squeeze crush designs to see which are the most practical for spaying and cheapest to build. Plans and specifications of these will be made available from the Department when the study is complete. By that time, the instruments will be available.

The development of the auto flank knife and the ovary extractor is still proceeding. Further details of availability and cost will be sent to Departmental staff as they come to hand. Interested producers should keep in touch with their local Beef Cattle Husbandry Adviser or Inspector of Stock.

Brand returns

Did you know that:

- The brand return and stock return you have been submitting are two entirely different returns required by different Acts of Parliament and used by different sections of the Department of Primary Industries?
- Brand returns are still required and should be submitted on January 1 each and every year?
- There is no fee associated with a brand return?
- If a brand return is not submitted for three consecutive years, your brand can be cancelled under Section 18 of the Brands Act, 1915–1975?

For further information on brand returns contact:

The Registrar of Brands,
Department of Primary Industries,
William St.,
Brisbane. 4000.

Chianinas on Trial

by R. T. STRACHAN,
Beef Cattle Husbandry Branch.

EARLY results from a 3-year programme to evaluate the Chianina breed suggest that the breed has something to offer the Queensland cattleman.

Chianina steers from both Hereford and Brahman X Hereford cows have recorded superior weight gains in trials designed to compare their performance with Hereford and Brahman X Hereford steers. The trials are being conducted on Mr W. J. Peart's property 'Sunnyholt' in the Arcadia Valley north of Injune.

The availability of imported semen has allowed cattlemen to experiment with various exotic breeds of cattle. European breeds, especially the Charolais and the Simmental, have received most attention. The Chianina is an Italian breed that has received some attention in the United States of America and in Canada. Semen from the breed did not reach Australia until June 1973. Since that time, cattlemen have been watching the progress of the breed with interest.

'Sunnyholt' is a well developed property of some 6 800 hectares. The brigalow scrub has been replaced by buffel grass which supports a breeding herd of Hereford and Brahman X Hereford females. The property is tick-free and has an average annual rainfall of 625 mm.

The partnership of R. A. and W. J. Peart obtained some of the original Chianina semen imported. Since 1973, they have been engaged in a programme to assess the potential of the breed as an alternative to the Brahman in their grading-up programme or as a terminal cross over Brahman X Hereford females. Over the last 3 years, from 150 to 300 Hereford and Brahman X Hereford cows have been artificially inseminated to a selection of Chianina sires. In 1977, the partnership was running 300 half-bred Chianina females on 'Sunnyholt' with the aim of grading-up to a pure bred herd.

The interest in the Chianina resulted from a visit to Europe in 1972. Mr Wally Peart was impressed with the size and muscling of the Chianinas he saw in Italy. Their Asiatic and/or African ancestry, giving them a protective black skin and porcelain white coat, suggests they would be more suited to a tropical environment than other European breeds. He saw them as a possible alternative to the Brahman in tick-free areas or as a suitable breed for crossing with Brahman infused cattle in central and northern Queensland.

Breed observation

Since 1975, the Department of Primary Industries has been observing the performance of the breed. To this end, 150 steers in the observation were tagged and weighed at weaning. The final weighing was recorded in April 1977 when the steers were 28 months of age. The 150 steers consisted of 5 groups of 30 with the following breeding:

Group	Sire	Dam
1	Hereford	Hereford
2	Brahman	Hereford
3	Hereford	Brahman x Hereford
4	Chianina	Hereford
5	Chianina	Brahman x Hereford

During the post weaning period, the Chianina cross steers recorded an average gain of 346 kg compared to 333 kg for the Brahman X Hereford steers and 288 kg for Hereford and Hereford X (Brahman X Hereford) steers. The Chianina cross steers recorded significantly higher gains from 18 months of age. This would be a reflection of the later maturity of the breed.

A carcase assessment carried out on a sample of each breed group suggests that the Chianna cross steers have carcasses suitable to most export trades and a fat cover acceptable for the local trade.

Unfortunately, the Chianina steers in this phase of the observation are by the one sire and therefore cannot be taken to be a true representation of the breed. However, the results are encouraging and the trials are continuing with steers by different bulls.

During the course of the observation, steers are running in a 500 hectare paddock sown to Buffel grass in 1966. The area has been stocked at an average rate of 1 beast per 1·2 hectares.

Based on experience at 'Sunnyholt', the Chianina cross have a good temperament, when compared with the Brahman cross steers, yet are more alert and active than the Herefords.

Bovine brucellosis free herds (as at 12-7-77)

F. R. B. Anning, 'Cardross', Grandchester.	C.L.
Australian Estates, Eurella, Mitchell.	S.G.
Australian Estates, 'Wainui', Bowenville.	S.G.
A. V. Bauer, 'Warralea', Ipswich.	D.M.
G. W. Beck, 'Banbeck', Laidley.	D.M.
C. H. Beckingham, Cosme Jersey and Hereford Stud, Aspley.	J.S., H.F.
J. A. and A. W. Butler, 'Coochin', Beerwah.	B.F.
B. L. and M. O. Christensen, 'Elavesor', Poll Hereford Stud, via Rosewood.	P.H.
L. T. and T. J. Christensen, 'Coolaroo Jersey Stud', via Rosewood.	J.S.
V. R. and T. W. Crank, 'Gracelyn', Mt. Tyson.	A.I.S.
Mrs. M. Crombie, Old Hidden Vale Santa Gertrudis Stud No. 49, Grandchester.	S.G.
J. J. E. Davies, 'Glenwyn Park Stud', Toowoomba.	H.F.
L. DeLandelles, 'Cherokee', via Yeppoon.	B.M.
W. A. Dodd, Glengannon Stud, Rosewood.	P.H.
V. L. Duhs, Murray Grey Stud, Nambour.	M.G.
Fairymead Sugar Co., Marlborough Station, Marlborough.	B.M.
Ford Holdings, Maraja Stud, Caloundra.	B.M.
W. A. Freeman, Trevlac Stud, Rosewood.	C.L.
B. Goddard, 'Inverell', via Pittsworth.	A.S.
J. C. Grigg, 'Bethonga' Bradford Stud, Wamuran.	B.F.
S. K. Guppy, 'Lynstarr', Nambour.	F.S.
M. F. Hemmings, 'Bileena', Warwick.	A.I.S.
W. G. Henschell, 'Yarranvale', Brookstead.	H.F.
A. T. Holt and Son, 'Karowara Santa Gertrudis Stud', Tamborine Mountain.	S.G.
H. W. Hopper, 'Ellendean' Guernsey Stud, Maleny.	G.S.
M. E. and V. E. Hughes, 'Mi-Von', via Chinchilla.	H.F.
S. S. Knitter, 'Charnu' Stud, Forest Hill.	F.S., J.S.
B. G. and R. M. Lamb, North Kolan, Avondale.	B.M.
R. C. Mogg, 'Raymount' Friesian Stud, via Nambour.	F.S.
P. Mort, 'Franklyn Vale' Braford Stud, Grandchester.	B.F.
H. J. Murray, 'Greydale' Murray Grey Stud, Rosewood.	M.G.
J. D. O'Sullivan, Navilloween, Greenmount.	P.H.
R. J. Pontifex, Roburn Friesian Stud, Oakey.	F.S.
N. R. Potter and Sons, 'Acton Vale' Stud, Wellcamp.	P.H., A.I.S.
D. G. Raff, 'Forres', Karara.	A.G.
K. R. and G. A. Reid, Goomeran, via Warwick.	H.F.
N. N. Schelbach, 'Allanview', Warwick.	A.I.S.
W., L. W. and D. J. Schossow, 'Teviot Brooke', Boonah.	F.S.
E. I. Scott and J. S. Edwards, 'Auchenflower', via Forest Hill.	A.S., F.S.
J. and S. C. Siebenhausen, 'Merriton', Pittsworth.	A.I.S.
E. J. Smith, 'Hillcrest' Ayrshire Stud, via Ipswich.	A.S.
F. J. and H. R. Smith and Sons, 'Rubyvale' Angus Stud, Nambour.	A.G.
J. Z. Smith, Alum Rocks, Amiens.	H.F.
Dr. J. A. Stephenson, 'Sahwalid Sahiwal Stud', Belli via Eumundi.	S.W.
K. Sutton, 'Startwell', Wamuran.	B.M.
R. N. and C. M. Towner, 'Par Deux' Droughtmaster Stud, Laidley.	D.M.
J. P. and V. Trier, 'Tamrookum Valley' Braford Stud, Rathdowney.	B.F.
B. G. and B. Wells, Bundilla Murray Grey Stud, Laidley.	M.G.
A. C. and V. J. Westphal, 'Alun Jersey Stud', Roadvale.	J.S.
R. S. Wilson, Calliope Station, Gladstone.	H.F.
K. V. Wright, 'Wattle Vale', Boonah.	F.S.
Dr. B. R. Yeates, 'Ugarapul', Boonah.	S.G.

KEY

A.I.S.—A.I.S.
A.G.—Angus
A.S.—Ayrshire
B.F.—Braford
B.M.—Brahman
C.L.—Charolais
D.M.—Droughtmaster
F.S.—Friesian
G.S.—Guernsey
H.F.—Hereford
J.S.—Jersey
M.G.—Murray Grey
P.H.—Poll Hereford
S.W.—Sahiwal
S.G.—Santa Gertrudis

The blue-green aphid —a further new pest of lucerne

by T. PASSLOW, Entomology Branch.

THE blue-green aphid *Acyrthosiphon kondoi* Shinji was recorded for the first time in Queensland on 10 May 1977, in the Gatton district.

Since that date, it has been shown to be dispersed through the south-east part of the State. It has been collected in the Monto, Gayndah, Gympie, South Burnett, Darling Downs and Lockyer Valley districts.

The insect is of Asian origin but has been reported in recent years in Western U.S.A. and New Zealand. Overseas experience indicates that it breeds and spreads rapidly under cool conditions but that numbers wane during hot weather.

It has already caused significant damage in the Kingaroy, Darling Downs and Lockyer areas and may be expected to also cause problems during late autumn to early spring in Queensland.

Aphids are readily dispersed by wind so that the insect will probably spread rapidly into most areas where host plants are grown.

The blue-green aphid attacks a wide range of small-seeded legumes. Lucerne, clover and medics are regular hosts. It also is recorded as attacking *Meliotus* species, hexham scent, and *Lotus* species.

Unlike the spotted alfalfa aphid, the blue-green aphid concentrates its attack on the growing points of the plant. Damage symptoms include retarded growth, shortened internodes, leaf yellowing and the production of small, mis-shapen leaves. Complete loss of hay crops has been recorded in overseas areas.

The aphid as the name implies, is blue-green in colour with the body being somewhat darker than the head. The winged adult is characterized by a dark brown to near black thorax.

Control

Overseas data and initial observations indicate that insecticides recommended for the spotted alfalfa aphid will give control. It is suggested that where control is deemed necessary in lucerne hay production, a pesticide should be applied as soon as practicable after cutting.

Where infestation develops late in growth, the best procedure may be to cut and apply an insecticide as soon as possible afterwards to ensure rapid growth for the next harvest. Aphids can breed very rapidly so that population resurgence is a real possibility.

Long term aphid control based solely on insecticide use is most unlikely to be satisfactory. For this reason, the Department of Primary Industries is investigating the importation of parasites which are being used in biological control overseas and a programme to develop, at least in lucerne, varieties resistant to the insect is proposed.

Children's feet

CHILDREN'S feet have soft, pliable bones which may be easily moulded into the wrong shape by ill-fitting shoes and socks. As youngsters rarely complain of discomfort when shoes/socks are the wrong size, it is not until the teens, when foot bones begin to harden, that the effects are felt or seen.

Many adults with foot complaints can trace their troubles to childhood, when shoes bought for 'best' had to be worn out at home, AFTER they became too tight. This practice is definitely inadvisable as children's feet grow so quickly that shoes may be outgrown after only a few wearings.

Shoes should be at least half to three-quarters of an inch longer than the child's foot. They should grip snugly around the ankle and have a flexible sole plus a broad, flat heel. Leather shoes, correctly built up, are better than composition soles for children with flat feet or some leg abnormalities which need correcting.

Never buy shoes without first ensuring they fit the child for whom they are intended. And forget about 'breaking-in' new shoes. This usually means breaking-in the feet to fit the shoes, and foot troubles may result.

Socks should always be loose and comfortable. Discard them when they are outgrown, or they will constrict the toes, causing deformity and discomfort. Cotton or woollen socks are better than those made from artificial fibre such as nylon, which will not absorb perspiration. Wash socks daily, and keep shoes clean and polished to retain pliancy and prevent cracking.

Teach your children to wash their feet thoroughly each day, drying carefully between the toes to help prevent fungal infections. If you suspect your child may have foot problems —of any kind—seek prompt medical attention; healthy adult feet may depend on it.

From the Queensland Health Education Council.

Riversdale . . .

a selected line of common guinea grass

by C. H. MIDDLETON, Agriculture Branch.

RIVERSDALE, a cultivar of common guinea grass, was released for commercial use in Australia in July 1975. It is a pure and uniform line intended to replace common guinea grass.

Common guinea grass (*Panicum maximum*) is the most widely used grass in the wet tropics of northern Australia. It is also widely used in other tropical areas of the world. Guinea grass was introduced into Australia before 1900. When beef production began in the wet tropics of north Queensland in the mid-1930s, common guinea soon became the main pasture grass. It still maintains this position today.

Over the years there have appeared a number of guinea grass types possessing characteristics obviously differing from common guinea or any of the other commercial cultivars. One of these (coarse guinea) is quite unpalatable and is considered a serious weed in both pasture and cane fields. Many of the common guinea seed-producing areas have become contaminated with these off-types which cannot be distinguished from common guinea grass in seed samples.

The need was seen for a uniform and pure breeding line of guinea grass for both the local and export trades. With this objective in mind, selection was carried out at South Johnstone Research Station from a line of common guinea known to have high animal productivity. In association with legumes this line has consistently produced yearly liveweight gains in excess of 600 kg/ha. It was released for commercial use by the Queensland Herbage Plant Liaison Committee in July 1975.

The name 'Riversdale' is derived from the late Brice Henry's property at Tully. It was on this property, in co-operation with Brice Henry, that some of the first studies on the use of guinea grass in the wet tropics of north Queensland were conducted.

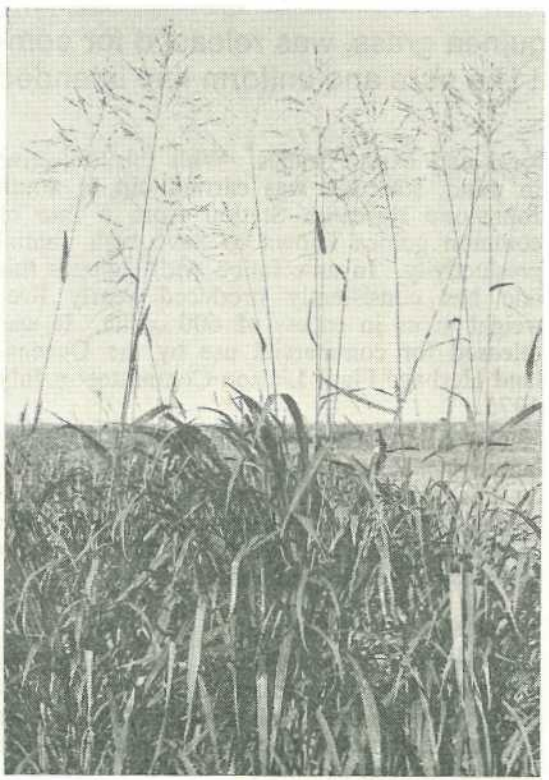
What is Riversdale?

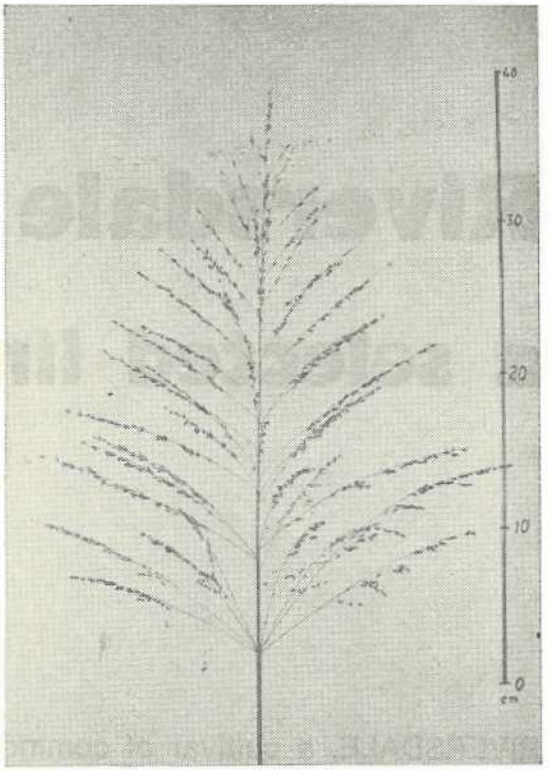
Riversdale is one line of common guinea selected to ensure botanical uniformity and purity. It cannot be distinguished from most existing 'common guinea' grass either in the field or in seed samples.

Riversdale is a medium height form (1·8 to 2·0 m) with an erect canopy. The stems are finer and leaves narrower than the other tufted cultivars (Hamil, Coloniao, Makueni) in use. Mature leaves can reach 70 to 80 cm in length and 15 to 18 mm in width. The leaves are sparsely hairy on the upper surface and the leaf sheath is moderately hairy, increasing towards the node. The expanded seedhead or panicle of healthy plants can reach 30 to 40 cm long and 20 to 30 cm wide.

The botanical features which distinguish the different guinea grasses in use in north Queensland are tabulated in a previous article in this Journal (May–June 1975). The features listed for 'common' guinea are identical with those for Riversdale.

Mature plants of Riversdale guinea grass at South Johnstone Research Station.





Close-up of fully expanded seed-head.

Use of Riversdale

It is intended that Riversdale be used in place of common guinea grass and as an alternative to Makueni on well drained soils of the wet coastal areas of north Queensland. In elevated areas with cooler winters (e.g. Atherton Tableland) Makueni should be used. Full details of the establishment and management of the guinea grasses have been published and readers should refer to the article by J. K. Teitzel and others in the April, May, June 1974 issues of the *Queensland Agricultural Journal*.

Seed availability

Seed multiplication began at Walkamin Research Station in late 1975. Riversdale seed will be certified to ensure purity. Only with certified seed can the buyer be certain that the sample does not contain the weedy 'coarse' guinea material.

Some seed became available commercially in mid 1977.

Maize varietal planting guide 1977-78 season

Compiled by S. R. WALSH, Agriculture Branch.

MAIZE varieties recommended for planting in the 1977-78 season are listed below.

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

Plant populations

The planting rate will be governed by environment, soil moisture, soil type, planting time, and whether irrigated or rain-grown; the rate should be varied according to the conditions. A 10% loss in field establishment can normally be expected.

Maize seed sold by the major seed companies is of high quality and is required to have a minimum laboratory germination of 90%.

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

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

APPROXIMATE PLANTING RATE KILOGRAMS PER HECTARE FOR A GIVEN PLANT POPULATION

Plants/ha	Seed kg/ha			
	Seed size (seeds/kg)			
	2 500	3 000	3 500	4 000
15 000	6·5	5·5	4·75	4·0
20 000	9·0	7·5	6·0	5·5
30 000	13·0	11·0	9·5	8·0
50 000	22·0	18·5	15·8	14·0
60 000	26·0	22·0	19·0	16·5

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

Disease

The main diseases affecting maize are leaf blight, head smut and maize dwarf mosaic.

Common leaf blight

The fungus *Drechslera turcica* produces grey or light-brown, large, spindle-shaped leaf spots commonly up to 15 x 2 cm in size. A description and colour plate of this disease appeared in the August 1974 issue of the *Queensland Agricultural Journal.*

Late maturing varieties have effective blight resistance. These include the QK, PQ, and GH varieties. Early maturing varieties with moderate resistance to the disease are Q739, XL389, XL81, and DK805A.

Maydis leaf blight

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

Head smut

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

Seed treatments may destroy externally borne spores on the seed but will not protect a crop against infection from smut in infected soil.

Varieties least susceptible to this disease are XL 81, XL 389, Q692, Q739, Q 1280 and GH 128, XL 99, XL 399.

Maize dwarf mosaic

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

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

Disease control cannot be effectively achieved by aphid control with insecticides and Johnson grass cannot be economically eradicated in all situations. Control of the disease is achieved by sowing resistant hybrids. Recommended hybrids with resistance to maize dwarf mosaic are listed below:

Highly resistant—Q 692, Q 739, QK 217, QK 231, GH 128, Q 1280, XL 99.

Moderately resistant—GH 390, PQ 500, XL 306, XL 81, XL 389, XL 399, XL 99, RX 204, Sergeant.

Wallaby ear

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

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

The following cultivars have been among the most susceptible in Departmental trials—XL 99, XL 399, Q 1280, GH 128.

Maturity

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

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

Region and Shires	Planting Time	Varieties	Planting Rate plants/hectare
Far Northern— Cook, Mareeba, Atherton, Eacham, Herberton, Mulgrave, Johnstone, Cardwell, Douglas, Etheridge, Hinchinbrook	Dec.–mid Feb.	M: QK217, QK231, QK487 (QK487 for severe head smut areas)	35 000
Northern— Dalrymple, Thuringowa, Ayr, Bowen, Proserpine	Mar.–July	*Irrigated* MS: XL389, XL99, XL399 M: XL81	60 000–70 000
Capricornia— Livingstone, Fitzroy, Calliope, Broadsound	Dec.–Jan.	S: Q692, GH128, Q1280 M: QP500 MQ: Q739	20 000–25 000
Banana, Duaringa	End Dec.–end Jan.	S: Q692, Q1280, GH128, GH390 MS: XL389 M: XL81 MQ: Q739	*Irrigated* 50 000 *Rain-grown* 35 000–45 000

Region and Shires	Planting Time	Varieties	Planting Rate plants/hectare
Burnett—			
Miriam Vale, Kolan, Gooburrum, Woongarra, Isis, Perry, part Biggenden, Hervey Bay, part Tiaro, Woocoo	Late Aug.–early Jan.	S: Q1280, GH128, GH390, GH134 MS: XL389 M: DK805A, XL81	20 000–25 000
Gayndah, Mundubbera, part Biggenden	Mid Nov.–early Jan.	S: Q1280, GH128, GH390 MS: XL389 M: XL81 MQ: Q739 *For trial* MS: XL99, XL399	18 000–25 000
Monto, Eidsvold	Mid Nov.–early Jan.	S: Q1280, GH128, GH390 MS: XL389 M: XL81 MQ: Q739 *For trial* MS: XL99, XL399	18 000–25 000
South Burnett—			
Kingaroy, Nanango, Wondai, Murgon, part Kilkivan, part Rosalie	Mid Nov.–mid Dec.	MS: XL99, XL399 M: XL81 *For trial* M: Sergeant, RX204	25 000–30 000
Near North Coast—			
Widgee, Noosa, part Tiaro, Maroochy, Landsborough	Nov.–Jan.	S: XL389, GH390, XL99, XL399 M: XL81	*Irrigated* 50 000 *Rain-grown* 30 000
East Moreton—			
Caboolture, Pine Rivers, Redlands, Albert, Beaudesert	Sept.–Dec.	S: Q692, Q1280, GH128, GH390 MS: XL389, XL99, XL399 M: PQ500, XL81 MQ: Q739	*Irrigated* 50 000 *Rain-grown* 25 000–30 000
West Moreton—			
Moreton, Esk, Kilcoy, Boonah, Gatton, Laidley	Sept.–Dec.	S: Q1280, GH128, GH390 MS: XL389 M: PQ500, XL81 *For trial* M: Sergeant	*Irrigated* 50 000 *Rain-grown* 25 000–30 000
Darling Downs—			
Wambo, Chinchilla	Sept.–Nov.	S: Q692 MS: XL389, XL99, XL399 M: XL81, PQ500 MQ: Q739, XT664 Q: XL306 *For trial* M: Sergeant, RX204	15 000–25 000
	Oct.–Dec.	M: XL81, PQ500 MQ: Q739, XT664 Q: XL306	15 000–25 000
Pittsworth, Millmerran (east of Condamine River), Jondaryan, Crows Nest, part Rosalie	Oct.–Dec.	MS: XL389, XL99, XL399 M: XL81, PQ500 MQ: Q739, XT664 Q: XL306 *For trial* M: Sergeant, RX204	20 000–30 000

Region and Shires	Planting Time	Varieties	Planting Rate plants/hectare
Darling Downs—*continued*			
Millmerran (west of Condamine River)	Oct.–Dec.	S: Q692 MS: XL389, XL99, XL399 M: XL81, PQ500 MQ: Q739, XT664 Q: XL306 *For trial* M: Sergeant, RX204	20 000–30 000
Clifton, Allora, Cambooya, Rosenthal, Glengallan	Oct.–Dec.	MS: XL389, XL99, XL399 M: XL81, PQ500 MQ: Q739 Q: XL306 *For trial* M: Sergeant, RX204, RX79	20 000–25 000
Stanthorpe	Nov.–Dec.	M: DK805A *For trial* M: Sergeant, RX79	20 000–30 000 Heavier rate eastern section
All Shires	Oct.–Dec.	*Irrigated* S: Q692 MS: XL389, XL99, XL399 M: XL81, PQ500 MQ: Q739 *For trial* M: Sergeant, RX204	50 000–60 000
Near South West— Balonne	Oct.–Dec.	*Irrigated only* MS: XL389, XL99, XL399 M: XL81 *For trial* M: Sergeant, RX79	50 000–60 000

KEY.—S = Slow maturity; MS = Medium slow maturity; M = Medium maturity; MQ = Medium quick maturity; Q = Quick maturity.

Use of symbol brands and earmarks

- An earmark may only be used on a beast which already bears a three piece or symbol brand.
- A symbol brand must be registered in conjunction with a three piece brand. However, either may be used alone to denote ownership.

Pasture reclamation and decline in the wet tropics

by J. STANDLEY, Agricultural Chemistry Branch.

A STUDY of pastures between 1973 and 1976 revealed several causes of decline:

- Inadequate use of fertilizer
- Inaccurate fertilizer application
- No weed control
- Weed spraying and slashing at the wrong time
- Overgrazing
- Undergrazing
- Unsuitable species on poorly drained sites
- Incomplete land clearing
- Development of inaccessible sites

The study involved pastures on granitic and metamorphic soils between the Babinda and Ingham areas. Sixty-one sites on ten commercial properties were recorded and sampled annually between May and July in 1973, 1974 and 1975. Three mismanaged properties were omitted in 1976, leaving 44 sites.

Pasture species in the study included the grasses, common guinea and cv. Hamil (*Panicum maximum*), pangola (*Digitaria decumbens*), signal cv. Basilisk (*Brachiaria decumbens*), para (*B. mutica*), and the legumes puero (*Pueraria phaseoloides*), stylo cv. Schofield (*Stylosanthes guyanensis*), common centro (*Centrosema pubescens*) and calopo (*Calopogonium mucunoides*).

Among the weeds, the most common grasses were blady grass (*Imperata cylindrica*) and sour grass (*Paspalum conjugatum*); the commoner broad-leaved weeds were bluetop (*Ageratum houstonianum*), knobweed (*Hyptis capitata*) and snakeweed (*Stachytarphaeta urticifolia*); the dominant woody weeds included wattle (*Acacia flavescens*), devil's fig (*Solanum torvum*), wild tobacco (*S. auriculatum*), sida-retusa (*Sida rhombifolia*), flannel weed (*S. cordifolia*) and pink burr (*Urena lobata*).

Fertilizer use and pasture protein

Fertilizer use decreased during the study. Of the 61 sites sampled, 56% received superphosphate between May 1973 and June 1974 compared to 8% between May 1975 and June 1976; 7% received muriate of potash in 1973-74 and none in 1975-76; 44% received fertilizer nitrogen in 1973-74 compared to 3% in 1975-76.

As the use of fertilizer nitrogen on pure grass swards decreased so the crude protein of pasture samples plucked by hand decreased from an average of 12·0% in 1974 to 10·1% in 1976. Conversely, the effectiveness of legume increased, raising the average crude protein of grass-legume pastures from 11·6% in 1974 to 14·1% in 1976. However, even in 1976, the crude protein content of some grass-legume pastures was below the average for grass pastures.

Pasture reclamation

Overgrazed and weed infested pastures will recover with correct management. Plates 1 to 6 illustrate case histories from the study where attention was paid to:

- Weed control by slasher or roller chopper, possibly in conjunction with hormone spot spraying.
- Maintenance of soil fertility with superphosphate and trace elements.
- Lenient grazing of paddocks to give them a chance to recover.

Plates 1 to 3 show successive stages of improvement due to weed control and use of fertilizer. The grass-legume pasture in Plate 1 was fertilized with superphosphate raising acid extractable phosphorus from 30 to 84 p.p.m. in 1974; weeds were controlled by hormone spray in 1973 and roller choppers in 1975. The result was a pasture similar to that in Plate 3.

On another property, sour grass dominating a hamil grass-centro pasture was overcome by fertilizing the area with superphosphate containing molybdenum and withdrawing cattle for a time. Similar weed control measures have been effective in pure grass swards:

Plate 1. First year—A guinea grass-centro pasture with 60% weeds, sour grass, bluetop, tobacco bush and pink burr. This had just been fertilized but needed further weed control.

Plate 2. Second year—The same guinea grass-centro pasture after roller chopping, only 10% weed.

tobacco bush in a pangola grass paddock was successfully controlled by slashing where the paddock had been fertilized regularly with nitrogen and superphosphate.

Plate 4 shows a signal grass pasture on the verge of decline. It has been heavily grazed and it was originally a pure grass sward. However, no superphosphate and nitrogen were applied after 1973-74 and soil phosphorus decreased from 27 p.p.m. in 1973 to 11 p.p.m. in 1976. The property manager will encounter serious problems in 1977 unless he uses more fertilizer and controls weeds present in 1976.

When part of a property is flooded during the wet season, cattle are moved to higher paddocks. The overgrazing which follows need not be disastrous. The pangola pasture in Plate 5 had been seriously overgrazed in 1974 but it also received fertilizer regularly; by 1975 the grass had fully recovered (Plate 6).

Pasture mismanagement

Pasture decline occurred more frequently than pasture improvement during the study. Plates 5, 7 and 8 illustrate cases of:

- Overgrazing
- Undergrazing
- No weed control
- Ineffective weed control resulting in inefficient use of fertilizer.

At one extreme, paddocks similar to Plate 5 were so heavily stocked on one property that cattle died, improved pasture species disappeared and fertilizer would not have saved the situation. At the other extreme, undergrazing resulted in the rank growth of grass shown in Plate 7. Such pasture is largely wasted and makes it hard to find and muster cattle.

Plate 3. Third year—Successful recovery of grass-legume pasture with well managed grazing.

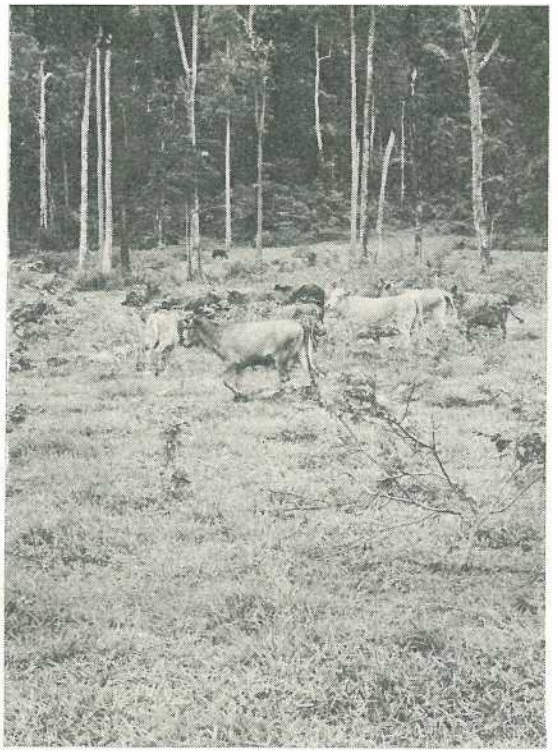


Plate 4. Signal grass pasture on the verge of decline with 10% sour grass, tobacco bush, devil's fig and knobweed. Acid extractable soil phosphorus had decreased to 11 p.p.m. This site requires fertilizer and weed control; problems will become serious if action is not taken soon.

Where no attempt was made to control weeds or use fertilizer, woody weeds unchecked by spray or machine in the Ingham area produced growth like that in Plate 9. Sometimes benefits of fertilizer were not obtained because of incorrect weed control. The excessive knobweed in Plate 8 persisted because slashing in 1974 was too late and complete areas were missed with hormone sprayed in 1975. Soil phosphorus was maintained at 20 to 34 p.p.m. between 1973 and 1976, grass and legume persisted although smothered by the knobweed and if weeds had been controlled properly, fertilizer would have been used efficiently.

Native species generally do not respond to fertilizer. On one site assessed as 99% blady grass, broad-leaved and woody weeds, superphosphate raised soil phosphorus from 7 to 33 p.p.m. but there were too few improved pasture species to benefit.

Unsuitable sites and poor establishment

Decline of some pastures can be traced to:

- Inappropriate choice of species
- Incomplete land clearing
- Inaccessibility.

Guinea grass and pangola grass did not grow well on poorly drained sites where para grass would thrive.

Plate 9 illustrates incomplete land clearing. Soil phosphorus was 24 to 30 p.p.m., guinea grass and centro were established years ago and still remained, smothered by pink burr, in 1975. Complete clearing of this site will be necessary before slashers and fertilizer spreaders can be driven safely across the area.

Plate 5. First year—Overgrazed pangola grass with some guinea grass.

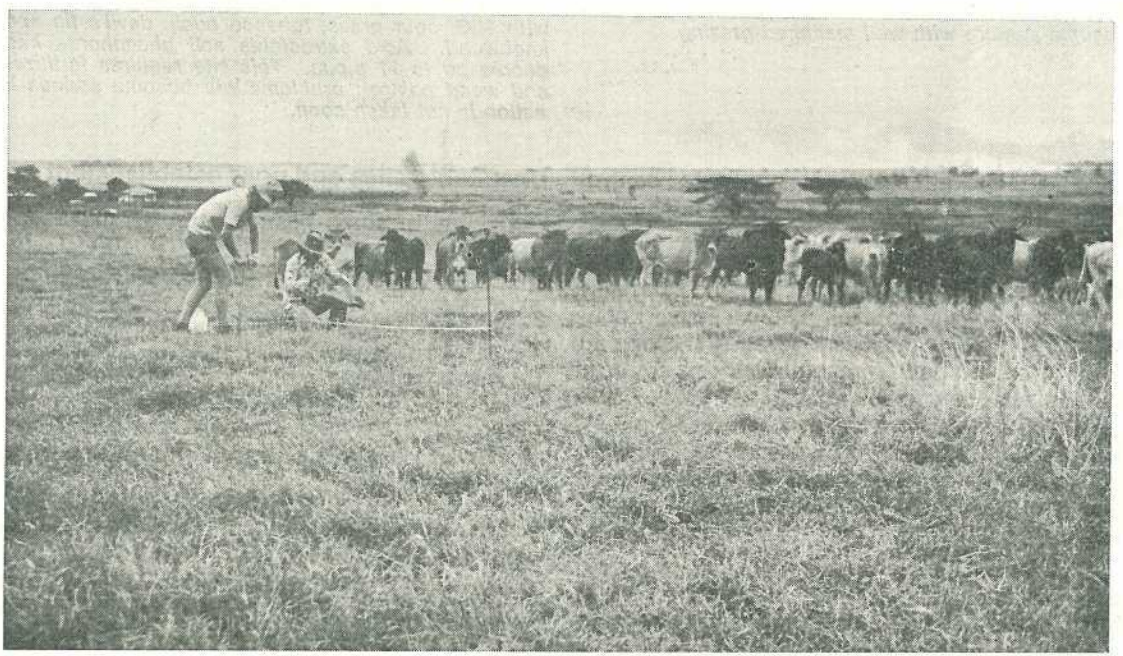
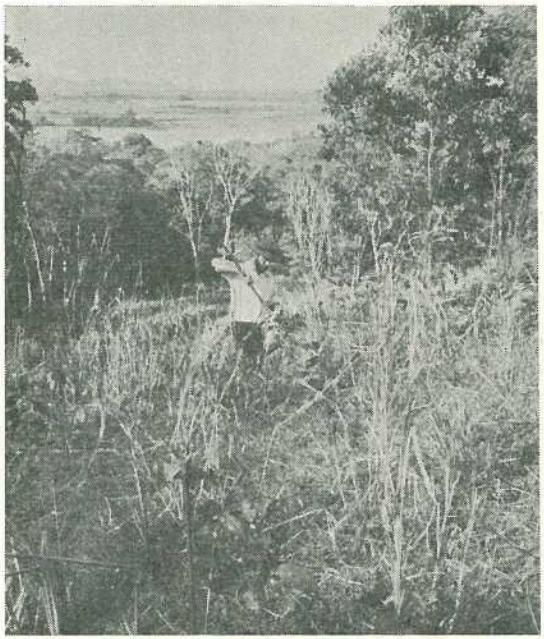


Plate 6. Second year—The overgrazed pasture had been fertilized annually and it recovered. Without fertilizer, weed would probab'y have taken over.

Plate 7. Undergrazing; rank hamil grass with some centro and stylo. Much of this feed is wasted and mustering cattle is difficult.

Plate 8. Guinea grass and centro smothered by knobweed with crotolaria in the foreground. Improved pasture species cannot respond effectively to fertilizer until weeds are properly controlled.

Plate 9. Remnants of guinea grass and centro lost amongst pink burr, fallen timber and stumps. Seed and fertilizer are wasted unless land is properly prepared.



ABOVE. Plate 10. First year—Hamil grass with stylo and centro recently established on an inaccessible ridge.

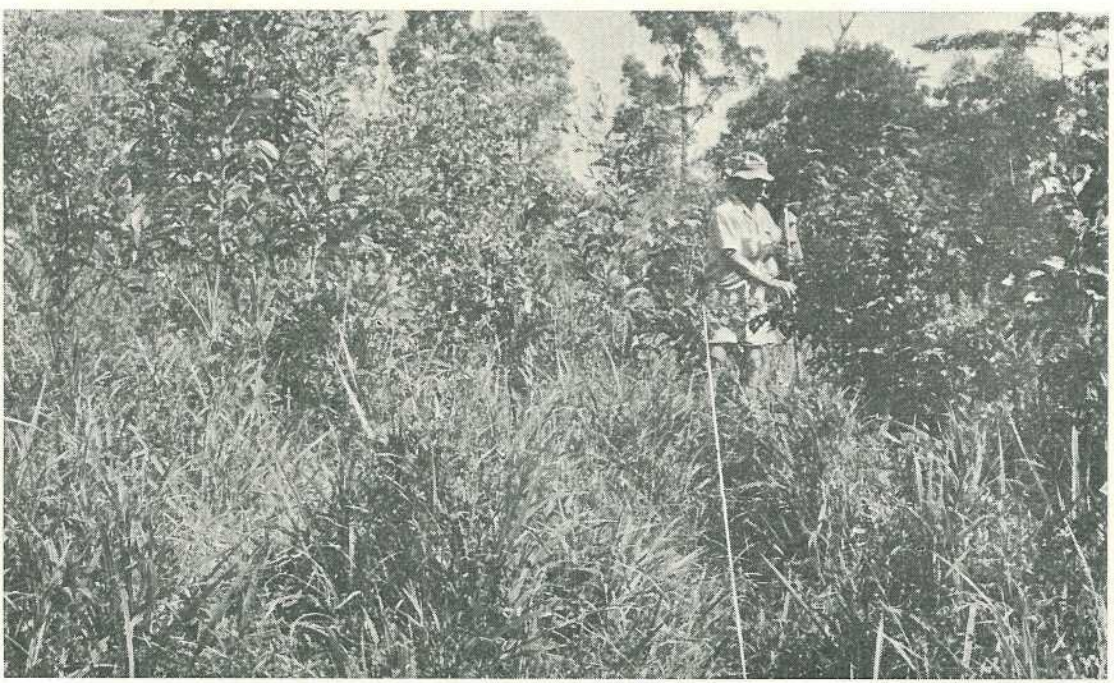
BELOW. Plate 11. The same ridge in later years. Erosion occurred at the top, fertilizer was only spread at the bottom and wattle regrowth flourished.

Plates 10 and 11 show successful hamil, stylo and centro establishment on an inaccessible ridge. Between 1974 and 1976, erosion occurred at the top of the hill, the fertilizer spreader only covered the lower area, and wattle, encroaching in 1975 (Plate 11), continued to spread in 1976. Such sites present hazards to tractor drivers and should preferably remain uncleared.

Uneven fertilizer distribution; inaccurate records

The study revealed uneven distribution of nitrogen fertilizer (Plate 12) and superphosphate. In 1974, the property manager recorded a rate of 250 kg per ha for the pasture in Plate 1 but soil phosphorus analyses indicated that between 320 and 2300 kg of superphosphate per ha had been spread on different parts of the paddock.

In another paddock of 240 ha, no records of sections fertilized were kept. From the rate of superphosphate recorded in the paddock, book increases of between 5 and 10 p.p.m. soil phosphorus were predicted but analysis of soils from different parts measured changes of −8 to +43 p.p.m.



On a property in the Innisfail area, soil analyses verified that part of one paddock had been fertilized twice while the top of the hillslope in Plate 10 had not been fertilized at all; the manager omitted these points from his records.

Before fertilizer is ordered, reliable estimates of areas of pastures are required. At least one property manager spread fertilizer and when this proved too much or too little for a paddock, the area estimate was revised accordingly.

These problems can be avoided by measuring paddock areas and supervising operations, especially in large paddocks of more than 100 ha. Accurate paddock records provide vital information for future planning and for understanding reasons for the success or failure of pastures.

Hints for effective management

This study has suggested guidelines to assist property managers to establish and maintain productive pastures. Managers should:

- Avoid inaccessible areas.
- Ensure that clearing is done correctly, with fallen timber at least pushed into windrows and preferably removed completely.
- Select species suited to the area (for example, para grass for waterlogged soils).
- Obtain reliable estimates of paddock areas.
- Consult the local agricultural adviser for fertilizer recommendations.
- Apply correct fertilizers during pasture establishment.
- Apply adequate maintenance fertilizer.
- Supervise fertilizer applications.
- Be conscious of stocking pressure and grazing management.
- Select the most suitable weed control method and timing. Chemical or mechanical? Spot spray or blanket spray? Roller chopper or slasher? Winter or spring?
- Keep records of management operations.
- Spend limited finance developing 100 hectares thoroughly rather than 200 hectares inadequately.

Plate 12. Inaccurate distribution of nitrogen fertilizer revealed at first by light and dark green grass strips in the paddock. Many cases of uneven superphosphate distribution were revealed by soil analyses during the study.

Soybean varieties 1977-78 season

Compiled by S. R. WALSH, Agriculture Branch.

SOYBEAN varieties recommended for planting in Queensland in the 1977-78 season are listed below.

December is the main planting time, but under some situations this period may be extended from November to January. The crop has critical requirements for cultivation, nutrition, moisture, weed and insect control.

Plant maturity is decreased by shortening day length and the planting rate should be increased with the later plantings.

The planting rates refer to a desirable plant stand; the lighter rates for early sowing and the heavier rates for late sowing.

Late January plantings in coastal regions should be avoided, because of the possibility of rust developing causing severe losses.

Although Semstar is recommended in certain situations, it is highly susceptible to bacterial pustule and wild fire; these diseases may cause yield losses.

Two new soybean varieties, Collee and Flegler, were recently released by the Department of Primary Industries.

Collee

This variety was selected at the Hermitage Research Station from a cross of Hill x Lee made in 1965.

Collee is early maturing and will flower 1 to 2 days earlier than Hill. It has a determinate growth habit with purple flowers and tawny pubescence. The shiny yellow seeds have black hila.

Collee is resistant to shattering, lodging, bacterial pustule and to wild fire. It has a higher protein content and slightly lower oil content than Hill.

Flegler

Flegler was selected at the Hermitage Research Station in 1970 from a natural cross in the variety Patterson.

It has a determinate growth habit with purple flowers and tawny pubescence. Flegler flowers 2 to 3 days later than Bragg. The seeds are yellow with a black hila.

It is resistant to bacterial pustule, wild fire and to shattering.

Limited seed supplies of Flegler will be available for the 1977-78 season.

Region and Shires	Planting Time	Varieties	Planting Rate plants/hectare
Far Northern—			
Cook, Mareeba, Atherton, Eacham, Herberton, Mulgrave, Johnstone, Cardwell, Douglas, Hinchinbrook	Dec.–mid Jan.	Ross	300 000
Northern—			
Dalrymple, Thuringowa	Dec.–mid Jan.	Ross	300 000
		Irrigated	
Ayr, Bowen, Proserpine	Dec.–mid Jan.	Gilbert, Ross	250 000–300 000
Capricornia—			
Livingstone, Fitzroy, Calliope, Broadsound	Dec.–early Jan.	Davis	250 000–300 000
Emerald, Peak Downs, Belyando	Mid. Dec.	Daintree	200 000–250 000
	Mid. Jan.	Wills, Davis	300 000–375 000
	Mid Jan.–mid Feb.	Davis	375 000–500 000

Region and Shires	Planting Time	Varieties	Planting Rate plants/hectare
Capricornia—*continued*			
		Irrigated	
Banana, Duaringa	Dec.	Davis, Bragg, Wills	250 000–300 000
	Early–mid Jan.	Davis	350 000
		For trial	
		Collee	
		Raingrown	
	Dec.	Davis, Bragg, Wills	200 000–250 000
	Early–mid Jan.	Davis	300 000
Burnett—			
Miriam Vale, Kolan, Gooburrum, Woongarra, Isis, Perry, Biggenden, Hervey Bay, part Tiaro, Woocoo	Dec.–early Jan.	Bragg, Davis, Wills *For trial* Collee, Flegler	250 000–300 000
Gayndah, Mundubbera	Dec.–early Jan.	Bragg, Davis, Wills, Collee	250 000–300 000
Monto, Eidsvold	Dec.–early Jan.	Bragg, Davis, Wills, Collee	250 000–300 000
South Burnett—			
Kingaroy, Nanango, Wondai, Murgon, part Kilkivan, part Rosalie	Late Nov.–early Jan.	Davis, Bragg, Semstar *For trial* Collee, Flegler	250 000–300 000
Near North Coast—			
Widgee, Noosa, part Tiaro, Maroochy, Landsborough	Mid Nov.–mid Jan.	Bragg, Davis, Wills	250 000–300 000
East Moreton—			
Caboolture, Pine Rivers, Redlands, Albert	Mid Nov.–mid Jan.	Davis, Bragg, Wills *For trial* Collee	250 000–300 000
West Moreton—			
		Irrigated	
Moreton, Esk, Kilcoy, Boonah, Gatton, Laidley, Beaudesert	Dec.–early Jan.	Davis, Bragg, Wills *For trial* Collee, Flegler	300 000–400 000
		Raingrown	
	Nov.–early Jan.	Bragg, Davis, Wills	250 000–300 000
	Nov.	Collee	300 000–350 000
		For trial	
		Flegler	
	Late Jan.	Davis	350 000–400 000
Darling Downs—			
		Irrigated	
Wambo, Chinchilla	Nov.–Dec.	Davis, Bragg, Collee *For trial* Flegler	300 000–400 000
		Raingrown	
		Semstar	150 000–200 000
		Irrigated	
Pittsworth, Millmerran, Jondaryan, Crows Nest, part Rosalie, Cambooya	Nov.–Dec.	Davis, Bragg, Collee, Hill *For trial*	300 000–400 000
		Flegler	
	Early Jan.	Davis	250 000–300 000
		Raingrown	
	Nov.–Dec.	Collee, Hill	200 000–300 000

Region and Shires	Planting Time	Varieties	Planting Rate plants/hectare
Darling Downs—*continued*			
		Irrigated	
Clifton, Allora, Rosenthal, Glengallan	Nov.–Dec.	Davis, Bragg, Collee, Wills	300 000–400 000
		For trial	
		Flegler	
		Raingrown	
		Collee, Davis, Bragg	200 000–300 000
		For trial	
		Flegler	
	Early Jan.	Davis, Collee, Hill	250 000–300 000
Stanthorpe	Nov.	Collee, Hill, Wills	300 000–350 000
	Dec.	Collee, Hill	300 000–350 000
		Irrigated	
Inglewood	Late Nov.–Dec.	Bragg, Wills, Collee	300 000–350 000
		For trial	
		Flegler	
	Early Jan.	Collee	300 000–400 000
		Raingrown	
		Not recommended	
Near South West—			
		Irrigated	
Balonne	Nov.–early Jan.	Wills, Davis	300 000–400 000
		For trial	
		Collee, Flegler	
		Raingrown	
		Not recommended	

For further information on varietal performance in your district, consult your Agricultural Extension Officer.

A Trap Yard for Cattle

by A. J. ERNST, Beef Cattle Husbandry Branch.

IN areas where cattle water at permanent watering points, trap yards provide an excellent way of reducing mustering costs.

IN the past, trap yards have been used to trap wild cattle. However, they can also be used as a labour saving device to trap quiet cattle. They are also of particular use in inaccessible and difficult to muster country.

The basic idea of the trap yard is to enclose the watering point in a strongly built yard. These yards are often built with cables.

One or two re-entrant funnel-shaped crushes are built into the sides of the yard. These allow cattle movement in one direction only. The first of these crushes allows animals to enter the yard while the second allows the animals to leave the yard. Where only one funnel-shaped crush is used the exit crush is replaced by a gate. The exit crush or gate is normally left open to allow stock to come and go freely.

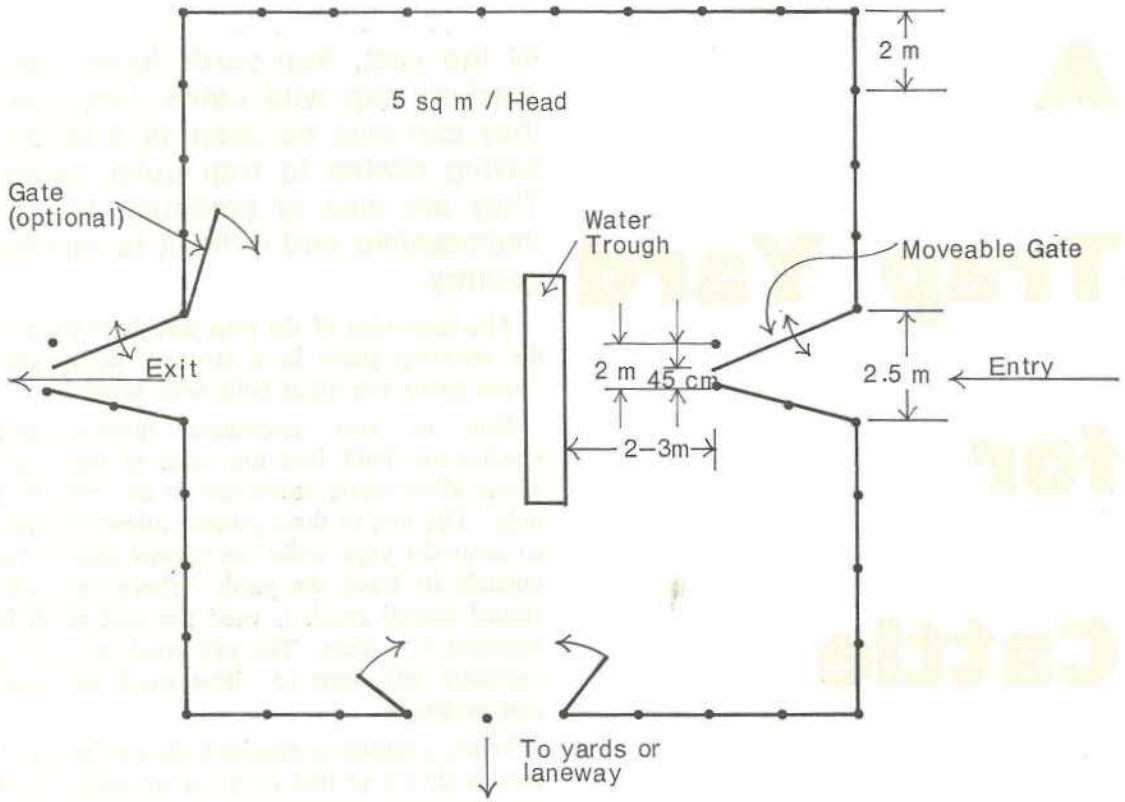
When a muster is required, the exit crush or gate is closed so that once the animals are in the yard they cannot leave. It normally takes 1 to 2 days to trap all the stock depending on the type of country, and time of the year. In the cool months and with some herbage, cattle can spend quite a few days away from water.

The yard

The Layout of the yard is shown in the yard plan.

Details of alternative types of yard panels are illustrated. These panels may have a capping rail. All posts used in the yard should be 20 to 25 cm in diameter. The yard panels may be made of cable, wire or of battens supported by twisted wire. The required strength of the yard is determined by the temperament of the cattle being trapped. Fences do not have to be over-built for quiet cattle.

FIGURE 1. YARD PLAN



Important features which should be considered in building the yard are:

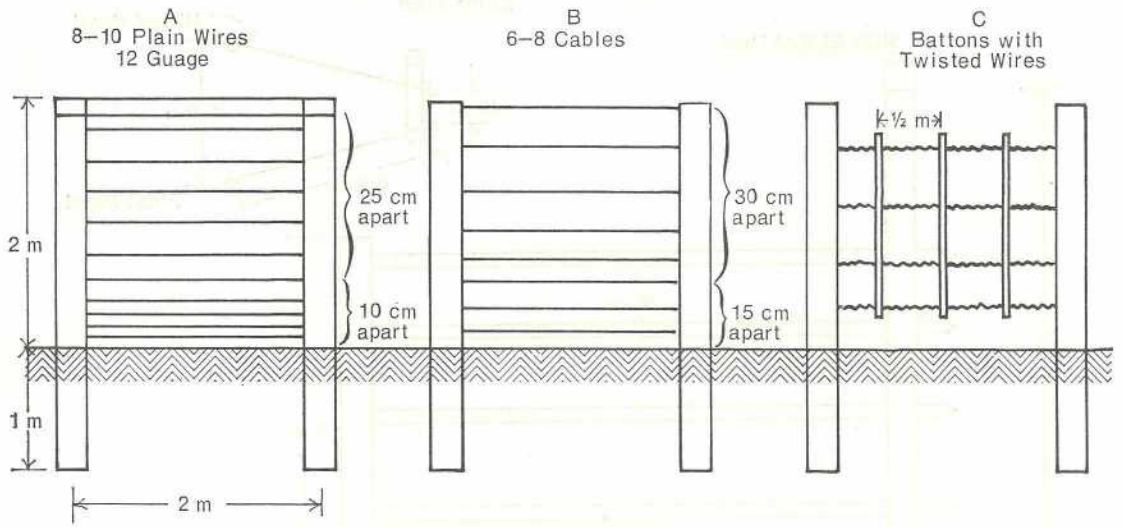
1. The yard should be large enough to provide 5 square metres per beast trapped.
2. The entry and exit crush should be built across the normal pads used by the cattle when they arrive at and leave the watering point. If possible these gates should be on different sides of the yard to avoid congestion.
3. To get the most benefit from the trap yard it should adjoin an existing set of yards, a laneway, or a site where portable yards can be erected.

The trap

The accompanying illustration gives the design for a funnel-shaped trap crush.

The trap funnel consists of one fixed panel on one side and one moveable panel on the other side (normally the one on the right hand side as you look into the mouth of the trap from the outside). The moveable panel is hinged at the yard post. The panels are set so a gap of 45 cm is left between the moveable and fixed panels at the narrow end of the funnel-shaped crush. The ends of the rails of both crush panels are sharpened to a point at the narrow end of the funnel. As the cattle walk through, the moveable gate swings out, allowing the animal free passage.

FIGURE 2. YARD—PANEL DESIGN



After each beast has passed through, the moveable panel swings back into place either by spring action or by a weighted pulley. As the tips of the rails are sharpened and free the cattle are prevented from forcing their way back through the funnel crush. The ends of the rails in the moveable panel can be joined by wire or by a timber batten.

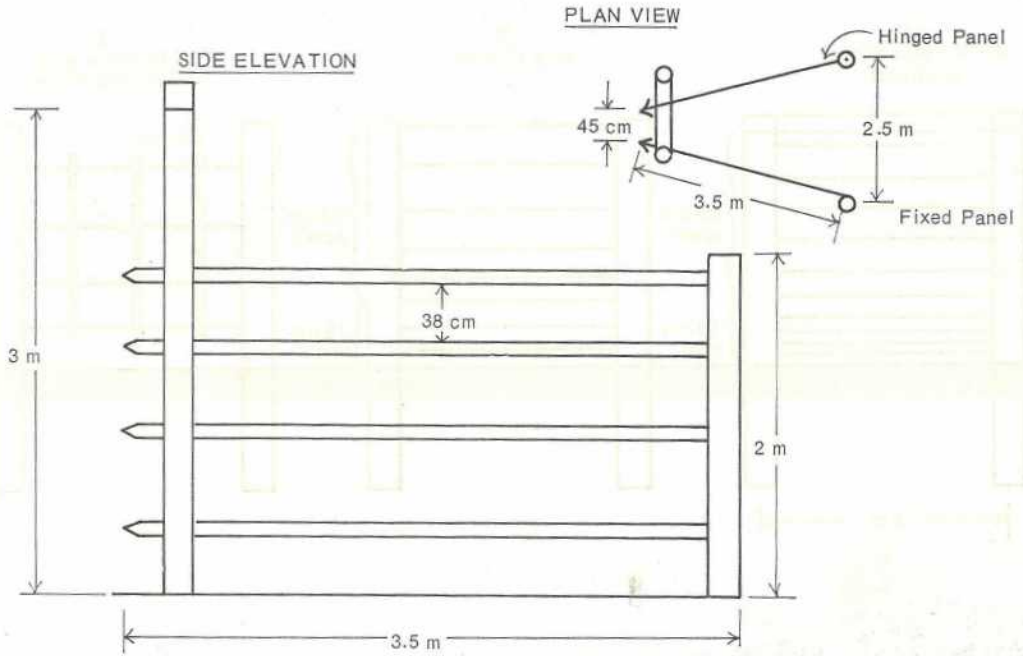
The rails used in the crush should be about 10 cm in diameter. Where only one funnel-shaped crush is used, the narrow end should be within 3 to 4 m of the watering point. This is so animals which normally come and go via the exit gate will be able to find their way to water when their normal pad is blocked by the closed gate. The one crush system has been used successfully on a number of properties. The two crush system is probably the more efficient.

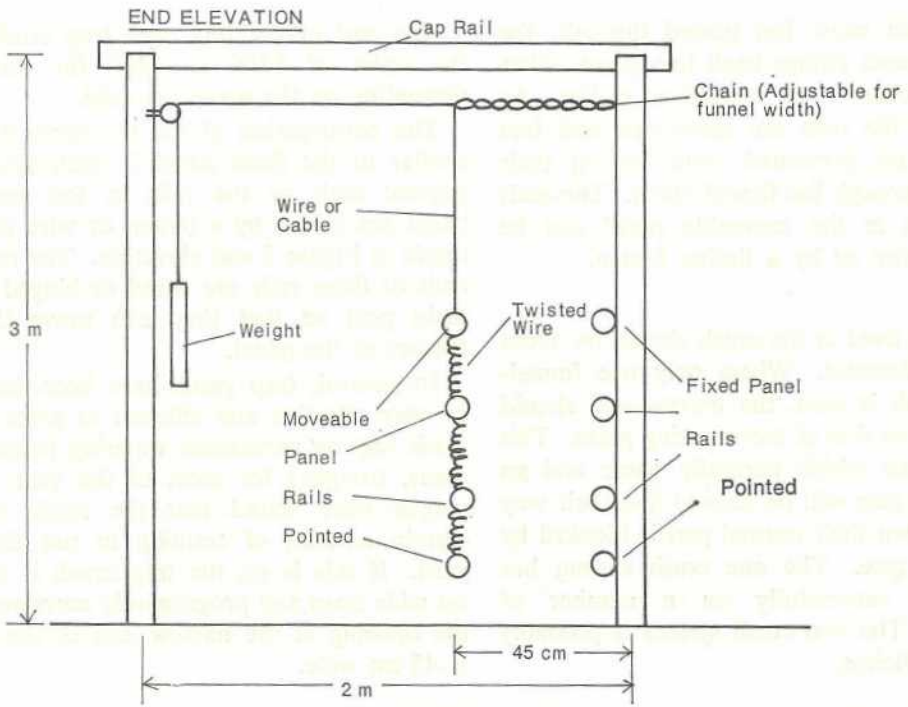
The cost of building each trap crush is in the order of $300 to $400 for materials, depending on the materials used.

The construction of the moveable panel is similar to the fixed panel in materials. The pointed ends of the rails in the moveable panel are joined by a batten or wire as illustrated in Figure 3 end elevation. The opposite ends of these rails are wired or hinged to the main post so that they can move through the arc of the panel.

In general, trap yards have been found to be very effective and efficient in areas where stock rely on permanent watering points (e.g. dams, troughs) for most of the year. Some people have found that the stock need a certain amount of training to use the trap yard. If this is so, the trap crush is initially set wide open and progressively narrowed until the opening at the narrow end of the funnel is 45 cm wide.

FUNNEL SHAPED TRAP CRUSH DESIGN





Cropping in the north-west

Part 4

by E. J. WESTON, Senior Agrostologist and P. C. SMITH, Beef Cattle Husbandry District Adviser.

A STUDY of the use of irrigation water from a shallow storage dam at Richmond has been in progress for some years. Previous articles in this series (*Queensland Agricultural Journal* 1971, 1972 and 1973) dealt with three aspects of the work.

The articles described the history of agriculture in north-west Queensland, the supplementary irrigation of grain sorghum from shallow storage dams, and the theoretical economics of using the products of irrigation to feed sheep for increased lamb marking percentages.

Experience over 8 years has shown that cattle can make good use of forage crops and crop stubbles grown in a shallow storage irrigation system. This article describes their performance on a wide range of forage crops grown within the dam area and on the adjacent area of grain sorghum stubble.

Progressive planting of crops in the ponded area of a shallow dam leads to a range of maturities in the material available for grazing.

Shallow storage irrigation

The Richmond Shallow Storage Research Project was established in 1967 to determine the feasibility of this novel type of irrigation. Unlike conventional irrigation systems, shallow storage involves—

- Ponding shallow water over a large area (50 to 100 ha).
- Planting annual crops, during the most favourable growing period (late summer), on an adjacent area.
- Using furrow irrigation to apply the water remaining after evaporation to these crops to bring them to maturity.
- Planting crops in the saturated soil of the exposed bed of the dam.

On the furrow-irrigated area, water from the dam is applied as supplementary irrigation to grain sorghum. The products of this irrigation are intended for storage, and grain has advantages in handling, volume of storage and feeding out. This crop also provides valuable stubble.

The bed of the emptied dam provides ideal conditions for planting forage crops. Planting of this area is initially carried out at 1 to 3–week intervals as evaporation reduces the volume of stored water. Progressive planting is necessary to take advantage of moist soil as it is exposed. Following the removal of water for furrow irrigation, larger areas of arable land are rapidly exposed.

Little or no preparation of the soil in the bed of the dam has been required. In some favourable seasons, ratoon growth of sorghum will have occurred in the shallowest portions thus reducing the necessity for some planting.

Crops tested in the exposed bed of the dam include grain and forage sorghums, bulrush millet, white panicum, oats, wheat, barley, rape, turnip, cowpea, lablab bean, horse gram, mung bean and safflower. These trials indicated that summer-growing forage sorghum crops provide the greatest quantity of good quality grazing in this situation.

Although forage oats grow well during favourable winter seasons, these conditions occur infrequently. Normally, winter cereals fail to develop secondary root systems and are restricted in their development. Summer species will give greater dry matter yields during the normally mild winters and their growing season is longer.

In 1968, a reasonably favourable season for winter species, oats planted after May produced 2 500 kg dry matter per hectare, compared with 7 000 kg from forage sorghum planted at the same time. Late summer-autumn plantings of sorghum produced 11 500 kg of dry matter per hectare. Subsequently, yields have declined in all species and this is the subject of further investigations. Even with reduced yields, however, satisfactory cattle grazing has been obtained.

Cattle on Mitchell grass downs

A major increase in cattle numbers occurred on the rolling Mitchell/Flinders grass downs when wool prices slumped in the late 1960s and early 1970s. While meat prices have subsequently fallen, cattle numbers may not decline until drought forces this class of animal off the open grasslands. In the meantime, most graziers will take the opportunity to maintain diversified production.

In bountiful seasons, there are not enough sheep and cattle on these open grasslands to eat the available dry matter. In average seasons, native pastures can provide good year-long grazing depending on stocking rate and the conditions experienced in the previous season. Normally, good fattening conditions exist for the first half of the year. In below-average seasons, while very high quality forage is available for a short period, the quantity of feed required to maintain cattle is a major problem.

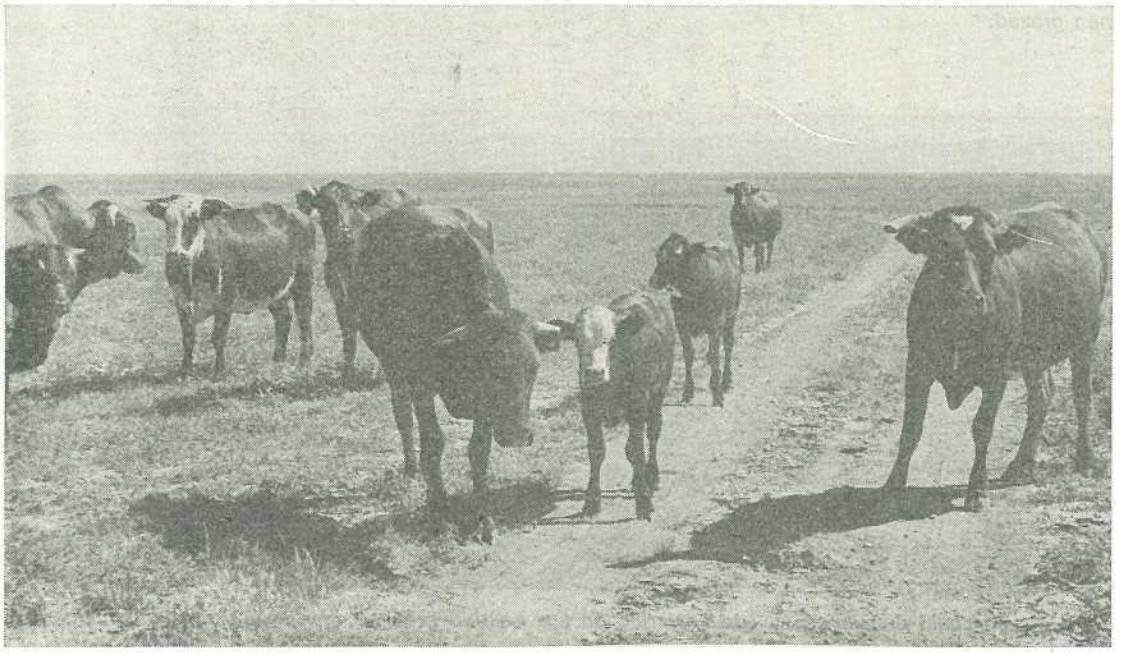
In average and below-average seasons, planted crops become a valuable source of quality forage for finishing or maintaining cattle. Even in very good seasons, forage from shallow dams can be used to bring cattle to market condition at a time when native pastures have lost their quality.

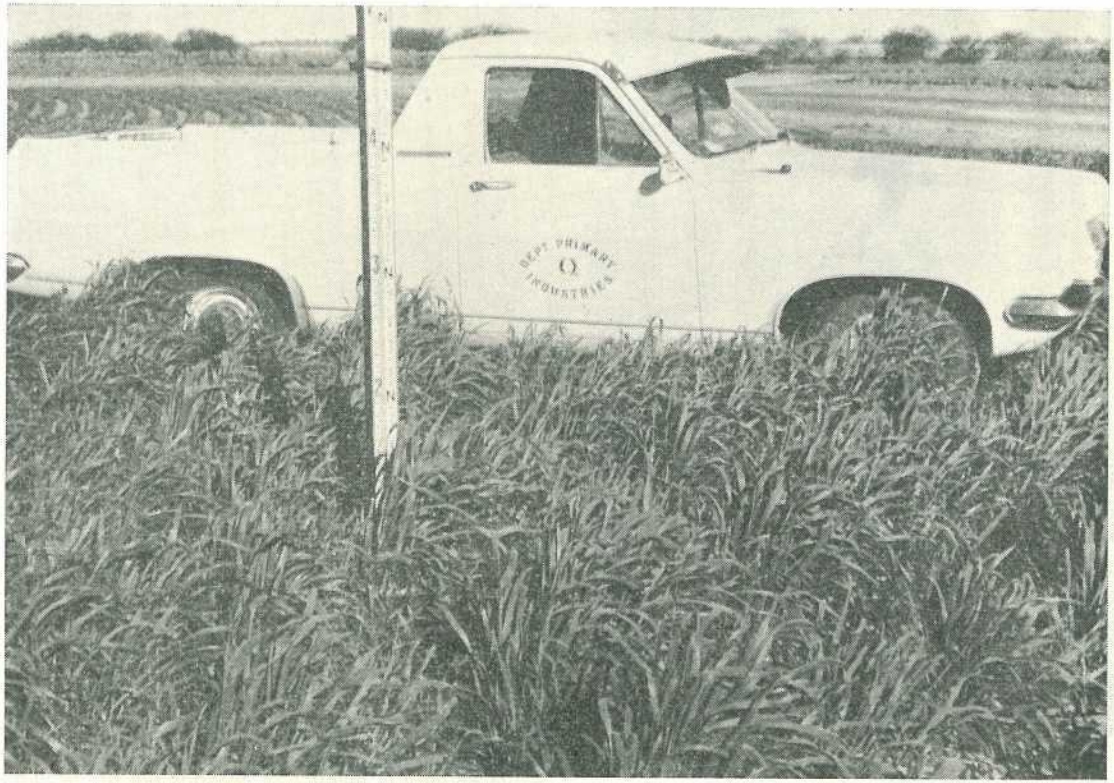
Grazing material for cattle

Five groups of cattle, ranging from 37 to 102 head, have been fattened. Various crops have been planted, the area of each and the range of types changing from season to season.

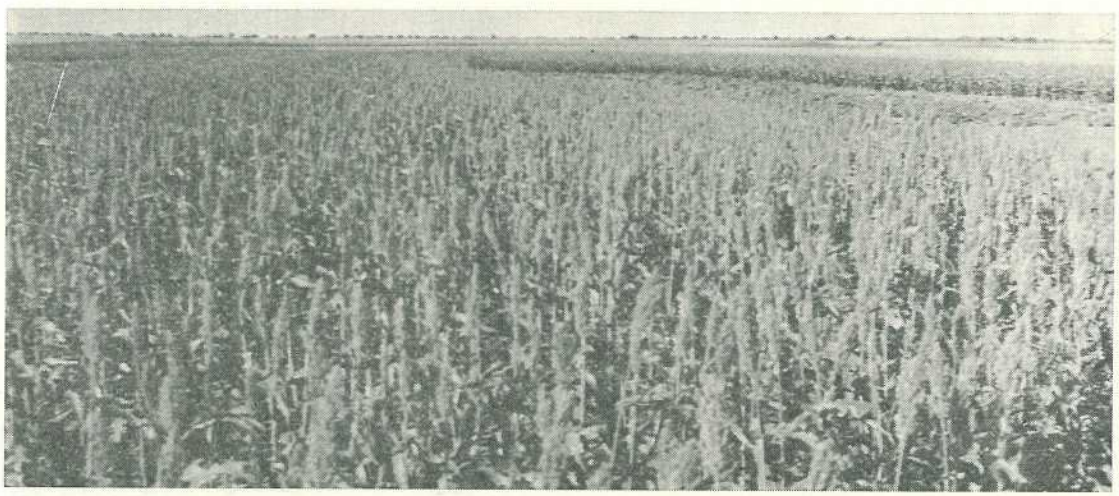
This hybrid forage sorghum crop was made into hay at the preflowering stage. Useful ratoon growth occurred.

Africander-cross cattle on Toorak Sheep Field Research Station. The open grasslands are good cattle country in favourable seasons but the drought problem is accentuated with large animals.

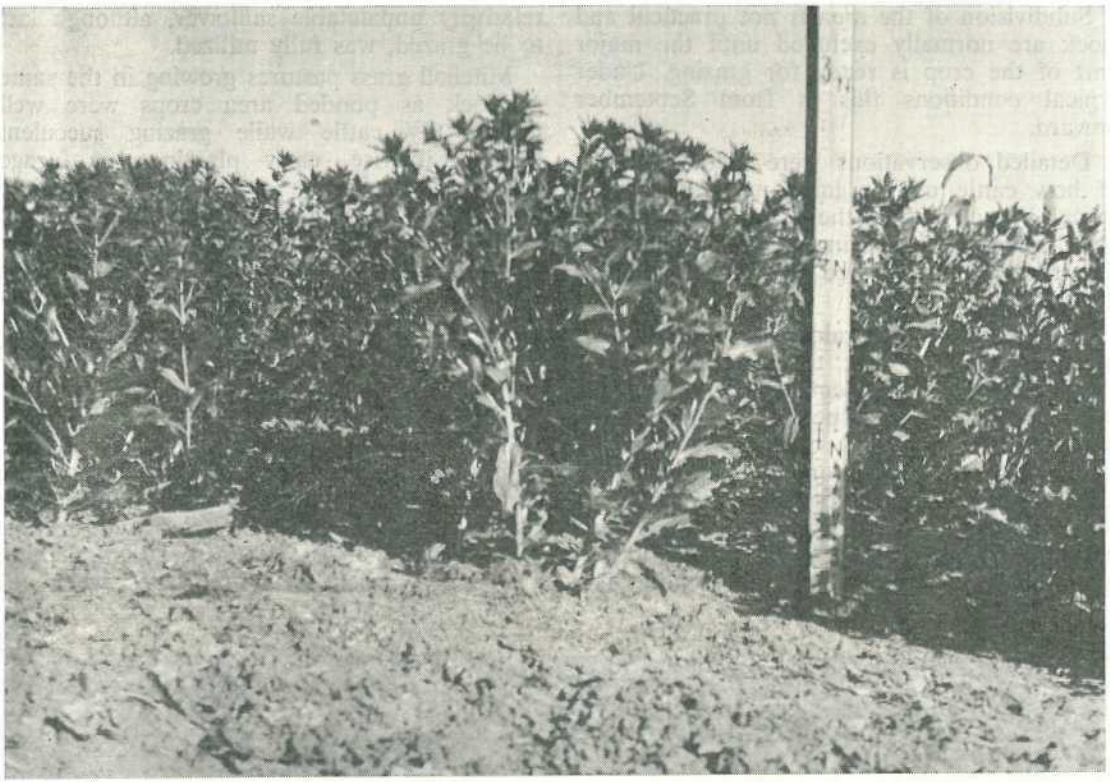




A good stand of forage oats in the foreground with sorghum and pulse crops in the background. Without some winter rainfall, oats will not develop a secondary root system, will yield poorly and pull out when grazed.



This grain sorghum developed well to flowering on the ponded area but grain yield was not high. It is better to plant grain crops on land which can be irrigated by water drawn from the dam.



Safflower grows well in the bed of the dam when water is removed. Although relatively unpalatable, it was all eaten by cattle.

The aim was to measure crop suitability for this particular location, and plant production. Cattle were not restricted in their grazing to any one crop and their overall performance can be related only to the total area of crop available. However, observations on grazing duration and cattle preferences are available.

Native species also contribute to the fodder supply on a shallow dam. Although curly Mitchell grass (*Astrebla lappacea*) is killed by ponded water, it grows well around the perimeter of the dam. The first species to multiply after the construction of the Richmond dam were nardoo (*Marsilea drummondii*) and downs nut grass (*Cyperus bifax*). Some mimosa (*Acacia farnesiana*), prickly acacia (*A. nilotica*) and parkinsonia (*Parkinsonia aculeata*) occurred in the area. Small plants of these species were killed while plants at least half out of the water survived. Subsequently there has been a mass germination of prickly acacia in areas subject to only shallow inundation.

After 7 years, saltbush (*Atriplex* sp.) and rat's tail couch (*Sporobolus mitchellii*) are developing within the dam area and are valuable grazing. Species which contribute little or nothing to grazing are Noogoora burr (*Xanthium pungens*), *Cassia notabilis* and *Psoralea cinerea.*

Cattle grazing observations

A major advantage of both crop residues and ponded area forage crops is that they provide quality feed after native pastures have matured. Grain sorghum stubble from irrigated crops is available within the period July to September. Crops planted in the exposed ponded area have a range of maturities in keeping with the sequential planting which occurs.

Subdivision of the area is not practical and stock are normally excluded until the major part of the crop is ready for grazing. Under typical conditions this is from September onward.

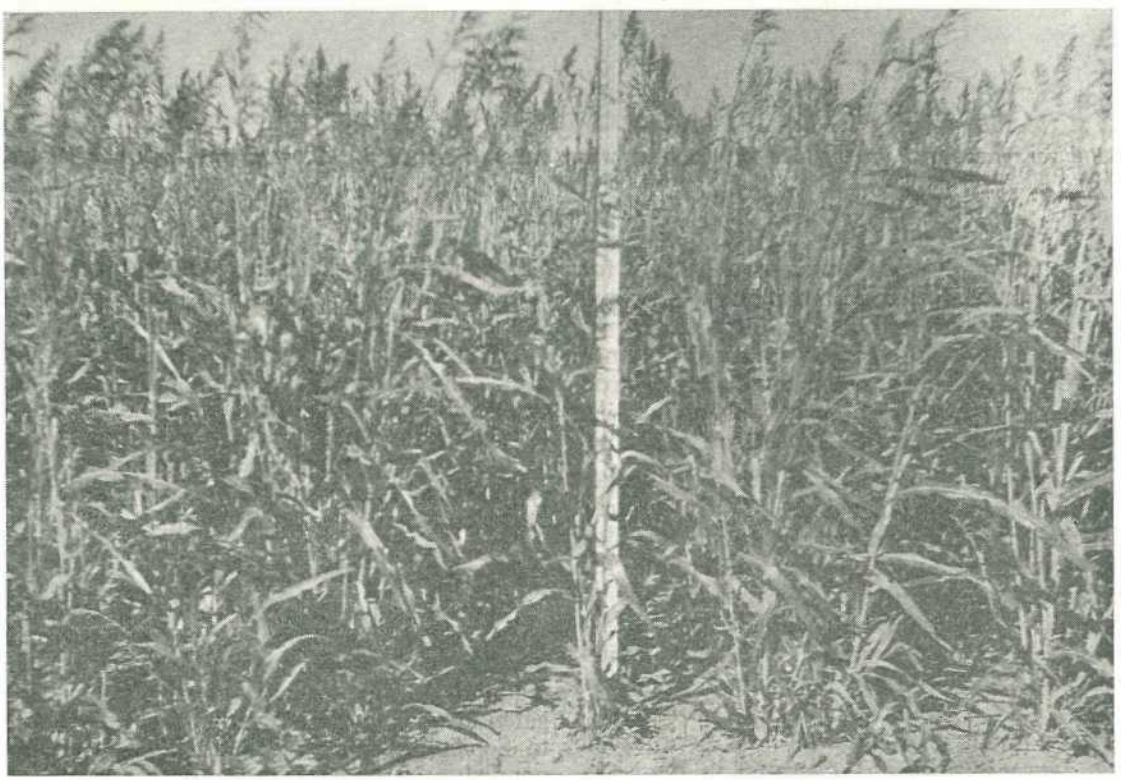
Detailed observations were made in 1968 of how cattle used a large number of crop types. When offered the complete range of plant materials remaining after crop production trials, cattle showed very strong grazing preferences.

Winter forage and grain crops (oats, wheat, barley) were the first to be grazed. They were followed by the legume crops and then the range of sorghum species. During grazing of the sorghum species, cattle were observed to use other available forage for short intervals although ample sorghum remained. It was speculated that these could have been periods of high toxicity as sorghum contains prussic acid at some stages of growth. The relatively unpalatable safflower, although last to be grazed, was fully utilized.

Mitchell grass pastures growing in the same paddock as ponded area crops were well utilized by cattle while grazing succulent crops. Likewise, early plantings of forage sorghum, which were over-mature by spring, were well utilized in conjunction with succulent crop. So too were the native species growing in the dam such as nut grass, saltbush, nardoo and rat's tail couch. While cattle showed a liking for parkinsonia, they exerted insufficient grazing pressure on prickly acacia to control its spread.

Cattle fattening records

During the period from 1967 (when the dam was constructed) to 1974, cattle were grazed each year except 1967–68 and 1969–70. For the first year of cattle fattening (1968–69) when weighing scales were not



Forage sorghums make best use of the available moisture. Yields have declined since 1968 when this crop of Sudax yielded 30 tonnes per hectare of green material.

available, dressed weight estimates were obtained from cattle buyers when cattle were introduced to crop. At the time of marketing, some cattle were killed and weighed locally while others were killed in Townsville and meatworks figures obtained. From 1971 onwards weighing scales were available at Richmond and cattle were weighed at intervals straight out of the crop using a standardized procedure.

SUMMARY OF GRAZING AND WEIGHT GAIN INFORMATION

Season	Peak No. of Cattle	Duration of Grazing	Beast Grazing Days	Pre-Wet Season Live Weight Gains	
				kg/head	kg/day
1968–69	66	25 Sep —31 Jan	7 359	75	0·68
1970–71	80	1 Aug —13 Dec	7 026	52	0·70*
1971–72	67	2 Nov — 3 Mar	7 250	40	0·57
1972–73	102	16 Sep —12 Apr	12 356	48	0·57
1973–74	37	7 Aug — 1 May	7 859	88	0·58

* In 1970–71 cattle on sorghum stubble were supplemented with biuret and grain sorghum.

Because cattle grazing was secondary to the major objective of the project, the same management practices were not adopted each year. Consequently, each year is considered separately.

1968–69. Sixty-six aged cows, initially in poor condition were grazed for 18 weeks beginning in September. After pregnancy diagnosis, some of these cattle were sold 'in calf', some to Townsville meatworks while a few were killed locally. The crop consisted of 20 ha of failed grain sorghum and 50 ha of mixed summer and winter ponded area crops.

1970–71. Up to 80 store steers grazed stubble and ponded area crop for 19 weeks from August to December. The peak number was reached during 4 weeks in October after which 25 head were sold. One group of 40 head grazed 20 ha of grain sorghum stubble for 90 days. These received biuret and grain sorghum as a supplement and gained weight at the rate of 0·7 kg liveweight per day. The ponded area crop of 40 ha contained summer and winter grain and forage crops.

1971–72. Sixty-seven store steers were introduced in November, one draft of 22 being sold after 12 weeks, the remainded after 17 weeks. The crop consisted of 15 ha of grain sorghum stubble and 31 ha of ponded area crop, two-thirds of which was hybrid forage sorghum.

1972–73. One hundred and two store steers were grazed, some of these for 28 weeks, beginning in September. Overstocking led to the early sale of 42 head after 6 weeks. In addition to 16 ha of grain sorghum stubble, 50 ha of predominantly hybrid forage sorghum crop was available.

1973–74. Thirty-seven head of store steers were introduced in August and some were run for up to 38 weeks. The extended period was the result of interruption to grazing caused by flooding of the dam site. Crop area available for grazing consisted of 16 ha of grain sorghum stubble and 45 ha of mainly hybrid forage sorghum on the ponded area.

Conclusions

Budget analyses of the five grazing seasons are not presented because of the atypical conditions associated with experimental work, the mixture of plant materials utilized by cattle and the difficulty of placing a value on the grazing obtained from each of these.

However, in each season, cattle grazing on forage crops grown on a shallow storage system has been practical. Cattle can be bought in the second half of the year at prices attractive to the buyer; alternatively they can be drawn from station-bred cattle.

Cattle on native pasture lose weight from September to the beginning of the summer season (January). These animals do not reach marketable weight until autumn or winter. Cattle on shallow storage forage in the spring period gain liveweight at 0·4 to 0·6 kg per head per day. These gains have proved sufficient to turn off cattle for the Townsville butchers' market during summer when premium selling prices are generally available.

Snake bite

AUSTRALIA has achieved the reputation for being the home of some of the most venomous snakes in the world, and, although there are plenty of highly venomous snakes in all States of Australia they are generally shy and solitary animals that prefer to live where they can find the food they need and the concealment so necessary to their survival.

They do not normally inhabit towns and cities, but prefer areas where they can live undisturbed.

Occasionally someone is bitten by a venomous snake. This often happens in some out-of-the-way place where immediate medical help is not available. So it is important to know how to deal with a bite.

The first, and most important thing to remember is **NEVER PANIC.** Death from snakebite is now a comparatively rare event. If the snake is still attached to the victim it should be removed as quickly as possible. If possible, kill or immobolize the snake for later identification, but do not waste time or endanger yourself trying to do this. If the task is likely to take more than four or five seconds don't waste time with it.

If practical, tie a tourniquet tightly around a single boned part of a limb at a position between the bite and the heart and as near to the wound as practicable. A tourniquet should be about two inches wide if possible.

Wash the wound to remove surface venom and make the victim as comfortable as possible while you send for, or take the patient to medical help. Try to keep the patient calm and at rest, as even moderate activity increases the absorption of venom from the bite. If medical help is delayed and the patient suffers respiratory or heart failure, mouth-to-mouth resuscitation or external heart massage should be applied.

Do not try to lance the site of the bite, for even a fairly experienced first aider can often do more harm than good by severing a tendon, nerve or vein. Although Condy's crystals were once in every snake bite kit they should not be used as a first aid measure. Their powerful oxidizing properties will cause destruction of healthy tissue and the end result is often destruction of a lot of tissue but an insignificant amount of venom.

Cutting out the affected area is another practice that is not now favoured. It both shocks and disfigures the victim without adding much to the prospects of an uneventful recovery.

It is also very important to slowly release the tourniquet for 30 seconds every 20 minutes.

The Queensland Health Education Council.

The honey bee colony

by C. ROFF.

IT is essential for beekeepers to know the composition of a colony and the behaviour of the honey bees.

Successful bee husbandry requires the beekeeper to understand the purpose and timing of management methods.

The nest

Honey bees kept in modern hives are no more domesticated than those occupying nests in nature. In both cases, honey bees live in a nest of comb constructed by workers. The compact, hexagonal-shaped cell design is structurally strong and provides protection for eggs, larvae, pupae and surplus food in the form of honey and pollen.

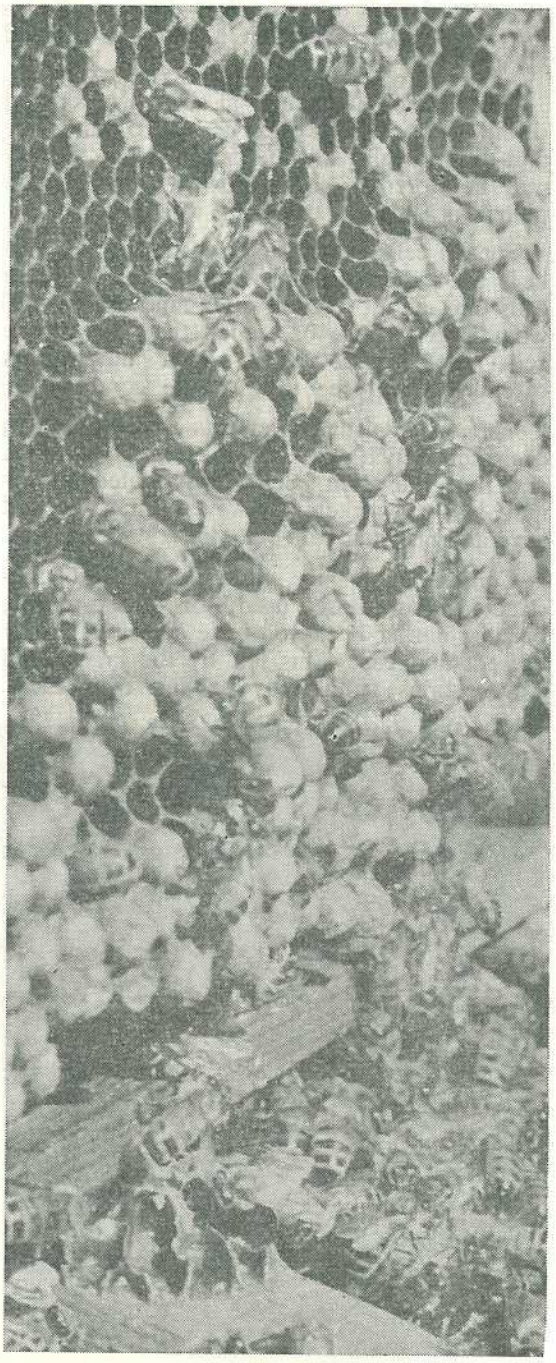
In the wild, the honey bee colony is usually established in hollow limbs or trunks of trees and occasionally in a sheltered rock cavity or hanging from a large limb in the open. In urban locations, cavity walls of houses are favoured sites for nests. Man provides standard-sized homes for honey bees when he keeps them in modern, movable frame hives.

Castes of the colony

A colony of honey bees in the active season (September to March), consists of a queen, several hundred to several thousand drones, many thousands of workers, and brood (eggs, larvae and pupae) in all stages of development. The various castes (queens, drones, workers) are so highly specialized that none is capable of maintaining or establishing a nest alone.

The honey bee nest has often been described as a living organism with individual bees as component cells which are replaced as they wear out. The nest comprises a number

Mr. C. Roff, formerly an officer of the Apiculture Section of the Department's Entomology Branch, is now Fauna Management Officer, Queensland National Parks and Wildlife Service.



Sealed drone cells—late larval to pupal stage of development.

of combs about 7·9 mm apart, made up of six-sided cells constructed from beeswax, a product of their own bodies. Hive temperature during wax secretion is between 35 and 37° C.

Cells are of two principal sizes, worker and drone cells. Worker cells are 5 mm wide and drone cells are 6·25 mm wide. Honey may be stored in both types of cells although pollen is mostly stored in worker cells.

Special cells are constructed in which queen bees are reared known as queen cells. These cells are about 25 mm long and are somewhat larger at the base than the tip. Queen cells are worker cells which have been extended down the face of the comb.

The queen usually deposits a single egg in each cell which develops to a larva, a pupa, and then the adult bee. Newly-mated queens and laying workers, however, may deposit several eggs in a cell.

Combs are nearly white when first constructed but those used for brood-rearing become darker because of the accumulation of excreta and cast skins left by the larvae and travel stains from bees passing over them.

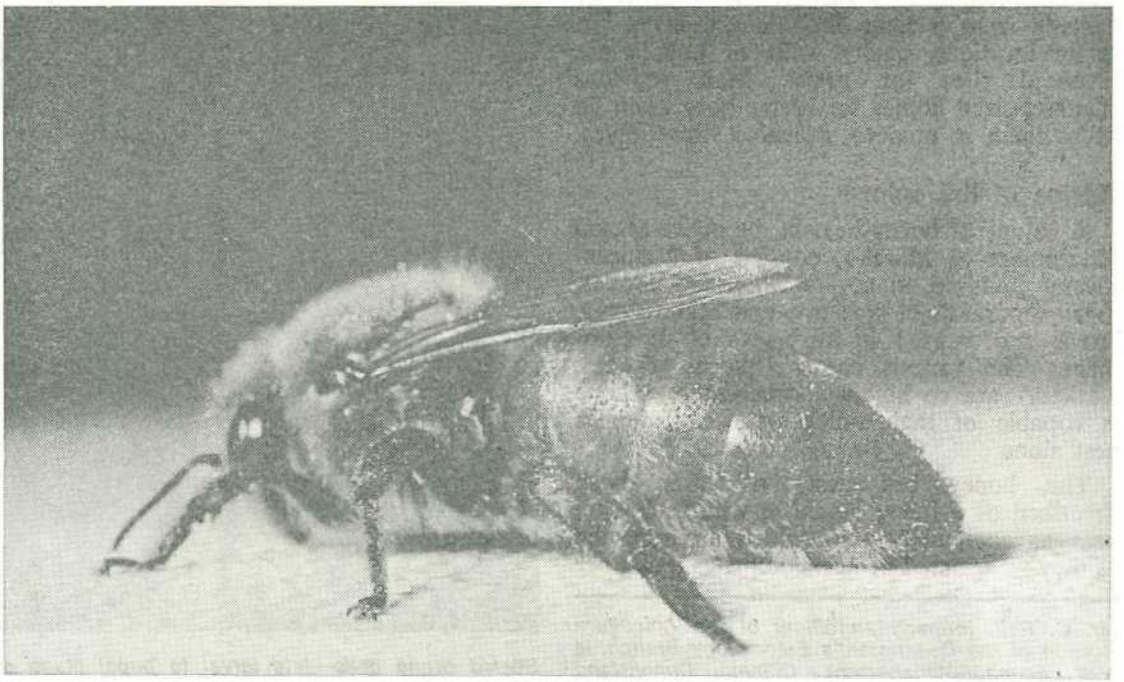
Brood cappings, light brown in colour, are constructed from pieces of wax taken from various other combs. They are combined to form a porous cover through which the developing insect can breathe. Whitish cappings over honey are usually made from new wax. Eventually these may become travel-stained.

Cells are never completely filled with pollen, and are not capped unless the pollen is covered with honey which acts as a preservative.

Queen bees

The longest bee in the colony is the queen and she is required to be a prolific egg-layer if a colony is to be strong and efficient. She is an egg-laying machine and may lay about 1 200 eggs in twenty-four hours for a short period under favourable conditions. When food is scarce or conditions are cold, egg-laying may cease.

Queens are reared under three conditions, supersedure, swarming and queenless-ness. The queen is the only member of the colony capable of depositing eggs which have been fertilized by drone spermatozoa.



A queen bee.

Queens develop in special large cells which are constructed as required then dismantled shortly after being vacated. However, bees regularly partly construct queen cells and demolish them without ever developing a queen in them. These dismantled cells are known as dummy queen cells.

The queen emerges by cutting her way out of the cell with her mandibles. She may help herself to some honey but she does not appear to take pollen. Occasionally, she will solicit food from workers. When mated, workers feed her with large quantities of brood food.

If another virgin queen emerges, a battle ensues until one of the queens is stung to death. If the virgin comes across any other sealed queen cells she will destroy them by attacking at the base of the cell and tearing a hole in it.

Even when they are still in the cell prior to emergence, virgin queens make a curious shrill sound called 'piping'. An old queen prior to swarming will 'pipe' when adjacent to a queen cell. The manner in which this noise is made is not fully understood; it may be due to the forcible expulsion of air through the breathing spiracles or to the vibration of small plates at the wing bases.

After several days, the queen will take orientation flights. She will gradually extend the distance and time she is away from the hive. Queens take one or more mating flights and have been known to mate when only four days old; some take up to sixteen days. The usual time appears to be between six and ten days. She may mate from one to ten times on such flights, and seldom leaves the hive after commencing to lay eggs, except to accompany a swarm. Mating takes place on the wing between 6 and 60 metres above ground level.

It was once accepted that the presence of the drone organ attached to the queen indicated that she mated only once. Actually, this mating sign becomes detached readily from the queen and she then successfully mates with other drones.

After mating, the workers in the colony pay great attention to the queen, continually touching her body with their antennae, and also licking her. Pheromones from her mandibular glands, referred to as queen substance, serve to integrate the colony.

After mating, the abdomen increases enormously in size and three or four days later she commences egg-laying. A brood area is maintained by the workers at a temperature of between 35 and 36·5°C, and it is in this area that she lays.

The queen does not lay eggs in concentric circles, she lays in the brood area at random, constantly recrossing her tracks. She lays unfertilised eggs in drone cells and fertilised eggs in worker cells.

As she is laying, young household bees form a circle around her and constantly attend to her needs such as grooming, feeding and removing faeces.

A queen may live 6 to 7 years and lay as many as 600 000 eggs during her lifetime. Maximum egg production occurs during the first two seasons when she may lay at the rate of 200 000 or more a year.

Eventually, in natural circumstances when the queen begins to fail, she is superseded by one of her own daughters especially reared for the purpose. Supersedure activity is started when the queen stops producing glandular pheromones.

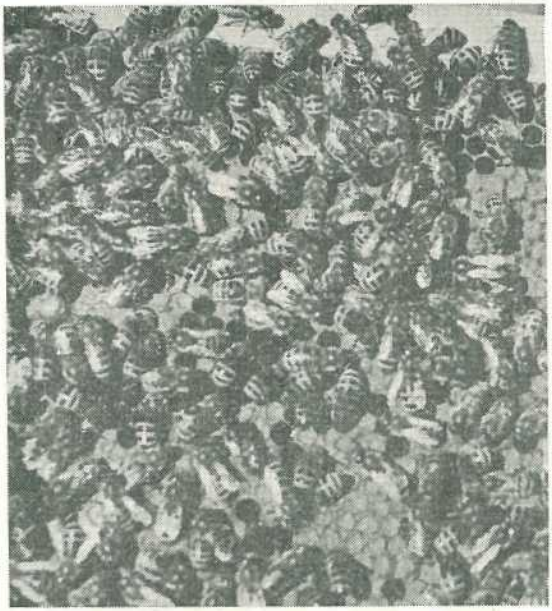
The queen possesses a sting which does not have barbs and is seldom used apart from destroying a rival queen.

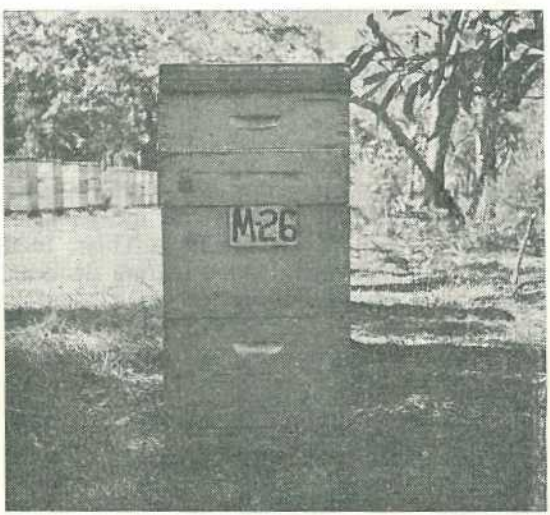
Drones

The drones are the male bees. They do not have stings, nor do they perform hive duties. Structurally, drones are incapable of collecting food in the field. Their food supply is stopped when brood rearing slackens. This occurs in late autumn or when a dearth period is experienced. In the hive, they are fed by worker bees.

Because of limited food stores, drones are not maintained in the hive during winter. When weakened, their wings may be torn-off by the workers, their legs pulled and eventually they will be dragged out of the hive. Also, drone larvae and pupae are sometimes removed from the hive.

Their definite function is to mate with a virgin queen on a mating flight. When about ten days old they are capable of impregnating a queen. This takes place outside the nest in the air (6 metres or higher) and the successful drone dies following the act.





Copulation may take place up to 12.8 kilometres away from the hive and there is considerable evidence to suggest that drones frequent drone congregating areas. A pheromone produced by the drones may identify such an area.

Drones contribute to the natural equilibrium of a colony and hives from which drones have been artificially trapped and removed during principal brood rearing periods do not prosper as well as those with a relevant complement of drones.

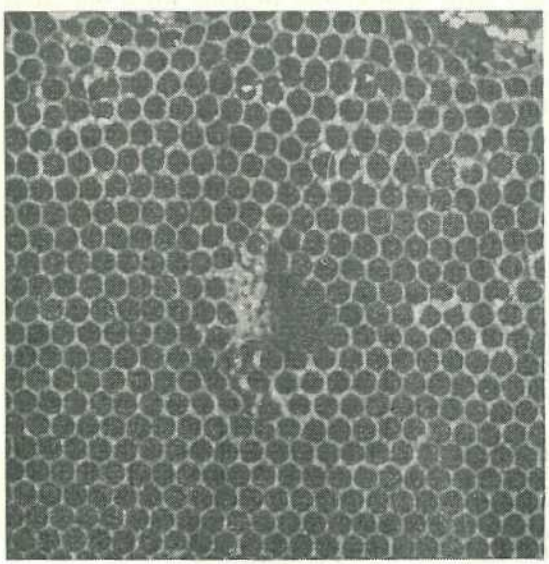
Drones that drift into a strange hive when nectar and pollen are abundant often are not attacked and are permitted to stay.

Worker bees

At the peak of the season, the colony may consist of anything from 30 000 to 80 000 worker bees.

The worker gnaws through the cappings of her brood cell with her mandibles and after emergence is easily recognizable by her bedraggled appearance and weak condition. After a few days she grows considerably larger, and her appearance is bright and fresh.

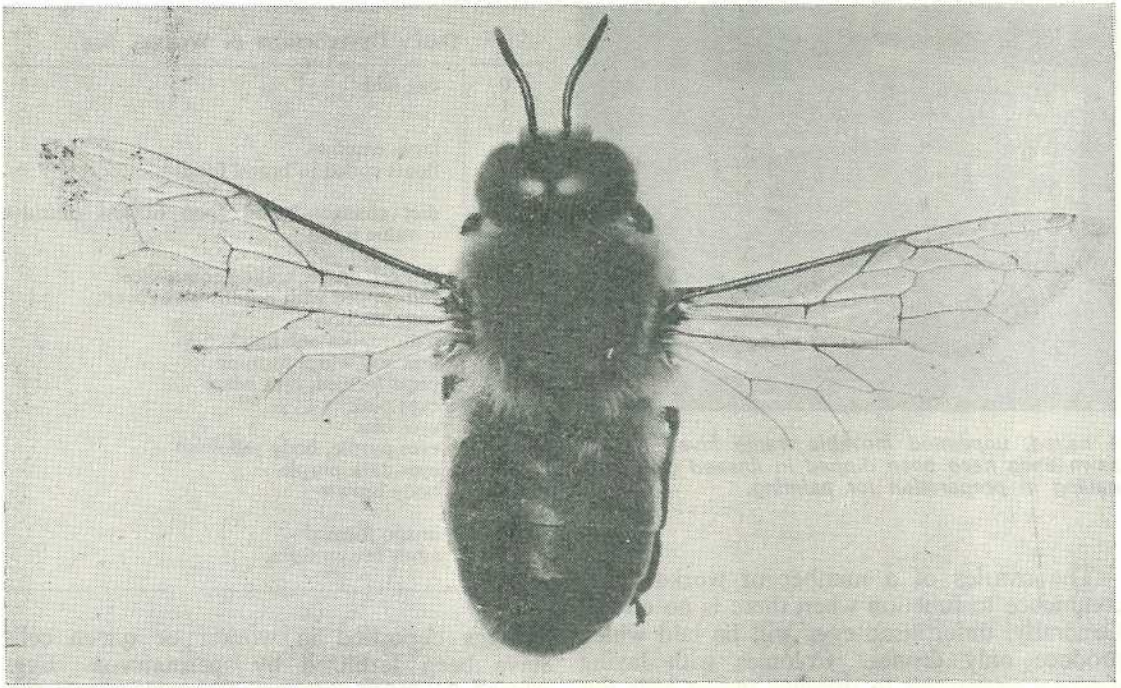
The life-span of the worker is short if she is required to work a winter nectar flow.



UPPER. Worker bees on sealed brood.

LOWER. A well established hive displaying a registered brand number.

RIGHT. A dummy queen cell.



A drone.

Workers reared in spring and the early part of summer live about 25 days while those bred at the close of summer and early autumn survive for about 56 days over the winter period. Workers reared in late summer and autumn often die quickly when working pollen-short autumn and winter nectar flows. Those surviving winter often succumb naturally during early spring. A worker bee's life span is related to the condition of her wings which wear out quickly during a busy season.

The worker is a modified female bee and performs the work of establishing and maintaining the colony. She gathers nectar, pollen, propolis and water, builds combs, controls the hive temperature, attends the queen, produces brood food, nurses the brood, cleans the hive, resists diseases, ripens and stores honey and protects the nest against intruders.

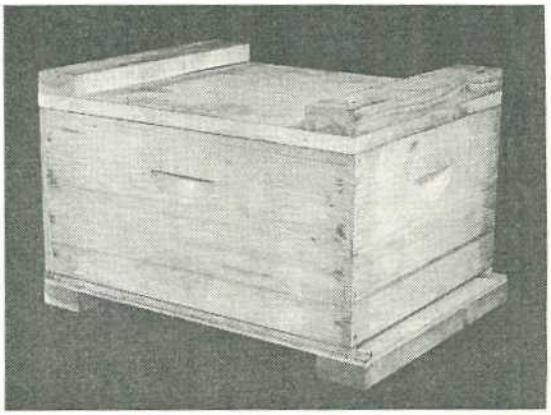
The worker is well equipped to carry out these duties. She has a honey sac in which to carry nectar and water and a large receptacle on each hind leg to carry pollen. The worker bee possesses an efficient navigational system and has developed a method of communicating the locations of nectar and pollen sources to other worker bees of the colony. Her wax glands provide nest building materials while other glands provide brood food. By working together worker bees are able to lower or raise the temperature within the nest.

The worker bee possesses mouthparts with a wide variety of functions. She also possesses genetical and chemical factors that assist her to resist disease. She has a scent gland that secretes an identification odour, and a sting to protect the nest from enemies.

A worker's sting can be thrust into other insects repeatedly; when the sting pierces the skin of a warm-blooded animal, however, barbs hold it fast and it is usually torn from the bee, resulting in her death.

Laying workers

When the colony does not have a queen, the development of laying workers may depend on two factors, a nutritional influence and the absence of an inhibitory pheromone derived from the queen.



A nailed, unpainted movable frame hive. All the sawn ends have been dipped in linseed oil before nailing in preparation for painting.

The ovaries of a number of workers will commence to function when there is no queen. Generally, unfertilised eggs will be laid which produce only drones. Colonies with laying workers endeavour to produce queen cells but rarely is a female bee produced. Abnormality in the division of chromosomes (meiosis) may result in the development of a female bee from an unfertilized egg. This occurs about one in a thousand in unfertilized eggs.

Brood

In Queensland, the active period may extend over the greater part of the year, particularly in the tropics. During this period, there are all stages of developing bees (brood) in addition to adult honey bees within a colony. All castes pass through four stages; egg, larva, pupa and adult. Each caste has a different time to complete their stages of development.

STAGES OF DEVELOPMENT IN DAYS

—	Egg	Larva	Pupa	*Emergence
Queen ..	3	5·5	7·5	16
Drone ..	3	6·5	14·5	24
Worker ..	3	6	12	21

* Emergence times vary slightly depending on colony strength, temperature and availability of food.

DAILY DEVELOPMENT OF WORKER BEE

0–	egg laid
1–	
2–	
3–	larva emerges
4–	floats coiled in brood food
5–	
6–	diet change—brood food of less nutritive value is fed
7–	
8–	fills cell space, sealing commences
9–	cell capped with porous wax cover
10–	spins cocoon
11–	mature, lies outstretched
12–	legs and wings forming
13–	pupa formed, eyes white
14–	eyes pink
15–	eyes lilac
16–	eyes purple, body yellowish
17–	eyes dark purple
18–	body brown
19–	
20–	imago formed
21–	adult bee emerges

Eggs deposited in worker or queen cells have been fertilized by spermatozoa. Eggs placed in drone cells are unfertilized and this method of development is called parthenogenesis. Accordingly, drones have no male parent and only carry the hereditary features of the queen.

Larvae on hatching are provided with an abundant supply of brood food in which they float. The food of newly-hatched larvae is royal jelly. Those in queen cells receive an abundance of this food throughout their feeding period while the diet of those in worker and drone cells is changed to honey and pollen on the third day of feeding.

Legless honey bee larvae do not leave their cells during development. At the end of the feeding period, adult house bees fix porous wax cappings that seal the cells containing mature larvae.

Cappings of sealed worker brood are slightly raised while those of the drone brood are dome-shaped.

After sealing, larvae spin cocoons which line the insides of the cells, then stretch out and pupate. During growth, each larva sheds its skin (moults) five times. The last moult produces the pupa, which moults once before the adult bee emerges from its cell.

Dehorning beef cattle

by A. J. ERNST, Beef Cattle Husbandry Branch.

HORNS cause large losses to the beef industry each year through bruising.

Over half of the beef cattle marketed in Queensland have horns. In excess of $17 million worth of meat is bruised each year. This is caused mainly by horned cattle.

A series of five trials have examined the problem of bruising with horned cattle. In these trials, groups of horned, polled and mixed horned/polled groups have been used. The mean weight of bruised tissue trimmed from carcasses in the horned groups was 1·9 kg. There was only 1·1 kg of trim in the polled group. This is a difference of 0·8 kg per head.

When horned and polled animals were mixed, the polled animals had 0·44 kg more bruising than a group of all polled animals. The horned animals in the mixed group had similar bruising to the all horned group.

From this, the losses due to horns are obvious but what are the effects of dehorning? Trials with adult cattle show that dehorning or tipping depresses liveweight performance. This occurs in the month after the operation and performance from there on is similar to horned cattle. The total effect is about 4 to 5 kg of carcass.

However, although the loss due to bruising is less than the performance loss, trimmed carcasses may be down-graded as well. The effect on liveweight when animals are dehorned at younger ages is less.

Trials with 7 month old weaners have shown that the depression in liveweight of these younger animals is one-quarter of that of adult cattle. There are further indications that these young cattle may compensate for this reduced growth over the following months. However, there are many other advantages of dehorning.

With over 50% of beef cattle marketed in Queensland still with horns there is much room for improvement.

What are the advantages?

- A reduction in bruising losses is the main advantage but there are others.
- Dehorned cattle will travel better over greater distances.
- More polled cattle will fit in a truck or rail wagon without over-crowding. This provides a saving in freight costs.
- Dehorned cattle are quieter, easier and safer to work in yards.
- When cattle are being fed in a feed lot or during periods of drought, less trough space per beast is required for dehorned animals.

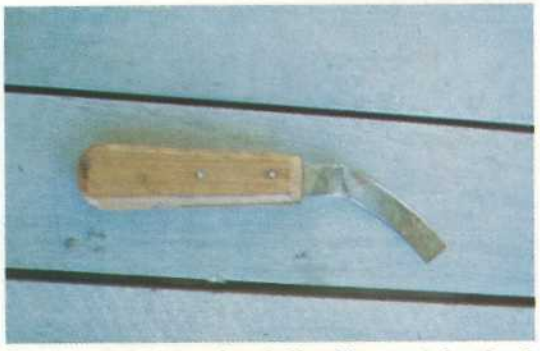
What are the disadvantages?

- There is a depression in the liveweight performance of cattle following dehorning. This depression is insignificant in calves and is outweighed by the many advantages of dehorned cattle.
- Concern over the time and trouble involved in dehorning.
- Fear of losses due to infection. The risk of infection can be reduced by placing the dehorning instrument in a bucket of antiseptic solution after each beast is dehorned and avoiding very dusty conditions.
- Fear of losses due to flystrike. Every attempt should be made to avoid hot, wet weather and times when flies are active. Some cattlemen take the added precaution of applying a commercial fly dressing to the wound while others declare this unnecessary.
- The slightly gory nature of the operation. No treatment is required for bleeding which may be quite extensive with older cattle, as the frontal sinus is often exposed. Cattlemen who regularly dehorn their calves have found that losses are negligible or non existent, the operation is easy and takes very little time.

Over half of the beef cattle marketed in Queensland have horns (plate 1).

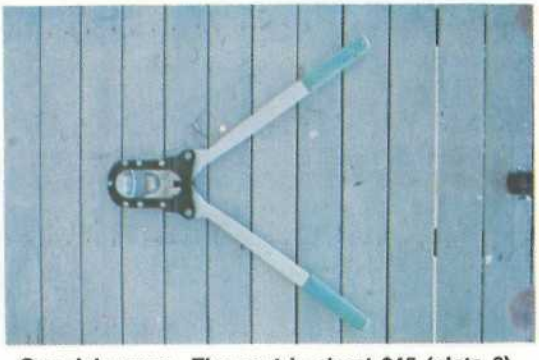
Horns can result in bruising which means heavy losses due to trimming (plate 2).

Polled cattle do not have as much bruising. As a result, they produce better carcasses (plate 3).



One type of dehorning knife. The cost is about $7 (plate 4).

A dehorning knife in action. This knife is very suitable for young calves (plate 5).



Cup dehorners. The cost is about $45 (plate 6).

Cup dehorners can be used with animals up to 12 months old (plate 7).

With older cattle, cup dehorners should be held down on to the horn (plate 8).

Scoop dehorners. The cost is about $40 (plate 9).

Scoop dehorners in action (plate 10).

Note the ring of hair around the base of a correctly removed horn (plate 11).

When dehorning older cattle, the sinuses in the horn base become exposed (plate 12).

Time is important

Cattle are best dehorned as calves, 2 to 4 months old. At this age, the operation is easy and there is little risk of flystrike. For this reason, branding is an ideal time for dehorning. If time does not permit or any calves are missed at branding, weaning is not too late for dehorning.

Three methods of dehorning

There are three main methods of dehorning cattle under one year of age.

- Dehorning knife
- Cup dehorners
- Scoop dehorners

All are equally effective when performed correctly.

Dehorning knife

Any sharp knife will do but the curved dehorning knife illustrated in Plate 4 has an advantage. The ideal time to use the knife is while the calf is in the branding cradle.

Hold the knife as shown in Plate 5 and start the cut 2 cm away from the base of the horn. Draw the knife through the skin, cutting off the horn level with the skull. This will remove an eliptical piece of skin with the horn in the centre.

If the cut is less than 0.5 cm from the horn, cut off a bit more skin to ensure that there is no horn-forming tissue left. If any horn-forming tissue is left behind, a scur may develop.

The operation requires a firm, swift cut. The lower horn may be done by twisting the calf's head into a vertical position to allow easy access.

With a little practice, it is a simple, quick and neat way to dehorn calves under 4 months old.

A dehorning knife similar to that in plate 4 costs about $7.

Cup dehorners

Cup dehorners (see plate 6) act like a pair of shears. The dehorners are placed over the horn (plate 7) and the handles closed by applying firm pressure. Again it is important to remove an area of skin and hair of about 1 cm around the base of the horn. This method may be used with animals up to 12 months of age.

With the older classes of animals, it may be necessary to have an assistant press down on the top of the dehorners as in plate 8 and help to restrain the calf's head. This stops the dehorners riding up the horn and ensures all the horn-growing tissue is removed. It further ensures a neat result. The operation may be performed in the branding cradle or the head bail. Cup dehorners cost about $45.

Scoop dehorners

Scoop dehorners are illustrated in plate 9. The dehorners are worked by pressing them down vertically over the horn. The handles are then pushed outwards with strong pressure (plate 10) to remove the horn base. An assistant may be required to help restrain the animal's head. Scoop dehorners cost about $40.

Important

With all three methods, once the horn is removed there should be a ring of hair and skin, as in plate 11, around the base of the horn. If this is not present, unsightly scurs may develop. Alternatively, the situation may be rectified by trimming the area with a sharp knife.

Plate 12 shows the wound which remains and the open sinuses which occur with older animals.

Summary

- Use a dehorning knife for animals under 4 months of age.
- Use either cup or scoop dehorners for animals up to 12 months of age.

Cattlemen who are practised in using any of these methods have found them quick and effective with few animals developing scurs or becoming infected.

Dehorning must be a worthwhile practice.

Project tick control

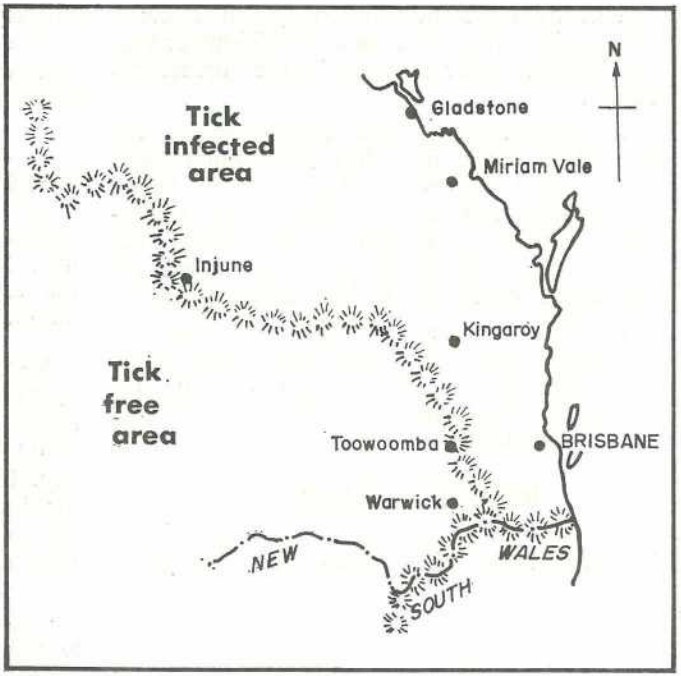
Compiled by R. T. POWELL, Information and Extension Training Branch.

PROJECT TICK CONTROL is designed to help beef cattle producers in south-east Queensland where the tick problem costs the industry about $13 million a year.

However, the recommended tick control measures based on tick-resistant cattle, strategic dipping and pasture spelling generally apply to all tick-infected areas.

Information in this publication has been compiled from research work conducted by both the C.S.I.R.O. and the Queensland Department of Primary Industries. Any enquiries concerning tick control in cattle should be directed to Department of Primary Industries advisory officers in local areas.

Further information on this subject is to be found in 'Cattle Ticks in Australia' from the Cattle Tick Control Commission Inquiry—Report 1973. This book is available from the Australian Government Publishing Service, P.O. Box 84, Canberra, 2600. The price is $2.80 plus 60c postage to Queensland.



THIS article is part of an extension programme on cattle tick control in south-east Queensland, covering the area from Miriam Vale to the border and west to the Great Dividing Range.

The control programmes described are based on tick-resistant cattle, strategic dipping and pasture spelling. They are aimed mainly at beef cattle producers. However, as the same principles apply to dairy farmers, a chapter has been included on tick-resistant dairy cattle.

The question is often asked: why not eradicate the cattle tick? Evidence suggests that an eradication campaign in Queensland with its large holdings, would be impracticable. A national enquiry into the cattle tick problem in 1973 reported that an eradication campaign is warranted only when the following conditions are met:

- The ability to muster all favourable hosts for treatment at 14 day intervals or to destock country which cannot be mustered.
- Adequate facilities for treating cattle.
- Justification of the programme by benefit-cost analysis.
- Effective industry co-operation.
- Reasonable prospects of protection from reinfestation.
- Availability of efficient chemicals.
- Adequate finance to ensure uninterrupted progression of the programme.

Under Queensland's present systems of cattle raising, it is clear that these conditions cannot be fulfilled either now or in the foreseeable future.

In north-eastern New South Wales, the control of cattle ticks has been under close Government supervision for over 50 years. Eradication programmes have been undertaken with varying degrees of success and, despite these efforts, the cattle tick remains a problem in north-eastern New South Wales.

In the U.S.A., where eradication has been acclaimed as a success for many years, there have nevertheless been major breakdowns. The most recent outbreak started in 1972 and is still continuing.

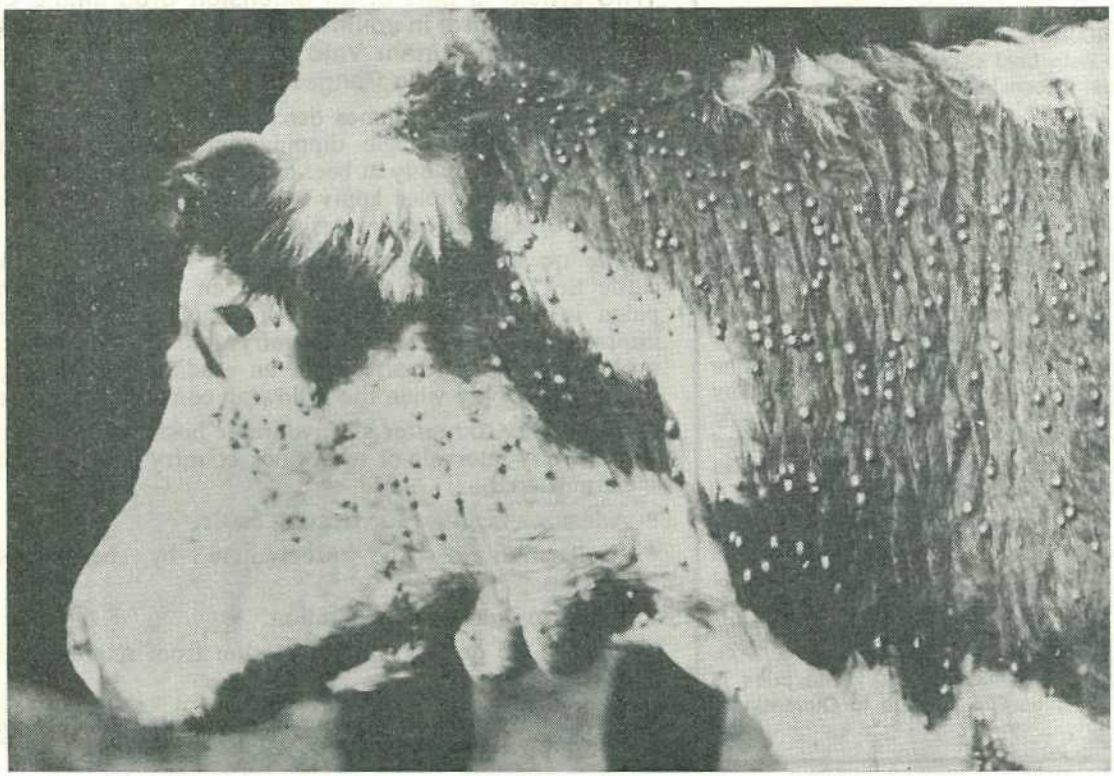
Industry perspective

The cattle tick, *Boophilus microplus,* is an imported Asian tick which, in Asia, feeds primarily on Zebu cattle, buffalo and deer. It is claimed to have been introduced into the Northern Territory from Java in 1872 with a group of cattle.

In Australia, the beef industry was founded on those breeds of cattle brought by Anglo Saxon immigrants—the European breeds, Hereford, Shorthorn etc. These cattle evolved in a tick-free area and when exposed to ticks, the cattle were unable to prevent excessive numbers from feeding on them.

Today, the situation is the same and these cattle can survive in ticky country only if dipped regularly to kill the ticks. Perhaps this could have been carried on indefinitely, but experience has shown that ticks can adapt to dipping. This means that they can overcome the most practical method available to allow European cattle to survive in ticky country.

A heavily tick-infested beast. A female tick sucks up to 3 ml of blood to become fully engorged and mature. A thousand ticks take 3 l of blood during their 3 week attachment to the beast.



In contrast, tropical South America was stocked mainly with Zebu cattle and despite their cattle population being larger than Australia's their market for tickicides is much smaller.

The origin of beef breeds in Australia must be seen as a historical accident which worked well for the temperate zones but not so well in the more tropical areas.

Great progress has been made against tick fever, a disease caused by blood parasites and carried by the tick. Tick fever can now be prevented by vaccination. Unfortunately, there has not been a major breakthrough in tick control in South-east Queensland and the industry has continued to rely solely on chemical tickicides. It has been remarkable how the chemical industry has managed to keep up a supply of new tickicides to replace those lost due to the development of resistance.

Since the 1940s, there has been a long list of tickicides to which the cattle tick has developed resistance.

This has involved quite different groups of chemicals—arsenic, chlorinated hydrocarbons, organophosphates and amidines. Like mining, the discovery of new supplies is a risky and expensive process which makes their future supply uncertain and more costly.

In south-east Queensland, within the area from Miriam Vale to the border and west to the Great Dividing Range, it is estimated that the cattle tick costs the industry about $13 million a year. On a State-wide basis, the figure was estimated at about $33 million in 1972–73.

The effects on the cattle industry vary from region to region. In south-east Queensland, the problem is more serious because of the climate and delay in the introduction of tick-resistant cattle.

Production losses and the cost of control measures due to tick infestation are borne by the producer. In Queensland, the Government is concerned with the control of stock movements from tick-infested to tick-free country, the production of tick fever vaccines, the registration of tickicides and extension.

Ticks affect graziers' profits in two ways—they reduce income and they increase costs.

Despite conventional dipping, susceptible cattle lose an average of 8 kg live weight gain (L.W.G.) each year. Without dipping, the losses could be enormous. In fact, in much of Queensland, the losses could be very serious to beef production with European cattle. Tick-resistant cattle prevent these losses but they also lose about 8 kg L.W.G. per year if not dipped once or twice during the autumn.

Cattle ticks and profitability

Three different methods of tick control are compared.

1. Traditional dipping programme: ten dippings per year as traditionally practised by producers with European cattle.
2. Strategic dipping: six dippings per year as recommended for European cattle.
3. Dipping programme for resistant cattle: two dippings per year as recommended for Zebu type cattle.

The factors that have been taken into account in this study are:

- The cost of tickicides.
- The cost of tickicides pumped out of dips because ticks have developed resistance.
- The cost of labour used when cattle are dipped.
- The cost of the labour and materials used when Zebu type cattle are yard weaned.
- The effect of breed differences on calving percentages, growth rate and sale yard prices.

Other factors which have not been taken into account in this costing are:

- Hide damage caused by ticks.
- The cost of tick fever.
- The cost of establishing and maintaining dipping facilities.

These costs will occur regardless of the method of tick control. Therefore, they will have no effect on the relative profitability of the different methods of tick control.

A further, very significant cost factor is also ignored because it is too difficult to measure. This is the cost of using up tickicides for which there may be no replacement.

The useful life of these tickicides is reduced each time cattle are dipped. The group of chemicals now used will lose their effectiveness. They will probably be replaced by others which are much more expensive. When the expensive tickicides are used up, there may be no effective replacements, regardless of the money spent on the search for new tickicides.

If the supply of tickicides is exhausted there will be massive losses in the beef industry.

Table 1. shows the differences in profit between three dipping programmes for a herd of 100 breeding cows and their progeny.

TABLE 1

If sold at	Traditional dipping programme 10 dippings per year	Strategic dipping for European cattle 6 dippings per year	Programme for Zebu type breeds 2 dippings per year
12–15 months	Standard	$420 more	$571 more
24–30 months	of	$644 more	$927 more
36 months ..	comparison	$868 more	$1 948 more

The profit differences are due to:

- Different numbers of dippings—see tables 1, 3 and 4.
- Different reproductive rates—Zebu breeds are assumed to be 5% lower than European cattle. See tables 3 and 4.
- Different weight gains—the turn-off weight of Zebu cattle is assumed to be 10% higher. See table 4.
- Different prices—the present sale price of store yearling and 2-year-old Zebu cattle is assumed to be 2c per kg L.W. less than for equivalent European cattle.
- Extra weaning costs estimated at 0.75c per head are considered in the measures for Zebu cattle.

Table 1 shows that strategically dipped European cattle (six dippings per year) are $4 to $9 per cow more profitable than traditionally dipped cattle (ten dippings per year).

Zebu type breeds dipped twice per year are $6 to $19 per cow more profitable than traditionally dipped cattle.

Zebu type cattle are $2 to $10 more profitable per cow than strategically dipped European cattle.

The future

- Improved methods of marketing will encourage more objective buying.
- Biological control based on tick-resistant cattle will increase.
- As buyers become better informed, their resistance to Zebu cattle will diminish.

The cost of tickicides (1976)

- The cost of tickicides to dip one adult beast is approximately 14c (3.5 litres per head).
- The cost per adult beast per dip of replacing a tickicide after 40 dips (estimated effective life) will depend on the number of cattle using the dip.

This is shown in table 2.

TABLE 2

THE ESTIMATED COST OF TICKICIDE REPLACEMENT

Size of herd ..	50	200	400	600	800	1 000
Cost to charge 12 000 *l* dip ..	$467	$467	$467	$467	$467	$467
Number of cattle dipped during dip life ..	2 000	8 000	16 000	24 000	32 000	40 000
Cost per head per dip (cents)	23·3	6·0	2·9	1·9	1·5	1·2

The cost of replacing tickicides is probably greater than the cost calculated because the replacements are usually dearer than those being used.

In the calculation of this section, 6c per head per dipping is used to cover the cost of tickicide replacement.

The total cost of tickicides is assumed to be 20c per head per dip.

Labour costs (1976)

	$
Award rate—$108/week x 48 weeks	5 184
Annual Holiday Pay—$108 x 4	432
Holiday pay loading—17½% of $432	76
Food—48 weeks x $15.00	720
Accommodation (repairs, maintenance, insurance, depreciation and interest on portion of quarters)—15% of $6 000	900
Electricity—48 x $2.00	96
Workers compensation—4·51% of gross earnings including keep (at $8.50 per week) ..	274
Total	$7 682

The cost of employing, accommodating and providing rations for a station hand for 12 months is $7 682.

However, a station hand does not work 52 weeks. In fact, he will probably work only 42 weeks. The other 10 weeks may be taken up by:—

Annual leave	4 weeks
Sick leave	1 week
Public holidays	2 weeks
Long service leave	1 week
Lost time—wet weather, etc. ..	2 weeks
Total lost time	10 weeks

Therefore, the real cost of labour is $7 682 ÷ 42 = $183.00 per week, $36.58 per day or $4.57 per hour.

Labour costs for dipping depend on the number of cattle dipped per man per day as shown in the following table.

LABOUR COST PER HEAD PER DIPPING

Cows dipped per man per day	40	60	80	100	120
Labour cost per head per dipping	0·92c	0·61c	0·46c	0·37c	0·30c

A recent informal survey of cattlemen in south-east Queensland revealed a range of 19 to 125 cows dipped per man per day. Many cattlemen would be surprised at the labour component of their dipping costs. Sixty head per man per day is used in the study.

The labour cost used in this study is 60c per head per dipping. The cost of labour and tickicide per dipping is taken to be 80c per adult equivalent.

THE COST OF DIPPING ANIMALS WITHIN A 100 COW HERD WITH DIFFERENT SALE AGES

When the cost of tickicide and labour used per dip is known it is possible to calculate the cost of dipping different classes of cattle within a herd.

It is then possible to estimate the cumulative cost of dipping each beast. For example: A cow must be dipped for 12 months while she is producing a calf. The total cost of dipping a 1-year-old includes the cost of dipping a cow. The cumulative cost of dipping a 3-year-old includes the cost of dipping it when it was a 1 and 2-year-old as well as the cost of dipping its mother for 1 year (with allowance for calving percentage, death, etc.).

A person who buys a 2-year-old to fatten, in effect, pays the seller for dipping the animal's mother, and the animal itself while it was a 1 and 2-year-old. The final column in table 3 shows the total cost of dipping 1, 2 and 3-year-old stock.

TABLE 3

—	Adult equivalent	Number	Cost per head per year $	Cost per age class $	Annual herd dipping costs for different sale ages $
1. Traditional programme—10 dippings per year					
Bulls ..	1	3	8.00	24	..
Breeders ..	1	100	8.00	800	..
Calves ..	0·4	75	3.20	240	1 064
1–2 year old	1	70	8.00	560	1 624
2–3 year old	1	70	8.00	560	2 184
2. Strategic programme—6 dippings per year					
Bulls ..	1	3	4.80	14·4	..
Breeders ..	1	100	4.80	480	..
Calves ..	0·4	75	2.00	150	644
1–2 year old	1	70	4.80	336	980
2–3 year old	1	70	4.80	336	1 316
3. Programme for resistant cattle—2 dippings per year					
Bulls ..	1	3	1.60	4·80	..
Breeders ..	1	100	1.60	160	..
Calves ..	0·4	70	0.64	44·80	210
1–2 year old	1	65	1.60	104	314
2–3 year old	1	65	1.60	104	418

Yard weaning is recommended for all cattle. Zebu breeds may need to be held longer in the yards. This costing allows for an extra 3 days in the yard—estimated to cost an additional 75c per weaner.

TABLE 4

COST COMPARISON OF TRADITIONAL, STRATEGIC AND RESISTANT DIPPING PROGRAMMES FOR A 100 COW BREEDING HERD

Age of progeny sale	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9	Column 10
	No. of progeny for sale	Estimated L.Wt. at sale kg	Sale price cents per kg LW.	Animal sale price $ per head (rounded) (col. 2 x 3)	Gross income for 100 breeders (col. 1 x 4)	Cost of dipping herd	Additional weaning cost	Total herd cost (col. 6+7)	Gross income less total costs (col. 5–8)	Difference in profitability compared with traditional programme
					$	$	$	$	$	$
TRADITIONAL—10 dippings/year British Breed—										
12–15 months	75	225	28	63	4 725	1 064	0	1 064	3 661	Standard
24–30 months	70	350	30	103	7 350	1 624	0	1 624	5 726	of
36+ months	70	450	33	148	10 360	2 184	0	2 184	8 176	Comparison
STRATEGIC—6 dippings/year British Breed—										
12–15 months	75	225	28	63	4 725	644	0	644	4 081	+420*
24–30 months	70	350	30	105	7 350	980	0	980	6 370	+644
36+ months	70	450	33	148	10 360	1 316	0	1 316	9 044	+868
ZEBU TYPE—2 dippings/year Zebucross—										
12–15 months	70	247	26	64	4 495	210	53†	263	4 232	+571
24–30 months	65	385	28	108	7 020	314	53†	367	6 653	+927
36+ months	65	495	33	163	10 595	418	53†	471	10 124	+1 948

* $4 081 − $3 661 = +$420
  $6 370 − $5 726 = +$644
  } Similar calculations for other values in column 10.

† 70 head are assumed to be weaned, additional cost $0.75 per head.

Biology

The life cycle of the cattle tick

The common cattle tick is called a one-host tick because it completes the three parasitic stages on the one host (nearly always cattle).

When fully fed, the adult female tick detaches from its host, falls to the ground and finds a sheltered hiding place such as in a tuft of grass or under a stone or log. Provided the weather is warm, egg laying commences within 1 week.

The time eggs take to hatch depends upon the temperature. In summer, eggs can hatch in 4 weeks but eggs laid in April are trapped by the low winter temperatures and may not hatch for up to 20 weeks in south-east Queensland.

The numbers of eggs which hatch depend largely on the relative humidity at the soil surface so that eggs hatch successfully during wet weather. Eggs which are laid between April and July are affected by the low temperatures and many fail to hatch. Normally, a female tick can lay up to 2 500 shiny, brown eggs.

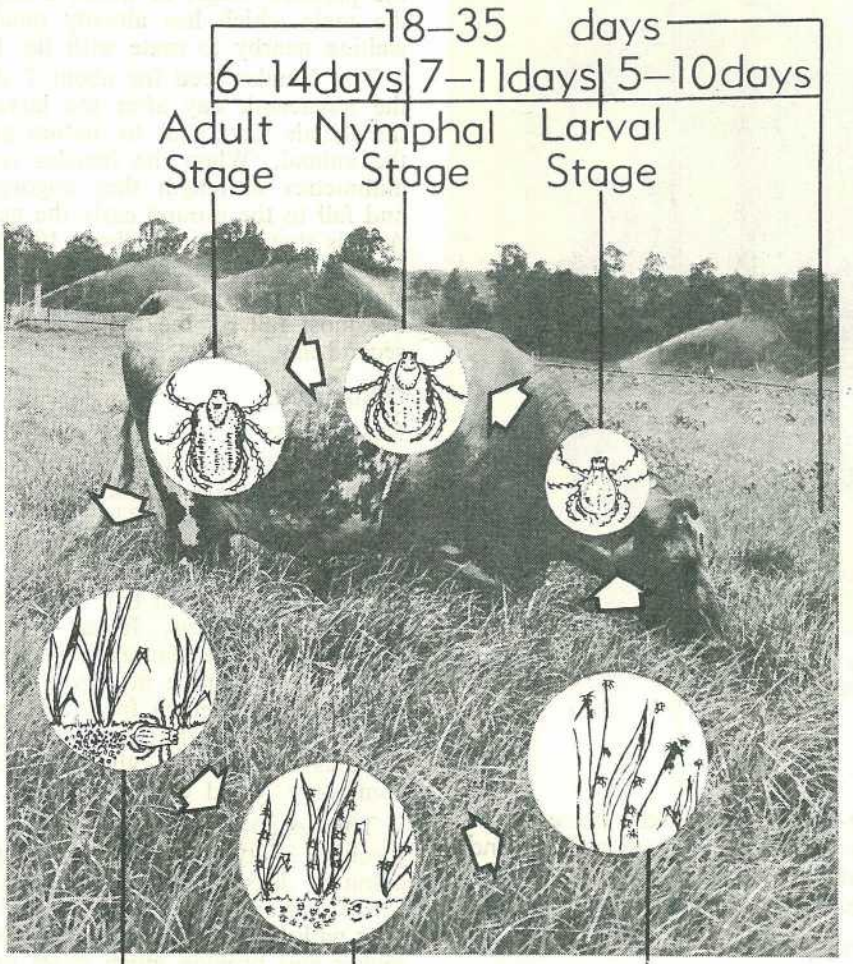
Even in droughts or after fires and floods, a small proportion of ticks manage to have adequate shelter and survive to continue the life cycle.

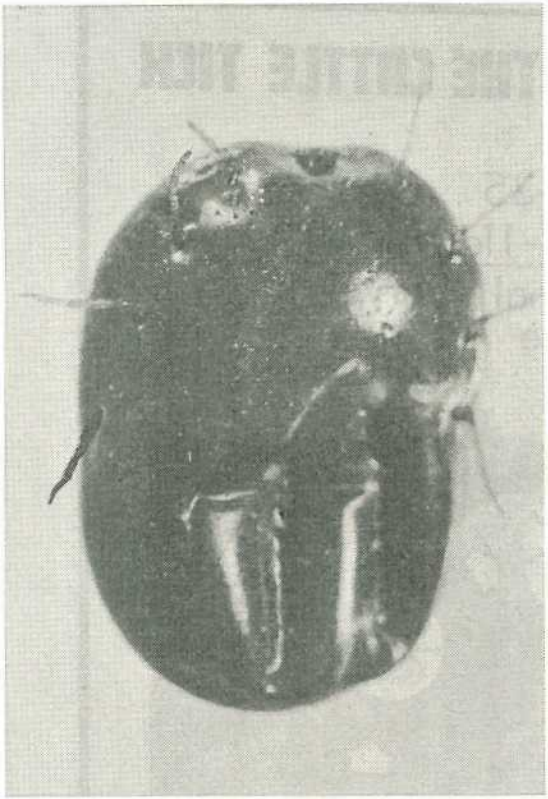
THE LARVAE

Larvae or seed ticks are minute, six-legged, reddish-brown ticks no larger than a pin head. They hatch from eggs and after a few days climb the grass and wait on the tips for passing cattle. Larvae are hardy creatures and they survive for periods of several months on pastures depending upon the weather. In hot summer weather, many will die in less than 3 weeks, while in winter they live for 2 to 3 months.

Larvae can detect the presence of cattle by their smell and they grasp onto cattle as they pass by. The larvae immediately attach to the skin and try to feed, but they find it more difficult to feed on resistant cattle, for some as yet unknown reason. Usually on the sixth day after attachment they moult (shed their outer skin) and emerge as eight-legged nymphs.

THE LIFE CYCLE OF THE CATTLE TICK





An engorged female tick can lay about 2 500 eggs. (About 7 times actual size).

In south-east Queensland, the cattle tick usually has four generations a year. Generations occur at approximately 2 monthly intervals between November and June.

The Nymph

As the young nymphs grow, they change colour from light brown to greyish blue. After about 7 days they moult and become adult males or females. The moulting nymph is the most difficult to kill with tickicides. It is assumed that the old skin protects the nymph until the skin has been shed.

The Adult Stage

The Male: The young male adult emerges on about the thirteenth day of the parasitic stage, it is smaller than the female and may remain on the beast for at least 1 month before dying. The males spend their life wandering over the beast feeding and looking for females with which to mate.

The Female: The young female adult usually emerges on the fourteenth or fifteenth day of the parasitic stage, or about a day later than the male which has already moulted and is waiting nearby to mate with the female.

The females feed for about 7 days and by the nineteenth day after the larvae attached, the female ticks start to mature and drop off the animal. When the females reach 4 to 5 millimetres in length they engorge overnight and fall to the ground early the next morning. At this stage, they are about 10 mm in length. Engorged female ticks may fall as early as the eighteenth day or as late as the thirty-sixth day but most fall on the twenty-first and twenty-second days.

Other ticks

Bush Ticks

Other species of ticks are also to be found on cattle and these should not be confused with *Boophilus microplus*. The 'Bush tick' or New Zealand cattle tick (*Haemaphysalis longicornis*) is to be found in the Gold Coast Hinterland, Maleny, Cooroy, Kin Kin, Dalrymple Heights and Atherton areas. It has a three-host life cycle, that is, the larvae, nymphs and adults each have to find a new host on which they feed and then detach from and return to the pasture. The bush tick also differs in that it feeds on animals other than cattle. It is commonly found on dogs, horses and sheep.

The engorged female cattle tick is a greenish, slaty-grey colour with pale, straw-coloured legs. The engorged female bush (New Zealand) tick is shiny and dark blue-grey with dark brown legs. The legs are also longer and provide much more mobility than the common cattle tick.

Paralysis Ticks

The paralysis or scrub tick (*Ixodes holocyclus*) is found along the eastern coastal fringe of Australia. It prefers moist, humid conditions and is usually confined to scrub country. The unfed paralysis ticks are a yellowish colour with a grey shield on the back of the females. As the paralysis tick feeds, it turns a grey-green colour and develops an attractive shell-type appearance with a ring round its edge.

It also grows very large compared to the cattle and bush tick. This tick is responsible for deaths in cats and dogs and young cattle and horses, particularly when cattle are introduced to forestry leases.

Available tick control methods

The industry now has a choice—either to continue to rely completely on a technology invented 80 odd years ago, which has proven invaluable in the past, but at the same time has failed to provide stable, economical control, or to change to biological control of ticks with tick-resistant cattle.

Tickicides can then be used to reduce losses of production, instead of continuing their present role of maintaining the gross ecological imbalance caused by keeping European cattle in tick-infested areas. It should be remembered that the introduction of European cattle into Australia was fortuitous, arising from the settlement of the country by early British settlers.

The arguments for a complete change in technology are overwhelming. History has shown that tickicides have failed to provide stable and economical tick control and that we must expect resistance to all tickicides in the future. Costs of dipping have increased, with labour and tickicide costs having gone up faster than beef prices.

Further, there are the management problems associated with dipping, and with residues in meat. Manpower is used for dipping when it could be used more productively on other activities. On top of this, there have been two occasions already (Biarra in 1966 and Mt. Alford in 1970) when resistance has been controlled with unregistered tickicides. There is no reason to expect the situation to improve in the future.

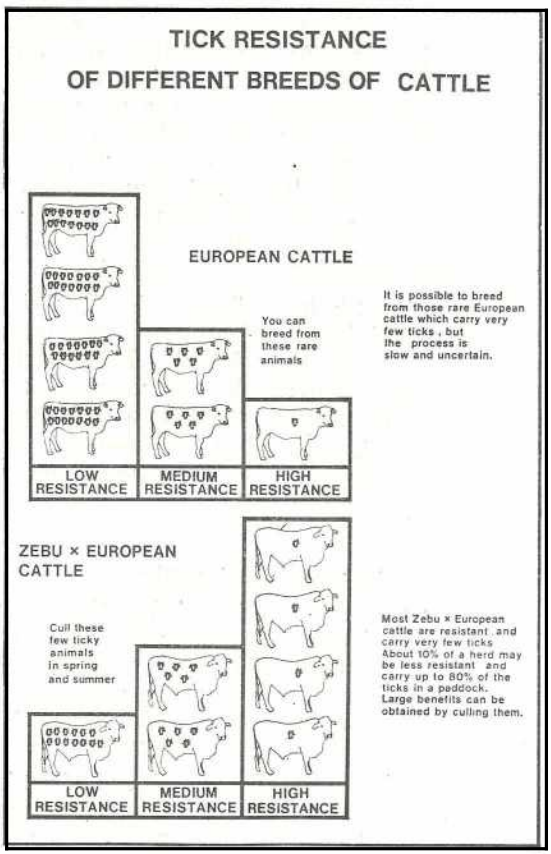
Cattlemen faced with the problem of what to do about tick control must weigh up the pros and cons of the three available control methods—resistant cattle, dipping and pasture spelling.

Both dipping and pasture spelling can control ticks on European cattle but they rely on an uncertain supply of effective, new tickicides and require a large input of labour, capital or management.

With the increasing costs of labour and tickicides these control methods have limited long-term attraction. On the other hand, tick-resistant cattle are a natural biological control method and the cost is restricted to the purchase of Zebu bulls and either one or two dippings a year. Statistics show that graziers in central and north Queensland with resistant Zebu x European cattle are better off financially than those with European cattle.

Tick resistant cattle

The favourable nature of the host influences the success or failure of ticks to feed. Cattle breeds vary greatly in their level of favour to ticks, with Zebu cattle from Asia being less favourable than European cattle.



Scientists are studying the mechanisms which make cattle resistant to ticks. Although most European cattle are favourable hosts, as are a few of the Zebus, the occasional European animal and the majority of Zebus allow only a few ticks to survive on them, and those cattle are said to be highly resistant. From 10 to 30% of tick larvae may feed successfully on animals with low resistance, whilst only 1 to 2% may do so on highly resistant cattle.

Tick resistance is an acquired immunity and is nature's way of creating a balance between ticks and their natural host, the Zebu cattle. Until recently, the Australian beef industry has not been prepared to utilize this biological control method and has relied almost completely on tickicides. However, by crossbreeding, the benefits of both the Zebu and European breeds can be obtained, and at the same time reliance on tickicides to control ticks is reduced.

Tick resistance, like any other immunity to disease, depends on the animal being healthy and well fed. When cattle are sick or suffer nutritional or lactational stress they lose some of their tick resistance temporarily. Likewise, cattle are less resistant to ticks in the autumn than in the spring for some unknown reason. These changes make it more difficult to discriminate between high and low resistance animals in autumn than in spring or summer, and it is unreliable to cull or select cattle for tick resistance while they are stressed.

Breeds of cattle have different levels of tick resistance and Zebus of all types are more resistant than European breeds. Fortunately, tick resistance is heritable and much of the Zebu resistance is transferred to the F_1 (first cross) progeny during crossbreeding. F_1 progeny with half Zebu are considered to be adequately tick-resistant for south-east Queensland.

Breeding of tick-resistant cattle

It is now a well established fact that most Zebu crossbred cattle develop a high level of resistance to the cattle tick. Also, they are less affected by worms than European cattle. Generally, the higher the level of Zebu blood the higher the level of resistance to parasites.

There are individuals in every breed of cattle which are tick-resistant. But in European breeds, the frequency of resistant cattle is very low, being of the order of 10%, while in Zebu cattle most animals have a high degree of tick resistance. In Zebu X European breed cattle about 80 to 90% of the population is highly resistant.

Furthermore, the heritability of tick resistance in Zebu and crossbred cattle is high. Thus, considerable improvement in tick resistance of a herd can be gained quickly by selecting for this important character.

While it would be possible to eventually select a herd of European breed cattle with a high level of tick resistance, this would take many years.

How much Zebu?

We know that the higher the level of Zebu blood the higher the level of tick resistance. However, we do not know the minimum level of Zebu blood which will impart an acceptable degree of resistance.

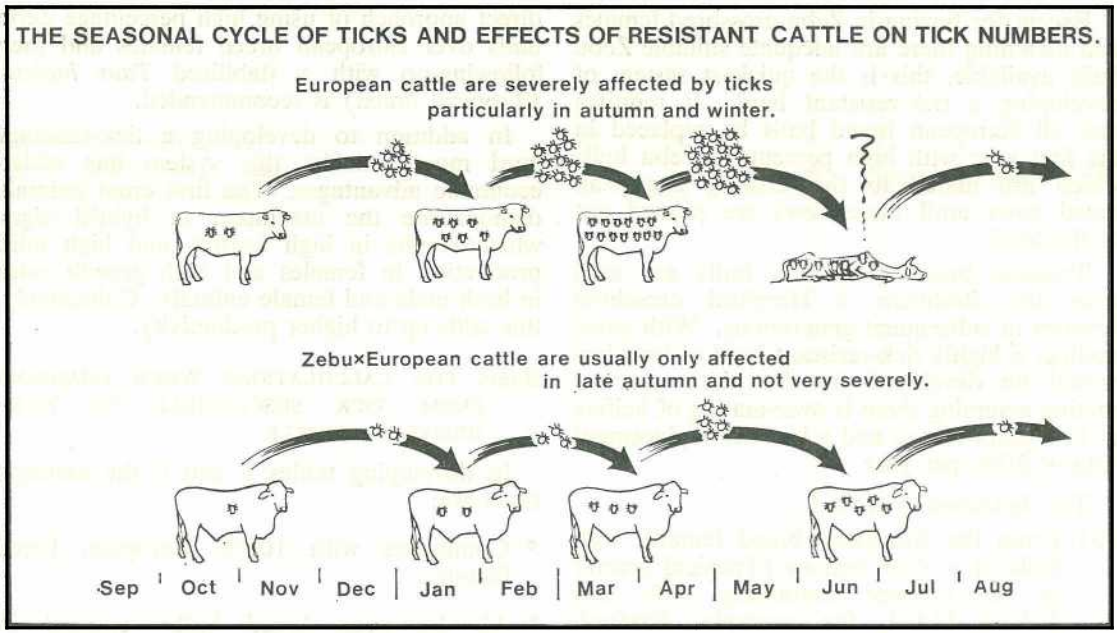
Until further proof is available, 50% in the crossbreed should be regarded as the minimum Zebu content for satisfactory tick control.

What are the disadvantages?

Fertility is an important factor in cattle productivity. First cross females from a Zebu X European breed mating generally are highly fertile due to the effect of hybrid vigour. Fertility levels in the high percentage Zebu tend to be lower than that of the first cross. There is evidence that the level is also lower in matings between subsequent crossbred generations. There is no evidence to support that this lowering of fertility occurs in Africander crossbreds.

There is insufficient information on the fertility of the stabilized *Taur indicus* tropical breeds such as Santa Gertrudis, Droughtmaster, Braford, Brangus, Charbray, etc., to allow informed comment. But it could reasonably be expected that a similar situation as that confirmed for interbred Zebu crossbred cattle might also apply to these breeds.

Therefore, where stabilized crossbreed cattle are adopted, the possibility of a reduction in fertility should be kept in mind and steps taken to counter the effect of this on herd productivity. Rigid culling of sub-fertile animals should be employed.



Temperament is an important factor determining ease of handling cattle. Zebu cattle are alert and need to be handled with more care than European breeds. As with any breed of cattle, bad temperament animals should be culled.

Changing the herd

If, for no other reason than converting the herd to tick-resistant cattle, the change should be made as quickly as possible to capitalize on the benefits of this decision.

Breeding is a slow process and it takes about 8 or 9 years before all the original breeders are phased out of the herd. Thus, you will continue to be saddled with the problem of controlling ticks on your low resistant breeders in the change-over period.

There is a good reason for infusing sufficient Zebu blood into the herd as quickly as possible.

Thus, high percentage Zebu bulls should be used in the breeding programme in the initial stages.

Assuming that your herd is presently European breed cattle you could decide to follow a straight breeding programme changing over to one of the stabilized *Taur-indicus* tropical breeds. Alternatively, you can capitalize on the productivity advantage of hybrid vigour through a two or three-way rotational breeding programme.

Straight Breeding

There are two basic approaches:

(a) Cross the European breed females with high percentage Zebu bulls to produce females carrying 50% Zebu content. These can then be mated to bulls of one of the Tropical breeds (*Taur indicus*) (approximately 50% Zebu 50% European).

Here is an example of this method:

Hereford cows x Brahman bulls = 50% *Bos indicus*

50% Hereford 50% Brahman cows x Braford bulls = 50% *Bos indicus*

25% Hereford 25% Brahman 50% Braford cows x Braford bulls = 50% *Bos indicus*

12·5% Hereford 12·5% Brahman 75% Braford cows x Braford bulls

Continue to grade-up to Braford.

It is essential that the Braford bulls used have 50% Brahman blood and are selected for high tick resistance.

Except for buying in Zebu crossbred females and assuming there are adequate suitable Zebu bulls available, this is the quickest system of developing a tick-resistant herd. It requires that all European breed bulls be replaced in the first year with high percentage Zebu bulls which are mated to the existing European breed cows until these cows are phased out of the herd.

Tropical breed (Braford) bulls are used over the Brahman x Hereford crossbred females in subsequent generations. With some culling, a highly tick-resistant herd of breeders would be developed by the ninth year of mating assuming there is over-mating of heifers at two years of age and a breeder replacement rate of 20% per year.

This is shown in table 5.

(b) Cross the European breed females with bulls of a *Taur indicus* (Tropical breed) of your choice containing 50% *Bos indicus* blood, for example, Braford, Droughtmaster etc.

Again an example:

Hereford cows x Droughtmaster bulls = 25% *Bos indicus;*

50% Hereford 50% Droughtmaster cows x Braford bulls = 37·5% *Bos indicus;*

25% Hereford 75% Droughtmaster cows x Braford bulls = 44% *Bos indicus.*

Continue to grade-up to Droughtmaster.

This system is a slow approach to developing a tick-resistant herd with 50% Zebu blood. It would take 8 years to clear the herd of European breed (Hereford) cows and a further 8 years to develop a herd of breeders carrying 37·5% or more of Zebu blood (assuming, of course, that the tropical breed bulls themselves were at least 50% Zebu).

This is shown in table 6.

Because the purpose of crossbreeding in this instance is to develop a herd of highly tick-resistant cattle as quickly as possible, a breeding system using tropical breed bulls (50% Zebu) over European breed cows from the outset is a very slow process and takes too long to give the desired result. While it may have advantages in respect to less important factors such as greater uniformity in colour, fewer temperament problems and perhaps greater buyer acceptance, the more direct approach of using high percentage Zebu bulls over European breed females and then following-up with a stabilized *Taur indicus* (Tropical breed) is recommended.

In addition to developing a tick-resistant herd more quickly, this system has added economic advantages. The first cross animals demonstrate the maximum in hybrid vigor which results in high fertility and high milk production in females and high growth rates in both male and female animals. Collectively, this adds up to higher productivity.

Basis for calculations when changing from tick susceptible to tick-resistant cattle

In developing tables 5 and 6 the assumptions are:

- Commence with 100% European breed females.
- All European breed bulls replaced in year 1.
- Similar reproductive and survival rates between European and Zebu crossbred animals (although a lower reproductive rate was assumed in the section on 'Cattle Ticks and Profitability').
- An annual loss of 3% and a further culling of 10% of survivors in each age group, except 2-year-olds, for fertility and other factors.
- For 2-year-olds, mating of extra heifers is employed in the first year of mating. Replacement heifers are selected on the basis of culling 20% for low tick resistance, 10% of mated heifers for low fertility and 20% of the remainder for failure to rear a calf, poor mothering ability, poor temperament and other defects, to provide a replacement level of 20% in the second year of mating.
- Heifers are mated at 2 years of age and cows are removed from the herd after six mating seasons, that is, at 8 years of age after their last calf is weaned.
- A calving of 90% for heifers and 70% for older cows to give an overall herd calving of 75%.

TABLE 5

CHANGING FROM EUROPEAN BREED TO 50% ZEBU USING BRAHMAN BULLS OVER HEREFORD COWS AND BRAFORD BULLS OVER FIRST-CROSS FEMALES

APPROXIMATE PROPORTION (%) OF EACH CROSS IN BREEDING HERD

Mating	Breeders			Bulls		Calves			Heifer replacements		
Year	Hereford	½ Hereford ½ Brahman	Braford X	Brahman	Braford	Hereford	½ Hereford ½ Brahman	Braford X	Hereford	½ Hereford ½ Brahman	Braford X
Y1 ..	100	..	..	100	..	100	..	..	100	..	..
Y2 ..	100	..	..	100	..	..	100	..	100	..	..
Y3 ..	100	..	..	100	..	..	100	..	100	..	..
Y4 ..	80	20	..	80	20	..	100	..	..	100	..
Y5 ..	60	40	..	60	40	..	74	26	..	100	..
Y6 ..	42	58	..	42	58	..	55	45	..	100	..
Y7 ..	26	69	5	26	74	..	38	62	..	75	25
Y8 ..	12	74	14	12	88	..	24	76	..	55	45
Y9 ..	..	75	25	..	100	..	10	90	..	40	60

N.B.—By the ninth year of mating, all Hereford cows and Brahman bulls are phased out and the breeding herd will carry approximately 50% Zebu blood.

TABLE 6

GRADING-UP FROM EUROPEAN BREED TO A STABILIZED TROPICAL BREED USING DROUGHTMASTER BULLS (50% ZEBU BLOOD)

APPROXIMATE PROPORTION (%) OF EACH CROSS IN BREEDING HERD

Mating	Breeders			Bulls	Calves			Heifer replacements		
Year	Hereford	½ Hereford ½ Droughtmaster (25% Zebu)	¾ Droughtmaster (37½% Zebu)	Droughtmaster	Droughtmaster	½ Hereford ½ Droughtmaster (25% Zebu)	¾ Droughtmaster (37½% Zebu)	Hereford	½ Hereford ½ Droughtmaster (25% Zebu)	¾ Droughtmaster (37½% Zebu)
Y1	100	..	..	100	100	..	..	100	..	..
Y2	100	..	..	100	..	100	..	100	..	..
Y3	100	..	..	100	..	100	..	100	..	..
Y4	80	20	..	100	..	100	..	..	100	..
Y5	60	40	..	100	..	74	26	..	100	..
Y6	42	58	..	100	..	55	45	..	100	..
Y7	26	69	5	100	..	38	62	..	75	25
Y8	12	74	14	100	..	24	76	..	55	45
Y9	..	75	25	100	..	10	90	..	40	60
Y10	..	61	39	100	..	..	100	..	25	75
Y11	..	46	54	100	..	..	100	..	5	95
Y12	..	31	69	100	..	..	100	..	..	100
Y13	..	19	81	100	..	..	100	..	..	100
Y14	..	10	90	100	..	..	100	..	..	100
Y15	..	4	96	100	..	..	100	..	..	100
Y16	..	..	100	100	..	..	100	..	..	100

N.B.—By the ninth year of mating, all Hereford cows are phased out but only 25% of breeders will carry 37·5% or higher Zebu blood. It is not until the sixteenth year that all breeders will carry this level of Zebu blood.

Rotational crossbreeding

From the point of view of production performance there is evidence that a system of continual or rotational crossbreeding is a better approach than grading-up to a stabilized crossbreed. This is because a degree of hybrid vigor is maintained in the cattle which is conducive to higher production performance by individual animals and the herd as a whole.

Rotational crossbreeding programmes involve the use of two or more breeds of bulls which are used alternately or in succession in the breeding herd. The simplest form is a two-breed rotational crossing system where two different breeds of bull are used alternately over successive generations of cows.

In practice, two breeding herds are maintained with high percentage Zebu bulls used continuously in one herd and European breed bulls used continuously in the other. Selected heifers sired by the Zebu bulls go into the European breed bull herd as breeder replacements and selected heifers from the European breed bull herd go into the Zebu bull herd as breeder replacements.

Thus, it is a simple criss-cross breeding system.

When equilibrium is reached after the sixth female generation, one half of the herd would carry 67% European blood and 33% Zebu blood and the other half 67% Zebu and 33% European breed blood. Under this programme, half the herd would have a low level of tick resistance. These animals would contaminate the pastures with larval ticks and infest the rest of the herd.

Another form of rotational crossbreeding is a three breed rotational crossing system, where three different breeds of bulls are used over successive generations of cows.

Selecting breeding stock

The emphasis in the breeding programme will be to produce highly productive, tick-resistant cattle.

Cattle growth rates and tick resistance in Zebu and crossbreed cattle are highly heritable and worthwhile economic gains can be made by selecting for these characters.

Therefore, when selecting breeding stock these points are important:

(i) Use only bulls which are highly tick-resistant and which have demonstrated above average growth rate in relation to bulls of the same age group in the herd from which they are selected. Weight gain tests off grass are more meaningful than those carried out under hand feeding conditions.

(ii) Replacement heifers should be selected for high tick-resistance and, where possible, also select those with the highest growth rates. In Zebu crossbred herds, 10 to 20% of animals will have low resistance and such heifers should be culled.

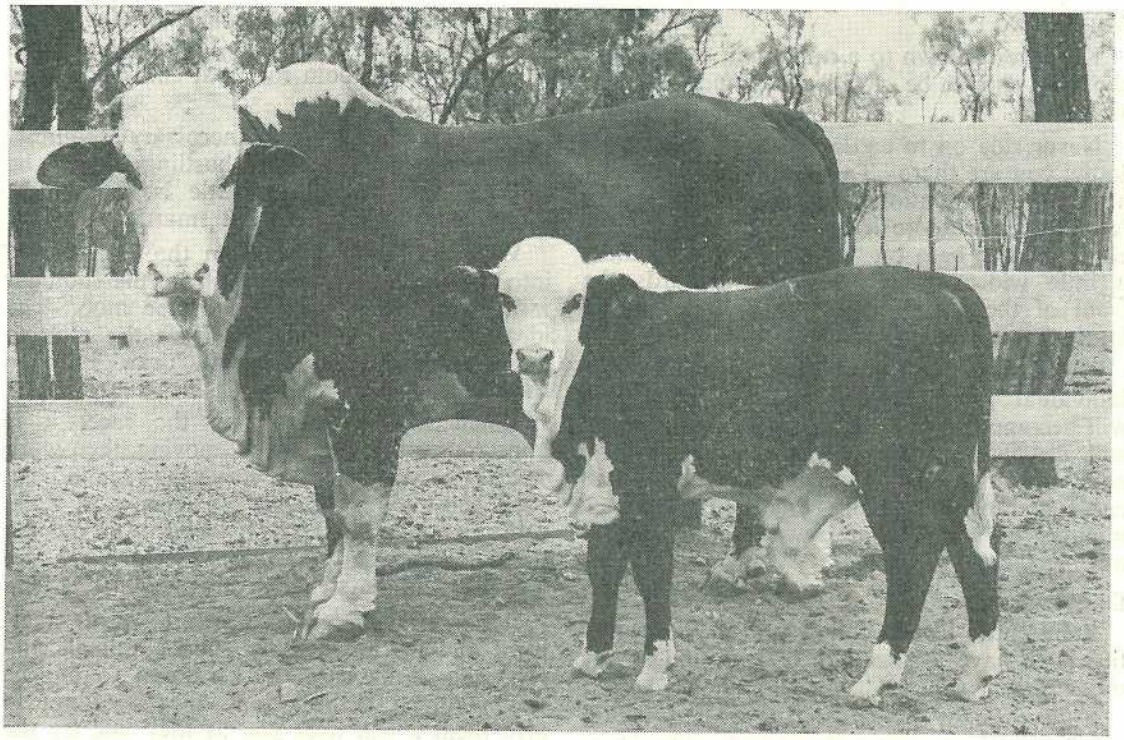
(iii) Culling heifers with low resistance should be carried out as yearlings in summer (November to March) after the spring rise in ticks when cattle have received a worthwhile tick challenge. The heifers should not have been dipped in the preceding months.

(iv) Tick resistant wanes in cattle under stress conditions and, consequently, lactating breeders should not be compared with dry cows in a culling programme. However, tick resistance also declines with age and it would therefore be advisable to cull aged breeders showing heavy tick infestations.

(v)—

- Cull all first mate heifers that fail to go in calf.
- Cull any heifer that does not produce a calf.
- Cull heifers that do not rear a calf and those with poor mothering ability.
- Any breeder should be allowed to miss only one calf and should be culled on the second failure.

(vi) Bad temperament is a liability and all animals showing this tendency should be culled.



Most cattle carrying 50% or more of Zebu blood are highly resistant to ticks and pass on resistance to their offspring (Queensland Country Life *photograph).*

Handling Zebu cattle

Cattlemen who are experienced at handling European breed cattle will find that there are certain fundamental differences to appreciate if Zebu type cattle are to be managed successfully.

Zebu cattle have an alert, active temperament and do not like being worked noisily, fast or being jammed-up. They are less affected by heat stress and can travel faster and for longer periods than the European breeds.

Whereas European breed cattle have to be driven, Zebu cattle have to be blocked and steadied-down. They like to follow and are not unlike horses in this respect.

Temperament

This trait is conditioned by both heredity and treatment. It is difficult to separate the factors but the hereditary part can be improved by culling and selection. The treatment part is linked with the producer's management system, including the design of yards and handling methods that a beast will encounter from birth onwards.

Unmanageable cattle should be culled. However, simply culling animals from a herd which is badly managed is not the full answer. Often, the management should be questioned rather than adopting the attitude that the fault lies entirely with the breed.

Mustering

Keep noise down to a minimum, yelling and shouting should be avoided as much as possible.

Never ride on to cattle without letting them know you are there. Talk to them and quietly attract their attention. Let them stand for a few moments before letting them move off. If cattle tend to be a bit 'touchy', approach them a little wider and ride around towards the front of them and steady them up. Do not let them run, make them walk.

Develop a set mustering procedure for individual paddocks and stick to it. Cattle will become used to this mustering pattern and will usually conform. Muster to a common end-point in the paddock and when all the cattle are together, block them up for a few minutes to settle them down before moving off.

Droving

Zebu cattle like to follow and a good practice is to have a stockman to lead and steady the mob.

Talk to your cattle freely. This helps to get them accustomed to men and settles them down.

When working cattle through gateways, once the mob starts to draw, ease back from the mob and let them feed through the gateway quietly. It is an advantage for a stockman to position himself near the gateway to stop the mob from 'bunching-up' and to keep them moving freely.

Yards

Very old yards often have some weak panels. These should be repaired and regular maintenance carried out to ensure that rails can withstand the occasional hard bumping from cattle.

Zebu and crossbreed cattle are capable of hurdling yards. While it may be impractical to increase the height of existing yards, this point should be kept in mind in any new conconstruction. Most existing yards are about 1·6 m high. A height of about 2·0 m is recommended for Zebu and crossbred cattle.

Yardmanship

Zebu cattle become very accustomed to working through yards and a set routine is important. Cattle should never be worked tightly, particularly in the smaller forcing yards. Therefore, never over-load forcing yards and allow plenty of room for both cattle and man to move freely.

As with mustering, unnecessary shouting, yelling and hustling and bustling should be avoided, but talking to cattle is, as always, desirable. Work quietly but smartly.

When working cattle from the forcing pen into the race, work the mob from the shoulder rather than from the back of the mob. The idea is to ease the leaders from the mob to 'string' them out so they will 'draw' into the race.

When working cattle up the race, it is important to get the leaders moving, then work smartly but quietly back along the race moving each beast along as you go. However, Zebu cattle have a tendency to work too quickly through the race once they start to move and may need to be steadied down.

Zebu cattle are sulky, object to harsh treatment and bail-up quickly. Older animals and especially bulls very quickly learn to bluff a stockman. It is important, therefore, not to give them a win over you as they will try the bluff at every opportunity.

This does not mean that such animals should be harshly handled. If an animal gets stirred-up and you are in the yard with it, stand still and quietly and in most cases the animal will soon settle down.

Noise and movement very often upset the animals more. Situations do arise, however, where it becomes necessary to show the animal who is boss. For individual animals which persistently demonstrate bad temperament and roguery, their place is in the meatworks at the earliest opportunity.

Weaning management

There is ample evidence that time and effort expended in educating cattle at weaning time is a sound investment.

Cattlemen who have handled both European breeds and Zebu cattle generally agree that training at weaning time is especially important with Zebus if they are to be easily controlled as adults. In general, Zebu crossbred cattle which have been properly weaned are much easier to handle and have a better temperament than those where sound weaning management is not practised.

Yard weaning over a period of at least 7 to 10 days is by far the best system.

From the start of weaning, they should be given access to water and hay. As little as 1 to 1·5 kg of hay is sufficient for the first two days increasing to 2 to 2·5 kg from the third day. If drum lick feeders are to be used on the property, it is a good idea to place a couple of licker drums containing a molasses/water mixture in the yard. Weaners learn to use the lickers and more importantly lickers help to quieten them.

From the fourth day, if time and manpower are available, it is an advantage to 'tail' the weaners out on horseback and get them used to being worked. A lead stockman is most important and during this phase of training weaners should be taught to follow and be blocked-up. While this is particularly important for the first few times the weaners are taken out of the yards, the practice should be adopted for all classes of cattle being released from the stockyards at all times.

After a couple of days of 'tailing-out', weaners can be taken out into a small, well-fenced holding paddock adjacent to the yards and left there during the day but returned to the yards at night.

During the weaning process they should be worked quietly through gateways from one yard to another to get them used to being handled. Every opportunity should be taken to walk quietly through the mob, talking to them in the process.

The ideal weaning period is at least 7 to 10 days, depending on how well they settle down. However, with the current cost of labour this period may have to be reduced. Any reduction in the weaning period should be avoided as time spent educating cattle at this stage will be more than recouped later on through easier handling.

At the end of the weaning period, the weaners should be transferred to a well-fenced paddock located well away from the breeder paddocks to reduce the possibility of re-mothering. It is an advantage if the paddock can be spelled for 2 to 3 months prior to weaning to reduce the level of worm infestation. A good idea is to run a few quiet, dry cattle with the weaners for a while as this has a settling effect on them. In addition, older cattle offer some level of protection against dingoes.

Continuing use of drum lick feeders in the paddock will further quieten the weaners.

If time permits in the ensuing weeks, regular checking and riding among the weaners in the paddock is a good practice. A bale or two of hay handed out to them on such occasions has a further quietening effect.

Zebu cattle are regarded as 'easy-care' cattle and as such need not be handled frequently. This then places tremendous importance on proper training and quitening of these cattle at weaning time.

Managing Zebu breeding herds

Managing the breeding herd is an aspect in which cattlemen will find several differences between Zebu and European breed cattle.

Zebus and their crossbreeds take longer to reach sexual maturity. Heifers need to be better grown for mating than their European breed counterparts and the desirable minimum liveweight at first joining is 300 kg compared with 275 kg for European breeds.

Likewise, Zebu bulls take longer to reach sexual maturity and are a risky proposition as sires before 2 years of age. Some cattlemen prefer to use Zebu bulls older than two years.

Zebu bulls tend to decline in sex drive (libido) when they are aged and this can be a cause of lowered reproduction. Thus, they should be considered for replacement at 6 to 7 years of age in commercial herds.

Zebu bulls tend to be shy and do not perform well if mated in the same paddock with European breed bulls. It is wise, therefore, to mate them separately from European breed bulls.

Body condition is more critical for reproduction in Zebu and crossbred females than for European breeds which will cycle at lower body condition than Zebus.

Zebu and crossbred females usually have a high milk production and will also continue to lactate under nutritional stress. Therefore they are more likely to be 'pulled-down' in body condition thus causing them not to cycle and go back in calf early in the next mating.

Strategic weaning before the winter nutritional stress period is therefore particularly important with Zebu and crossbred breeders, as indeed it is for the European breeds.

High grade Zebu and stabilized crossbred females tend to be lower in fertility than European breeds. However, high reproductive rates can be achieved if sub-fertile females are rigidly culled.

Zebu cows have a strong mothering instinct and are protective towards young calves. Stockmen need to be aware of this and take necessary precautions.

The incidence of dystocia in Zebu type females is much lower than in European breeds. Therefore, calving heifers do not require as much supervision as European breed heifers.

When changing from a European breed to a Zebu crossbred herd, the European breed cattle should be run separately from the Zebus for two reasons:

- Firstly, the Zebu crossbreds are more tick-resistant and require far less dipping. If the two breeds are run together, the Zebus will be mustered unnecessarily every time the European breeds have to be dipped.
- Secondly, Zebu crossbreeds work faster and tolerate hot conditions better and it is difficult to keep a mixed mob of Zebu and European breed cattle together when mustering and droving. The European breeds have difficulty in keeping up with the Zebu leaders and become stressed in the process.

Tick-resistant dairy breeds

Tick control in the dairying industry depends mainly on strategic dipping. As milking cows are handled twice daily, any upsurge in the tick population can be easily identified and a dipping programme commenced. However, the incidence of resistant strains of ticks has created similar problems for the dairying industry as it has for the beef industry.

Because of the smaller size of holdings, pasture spelling techniques to control ticks are generally not practicable on dairy farms. In recent years, the breeding of tick-resistant strains of dairy cattle has been undertaken by both the C.S.I.R.O. and the Queensland Department of Primary Industries.

Two tick-resistant breeds have now evolved. The C.S.I.R.O. has developed the Australian Milking Zebu (A.M.Z.) and the Department of Primary Industries bred the Australian Friesian Sahiwal (A.F.S.). The bulls used in these breeding programmes were from the original importation of Sahiwal cattle from Pakistan in 1952.

A.M.Z.

The Australian Milking Zebu was developed by crossing Sahiwal bulls with Jersey cows. Early work also included Red Sindhi crosses but these were later discontinued because of poor milk production. Selection was made on the basis of milk production, heat tolerance and tick resistance. The first stage of the work was carried out at the C.S.I.R.O. Field Station at Badgery's Creek via Sydney and later work was done in the Lismore district where about a dozen commercial dairy herds are now in existence together with some in Queensland.

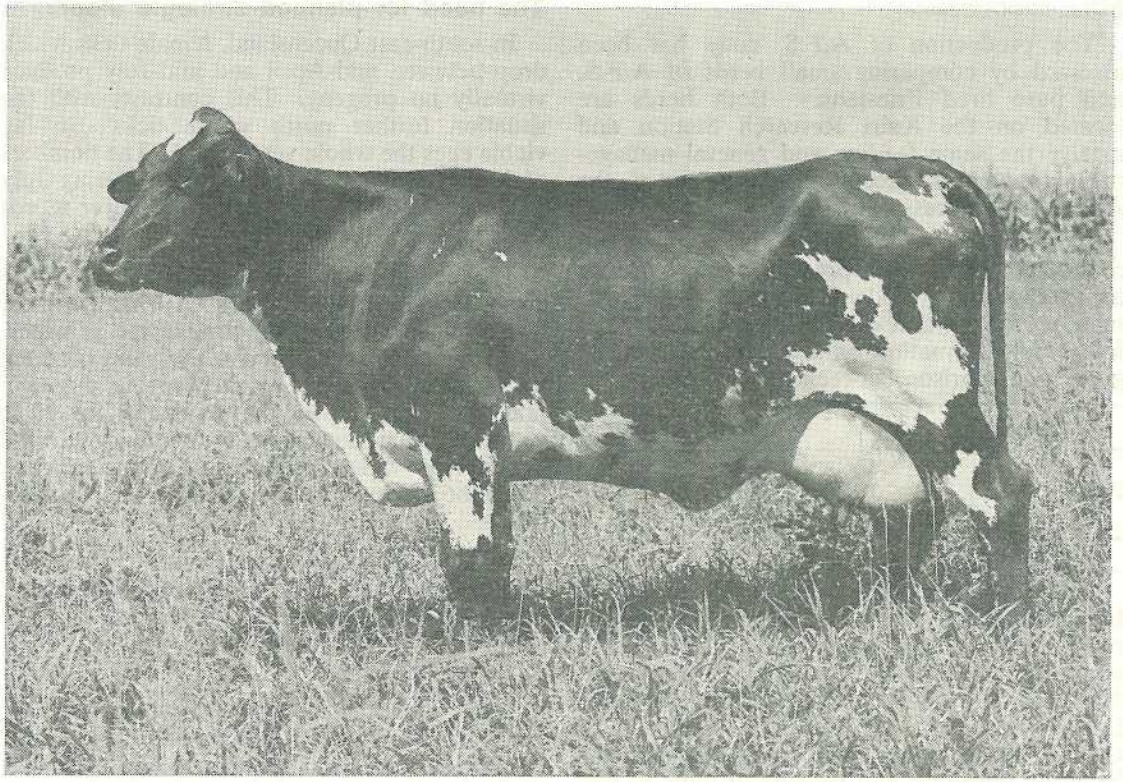
The milk production of these cattle compares favourably with Jerseys and they have the added advantage of heat tolerance and tick resistance. Heifers of this breed as well as semen from progeny tested A.M.Z. bulls have been exported to African, Asian and Central American countries. The export demand for A.M.Z. cows is now outstripping the supply.

Milk production

There is ample genetic variation within the breed, indicating that further selection will raise levels of production. Estimates of heritability of production indicate an expected genetic grain of about 2·5% per annum. Fat protein and solids—not—fat are all at good levels.

At the New South Wales Department of Agriculture's Wollongbar Research Station near Lismore, a comparative test with Guernseys and Friesians under similar conditions showed the A.M.Z. to have comparable performance in terms of both milk and butterfat.

Breed	Number	Milk	Fat	Test
		kg	kg	%
Friesian ..	15	4 290	138	3·2
Guernsey ..	29	3 000	124	4·1
A.M.Z. ..	12	3 403	146	4·3



The Australian Friesian Sahiwal (A.F.S.) combines the high tick resistance of the Zebu and the high milk yield of the Friesian.

A.F.S.

The Queensland Department of Primary Industries' breeding programme began in 1960. Jersey, A.I.S. and Friesian cows were crossed with Sahiwal bulls. The Friesian crossbred has been found to be the most reliable in terms of milk production and a breeding programme is now being developed by using this breed.

The aim is to breed animals which have half Sahiwal and half Friesian content. This allows for a desirable tick resistance (Sahiwal) and a satisfactory milk production (Friesian).

Tick resistance

Considerable emphasis is placed on selection for resistance to cattle tick. At the Kairi Research Station in north Queensland, A.F.S. heifers of the same age are run as a group and tick counts made on them once every month. This quickly shows heifers which are susceptible to ticks. These are subsequently culled from the programme. Bulls which are selected to be used in artificial breeding are subjected to a more intensive tick resistance evaluation.

In the comparisons of A.F.S. and Friesian heifers, it has been found that about one-third of the A.F.S. are as susceptible as Friesians to cattle ticks. Susceptible A.F.S. heifers are culled. The remainder are evaluated for milk production, and a further one-third are culled because of low production. The animals which satisfy both tests are then used to breed the next generation.

Mean tick counts over 6 days on unselected A.F.S. and Friesian heifers were:—

——	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
A.F.S. ..	2	7	15	16	13	10
Friesian ..	34	75	85	84	35	28

MILK PRODUCTION

The production of A.F.S. cows has been assessed by comparing small herds of A.F.S. and pure bred Friesians. Both herds are located on the Kairi Research Station and receive the same feeding and general management treatments except that dipping of the A.F.S. is unnecessary.

Individual A.F.S. cows have recorded 5 500 kg of milk. The present A.F.S. herd has an average milk production which is approximately 75% of that of the Friesian herd. The following information on lactation productions gives a comparison between the two breeds.

Breed	Milk	Butterfat	Test
	kg	kg	%
A.F.S.	3 250	143	4·5
Friesian	4 634	163	3·6

The development of these tick-resistant breeds of dairy cattle has been aided by the co-operation of dairymen who are concerned about tick control and its associated problems. Many dairy farmers are co-operating with the Department of Primary Industries and C.S.I.R.O. They are assisting chiefly with the breeding, selection and proving of bulls so that future generations of animals may be established successfuly.

Dipping

Dipping has enabled the beef industry to exist in tick-infested areas of Queensland for over 70 years. Without dipping, European cattle would not have survived and would have been driven out just as sheep were forced out of the central coast by encroachment of speargrass at the turn of the century. However, four factors are combining to make dipping less attractive to cattlemen.

- New, expensive tickicides have had to be produced to cope with resistant ticks.
- The cost of labour has risen sharply in the last decade.
- Low beef prices do not cover the cost of dipping and provide a reasonable income.
- The possible development of highly resistant ticks could ultimately mean that there will be no tickicides left to control them economically.

The need for planned strategic dipping

In south-east Queensland, female ticks which drop between mid-April and mid-July produce virtually no progeny. This contrasts with the situation further north where ticks can lay viable eggs the whole year round. The numbers of larvae available to infest cattle during July to October are reduced because of lower reproduction during winter.

The engorged female ticks dropped in the early autumn (March, early April) are most important in the over wintering of the parasites. Some of their larvae survive the winter, attach to cattle in late winter or early spring, engorge, and drop off. It is the tendency for their progeny to hatch at about the same time in the late spring which produces the 'spring rise'. Thus the 'spring rise' becomes the first generation.

As temperatures and relative humidity become optimum for tick reproduction, the second, third and fourth generations in the summer and autumn months produce enormous populations.

Most cattlemen control their ticks by conventional dipping. The emphasis of this method is placed solely on the destruction of ticks, dipping at 3 to 5 week intervals. Little attention is paid to the important principle of keeping pastures relatively free of seed ticks—a vital factor in the successful use of chemical control measures. In comparison with conventional dipping, strategic dipping can reduce the tick burden by 80%.

Because the eggs which over winter all hatch out at about the same time, it is more efficient to dip cattle during the spring rise. By dipping at intervals of 19 to 21 days, ticks are prevented from re-infesting the pastures.

The name 'strategic dipping' has been given to the practice of dipping 6 times starting in mid to late October. Its success depends upon an effective, available tickicide and rigid adherence to the 19 to 21 day dipping intervals and complete musters.

This strategic programme only applies to European or tick-susceptible cattle. Most Zebu (*Bos indicus*) and Tropical breed (*Taur indicus*) cattle are tick-resistant. These cattle need only be dipped twice during the autumn months when their natural resistance wanes.

If the programme fails, one of or a combination of the following factors may have arisen:

- Ticks are resistant to the tickicide in use.
- Dipping or spraying facilities are not efficient.
- Management of the dipping facility is not correct.
- Dipping intervals exceed 21 days.
- Clean musters are not achieved.
- Excessive numbers of ticky stock stray onto the property.

To plan a strategic programme for Zebu type cattle in southern Queensland, the following points should be considered.

- Cattle need to be exposed to ticks to acquire resistance.
- Tick resistance in the Zebus and their crosses is highest in the spring to summer months. There appears to be a natural wane in resistance in the late autumn and winter months which is independent of nutrition.
- Tick resistance is highest when nutrition is good and reduces when nutritional status falls.
- The third and fourth tick generations produce large populations. These generations occur in the autumn and early winter months.
- Trials in southern Queensland have shown that non-lactating crossbreds with 50% Zebu blood are not greatly disadvantaged if they are not dipped to control ticks.

Recommendations derived from these facts are:

- It is difficult to justify the dipping of non-lactating, resistant cattle when prices are about 30c per kg L.W.
- Breeding cattle can be dipped twice at a 21 day interval in autumn depending on the tick burden.

A proviso to these recommendations is that sale cattle should be dipped as preparation for sale although slaughter cattle must not be dipped within 10 days of slaughter.

Resistant ticks

The development of resistance in ticks is the underlying problem behind the cost and doubtful supply of new tickicides. Worldwide resistance is well known in many other insects as well as ticks. It develops most rapidly in those situations where chemical pesticides are over-used.

Just as a few European beasts are resistant to ticks, so occasional ticks have the ability to resist tickicides. These resistant ticks may be only one in one million or ten million; they have a genetically modified body chemistry which enables them to neutralize the chemical, or they may just not react to the poison.

Resistant ticks become more frequent in a population as the normal ticks are killed by dipping and eventually there may be one in 10 ticks which is resistant and this is when they become a problem to cattlemen.

The speed at which resistance develops will depend on many factors and it is impossible to define with certainty how many dippings are required before resistant ticks become a problem. However, experience in south-eastern Queensland over recent years suggests that resistance must be expected to appear within 5 to 10 years of the introduction of a new tickicide.

Resistance to DDT appeared after 9 years, to BHC (Gammexane) after 1 to 2 years, to dioxathion (Bercotox) after about 7 years, to coumaphos (Asuntol) after about 8 years, to chlorpyrifos (Dursban) after 4 years.

Resistance to chemicals is potentially present in all tick populations, but chance determines whether it is present on any particular property.

Hence the need to conserve tickicides by minimizing use and maximising results.

In susceptible herds, maximal control from strategic spring dipping is thought to delay resistance, provided a situation of near eradication is maintained, and resistance is not introduced.

It is unwise to dip cattle yarded for other reasons unless the tick infestation really warrants it. In other words, do not dip cattle just because they are in the yards.

In tick-resistant herds where treatment can be limited to a few autumn treatments in breeders, tickicides will have a much longer life expectancy. This is especially so since the ticks surviving autumn treatments in south-east Queensland only occasionally contribute to

the population next season. Resistant ticks are more likely to gain a footing in such herds by introduction.

Resistance in Queensland

Ridgelands strain with resistance to Bercotox, Dagadip, Neocidol and Sevin was discovered in 1964. The Biarra strain was uncovered in 1966, and has now become established throughout the south-east quarter. Most tick samples from the endemic area exhibit at least this level of resistance.

Mt. Alford type (1970) has been found in all sub-districts, and would undoubtedly have shown up further, but for the advent and widespread use of the amidine group.

Other parts of the State have resistance with varying capabilities against the tickicides in use. Each strain is named after the locality of discovery.

The mechanism of resistance to O.P. chemicals is reasonably understood. These chemicals inhibit an enzyme, cholinesterase, which plays a role in the function of nerve junctions.

The resistant strains of Ridgelands, Biarra and Mt. Alford have lower cholinesterase activity. The sensitivity of the cholinesterase to the inhibiting action of the tickicide also varies. Ridgelands strain, the least resistant, has less sensitive enzyme than fully dip-susceptible ticks. Biarra and Mt. Alford in turn have even less sensitivity in the enzyme, and hence have a wider range of resistance.

Mackay strain does not have the above mechanism. It carries fully sensitive enzyme, but has the ability to detoxify the challenging tickicide into less lethal components.

The Mt. Alford strain combines a similar mechanism to Mackay with the one earlier described.

Table 7 shows how various chemicals fare against local resistance problems. The efficiency required of a tickicide would be greater than 97% in a tick-susceptible herd.

Dipping facilities and their management

The methods of application used for the chemical control of cattle ticks are:

- Plunge dips
- Spray races
- Hand spraying

TABLE 7

Tickicide	Percentage of ticks killed		
	Normal	Biarra	Mount Alford
Arsenic	77	14	..
DDT (chlorinated hydrocarbon)	93	91	..
Bercotox (O.P.)	>99	41	..
Asuntol (O.P.)	>99	41	..
Ethion (Coopathon) (O.P.)	>99	74	34
Dursban 0·025% (single O.P.)	>99	90	46
Nexagan S 0·1% O.P.	>99	97	67
0·05% O.P.	>99	78	60
*Prolate O.P.	>99	96	95
Bimarit (AMIDINE)	97	99	98
Dipofene (AMIDINE)	97	97	97
Promicide (CARBAMATE)	98	98	99
Taktic (AMIDINE)	>99	>99	>99

(*Use as spray only)

Plunge dips

Plunge dipping is the most efficient chemical method of controlling the cattle tick (*Boophilus microplus*) provided the dipping fluid is maintained at an effective and uniform concentration.

Factors which consistently alter the concentration of the dipping fluid are: excess fouling and sedimentation, flooding during periods of heavy rain, evaporation during hot weather, leakage through poor construction, inefficient stirring, the tendency to strip (most of the organo phosphate, lipid-soluble carbamates and amidine tickicides possess this feature) and occasionally decomposition due to bacterial degradation.

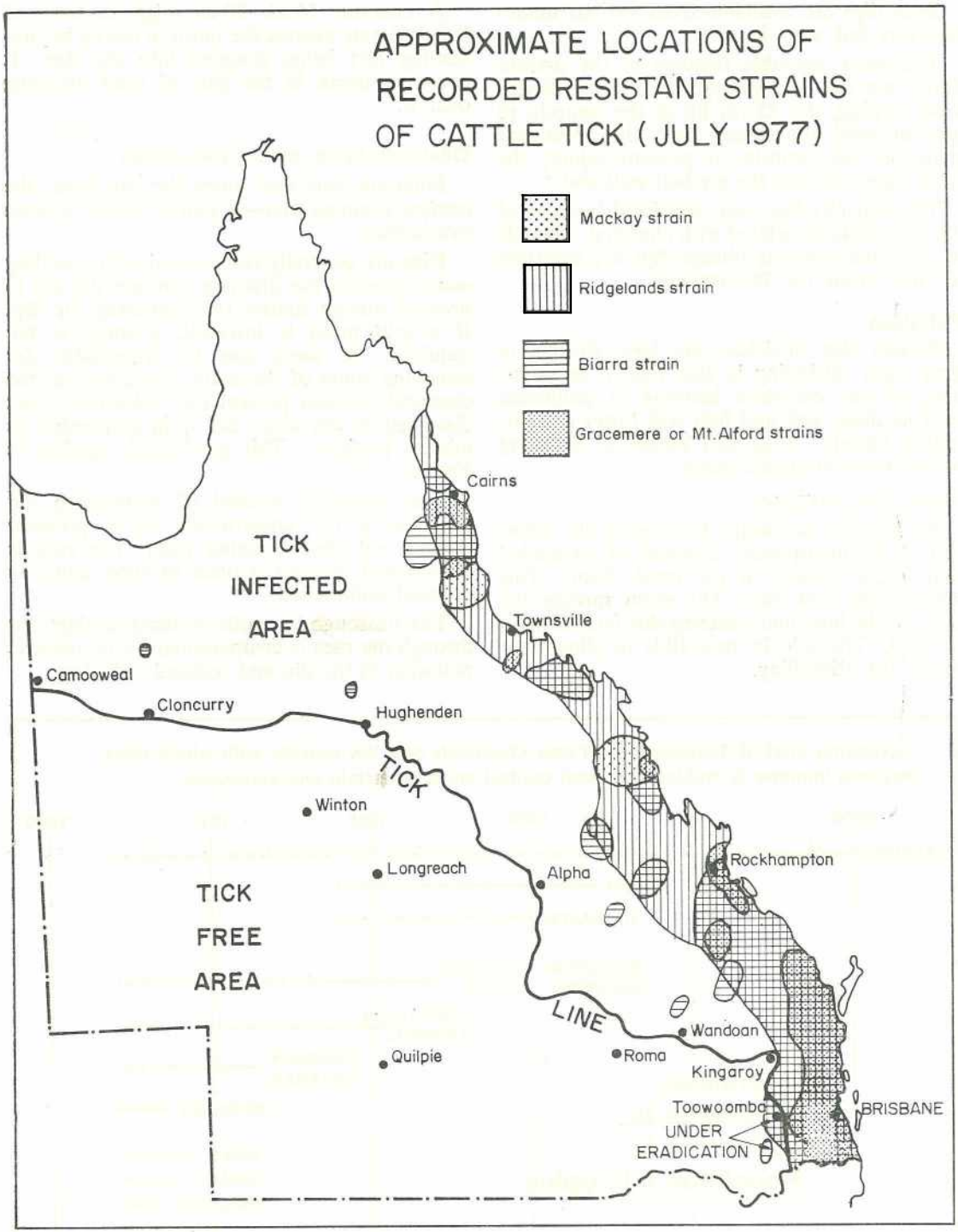
In addition, poor sampling results in incorrect analytical results thus causing confusion.

DESIGN AND MANAGEMENT

Some early dip designs contained many undesirable features. The present design available from the Queensland Department of Primary Industries incorporates such features as concrete approaches, protection against the weather and against flooding, features to minimize pollution, adequate facilities for emptying, charging and measuring the dip contents.

The dimensions of the present concrete, Besser block and fibreglass dips are:

Length of well	4·27m	(14′)
Walk out (steps)	6·86m	(22′ 6″)
Overall length	10·90m	(35′ 9″)
Width at top	1·07m	(3′ 6″)
Width at bottom	0·61m	(2′)
Depth of water at working level	1·98m	(6′ 6″)
Capacity	11·14 k*l*	2 450 gal.


APPROXIMATE LOCATIONS OF
RECORDED RESISTANT STRAINS
OF CATTLE TICK (JULY 1977)
Mackay strain
Ridgelands strain
Biarra strain
Gracemere or Mt. Alford strains
Cairns
TICK
INFECTED
AREA
Townsville
Camooweal
Cloncurry
Hughenden
TICK
LINE
Winton
Longreach
Alpha
Rockhampton
TICK
FREE
AREA
LINE
Wandoan
Quilpie
Roma
Kingaroy
Toowoomba
BRISBANE
UNDER
ERADICATION

Steel dips are available from various manufacturers but vary in size.

The most desirable features of the present design are the level jump-in to ensure efficient head wetting, the 23 cm lip of the jump-in to prevent swirl and splash back, the prominent grips on the jump-in to prevent injury, the short approach and the gradual walk-out.

The capacity has been restricted because of the high costs associated with charging. Moulds to construct concrete plunge dips are available for hire from the Department.

Pollution

Present day tickicides are less effective in dirty dips. Stripping is also related to pollution, so any excessive increase in pollutants such as dung, soil and hair will lower concentration unduly. Suggested means of reducing pollution are discussed below.

Crush and approach

An effective technique to combat dip pollution is to incorporate a panel of expanded metal (grid mesh) in the crush floor. This replaces the foot bath. The mesh spreads the claws of the hoof and adhering dirt falls through the grid. The grid is on a slide to allow easy access for shovelling.

A concrete block 30 cm high in front of the slide gate nearest the jump-in assists by preventing dirt being dragged into the dip. It causes a break in the gait of stock stepping over it.

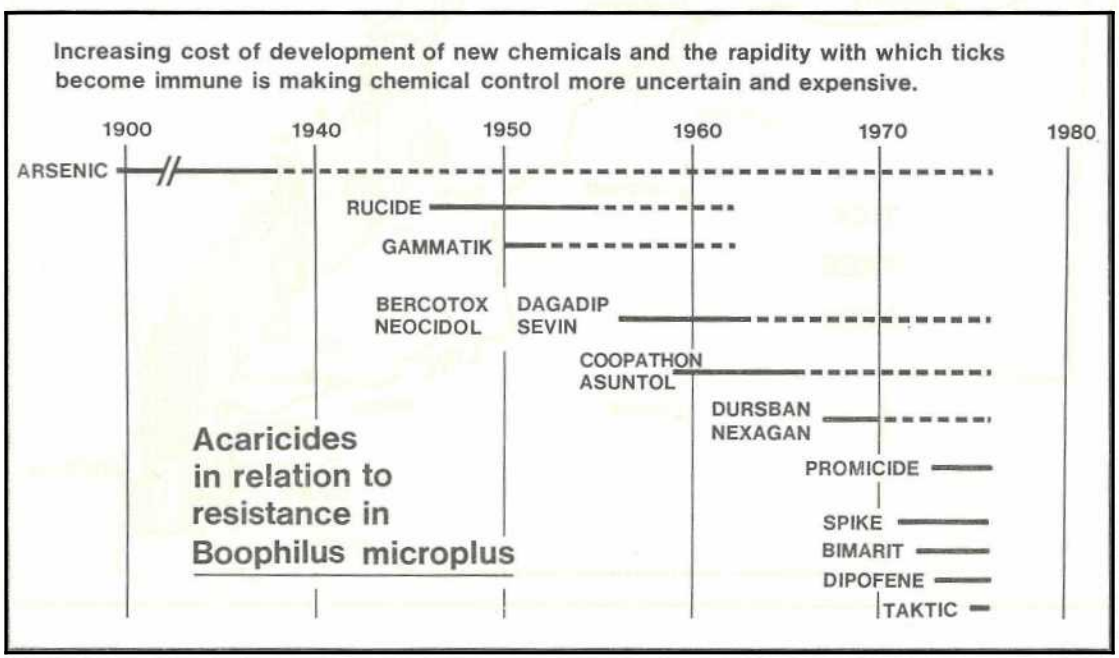
Draining pens, sumps and races

Pollution can also enter the dip from the cement draining pen—a source which is often overlooked.

Dips are generally constructed with a settling sump between the draining pen and the dip to prevent foreign matter from entering the dip. If a grid mesh is installed, a sump is not required. A sump can be responsible for removing some of the active ingredient as the chemical in most present day tickicides is not dissolved in the water but is in suspension as minute particles. This particularly applies to Taktic.

One successful method of overcoming this problem is the construction of a properly graded and sited draining race. The race is curved and the end is open to allow cattle to proceed unhindered.

The fluid lost by cattle walking straight out through the race is compensated for by reduced pollution in the dip and reduced stripping.



Operation of vat

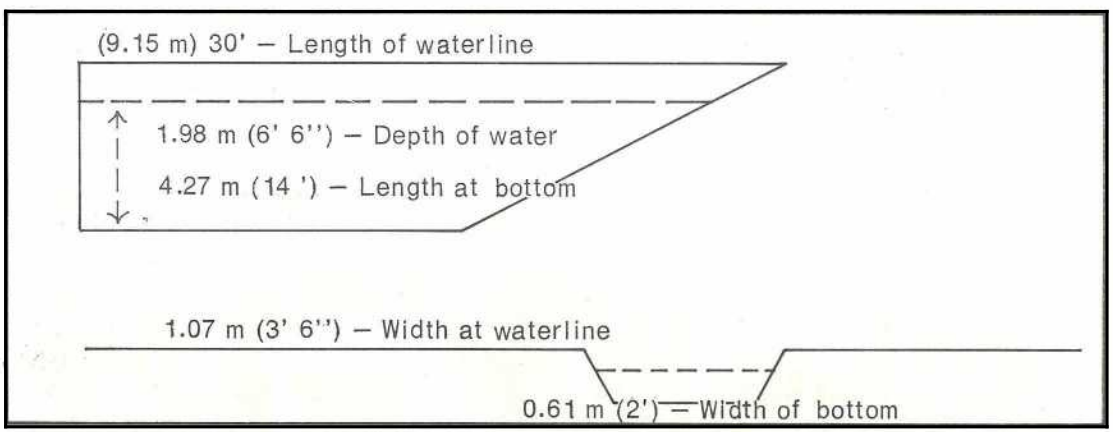
For efficient operation of the vat, it is necessary to know its exact capacity, the actual volume of fluid in the vat and the correct method of adding the necessary amounts of concentrate and water when charging and replenishing (topping-up).

Capacity of dipping vat

The volume of each vat must be measured accurately and this volume permanently marked on the vat. There are three methods of measurement, but whatever method is used, the level of each additional 225 *l* of water must be marked on the side wall of the dip or on a measuring rod. The different methods are:

- Use of a water meter (preferable for accuracy).
- Measure water into the vat from a tank of known capacity. This is the simplest method.
- Mathematically: the following formula may be used to determine the capacity of dipping vats:—

Measuring in metres, multiply the average length by average breadth by depth of water by 1 000 to give litres. Thus taking the quoted measurements:



Metric

$$\text{Average length} = \frac{9{\cdot}15 + 4{\cdot}27}{2} = 6{\cdot}71\text{m}$$

$$\text{Average breadth} = \frac{1{\cdot}07 + 0{\cdot}61}{2} = 0{\cdot}84\text{m}$$

Depth of water = 1·98m

Capacity = 6·71 × 0·84 × 1·98 × 1 000

Capacity = 11 160 *l*

1 000 litres in 1 cubic metre

Imperial

$$\text{Average length} = \frac{30' + 14'}{2} = 22'$$

$$\text{Average breadth} \times \frac{3\frac{1}{2}' + 2'}{2} = 2\tfrac{3}{4}'$$

Depth of water × $6\frac{1}{2}'$

$$\text{Capacity} = 22 \times \frac{11}{4} \times \frac{13}{2} \times \frac{25}{4}\text{ gal.}$$

Capacity = 2 458 gal.

$6\frac{1}{4}$ gallons in one cubic foot.

Wetting agents

These should not be added. All tick-killing preparations contain sufficient wetting agents in their formulation. Additional wetting agents in dips decrease efficiency by reducing the amount of chemical which is deposited on the hair.

It is also possible that the added wetting agent could be antagonistic to the original concentrate, thus causing additional problems in the vat.

Effect of hair

Broadly speaking, as long as cattle hair is removed from the vat before dipping, its removal will not have significant, harmful effects on the dip concentration.

Sound management, therefore, requires that the vat and approaches be kept as clean as possible, the concentration of chemical maintained at the correct level and common sense be used in handling the stock.

Types of spray races

NON-RECIRCULATING

These units are notoriously inefficient. Most are constructed for lice control and are unsuitable for tick control. They operate as low volume, high pressure units. It is impossible to successfully modify these units.

RECIRCULATING

Most of these units operate at high volume, low pressure. It follows that the higher the pressure, the more chance there is of incurring 'misting' rather than 'wetting'.

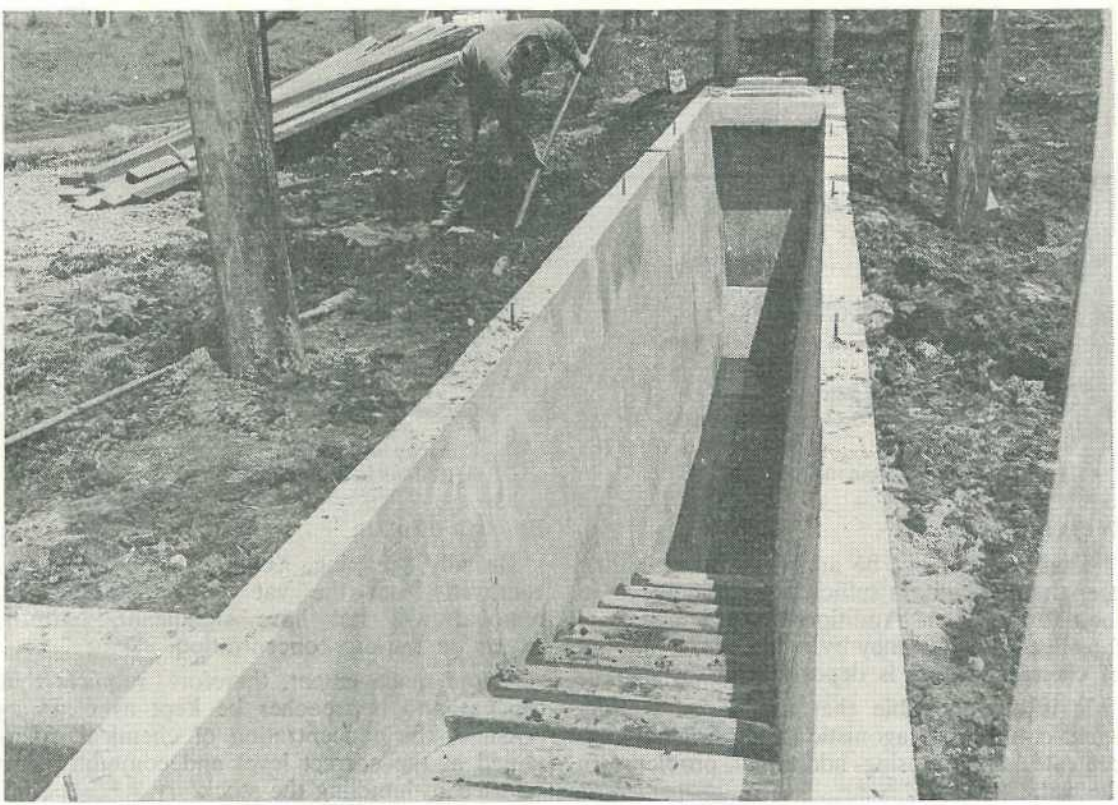
Their efficiency depends on the construction and mechanical efficiency of the pump, strainer and nozzle system. Placement and patterns of nozzles, volume and pressure determine the degree of efficiency.

Spray race designs

Plans are available from the Department of Primary Industries. The desirable features are:

- Pump capable of delivering 90 k*l* per hr (20 000 gals per hr).
- Overall length of 6 m (20′).
- Large orifice nozzles capable of delivering 40 *l* per minute (9 gal. per min).
- A minimum of 35 strategically placed nozzles.
- Floor side and overhead lines not to be less than 35 mm internal diameter in size.
- Filtration system to be efficient.

Plans and moulds for dip construction are available from the Department of Primary Industries.



ADVANTAGES

- Low cost of changing chemicals.
- By adjusting the quantity of dip to suit the number of cattle being treated, the destructive effects of pollution have less bearing on the efficiency of the tickicide.
- Ease of treating small numbers.

DISADVANTAGES

- Cost of maintenance.
- Sensitive mechanical devices on the unit require above average mechanical ability to carry out maintenance.
- Rapid stripping of the lipid-soluble O.P.'s. carbamates and some amidines.

Stripping

This phenomenon is equally as important to spray races as it is to plunge dips.

To understand stripping, it is necessary to understand a little about dip chemistry.

For many years, cattle were dipped in arsenic. When arsenic is mixed with water, it forms a true solution. Most of the modern dips do not dissolve in water, but rather are made into emulsions of minute particles which are suspended in the water.

When this mixture is sprayed over cattle, the hair acts as a filter and some of the minute dip particles are strained out of the water and are retained on the cattle hair. This is called stripping. Therefore, as more and more chemical is deposited on the cattle hair, the mixture in the sump becomes weaker and weaker. In practice, as the volume of the sump or dip decreases, the stripping rate increases.

Stripping is combated by adopting one or more of the following methods:

- Making the dipping mixture more concentrated than is recommended by the manufacturer or is required for the efficient killing of the tick. This method is wasteful and could lead to toxic effects when using certain chemicals.
- Reinforcement by adding concentrate to the sump without the further addition of water at intervals during dipping. If the reinforcing is made at wide intervals, for example, after a loss of volume of 675 *l* (150 gal.), the variation in dip strength is correspondingly wide. If the reinforcement is made at short intervals, for example, a loss of volume of 225 *l* (50 gal.), then dip strength does not vary greatly. This method involves the cost of additional chemical at each reinforcement.
- Replenishment by adding water plus chemical to the sump at a rate higher than that recommended for charging. This method embraces similar cost factors to reinforcement.
- Continuous replenishment. This simply involves continually running fresh wash from a side tank into the sump at the same rate that the cattle are removing the wash from the sump. This method is recommended as the most effective way of maintaining the volume of wash at almost the same strength.

HAND SPRAYS

Hand sprays are convenient only where there is a small number of animals to be treated and time is no object. Hand spraying is notoriously inefficient. It takes 10 *l* (2·5 gal.) of fluid to treat one adult animal thoroughly and even then it is difficult to thoroughly saturate all portions of the animal's skin.

Pasture spelling

Spelling paddocks prevents larval ticks from feeding. Larvae die rapidly in summer, a paddock will be quite clean if kept closed for 10 to 12 weeks depending on summer temperatures. There are inadequate data on the effects of pasture spelling on feed quality and cattle performance but, with low beef prices, spelling is attractive to cut down the number of dippings.

Certain aspects of spelling need attention.

- Good fencing and complete mustering are essential.
- An efficient dip is needed to clean cattle on movement between paddocks.
- Spelling in winter will have very little effect.
- Spelling improved pastures for 10 weeks in summer will increase the content of twining legumes under most circumstances, and this will usually be beneficial.

- As yet, there is insufficient information about the effects on different pastures, or about the effects on animal production to recommend summer spelling of pastures as a routine procedure.

Pasture spelling is demanding on management and susceptible to breakdowns. It is more likely to be useful in an opportunistic way but planned spelling should be carefully considered as a means of reducing dipping during the next decade while Zebu x cattle are phased in to replace European breeds. Small losses in production due to spelling may be more acceptable than the costs incurred in dipping.

Pasture spelling may be necessary for dairy cattle and research is needed into suitable spelling schedules for use in the dairy industry.

Pasture spelling schedules

- Two paddock rotation with dipping on transfer. The longer pastures are kept free of cattle the fewer tick larvae will remain, but pastures will also deteriorate. A compromise is necessary and, in practice, spelling of pastures in summer for less than 10 weeks in south-east Queensland may be too short and spelling for more than 16 weeks will yield no further benefit in tick control. In cooler seasons, spelling periods have to be extended and are less beneficial than summer spelling. The lengths of spelling periods to give moderate to good tick control starting in different months are given below.

  November 1 to mid January—10 to 14 weeks.

  Mid January to 1 March—12 to 16 weeks.

  1 March to mid April—16 to 23 weeks.

  Mid April to 30 June—vacate until September 30.

  1 July to October 30—vacate until December 31.

In a dry year, the shorter periods should give good control but in a wet year where large numbers of ticks have been dropped into a paddock, the longer periods would be desirable.

Benefits from pasture spelling are greater if an orderly rotation is established which prevents the cattle becoming ticky. Putting ticky cattle, which have just been dipped, into clean pastures is less satisfactory because a proportion of ticks always escape dipping. Cattle should always be dipped on transfer between paddocks.

- Opportunistic spelling. (For example, cropping, fodder conservation). The same spelling periods would apply.
- Zero grazing may be a useful method of tick control for dairy properties with problems from resistance or residues. The same principles apply as for pasture spelling.
- Fencing costs (suspension fencing estimated to cost $450 per km). If it is assumed that a paddock is to be divided in half, costs can be comparable to those in table 8).

TABLE 8

Size of original paddock	Length of fence	Cost of fence	Stocking rate	Cost/animal carried
ha	m	$	ha	$
50	700	315	1/2	12.60
50	700	315	1/5	31.50
500	2 000	900	1/2	3.60
500	2 000	900	1/5	9.00

Tick fever control

When cattle ticks first spread from the Northern Territory into Queensland in the 1890s they also spread the organisms responsible for tick fever. Tick fever causes high temperatures, anaemia and often death in cattle. In the early outbreaks, losses of up to 80% were experienced when cattle had no natural immunity to this disease.

Tick fever has remained one of the most serious diseases affecting cattle in the tick-infested areas of Queensland. It may be controlled by the use of drugs and prevention is possible with vaccination.

Zebu and Zebu cross cattle are relatively resistant to tick fever. The level of resistance is in proportion to the level of Zebu blood in the animals.

Causative organisms

Ticks are responsible for transmitting three different microscopic organisms, all of which may produce their own type of tick fever. Microscopic examination of blood smears from an affected animal shows the causative organisms inside the red blood cells.

Babesia argentina causes most tick fever; a similar organism *Babesia bigemina* infects most cattle but rarely causes sickness. Babesiosis is the name of the disease caused by these two parasites. The third organism is *Anaplasma marginale* which causes anaplasmosis.

Transmission

If *Babesia* organisms are present in the blood of a beast, some parasites may be swallowed by female ticks during engorgement and multiplication occurs in the tick. When the tick's progeny attach to another beast, transmission to the new host occurs by way of the young tick's mouth parts and saliva.

The transmission of anaplasmosis is quite different. Transmission from the engorged adult female to her progeny does not occur. Although the cattle tick is reputed to be a one host species it may not attach to its host for all of its life and temporary detachment may take place.

Thus if cattle are in close contact (for example, when in yards) some are able to transfer to a new host. Anaplasmosis may then be transmitted if ticks have been exposed to anaplasmosis organisms on the previous host. Male ticks are migratory and can transfer even more readily to a second host. They have been shown to transmit infection and could be the more significant transmitting agent.

Symptoms

Cattle suffering from acute babesiosis seek shade and water, show loss of appetite and are disinclined to move. If forced to walk, they may sway and stagger. Occasionally an animal may charge. These symptoms and the severe depression and convulsions sometimes seen are associated with brain damage. The term 'red water' has been used for tick fever but can be misleading because red urine is not always seen in tick fever and may occur in other diseases.

Rectal temperatures vary from 40·6°C to 42·2°C. Membranes of the eyes, gums and vagina may be very pale and/or yellow (jaundiced).

Anaplasmosis is usually of slower onset and longer duration than babesiosis. The sickness may extend over several weeks. Temperatures range from 40°C to 40·6°C. Loss of condition, depressed milk production and abortion are symptoms in non-fatal cases. The urine is rarely if ever red but may be brownish. As with babesiosis, anaplasmosis affects all ages but symptoms increase in severity with the age of the animal.

Post mortem findings

Pale or yellowish tissues are often seen. The liver is usually enlarged, orange or bronze and the bile is thick and granular. The spleen is enlarged with a 'raspberry jam' consistency when cut. If urine is present in the bladder, it may be red, in the case of babesiosis.

It is important that thin blood smears be submitted to the Department of Primary Industries' diagnostic laboratories for examination. Smears of blood on a glass slide are taken from such organs as kidneys, heart muscle, spleen or brain or from an extremity (for example, the ear). The smears should be air-dried and wrapped in clean tissue paper. Microscopic examination allows identification of the particular tick fever organism responsible for the disease.

How do outbreaks occur?

Cattle bred on the property

When many ticks are constantly present, a relative state of harmony exists with ticks perpetuating the passage of tick fever organisms through the herd without apparent sickness. Calves are rarely affected because of an immunity given to them at first by their dam and later by another mechanism associated with age.

With many calves, repeated exposure to tick fever organisms occurs before 9 months of age without any disease being seen. These early infections (or challenges), however, promote a lasting immunity against the disease. The longer the first challenge is delayed, the greater the chance that a clinical case of tick fever will result.

In practice, the first challenge is frequently delayed in Queensland. Even when ticks are not deliberately controlled, their numbers fluctuate under the influence of climate and the stocking rate so that a state of harmony may not occur. When tick numbers fluctuate, not only are young cattle left susceptible, but sometimes the ticks themselves lose their infections. This can lead to a situation in which both ticks and cattle are devoid of organisms.

It can be seen that, with low levels of the organisms in ticks, challenge and resultant immunity may not come at the most favourable age for some cattle. This may follow good tick control or occur naturally in areas where tick numbers periodically fall to low levels.

In most situations, one tick in 2 000 to 10 000 is infected with *B. argentina,* although wider variations occur depending on the numbers of ticks present, the presence of cattle capable of infecting ticks, the age of the cattle in the paddock (young cattle may infect ticks better than old animals) and the time of the year. In south-east Queensland, the disease incidence rises to a peak in autumn with the heavier tick burdens and possibly higher infection rates within the ticks.

Travelling cattle

Cattle introduced to ticky areas for the first time are naturally at risk. Outbreaks even follow movements within ticky areas. Thus shifting cattle from district to district, property to property and even paddock to paddock have all precipitated outbreaks.

As explained earlier, immunity may be inadequate in ticky cattle because the casual organism may have been present in small numbers or absent on the property of origin. The outbreak results from exposure to more heavily infected ticks in the new environment.

Strain differences are suspected as a cause of outbreaks. Cattle coming from an area where the *Babesia* is of low virulence and not capable of causing disease could be troubled by meeting organisms of higher virulence in another area.

Tick outbreaks in clean country

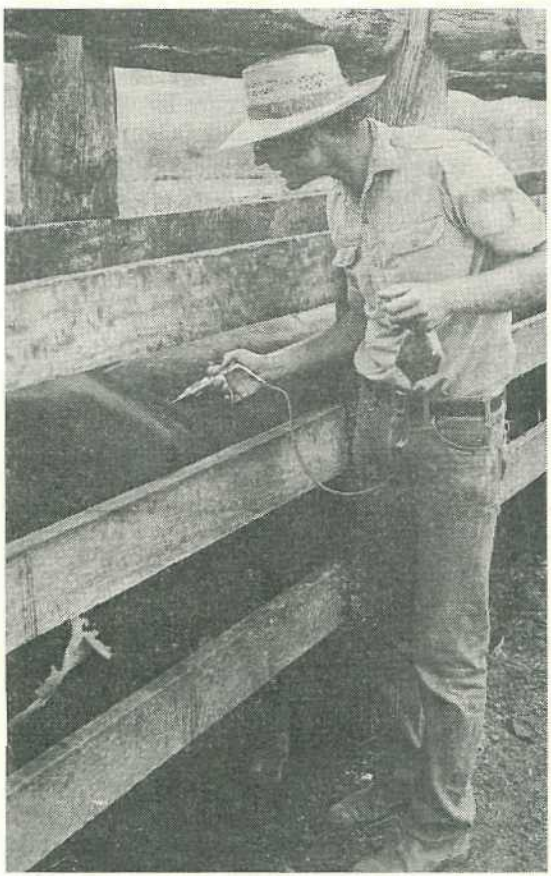
Tick fever is sometimes the first evidence that ticks have entered clean country. Some tick outbreaks in clean country are not accompanied by tick fever. This signifies that the causal organism must not have been present in the intruding ticks.

Prevention

Tick fever can be prevented by the use of a vaccine or through the animal building up a natural immunity to the disease.

Provided cows are immune, their calves are protected by immune substances received in the colostrum. This gives protection for about 2 months. Calves in this age group are quite susceptible to tick fever if they do not receive protection from colostrum.

At about 2 months of age, most calves develop a natural non-specific resistance to the disease and rarely develop symptoms of tick fever. At 7 to 8 months, they tend to lose this ability to deal with the infection and become clinically susceptible, and so may show signs of tick fever if exposed after this age.



Vaccination is an effective control for tick fever. A subcutaneous injection is made in the shoulder region.

To protect them against *B. argentina,* one vaccination induces a lasting immunity in most cattle. A second vaccination using a different strain of the organism in the blood is sometimes used to reinforce this immunity. A third vaccination can be given but should be required only in exceptional circumstances.

The laboratory now routinely changes the strain of *B. argentina* in the blood every 5 months for producers wishing to vaccinate more than once.

Taking into account that young stock start to lose their natural immunity at 7 to 8 months of age, it is obvious that they should receive their initial vaccination before this time. Second vaccinations, if performed, should follow 6 months or so later so that immunization of cattle is completed well before breeding has begun.

If anaplasmosis is considered a risk, young stock may be vaccinated by ordering vaccine containing *Anaplasma* as well as *Babesia.* This bivalent vaccine is often called 'two-shot' or 'two-germ', and should be used in the first vaccination.

In an outbreak of anaplasmosis in an adult herd, anaplasmosis vaccine may be used on its own when it is known that the immunity of the stock to babesiosis is sound.

Vaccines incorporating *B. bigemina* are not usually recommended mainly because this parasite rarely causes significant loss in Queensland.

If susceptible cattle are to be introduced to tick-infested areas, they should be vaccinated with the two-germ vaccine no later than 6 weeks before movement. This allows the cattle time to recover from their reactions. If this is not possible, they should be vaccinated on arrival at their destination, and kept tick-free during the reaction period. Provided the journey is completed within 4 to 5 days, the cattle could be vaccinated immediately before departure and allowed to react at their destination. It is most important, however, to avoid reactions in travelling stock.

For introduced, susceptible cattle it is recommended that a second vaccination be given six months after the first. It is important that both vaccinations incorporate the anaplasmosis vaccine. When plans can be made well ahead for the introduction of cattle, for example, bulls going to a regularly-held sale, give two vaccinations 6 months apart on the home property. Again, the first vaccination should be with the two-germ vaccine. Time the second for at least 3 to 4 weeks before the departure of the cattle.

If possible, avoid vaccinations when conditions are unfavourable to the cattle, for example, while being travelled, during very hot weather, if they are in very poor condition, or if other diseases such as ephemeral fever are present.

Inoculation reactions

Normally, reactions occur between 7 and 14 days after inoculation, and it is wise to inspect the mob daily during this period. Reactions are usually most obvious from 9 to 12 days after vaccination, although occasionally reactions as late as 21 days have been seen.

Many inoculated animals do not show obvious symptoms, but fever can generally be detected if temperatures are taken during the middle stage of the reaction period. Severe reactions are controlled by giving one of the available drugs. Treatment is indicated when the animal is obviously sick or when the temperature is 40·6°C or greater.

Vaccinated cattle should be kept in well-watered, shady paddocks close to yards so that animals with reactions can be quietly drafted off and treated. Do not aggravate reactions by disturbing the cattle unnecessarily.

Treatment

Modern drugs are now available through veterinary suppliers to treat tick fever.

Babesiosis

At present, the most commonly used drug for the treatment of babesiosis is amicarbalide ('Diampron'), which is readily available to stockowners. The recommended dose rate is 2·2 ml per 100 kg liveweight but more can be given to acute cases. It is usually given intramuscularly. The dose may be repeated after 24 hours if necessary.

Imidocarb ('Imizol') is also used at the same does rate. Although this drug is very efficient, it is presently unavailable. A group of drugs of which 'Acaprin' is the best known, is also difficult to obtain. While being efficient, it can

be toxic if used under adverse conditions. 'Imizol' and 'Acaprin' are both administered by subcutaneous injection. Another drug, euflavine ('Gonacrine'), which is available on veterinary prescription only, must be injected intravenously.

Tick fever drugs normally have a long storage life, but should be discarded if serious discolouration occurs.

Anaplasmosis

Due to the unavailability of 'Imizol', treatment of anaplasmosis has reverted to the alternative treatment, namely oxytetracycline ('Terramycin'). This drug is an antibiotic, available on prescription. It may be injected subcutaneously, intramuscularly or intravenously at the daily dose rate of 10 mg per kg or 20 ml per 100 kg liveweight on 3 successive days. Two days' treatment may suffice in mild cases. It should be injected slowly if administered intravenously. If 'Imizol' is available, the dose rate is 6·6 to 11 ml per 100 kg.

Control

There are several ways to control an outbreak of tick fever. While control measures are being initiated, it is most important to identify the organism causing the disease, that is, *B. argentina, B. bigemina* or *A. marginale.* This can be done by making smears from the blood of sick animals or from the blood and organs of dead animals. These are sent for microscopic examination to the Animal Research Institute at Yeerongpilly in Brisbane.

Your local veterinary surgeon or Department of Primary Industries Veterinary Services Officer can organize the investigations. An early, accurate diagnosis is a great help especially when initial control measures do not work as well as expected.

Babesiosis

Outbreaks caused by *B. argentina* in fully susceptible cattle may be quite severe. Death and acute sickness of several animals over a period of a few days suggest a severe outbreak is developing.

Outbreaks can be controlled by treating the sick animals in the mob with any available tick fever drug and vaccinating the remainder. With this approach, the mob should be dipped as soon as possible to remove the infecting ticks. Following vaccination, the cattle should be kept under observation for 3 weeks, particularly during the first 14 days when reactions from either natural infections and/or vaccination may occur.

Vaccination is not regarded as a likely cause of abortion in pregnant cows and a daily check of the cow's temperature during the reaction period, together with appropriate early treatment, should minimize any risk.

Should 'Imizol' become available again, it is a useful drug in controlling severe outbreaks. All animals in the affected group are treated immediately with 'Imizol' at 1·1 to 2·2 ml per 100 kg liveweight. This cuts off the outbreak sharply.

Tick burdens are removed by dipping all animals excepting those obviously ill, and the cattle are then inoculated with tick fever vaccine approximately 4 weeks after treatment with 'Imizol'.

Anaplasmosis

When anaplasmosis is diagnosed, the procedure again is to treat the sick animals, dip, and vaccinate the remainder with anaplasmosis blood vaccine. It is important to reduce the transmission of the disease by keeping ticks off the cattle, and repeated short-interval dipping may be necessary.

The cattle should be given plenty of feed, water and shade during the course of the disease and also during vaccination. It may take 8 to 10 weeks for this disease to be brought under control, and the cattle should be kept under observation during this period. Those showing signs of illness such as prolonged fever, anaemia, obvious loss of condition or appetite should be treated.

D-crush for horses

by R. M. DODT and A. E. HOLMES, Beef Cattle Husbandry Branch.

LIKE other assets on the property, the stock horse requires regular maintenance and sometimes repairs.

The use of a D-crush will simplify caring for the horse.

From the plan (figure 1), it can be seen that the straight line of the D is formed by two gates which are hinged 70 cm apart. Both gates are 290 cm long and 170 cm high.

The curved section of the D is constructed so that these gates can be moved to form a crush. This is shown in Plate 2.

To operate the crush, the required horse is led, or drafted, into the D-shaped yard. Both gates are then gently moved until the horse is confined as shown in Plate 1.

Confined horses are prone to injury. It is therefore preferable that the gates and the curved section be closely boarded to prevent the horse getting its legs caught. Greenhide leather, fixed to the inside of the actual crush, gives added protection against injury. Alternately, marine ply or rubber matting can be used.

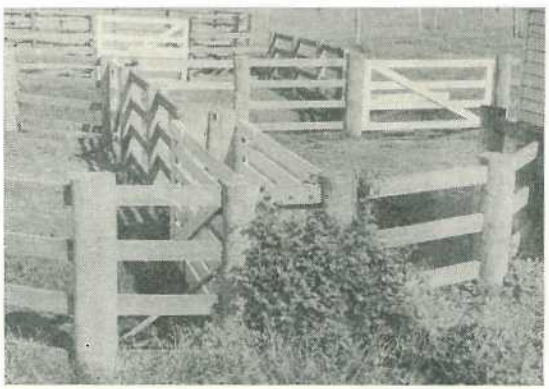
Safety to man is another consideration. The gates, when being closed on a horse, can be latched at each of the posts in the curved section. Also a length of galvanised pipe hinged to the back of each gate at the head will act as a safety stop should the gate be forced back. This pipe can be seen in the photographs and is detailed in figure 2.

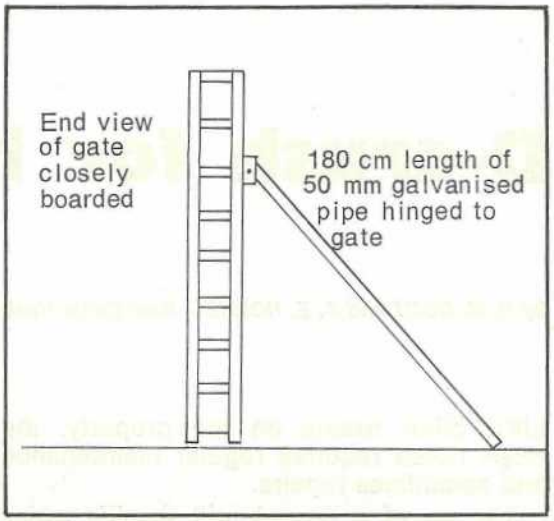
This type of crush is installed on research stations conducted by the Queensland Department of Primary Industries. Over many years, the design has proved effective for operations such as drenching, teeth care, vaccinations and minor surgery.

Plate 1. An adult horse which is securely confined. Note the safety pipe on the gate.

D-crush plans

The crush is suitable for all classes of horses from foals to adults and for both handled and unhandled horses.

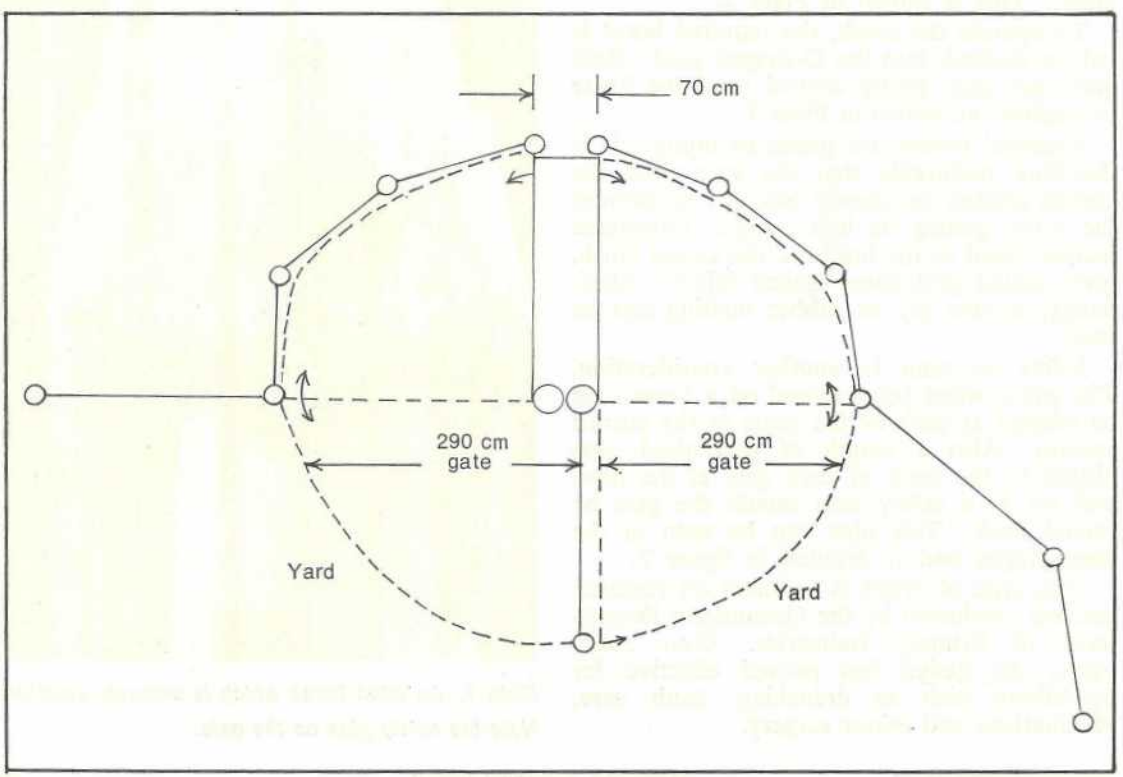




Above. Figure 2. Safety stop on gate.

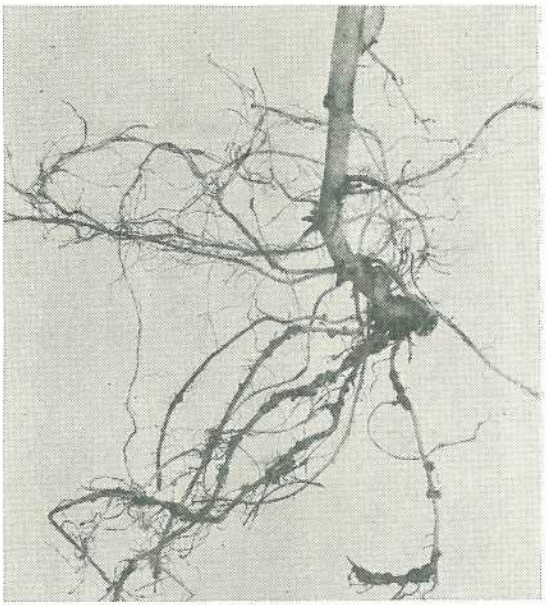
Left. Plate 2. The D-crush and associated yards at 'Swan's Lagoon' Cattle Field Research Station, Millaroo.

Below. Figure 1. Plan of D-crush and yards.



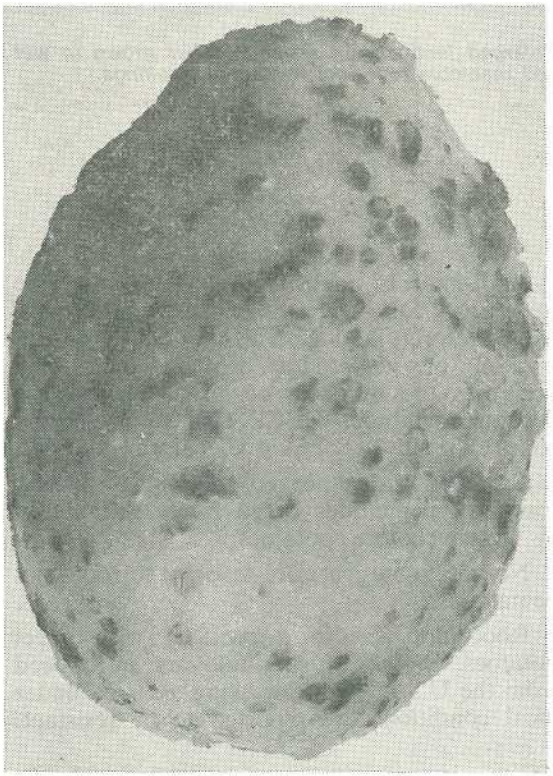
Nematodes and potatoes

by R. C. COLBRAN,
Plant Pathology Branch.



Top. Root-knot nematode galls on potato roots 4 weeks after planting.

Bottom. Potato tuber with severe root-knot 7 weeks after planting.



IN Queensland, root-knot and root-lesion nematodes attack potatoes causing the tuber disorders known as root-knot and pimple.

Root-knot is also a problem on sweet potatoes.

Root-knot

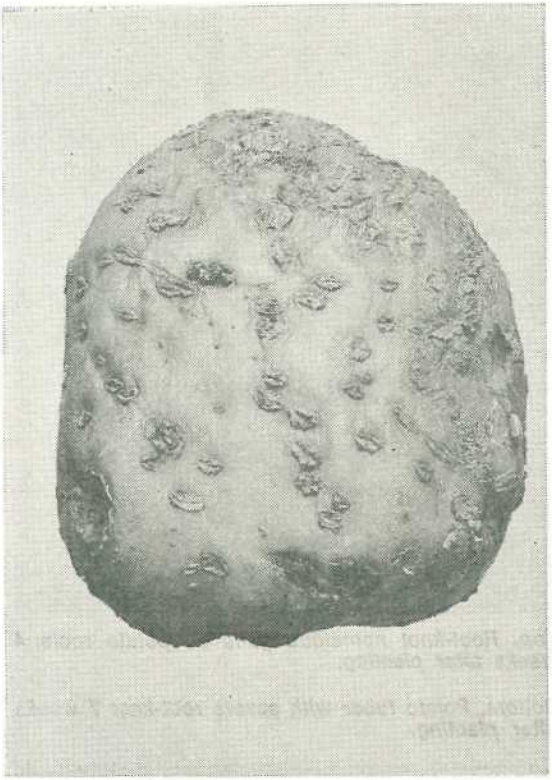
Larvae of root-knot nematodes (*Meloidogyne* species) in addition to causing root galls invade the lenticels and develop in the outer tissues of the tubers. This leads to the formation of swelling or galls on the surface.

When potatoes are peeled, clear areas around the nematodes are visible to the naked eye. Severe galling of tubers can develop well before harvest and continue in storage.

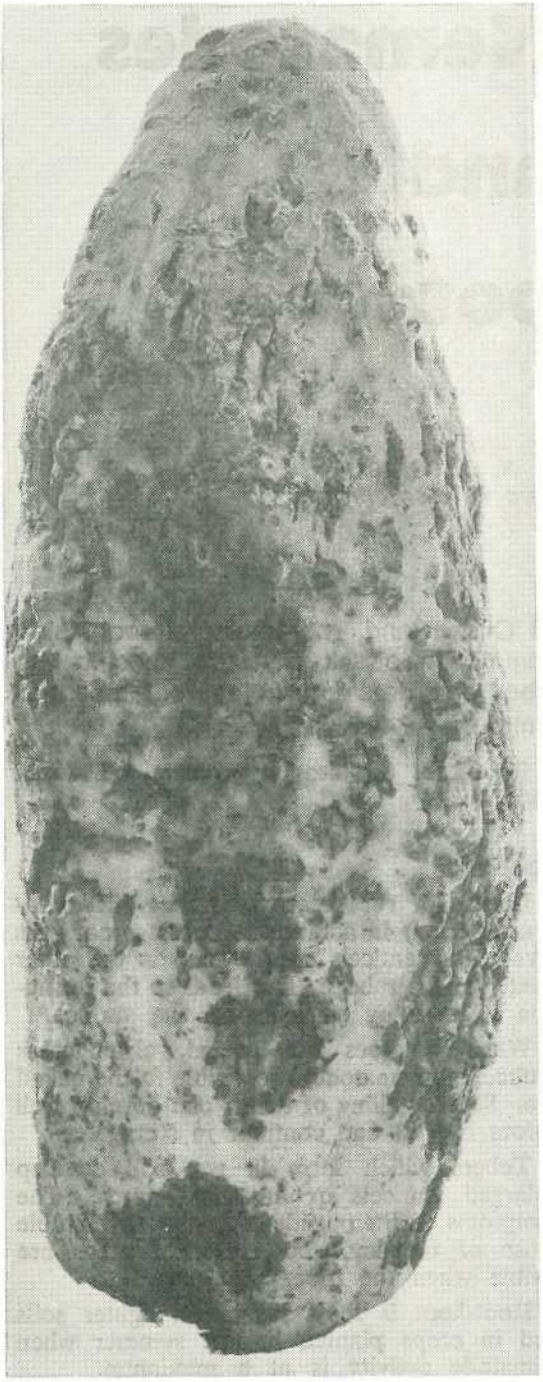
Tubers which form in wet soil develop enlarged lenticels or breathing pores. The symptoms on the outside of the tuber resemble those of root-knot but no clear areas are visible when the tubers are peeled.

Root-knot is most severe on lighter soils and in crops planted in late summer when nematode activity is at a maximum.

The use of infested seed is undesirable because, although it has only a small effect on yield, it may introduce races of root-knot nematodes not already in the area. Certified seed is not always free of nematodes.



Enlarged lenticels on a potato tuber grown in wet soil resemble root-knot nematode swellings.



Root-knot spoils the appearance of sweet potatoes.

Root-knot is controlled by fumigating the soil with EDB, DD or Telone two or more weeks before planting. This reduces the reproduction of nematodes on the roots and decreases the numbers of larvae around the developing tubers. DBCP (Nemagon, Fumazone) should not be used before potatoes.

Cowpeas and other cover crops in which root-knot nematodes breed freely should not be grown before potatoes.

No potato cultivars are resistant to root-knot nematodes.

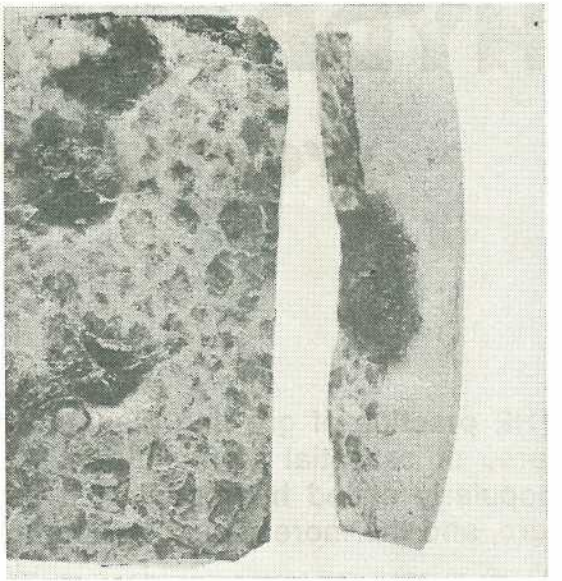
Root-knot is also a problem with sweet potatoes. Some of the cultivars introduced from the U.S.A. and now being assessed under local conditions are reported to be resistant.

Pimple

Potato pimple is characterized by the formation of areas of dead tissue around the lenticels. In extreme cases, much of the outside of the tuber is affected. The damage does not extend beyond a depth of 2 to 3 mm.

In Queensland, pimple is caused by the root-lesion nematode *Pratylenchus brachyurus*. Other species of root-lesion nematodes have been reported to cause similar symptoms overseas.

Potato pimple is not common and has only been seen where potatoes have been grown after pastures. Because of the low incidence, fumigation as a precautionary measure is not warranted. If pimple has been a problem, avoid cover cropping with cowpea or maize which are good hosts of root-lesion nematodes.



Potato pimple. Note the shallow areas of dead tissue around the lenticels.

Cattle earmarks

Did you know that:

- Cattle earmarks can only be registered **in conjunction with** a three piece horse and cattle brand?
- Cattle earmarks must not be made on a beast **unless** the beast has been branded with a three piece, or symbol, horse and cattle brand?
- Cattle earmarks are registered by district and cannot be used outside the district for which they are registered?

For further information on the registration and use of cattle earmarks contact:

The Registrar of Brands,
Department of Primary Industries,
William St.,
Brisbane, 4000.

HYDROPONICS

growing plants without soil

by P. E. PAGE and R. E. BARKE,
Redlands Horticultural Research Station.

THE practice of growing plants in a medium other than soil using mixtures of essential plant nutrient elements dissolved in water has been popularly called hydroponics. It includes water culture, aggregate culture, and the more recent flowing nutrient solution technique.

A typical, experimental sub-irrigation system.

Hydroponics is not a new concept. The earliest recorded use of the technique is by John Woodward. In 1699, he experimented in England with water cultures. Further advances were made in France by De Saussure (1804), while Boussingault (1851–6) began the use of sand cultures.

The real beginnings of the science of hydroponics were the classical experiments of two German plant physiologists Sachs (1860) and Knop (1861–5) who grew plants in mixed solutions of simple inorganic salts to show they were essential plant nutrients. These solutions provided the now well known major elements. By using specially purified salts, workers of the twentieth century have increased our knowledge of plant requirements so that current formulations contain trace elements as well.

In 1929, Dr. Gericke, working at the California Agricultural Experiment Station, conceived the idea that the water culture technique which had previously been used only for experimental scientific studies might be adapted to commercial use. He proceeded to devise special techniques for this purpose. This pioneering work received widespread publicity in the popular press in the 1930s and many enthusiastic amateurs attempted to grow the bumper crops reported. Unfortunately, the success rate was disappointing and the growing of plants in culture solutions was returned to the laboratories.

It has now become obvious that hydroponics is rarely superior to soil culture under comparable conditions. Success in growing plants in hydroponics cannot be assured if the operator does not have a sound knowledge of the physiological and horticultural principles involved in crop production, and he must have a more detailed knowledge of plant nutrition and basic chemistry than his field counterpart.

There are occasionally situations where the use of this technique can be useful. They usually involve lack of suitable agricultural soil or a particular need in time. One example of this was the provision of fresh fruit and vegetables to Allied troops on remote islands during World War II. Evidence from the eighteenth century had shown important benefits to health and morale if fresh fruit and vegetables were provided. These were produced in gravel culture because conventional methods in soil were not feasible and supply from outside was not practicable.

A second example of need is reported by Meir Schwarz in Israel. Religious reasons demanded that the soil should not be tilled in the sabbath year. There was still a need for food production so aggregate culture was introduced to fill this need.

Techniques

Three major types of hydroponic culture are possible—

(i) Water culture;
(ii) Aggregate culture;
(iii) Nutrient flow.

Water culture

This technique has been used mostly in scientific experiments. It has led to the increased knowledge of plant mineral nutrient requirements.

The technique involves growing plants with their root systems dipping into a solution of water containing the necessary major and trace elements as simple chemical salts. The plant is suspended from the container cover and held in place by a cork, sponge rubber or other suitable restraint system. The container and cover should be chosen or treated to ensure that light is excluded. This will prevent algae forming. The solution should be thoroughly aerated. This can be achieved by bubbling air through the solution continuously. The container can range in size from an ordinary fruit jar up to narrow beds depending on the scale of the operation. Solutions are usually changed at 7 to 10 day intervals.

Water culture is somewhat cumbersome and difficult to master. The other methods of hydroponic culture are more suitable for commercial use.

Aggregate culture

This method of hydroponic culture uses solid, inert, inorganic media such as sand, vermiculite, perlite, quartz or gravel. Nutrients are supplied by either watering from above or by sub-irrigation.

With surface watering it is usual to cover the vermiculite or perlite with a layer of coarse sand or fine gravel to keep it in place when water is applied. Some means of preventing aggregate loss through the drainage holes of the plant containers, such as crocks, coarse gravel or nylon gauze is necessary.

In sub-irrigation, the usual media are coarse gravel or quartz in a waterproof bed. The nutrient solution is forced into the container from the base and usually partially floods the bed to just below the surface. The liquid is then allowed to drain away to the storage reservoir, where it can be topped up and reused. (Diagram 1.)

This system allows for good aeration as the roots are exposed to an atmosphere with adequate amounts of oxygen except for the short time when the solution is pumped-up. The frequency of pump-up cycles varies from once an hour to only 3 or 4 times a day. Nutrients are always available provided the gravel is fine enough to hold sufficient moisture and coarse enough to allow free drainage of surplus water. Gravel between 2 and 9 mm is usually satisfactory. To control algae, the solution should not cover the top surface of the gravel. However, the bed should be watered from above or the nutrient solution allowed to flood above the gravel at least once a week to dissolve salts which have accumulated in the surface layer.

This technique is practical for commercial use but requires a large initial outlay. It gives reasonable control of nutrient solution balance and the pump-up and draining cycles can be automated.

Nutrient flow techniques

This technique also had its beginnings in experimental work. It has been modified for commercial use.

The general principle is that nutrient solution is continuously circulated past the plant roots as a thin film. The solution is topped up and nutrient composition monitored in a storage tank. Solution flows down a slight slope by gravity and is pumped back from the storage tank to the top of the sloped channel. Aeration of the solution is achieved when it falls to the collection drain before entering the storage tank. The solutions flow along polythene film gullies or fabricated polythene channels as shown in Diagram 2. Plants are held in place in small pots or blocks of inert material around which the polythene channel is fastened at regular intervals. Another variation is to use roofing fibrolite, the corrugations providing the troughs for the flowing nutrient solution.

This technique shows promise for commercial operations provided care is taken with disease control and solution monitoring.

The nutrient solution

In a field situation, plants obtain their supplies of essential mineral nutrients and water from the soil. The plant roots need oxygen to function and this is obtained in a field situation from the soil atmosphere. In hydroponics, the nutrient solution which bathes the roots must therefore be capable of performing these functions of supplying mineral nutrients, water and oxygen to the plant.

There are 13 essential mineral nutrients which must be supplied for healthy plant growth, and these are listed in Table 1, together with the concentration of them found in healthy dwarf French bean leaves. It is obvious from this information that the elements are needed by the plant in vastly different quantities. However, if any one of these essential nutrients is in short supply, it may cause equally drastic reductions in plant growth.

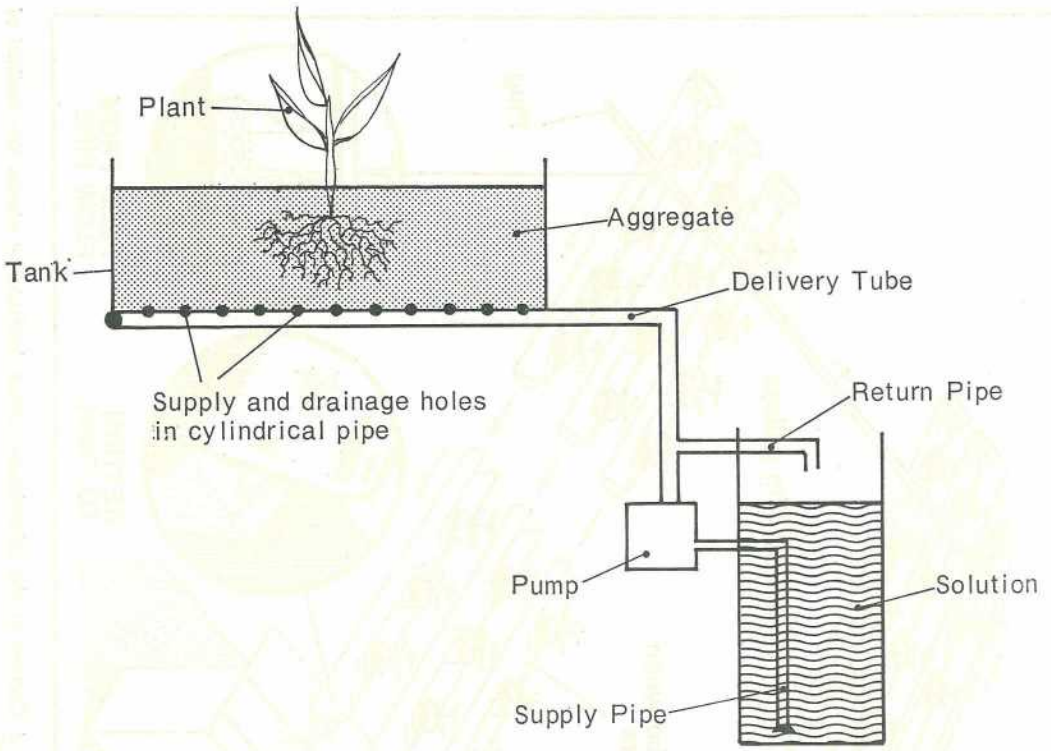
TABLE 1

CONCENTRATIONS OF THE ESSENTIAL PLANT NUTRIENTS FOUND IN THE LEAVES OF A TYPICAL HEALTHY DWARF FRENCH BEAN PLANT

Nutrient	Concentration (on dry matter basis)
Nitrogen	50 000 ppm (or 5·0%)
Phosphorus	4 000 ppm (or 0·4%)
Potassium	30 000 ppm (or 3·0%)
Calcium	20 000 ppm (or 2·0%)
Magnesium	4 000 ppm (or 0·4%)
Sulphur	4 000 ppm (or 0·4%)
Iron	150 ppm
Manganese	80 ppm
Zinc	35 ppm
Copper	8 ppm
Boron	30 ppm
Molybdenum	0·4 ppm
*Chlorine	8 000 ppm (or 0·8%)

*Chlorine is usually found in dwarf French beans at these concentrations or even higher. However, the plants requirement for chlorine is very low.

DIAGRAM 1. Schematic Diagram of Aggregate Culture.



There is no single optimal formula for the nutrient solution, and it is certainly not acceptable to add the elements to the solution in the same ratio at which they occur in the plant. This is because plants do not simply take up the nutrients from the solution, but absorb them in an active manner in quite a different ratio to that which they are supplied in the solution. It is important to note that the essential plant nutrients, and other elements which find their way into the nutrient solution, may prove toxic to the plant if they are present in too high a concentration. Therefore, there is an optimum range of concentrations for each nutrient. The most suitable nutrient solution for a particular situation will vary with the type of plant being grown, the climate, the water quality, the plant's stage of development and the design of the hydroponics system.

The only practical way to arrive at a suitable nutrient solution for a particular hydrophonics system is to start with one which has been suggested as being suitable by some text etc., and modify it gradually by experimentation. This involves growing plants in the solution and chemically analysing the plants at some specific stage of growth, where the concentrations of essential nutrients required for healthy plant growth are known.

Where the concentrations of elements in the hydroponically-grown plant are not optimum, then the nutrient solution composition is adjusted and a further trial run and chemical analysis of the plant is carried out. This procedure is repeated until the plant nutrient concentration is optimal. At least three complete crop cycles should be allowed for experimentation of this type to arrive at a satisfactory nutrient solution.

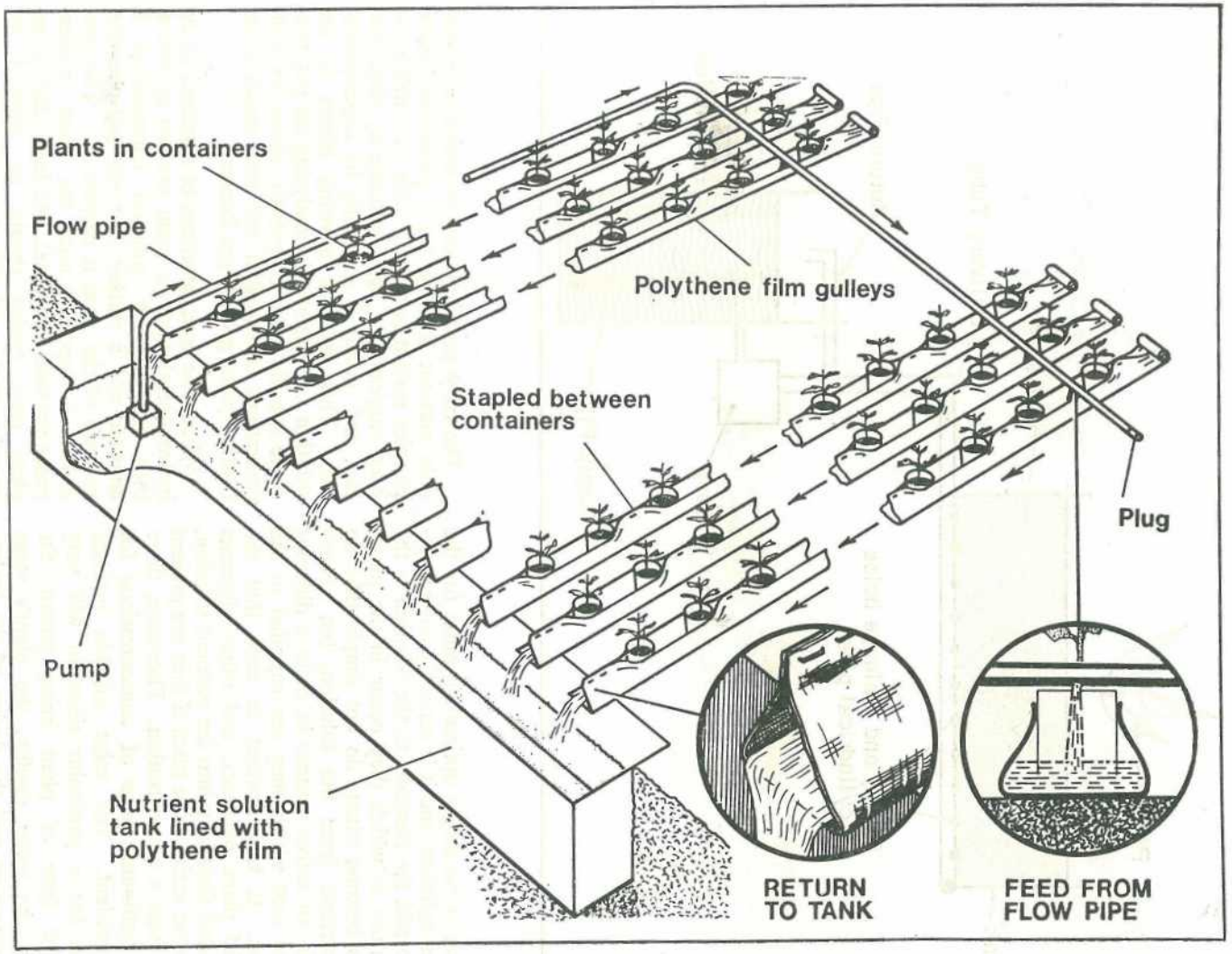


DIAGRAM 2. Nutrient flow technique proposed by Dr A. J. Cooper at the Glasshouse Crops Institute. It shows the method of gully formation and nutrient supply and drainage method.

In a soil, the mineral nutrients present are not all available to the plant at one time, and are held in various chemical and physical systems where they are only gradually released to replace the amounts of nutrient being removed by plant absorption. This ensures a relatively stable supply of mineral nutrients to the plant. However, no such stability of supply exists in a hydroponics system where the nutrients are all in the available form immediately they are added to the nutrient solution, and their concentration then gradually reduces as the plants absorb them. So more nutrients must be periodically added to the nutrient solution to replace those being absorbed by the plants, and maintain a stable supply.

One of the major complications of hydroponics systems is to know what replenishment nutrients to add and when to do it. Ideally one should carry out a complete chemical analysis of the nutrient solution at regular intervals and add the amounts of nutrients which have been taken up. Even better a continuous nutrient addition system can be set up to replace nutrients at the same rate at which they are being removed from the solution by the plants. This is a complex and expensive system to set up, and a complete analysis of the nutrient solution can generally only be attempted by a highly-equipped chemical laboratory.

The hydroponics grower would have to pay for such a routine solution analysis service. He could then have the nutrient solution and material from plants growing in it analysed on a regular routine basis, and this would allow him to understand and control his nutrient system. This would be an expensive operation and would have to be considered as a cost in operating a hydroponics system.

A less satisfactory system of maintaining some sort of stability in the composition of nutrients in the solution is to add nutrients, in the same ratio at which they were originally supplied, to maintain a relatively constant conductivity in the nutrient solution. A portable conductivity meter can be purchased for a few hundred dollars, and this measures the total concentration of salts in the solution.

The major problem with this approach is that it does not identify specific mineral elements but only the total concentration of them all, and thus one nutrient may gradually become more deficient because the plants are absorbing more than is being supplied, whilst another element may gradually become toxic because more is being added than the plants are using.

If this approach is used then the operator has to be prepared to throw the entire nutrient solution away at least once every three to four weeks and start afresh. This operation represents a considerable loss of expensive chemicals which must be taken into account when assessing the economic feasibility of a hydroponics system.

All natural sources of water contain salts in solution. Accurate analysis of the water source to be used in hydroponics is therefore essential to determine the quantities of salts to be added to produce a suitable nutrient solution. As a general rule, where the water supply contains less than 500 p.p.m. total salts it will be suitable for use in hydroponics without any major complications. Where the water supply contains more than 500 p.p.m. total salts, special care will be necessary in using it for hydroponics.

Another complication in growing plants in hydroponics arises because the acidity (pH) of the nutrient solution changes as plants absorb nutrients from it. These changes may be rapid and have detrimental effects on plant growth. There are a number of simple and relatively inexpensive methods of determining solution pH and this factor can then be adjusted by adding an acid or alkali.

In a commercial system this manual and irregular adjustment of solution pH is not really satisfactory because large changes may occur between readings and a continuous monitoring and adjustment system is required. A pH meter is set up to continuously monitor solution pH in the bulk nutrient supply tank. If the meter drifts below a pre-determined pH an electronic system adds dilute alkali (e.g. potassium hydroxide) to raise the pH, and similarly, dilute acid (e.g. sulphuric acid) is added if the pH rises above another predetermined point. This ensures that the solution pH is maintained within a narrow range.

It is essential to supply adequate oxygen to the rooting system of plants grown by hydroponics. Where the root system is continuously immersed in the nutrient solution then air must be bubbled through the solution in

sufficient quantities to remove CO_2 (from root respiration) and to maintain adequate oxygen levels in solution. This is best done in the bulk nutrient solution tank and the compressed air can be used to continuously stir the solutions to mix in chemicals being added at this point.

There are hundreds of combinations of salts which have been recommended as nutrient solutions for growing various types of plants in hydroponics systems. An example of a typical nutrient solution is given in Table 2.

TABLE 2

A TYPICAL NUTRIENT SOLUTION RECOMMENDED FOR HYDROPONICS

(a) *Major elements*

Chemical	g/100 litres of nutrient solution
Potassium Phosphate Monobasic	12·5
Potassium Nitrate	50·0
Calcium Nitrate	75·0
Magnesium Sulphate	37·5

(b) *Trace elements*

STOCK SOLUTION A—Dissolve the following amounts of chemicals in 1 litre of water:—

Boric Acid (H_3BO_3)	2·86 g
Manganese Chloride ($MnCl_2.4H_2O$) ..	1·81 g
Zinc Sulphate ($ZnSO_4.7H_2O$)	0·22 g
Copper Sulphate ($CuSO_4.5H_2O$) ..	0·08 g
Molybdic Acid ($H_2MoO_4.H_2O$) ..	0·02 g

Add 1 ml of this stock solution to each litre of nutrient solution.

STOCK SOLUTION B—Dissolve 115 grams of iron chelate (Sequestrene) in 5 litres of water. Add 1 ml of this stock solution to each litre of nutrient solution.

Pests and diseases

It is commonly claimed that problems with pests and diseases are eliminated in hydroponics systems. This is a fallacy, and while there may be some disease problems which are less in hydroponics, there are other diseases which are far more troublesome in hydroponics than they are in the soil. Generally, organisms which like a watery environment, such as Pythium, Phytopthora and certain bacteria may become an almost insurmountable problem with the culture of certain crops in hydroponics systems. There are many techniques which can be tried to overcome these disease problems, but they require a lot of experimentation and may fail to correct the problem in the end.

If hydroponics is used to grow plants in a glasshouse environment, then attacks by pests and diseases on the foliage may be substantially reduced, but this is a function of the glasshouse and not the hydroponics system. Even in the glasshouse there are leaf diseases which may be more troublesome than in the field but these can be minimised by cooling and changing the air in the glasshouse to prevent high temperatures and high humidities. The economics of using a glasshouse plus hydroponics system to grow crops would have to be very carefully considered as the capital outlay is very high.

Cultural operations

Seedlings are usually raised in trays of vermiculite, soil, compost or inert materials. Water and half strength nutrient solution are applied as necessary and the seedlings transplanted to the water, aggregate or nutrient flow systems. Occasionally, seedlings are raised in place in the aggregate culture.

At the appropriate time the seedlings are pricked out after a thorough watering to allow easy removal and minimise root damage. Removal of soil particles and treatment with fungicides will help to prevent soil-borne diseases spreading to the hydroponic bed. The seedling is then placed with its roots in the nutrient solution for water culture and the plant firmly supported in the container cover.

For aggregate culture the seedling may retain some vermiculite about the roots to help establishment in the immediate post-transplanting phases.

Common practice in the reported nutrient film cultures is to plant seedlings out in small pots or blocks of inert material directly into the bottom of the polythene gulley. In some systems the plants are placed directly into solution through holes in the cover in a manner similar to water cultures.

Growing plants in hydroponics systems requires the same cultural conditions as growing in soils. A knowledge of plant varieties, habits of growth and climatic adaptations is necessary and pests and diseases still have to

be controlled. Similar quantities of water are needed, adequate light is necessary and the same favourable temperatures are needed. Plant growth habit is not changed by hydroponic culture. Spacing of plants will depend on the crop being grown but will generally not be less than is possible in a good, rich soil.

Economics

There are no published, comprehensive studies available in Australia on the economics of growing various plants in a hydroponics system. A separate economic study would have to be made for every crop.

At this stage, with perhaps a few exceptions, the commercial production of crops under a hydroponics system appears a doubtful economic proposition. The prospective hydroponic grower is advised to study the economics of his potential system with a professional economic consultant.

Many claims for the advantages of growing plants hydroponically are unfounded. Plant growth and yield are often not appreciably greater under this system compared with crops grown in a fertile soil. Plants cannot be spaced much closer than in the field, because although water and nutrient supply may be optimum in hydroponics, light is the limiting factor in both systems. Insect pests and plant diseases present similar problems for both hydroponically and soil grown crops. There is also the necessity for a sound knowledge of plant nutrition, basic chemistry and general cultural practices, and the need for constant, expert supervision of solution concentration, acidity and sanitation. The cost of installing a satisfactory commercial hydroponics system is also very high.

However, growing plants in hydroponics may have some advantages over soil culture depending on the type of crop being grown. These factors include more crops per year in a given production area, a reduced labour requirement, a more uniform pattern of crop maturation, a cleaner working environment, a more accurate control over the supply of water and nutrients, and over solution pH.

There would appear to be a place for hydroponic culture of crops where special, limiting factors make production in soil difficult or impossible. There is a large capital outlay necessary for the construction of a hydroponics system, but the returns from some floriculture crops and some special high value vegetable crops may justify this. Under favourable climatic conditions, outdoor hydroponic culture may be economically feasible when soil conditions are adverse. Such a system can supply a continuously favourable source of nutrients and water and if combined with automatic devices can bring about economies of labour.

Anyone attempting hydroponic culture should begin with a small experimental set up in order to become familiar with the technique and its difficulties before committing large amounts of capital.

Erratum

On page 309 of the July–August 1977 issue of the *Queensland Agricultural Journal,* the sentence 'Although the Hen Quotas Act was proclaimed in September, 1973, more than 27 years elapsed before the administrative difficulties of implementing the scheme were resolved.' is incorrect.

It should read 'Although the Hen Quotas Act was proclaimed in September 1973, more than 2 years elapsed before the administrative difficulties of implementing the scheme were resolved.'

Brucellosis-Tested Swine Herds (As at 14/7/77)

Aboriginal and Island Affairs Dept., Cherbourg.	L.W.
P. and N. Batterham, Raby Park, Inglewood.	L., L.W.
R. A. and B. E. Bool, Rossvale Stud, Nobby.	L.W., L.
D. J. Brosnan, Bettafield, via Biloela.	L.W., L.
J. A. and M. A. Clegg, Karoma Stud, Mundubbera.	L., L.W.
F. D. and E. C. W. Corney, Pagel, Tara.	L.W.
N. J. Cotter, Olaroy, Goomeri.	L.W.
R. H. Crawley, Rockthorpe, Linthorpe.	B.
G. F. and A. M. Dean, Home Creek, Wooroolin.	L.W., L., B.
E. Diete, 'Ettrock', Ingoldsby.	X.
Mrs. W. S. Douglas and Son, Greylight, Goombungee.	W.
R. and L. M. Duckett, Fairview, Capella.	L., L.W.
C. P. and B. J. Duncan, Colley, Helidon.	L.W.
J. A. and B. L. Duncan, Ma Ma Creek.	L.W.
Dunlop Meats Pty. Ltd., Coondulla Stud, Townsville.	L., L.W.
D. R. and J. A. Eagle, 'Walugra', Toowoomba.	L.W.
J. and L. Fisher, Lyndhurst, Bell.	L., L.W.
L. Fletcher, 'Par-en-eri', Mundubbera.	L.W., L.
K. J. and B. D. Fowler, Kenstan, Pittsworth.	L., L.W.
K. P. Fowler, Northlea Stud Farm, Toowoomba.	L., L.W.
N. E. P. and M. P. Fowler, c/- Kewpie Enterprises, Kingaroy.	L., L.W., X.
K. H. and B. Franke, Delvue, Cawdor.	L.W.
W. A. Freeman, Trevlac, Rosewood.	L.W.
E. F. and N. E. Geysing, Oakhurst, via Maryborough.	L.W.
D. F. and R. F. Goschnick and W. M. and K. J. Pearce, 'Echoes', via Monto.	L.W.
T. G. and E. A. Gosdon, Naumia, Dalby.	L., L.W.
D. G. Grayson, Wodalla, Killarney.	L., L.W.
A. H. and R. N. Grundy, Markwell Piggeries, Toowoomba.	L., L.W.
G. R. Handley, Locklyn Stud, Lockyer.	B.
Mrs. M. Handley, Meadow Vale, Lockyer.	B.
R. D. and B. M. Heness, 'Russley', Goomeri.	L.
Research Station, Hermitage, via Warwick.	B.
H. M. Prison, Etna Creek, via Rockhampton.	L.W.
H. M. State Farm, Numinbah.	B., L.W.
H. M. State Farm, Palen Creek.	L.W.
G. A. Head, East Greenmount, via Toowoomba.	L.W.
D. F. and R. K. Hinchliffe, Oakview, via Rockhampton.	L., L.W.
R. F. and V. D. Hudson, Rondel, Wilsonton.	L., L.W.
K. B. and I. R. Jones, 'Cefn', Clifton.	L.W., L.
C. and D. I. Kajewski, Glenroy, via Toowoomba.	L.W., L.
R. E. and M. D. Kajewski, 'Robmar' Stud, Acland.	L.
A. R. Kanowski, Exton, via Crows Nest.	L.W.
S. E. Kanowski, Miecho, via Crows Nest.	T.
C. F. Kimber, Biggenden.	L.
E. R. Kimber, Tarella, Mundubbera.	L.W., B.
I. E. and C. C. Kimber, 'Splenda View', Biggenden.	L.
V. F. and B. L. Kruger, Greyhurst, Goombungee.	L.W.
V. and C. A. Kuhl, 'The Mounts', Oakey.	L.W.
R. R. and L. M. Law, 'Summerset', Kingaroy.	L.W., L.
A. L. Ludwig, Beau View, via Beaudesert.	B.
Maranoa Stud Piggery, Mitchell.	L., L.W.
K. Mathieson, Ideraway, Gayndah.	L.W.
W. Neuendorf, Kalbar.	B.
L. A. Peters, Moonlight, Bongeen.	L.
Qld. Agricultural College, Lawes.	B., L.W.
R. M. Radel, 'Turua Stud', Biggenden.	L.
V. V. Radel, Braedella, Coalstoun Lakes.	L.W.
Research Station, Biloela.	L.W.
A. B. Robin, Blaxland Road, Dalby.	L.W., L.
G. Rosenblatt, Rosevilla, Biloela.	L., L.W.
A. F. and V. M. Ruge, 'Alvir' Stud, Biggenden.	L.W.
D. W. and L. J. Sharp, 'Arolla', via Millmerran.	L.W., L.
N. O. and G. A. Smith, 'Miandetta', Warwick.	X.
R. A. H. and T. N. Smyth, Barambah Road, Goomeri.	L.W.
L. B. and L. J. Trout, 'Caminda', Kingaroy.	L., B.
Wearmouth Piggeries, c/- G. Varidel, Dalby.	X.
Westbrook Training Centre, Westbrook.	B.
L. J. Willett, Wongalea, Bowenville.	L.W., L.
K. Williamson, Kalkie, Bundaberg.	L.W., L.

KEY

Landrace = L.	Tamworth = T.
Large White = L.W.	Wessex = W.
Berkshire = B.	Crossbreed = X.

Pantry shelf meat loaves

by Mrs. Tess Mallos, Food Consultant, Australian Meat Board

MEAT loaves are a popular means of preparing minced beef—preparation time is minimal, the result more than satisfactory.

If you do not feel like shedding tears over onions and going through all the other standard preparation details, look to your pantry shelf for ideas to transform your minced beef into a gastronomic delight!

With any meat loaf, always mix ingredients lightly until thoroughly combined—a heavy hand makes a heavy loaf.

Mini meat loaves

750 g (1½ lb.) minced beef.
1 packet French onion soup mix.
½ cup dry breadcumbs.
1 cup canned evaporated milk.
1 teaspoon dried parsley flakes.
or
1 tablespoon chopped fresh parsley.

Beef should be finely minced and not too lean. A little fat adds flavour and moistness. Place onion soup mix, crumbs and evaporated milk in a large bowl, blend and leave for 5 minutes. Add beef and blend lightly with a fork until thoroughly combined. Salt and pepper is not required as the soup mix should provide sufficient seasoning. Lightly pack mixture into 12 large muffin tins, mounding mixture above tops of tins. Brush tops lightly with a little oil and cook in a moderate oven, 180–190°C (350–375°F), for 30–35 minutes. If using the smaller patty cake tins, shorten cooking time to 25 minutes. Serve with your favourite bottled or packet sauce mix and vegetables. Serves 6.

NOTE: These are also good served cold for packed lunches and picnics.

Meat loaf has always been a popular standby for the housewife because of its economy, simplicity of preparation and excellent result. Mini meat loaves provide a novel twist to this old favourite.

Glazed meat loaf

750 g (1½ lb.) finely minced beef.
¾ cup rolled oats.
¾ cup canned evaporated milk.
2 tablespoons dried onion flakes.
1 tablespoon chopped parsley.
or
1 teaspoon dried parsley flakes.
1½ teaspoons salt.
Freshly ground black pepper.

Glaze
3 tablespoons tomato sauce.
1 teaspoon Worcestershire sauce.
1 teaspoon instant coffee powder.

Lightly mix meat loaf ingredients in a large bowl until thoroughly blended. Pack lightly into a greased loaf tin and bake in a moderate oven, 180–190°C (350–375°F), for 1 hour. Drain off liquid from loaf into a small saucepan and combine with glaze ingredients. Bring to the boil. Turn meat loaf into an ovenproof dish and pour glaze over top. Return to oven and cook for further 15–20 minutes, basting occasionally with glaze mixture. Serve hot or cold. Serves 6.

NOTE: Dried onion flakes may be replaced with 1 medium-sized onion, grated.

The Australian Standard 250 ml cup and levelled spoon measures are used in these recipes.

S. R. HAMPSON, Government Printer, Brisbane

Four troublesome Queensland weeds

Mexican Poppies

(Argemone ochroleuca and *A. mexicana)*

ROBUST, annual herbs, usually with prickly stems, about 60 to 120 cm high; leaves blotched with white, edges spiny-toothed, blue-green or grey-green in *A. ochroleuca,* in *A. mexicana* more green; flowers in *A. ochroleuca* very pale yellow; flowers in *A. mexicana* bright yellow; seed capsules in both species prickly, full of small, round, brown seeds which are shed through small holes near top of capsule; seeds with pitted surface.

Mexican poppies are common summer-growing annuals. They favour disturbed sites such as road shoulders, creek flats and stock routes, as well as pastures and cultivation. They have been suspected of poisoning stock but are unpalatable. Cases of stock poisoning are rare. Fowls are commonly poisoned by eating contaminated grain. The spiny seed capsules sometimes accumulate in wool and reduce its value.

Ploughing, discing, harrowing or mowing will destroy the plants, but regeneration from seed usually makes it necessary to repeat this treatment several times. In the rosette and early flowering stages, Mexican poppies are susceptible to 2,4-D at a strength of 0·2%. The addition of a wetting agent is advantageous. In cereals, they can be controlled with 2,4-D at 0·5% kg per ha.

Noogoora Burr

(Xanthium pungens)

ROBUST, sparingly-branched annual up to 2 m, sometimes more, rough to the touch; leaves are alternate, broad, mostly 10 to 15 cm in diameter, the edges with irregular teeth or lobes; male flowers in a few clusters along slender stalks at the ends of the branches, soon dropping off; female flowers in clusters on the lower part of slender, terminal, flower-bearing branchlets and in clusters in the forks of the leaves, persistent, developing into hard, woody, spiny burrs; burrs when ripe, brown, about 2·5 cm long, densely beset with hooked spines with two stout, straight spines at the end; two seeds in different compartments of the same burr, one germinating the first year, the other remaining dormant until a subsequent, favourable season.

This burr is probably the commonest weed in Queensland. It is a serious pest along river and creek flats, on roadsides, in old, cultivated paddocks and in some pasture land, especially in the sheep-raising districts. The value of wool is reduced by burr infestation. The very young plants are poisonous to stock.

The principal aim in control is to kill the plants before they set seed, usually from February to April. This can be done by pulling, cutting below the surface of the soil or by spraying with M.C.P.A. or 2,4-D at 1·1 kg per ha.

Bathurst Burr

(Xanthium spinosum)

ROBUST annual, much branched, forming compact plants usually 60 to 90 cm high; stems with numerous three-pronged spines, one or two at the base of each leaf or branchlet; leaves are alternate, green above, paler beneath, 2·5 to 7·5 cm long, divided into three irregular lobes, the central lobe tapering to a fine point; male flowers few, borne in clusters at the ends of the branches or in the forks of the uppermost leaves; female flowers in forks of leaves all over the plant, developing into brown burrs with numerous hooked yellow spines; burrs with two straight, unequal spines at the end.

Bathurst burr is widespread as a weed in Queensland, growing on roadsides, old cultivated paddocks and run-down pastures in the farming areas and invading creek flats and pastures in the grazing districts of southern and central Queensland.

It can be destroyed by cultivation or by spraying with M.C.P.A. or 2,4-D at 1·1 kg per ha.

Compiled by officers of Botany Branch.

Expect trouble from these weeds

Mexican Poppy (Argemone ochroleuca)

Mexican Poppy (Argemone mexicana)

Noogoora Burr (Xanthium pungens)

Bathurst Burr (Xanthium spinosum)