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Cover: The potoroo or common rat kangaroo is abundant in eastern Australia and no fears are held for its continued survival.

Photograph by P. Amos.

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Living with Russian knapweed

J. F. Bourne, Agriculture Branch

A new approach to the control of the perennial Russian knapweed (*Centaurea repens*) has been successfully tried by a grain grower near Oakey on the Darling Downs.

For 2 years he has followed a system involving winter cropping and normal cultivation during the summer fallow, together with application of the herbicide dicamba when the weed is at the early flowering stage. Indications are that this system represents a viable alternative to control methods used in the past.

Low levels of weed infestation appear to have had little effect on crop yield potential under favourable conditions, and continued use of the system has gradually reduced the level of infestation. The screening of a number of possible herbicides for use in eradicating small areas has indicated that at least four herbicides are of value.

A number of other difficult to control summer growing perennial weeds are currently found on the Darling Downs. These include bindweed (*Convolvulus arvensis*) and perennial ground cherry (*Physalis virginiana* var. *sonorae*). Similar methods to that used in this demonstration with Russian knapweed could well apply in the control of these species.

Area of infestation

Russian knapweed was first identified on the Darling Downs in the Cambooya district in 1916. Since then small infestations, each covering up to several hectares, have been recorded from approximately forty properties. The majority of reports have come from the Oakey and Mt Tyson districts, while individual infestations have been noted at Bell, Jandowae and Millmerran. Outside of the Darling Downs, the weed has been recorded at Haigslea and in the Lockyer and the Fassifern Valleys.

The distribution of infestations has been closely monitored over the years by officers of the Lands Department in Queensland. A mail survey carried out during 1979 confirmed the main infestations and recorded some new sites. The current known distribution on the Darling Downs is shown in figure 1.

The rate of spread of the weed has been slow. Most areas under pasture have remained undisturbed and, under this system, patches have remained almost static in area over a period of 20 years or more.

The plant

Russian knapweed is a perennial, with a particularly extensive and deep root system. Local reports claim that roots have been dug up from depths of 10 to 12 m in the old Acland mine. The main growing period is during spring and summer. Cold, frosty weather suppresses growth.

New plants can establish from seed, but this is probably of minor importance. Most young shoots are produced from the network of roots, particularly following cultivation. Because of the nature of the root system, which provides a storehouse for plant foods, the weed can withstand repeated and prolonged attacks

against its top growth during the spring and summer. Few other plant species can match its smothering effect.

Young plants initially form a rosette, with leaves 5 to 7.5 cm long and 2.5 to 5 cm broad. The leaves are deeply but irregularly divided into blunt lobes and are silvery-grey in colour, becoming dull grey-green with age. The stem produced from the centre of the rosette is branched and grows approximately 50 to 70 cm high. Oval flower heads form at the top of each branch as a tuft of mauve or pink flowers.

The weed has a bitter, disagreeable taste and is reported to be poisonous to horses.

Severe infestation at Oakey

At one site in the Oakey district the infestation covers virtually the whole of a 160 ha property. In this situation, the weed severely restricts the agricultural enterprises in the farm. The degree of infestation on this property has meant that eradication methods previously attempted on small areas, using high rates of herbicides, are not economically feasible.

A common approach by local landowners, where small patches occur in a paddock, is to set aside the infested area for improved or native pasture. The weed will slowly spread following excessive cultivation. The owner of this property, however, wished to extend the range of enterprises available to him. He approached the Department of Primary Industries for assistance, to enable him to crop the land and gain some measure of control at the same time.

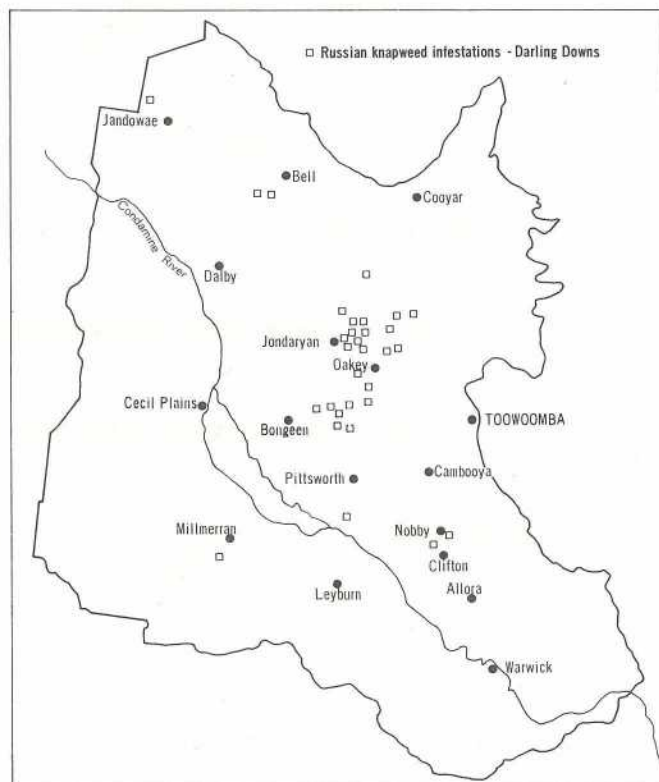


Figure 1. Russian knapweed infestations on the Darling Downs.



A heavy paddock infestation of Russian knapweed.

Demonstration area

A demonstration area was selected on the property to examine control measures. Two approaches were followed:

- An area of 18 ha was chosen to develop a cropping system, using current knowledge of the weed and herbicides recommended for its control. The area was contoured to control soil erosion and consisted of three bays each of approximately 6 ha.
- A randomized, replicated plot trial of less than 1 ha was used to screen a range of 16 new and currently available herbicides for control. This trial was under the supervision of the Department of Lands.

The demonstration aimed to identify an economically viable cropping system which would also reduce the infestation over a period of time. The herbicide trial was intended to screen likely herbicides for use in the eradication of small areas.

The cropping system

A number of factors were taken into account:

- The weed grew most actively during the spring and summer months.
- Local observation indicated that cultivation during the summer as frequently as every 2 to 3 weeks did not weaken the infestation but merely helped to spread the weed.
- The most promising herbicides for eradication of small areas, from previous trials by the Department of Lands, were dicamba and a picloram/2,4-D amine mixture, sold commercially as Tordon 50D*. The optimum time of application was at the point when the weed was in the early flowering stage.

The cropping system used was as follows:

- Continual winter cropping and summer fallow.
- During the summer fallow, treatment with dicamba when the Russian knapweed was at the early flowering stage. This is commonly in the April–May period. There is also some opportunity for a dicamba application immediately post-harvest during November–December. The chemical dicamba was chosen as repeated applications over a period would be less likely to result in a build-up of herbicide residues in the soil.
- Normal cultivation during the remainder of the summer fallow for control of grass and broadleaf weeds.

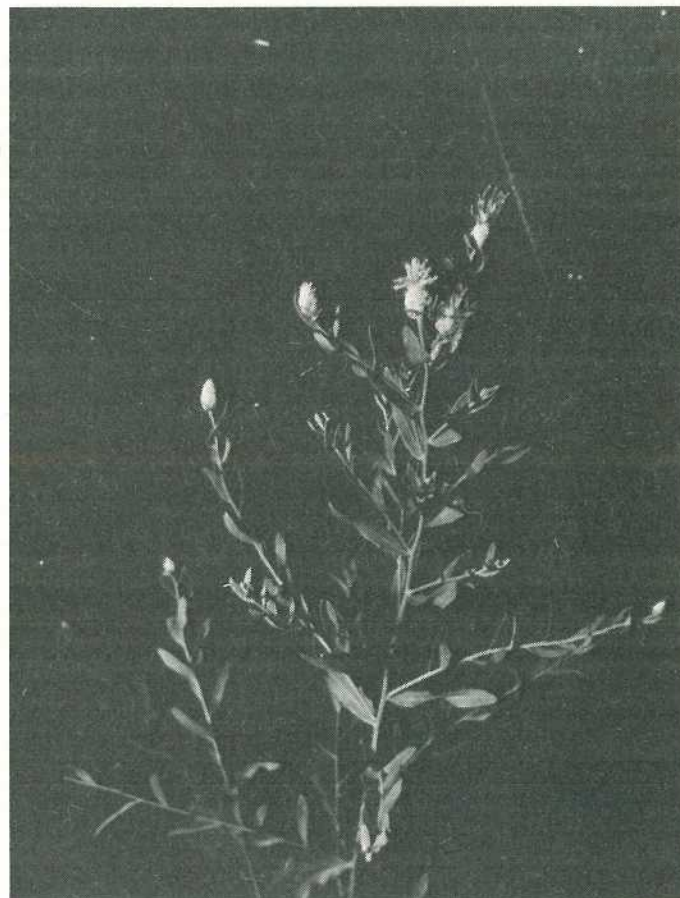
Two parameters were monitored, the level of weed infestation and final grain yield. This cropping system was monitored over 2 successive years.

Summer season 1978–79

Following harvest of the winter crop, the demonstration area was worked according to normal district practice during the summer fallow. This consisted of cultivation for general weed control approximately once each month from December to April. In late April the area was sprayed with 1 500 mL per ha of 20% dicamba. The rate is 14% of that recommended for complete eradication.

Winter season 1979

The area was sown to Clipper barley at the rate of 35 kg per ha. A soil test of the 0 to 10 cm zone indicated values of 9 ppm nitrate nitrogen and 12 ppm phosphorus bicarbonate extraction respectively. Fertilizer application included 60 kg per ha nitrogen as anhydrous ammonia and 10 kg per ha phosphorus. The



Russian knapweed in flower.

* Registered trade name of Dow Chemical (Aust) Ltd.

crop was sprayed for broadleaf weed control during the growing season with 1 L per ha of Tordon 242*.

The three contoured bays making up the 18 ha total were each harvested separately as each bay contained a different level of infestation. A visual assessment was made of the percentage area infested.

Bay 1 was estimated to have 15% of the area infested, 10% of bay 2 was infested, while 30% of bay 3 was infested with Russian knapweed. A number of plant counts were also made of randomly selected square metre quadrats. Plant counts were about 5 to 10 plants per m² over most of the area. In addition, there were several heavily infested patches of up to 30–35 plants per m².

Soil type varied slightly between bays. Bay 1 was a well drained, dark grey, self-mulching clay-loam, while bays 2 and 3 each contained a significant proportion of a more poorly structured (cloddy), dark grey, clay-loam.

The 1979 winter season was a particularly favourable one in the district. Crop yields and the respective assessments of infestation are shown in table 1. These yields illustrate two important points:

- Under favourable growing conditions, soil type and good crop management, such as in bay 1, low levels of infestation appear to have little effect on the yield potential of winter cereals.
- Higher levels of infestation, as in bay 3, cause a significant reduction in crop yields.

Table 1. Crop yields and level of weed infestation: Winter crop 1979

Bay	Infestation (% area of bay)	Crop yield (kg per ha)
1	15	5 434
2	10	2 223
3	30	1 235

Summer season 1979–80

During the second summer fallow, the area was again worked according to local district practice. This included a disking following harvest and three scarifyings to control both grass and broadleaf weeds.

Before planting the 1980 winter crop, the area was sprayed in May with 750 mL per ha of 20% dicamba. This rate is half that applied in 1979. The reduction did not affect herbicide efficacy but herbicide cost was reduced from about \$9 per ha to \$4.50 per ha.

Winter season 1980

Clipper barley was again sown at the rate of 35 kg per ha and fertilized according to a similar strategy to that used the previous year. Because of very poor seasonal conditions, the crop failed. However, an attempt was made to harvest what crop remained in each of the three bays. Yields obtained were 750 kg per ha in bay 1, 450 kg per ha in bay 2 and nil in bay 3.

Following harvest, a visual assessment was again made of the weed infestation. Over the whole area, the weed density was reduced to approximately half that of the previous season. The extent of the infestation was also reduced. The infestation in bay 1 was reduced to an estimated 12% of the area, while the infestations in bays 2 and 3 were reduced to 8% and 25% of the area respectively. The contour banks in the paddock



A large number of new shoots develop from the root system.

remained infested with Russian knapweed throughout the duration of the demonstration. They had not been cultivated at any stage, nor sprayed with herbicide.

No change was noted in the area infested during the period of the demonstration but final weed populations were observed to be about 5 to 15 per m².

The herbicide screening trial

Assessments of herbicide efficacy were made in December 1980, some 19 months after application. Very good control was obtained with high rates of the herbicides atrazine, dicamba, hexazinone and picloram, and 2,4-D amine. Hexazinone is marketed as Velpar* and picloram and 2,4-D amine are marketed as Tordon 50D.

Dicamba and Tordon 50D are the only herbicides presently registered for use in the control of Russian knapweed. The 20% dicamba formulation was used and 2 kg of active ingredient per hectare gave good control. Tordon 50D gave very good control when applied at 1 kg of the active ingredient picloram per hectare. Both these herbicides can be used to control, if not eradicate, small areas of Russian knapweed infestations.

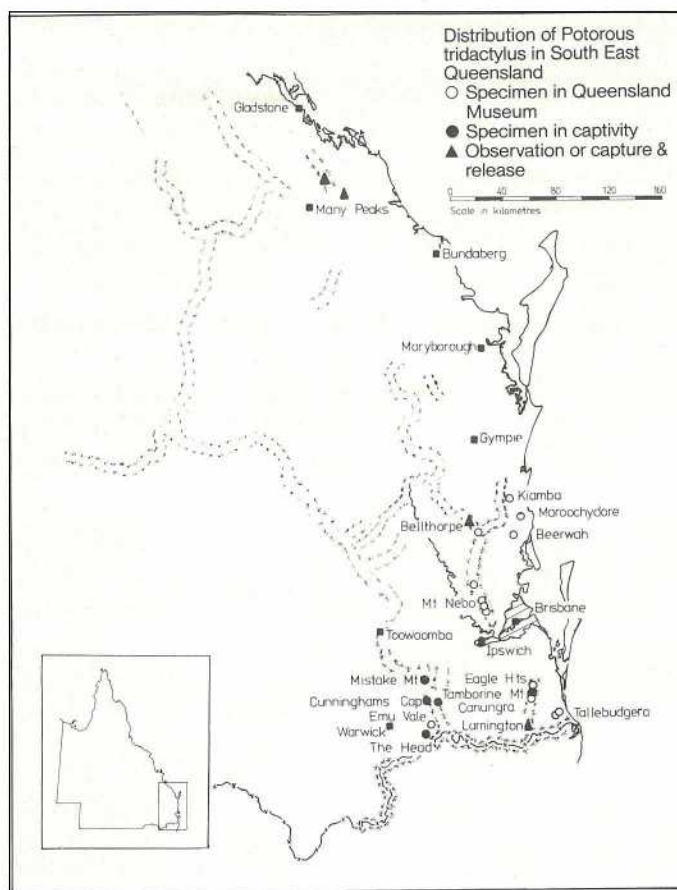
Summary

Small isolated patches of Russian knapweed can be controlled with high rates of Tordon 50D or dicamba. Cost prohibits the widespread use of these high rates which is therefore largely restricted to non-crop areas.

Extensive areas of the weed are more difficult to control. If possible the area should be returned to pasture. However, a system of winter cropping and summer fallow, together with an application of 750 mL of 20% dicamba per ha when the weed is at the early flowering stage, enables infested land to be cropped.

*Registered trade mark of the Dow Chemical (Aust.) Ltd.

*Registered trade name of Du Pont (Aust.) Ltd.



The potoroo in Queensland

P. J. Amos, National Parks and Wildlife Service

THE potoroo (*Potorous tridactylus tridactylus* (Kerr 1972)) or common rat kangaroo is a small member of the kangaroo family found in forested country with a dense understory.

The sexes do not differ markedly in size; adult males average 1.5 kg in weight and adult females average 1.2 kg. Tail length in both sexes varies from 28 to 32 cm and hind foot length varies from 8.5 to 8.8 cm.

Both sexes are similarly coloured. On the dorsal surface there is a base layer of short, soft dark grey fur with a longer (4 cm) and coarser fur extending through

and above this layer. This coarser fur varies from yellow-white with black tips through brown to black. The darker colours predominate dorsally and the lighter colours are found on the rest of the body surface. Hence the animal has the appearance of being dark grey-brown on the back with light grey to reddish-brown sides. The coarse fur of the underside is all white, and the base layer is grey, giving the ventral surface a whitish-grey appearance. The snout is long and pointed, while the muzzle is bare. The tapered tail is 6 cm in circumference at the base where it is covered with body fur; the remainder of the surface is scaly with



Plate 1. The common rat kangaroo or potoroo.

sparse short black hair. Occasionally, animals have a white tip to the tail. Head colour is the same as that of the body and the ears are rounded and do not protrude far above the fur.

Distribution

The potoroo occurs in suitable habitat throughout eastern mainland Australia and in Tasmania. In Queensland it is confined to the south eastern corner of the State within an area bounded by the McPherson Range in the south, the Many Peaks Range in the north and the Great Dividing Range in the west. Sites at which potoroos have been caught or observed recently include: The Head via Killarney, Emu Vale, Lamington Plateau, Mt Tamborine, Clayton's Gully (Cunningham's Gap), Mistake Range, Mt Nebo, Bellthorpe-Conondale Range, Many Peaks Range and Bulburin. Additional site records are available from specimens held in the Queensland Museum, but for some of these areas—Maroochydore, Terrors Creek, Kiamba and Jolly's Lookout—the last recorded specimens are 40 to 50 years old and it is doubtful if the animals still occur there.

Habitat

Poroos have been found in vegetation types ranging from notophyll vine forest to sclerophyll forest. The sclerophyll forests differ widely in species composition, but the common factor is the presence of a thick understory of grasses and shrubs.



Plate 2. Poroos occur in sclerophyll forests with a thick understory of grasses and shrubs.



Plate 3. Poroos excavate depressions at the bases of grass tussocks.

Breeding

Breeding occurs throughout the year. Although both males and females reach sexual maturity at about 245 days, females usually do not reproduce until 1 year old. Under normal conditions a female gives birth to single young at average intervals of 126 days. The period from mating to birth, provided no young is in the pouch, ranges from 36 to 41 days.

Birth is followed by mating and the resulting embryo ceases development at an early stage. This quiescent embryo resumes development if the first young is lost from the pouch and birth occurs 28 to 31 days after the loss. If the pouch young is not lost, development recommences in time for the quiescent embryo to be born when the first young is ready to be evicted from the pouch at 120 to 133 days.

General notes

For daytime resting, potoroos excavate depressions at the bases of grass or *Xanthorrea* tussocks and position themselves so that only the muzzle protrudes. They usually lie up singly, but in captivity several animals have been found to occupy the same depression. Most activity is nocturnal, and potoroos may be observed moving about and feeding at early morning, sunset and during the night on clearings and paths in the forest.

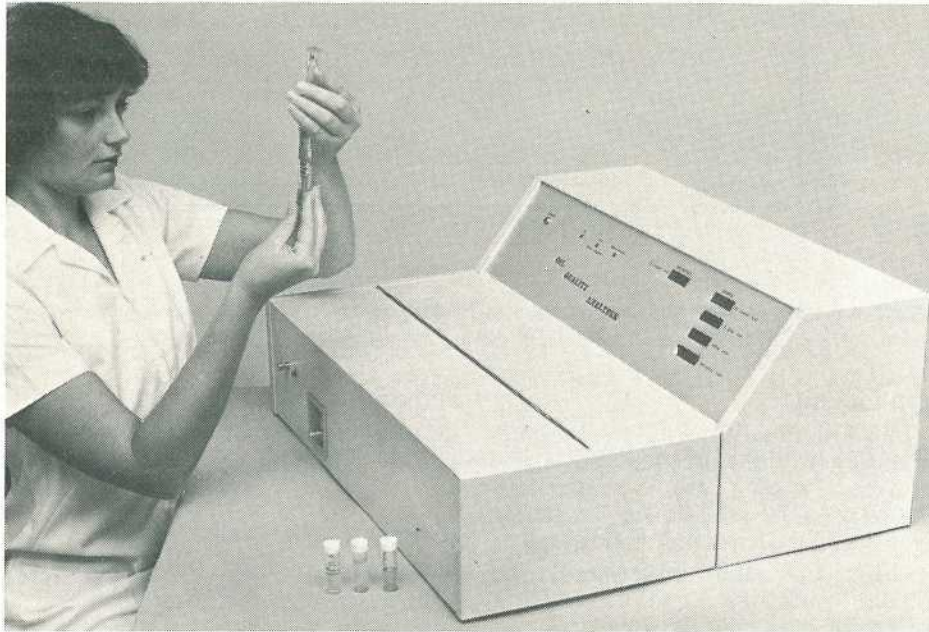
Longevity is not known. The oldest animal in captivity was caught when adult and is still alive after 8 years.

Conservation

Under the current legislation (Fauna Conservation Act 1974–1979) the potoroo is protected. As many of the areas from which it has been recorded are within or close to either national parks or forestry reserves, no fears are held for its continued survival in Queensland.

Oil Quality Analyser

D. J. Hamilton and B. W. Simpson, Agricultural Chemistry Branch



SUNFLOWER seed oil is more valuable to oil processors when it is more unsaturated. The degree of unsaturation of the oil is an index of the oil quality when the oil is intended for cooking and food purposes.

The Oil Quality Analyser, an instrument recently developed in the Agricultural Chemistry Branch, can provide a rapid indication of the quality of sunflower seed oil in this respect.

Composition of sunflower seed oil

The oil consists of triglycerides of palmitic, stearic, oleic and linoleic acids. Palmitic and stearic are saturated fatty acids. Oleic acid is an unsaturated fatty acid while linoleic acid is a doubly unsaturated fatty acid. Linoleic acid is included in the class of polyunsaturated fatty acids, and oils containing it are called polyunsaturated oils. Higher quality sunflower oil contains a higher percentage of linoleic acid.

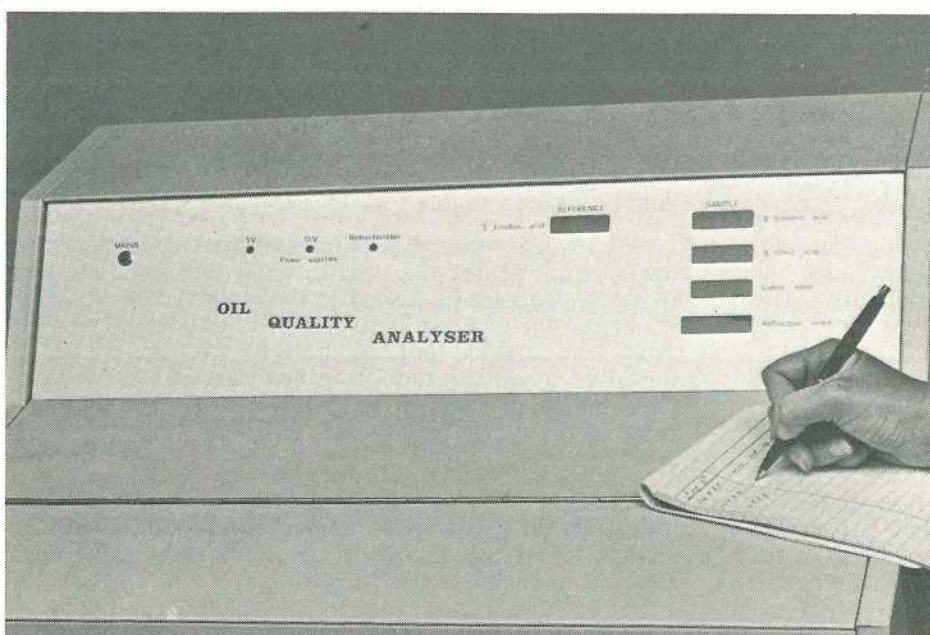
Iodine value, a chemical determination, directly estimates the amount of unsaturation in an oil. Alternatively, a chemical analysis for each of the fatty acids gives the complete composition of the oil. Each of these methods takes some time and a good deal of analytical skill to produce correct analyses.

Research carried out by Departmental scientists has shown that the quality of sunflower oil depends on the environmental temperature during early seed development. Such an effect can clearly result in a wide quality variation in sunflower oil produced throughout Queensland and Australia. Cooler temperatures during seed development result in a more polyunsaturated oil, that is an oil with a higher percentage of linoleic acid.

Refractive index

When a beam of light passes between air and a liquid it is deflected. The refractive index is a measure of the amount of deflection and is a characteristic of the liquid.

Since the early years of this century scientists have found for vegetable oils relations between refractive index and amount of unsaturation. Relations between



Lesley Ruddle, a technician in the Agricultural Chemistry Branch analysing sunflower oil samples on the Oil Quality Analyser.

refractive index, iodine value and fatty acid composition for sunflower seed oil have been published in the scientific literature. Some of this research has been done in Queensland and the present development is an outcome of this.

Instrument development

The Oil Quality Analyser has taken advantage of modern microprocessor technology to combine measuring, calculating and displaying capabilities in the one instrument.

It contains a differential refractometer which makes a refractive index measurement on the oil. Directly from this measurement the microprocessor calculates the iodine value and fatty acid composition and then displays the results on digital readouts. The microprocessor also controls the timing of operations, and repetitively takes new readings and makes calculations without operator intervention. The operator has to inject 1 mL of oil into the instrument's sample cell, recording the results 2 minutes later.

A prototype has been built in the Agricultural Chemistry Branch workshop. Testing of its performance is continuing. A provisional patent application has been filed with the Patents Office. The Oilseeds Research Committee, a Commonwealth rural industry funding authority, supported the research with a grant of \$8,000.

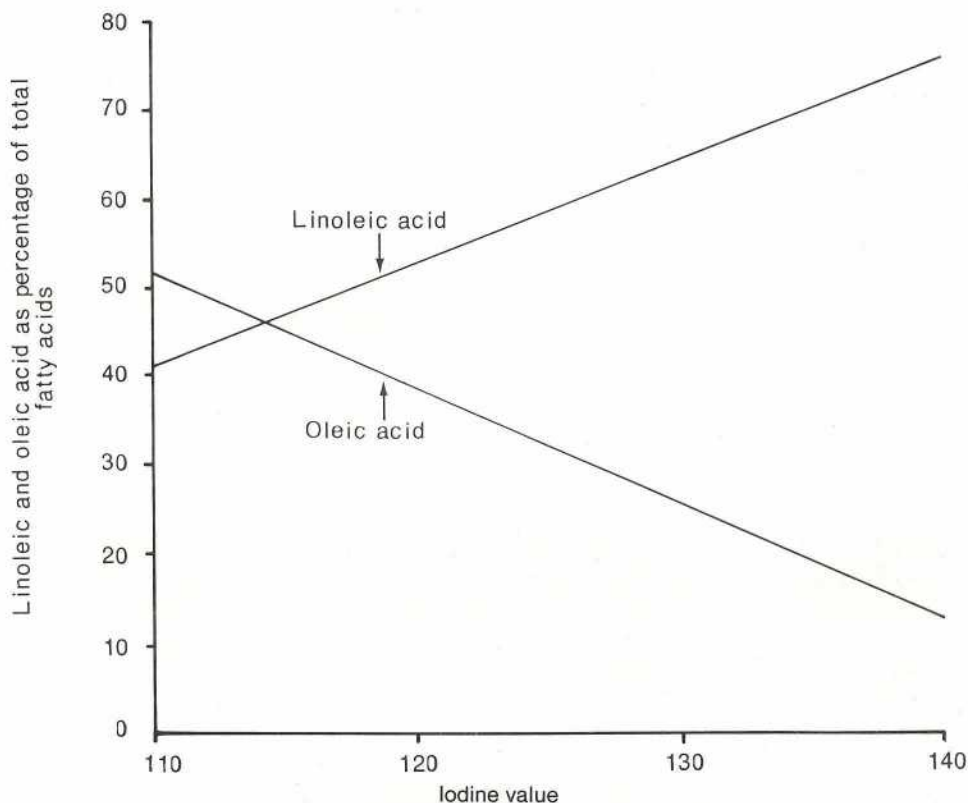


Figure 1. Relations between percentages of linoleic acid and oleic acid, and iodine value for Queensland grown sunflower oil.

Applications

The Oil Quality Analyser should be useful to plant breeders and agronomists who are continually assessing new sunflower varieties over a range of growing conditions.

Using this new instrument, the oilseed industry and marketing

authorities could monitor the oil quality of harvested sunflower seed before shipment or after extraction at the plant. Margarine manufacturers could obtain rapid assessment of bulk oil composition before the manufacturing process.

Another record cotton harvest in Queensland?

The production of raw cotton in Queensland this season could reach 130 000 bales which is 34 000 bales more than last year.

The Minister for Primary Industries, Mr Mike Ahern, MLA, made this forecast when officially opening the 18th Cotton Growers' Conference being held in Brisbane. Mr Ahern said that increased plantings this season had meant that the industry was set for a new record for the sixth season in a row. The State's cotton production had almost trebled in less than a decade and was now valued at more than \$45 million annually.

Mr Ahern said, 'Harvesting of the early planted crops is about to commence. The growing season has been generally good except for recent heavy rain in the St. George and Darling Downs districts where damage to some crops has occurred. Most of the expansion in the industry has taken place on the Darling Downs where it

is estimated that 8 350 hectares will be harvested to produce 40 000 bales. There was also a major expansion of plantings in the Emerald area where more irrigation land became available.'

The Minister said that officers of his Department and the Cotton Marketing Board were cooperating in a research programme aimed at developing new varieties which would increase both the yield and quality of the crop. Mr Ahern praised cotton growers for their initiative in quickly adopting new farming techniques, particularly in relation to biological control of insect pests and improvements in fertilizer and irrigation practices.

'I believe that our very survival in many primary industries rests with those who are prepared to adapt to change and grasp the benefits of the new technology which is available to us,' he said.

Auction sale of pigs by carcass description (classification)

Ian Jarratt, Marketing Division, and Ben Ball, Queensland Meat Industry Organization and Marketing Authority

A new livestock marketing system, auction sale by carcass description, is now operating for pigs in Queensland.

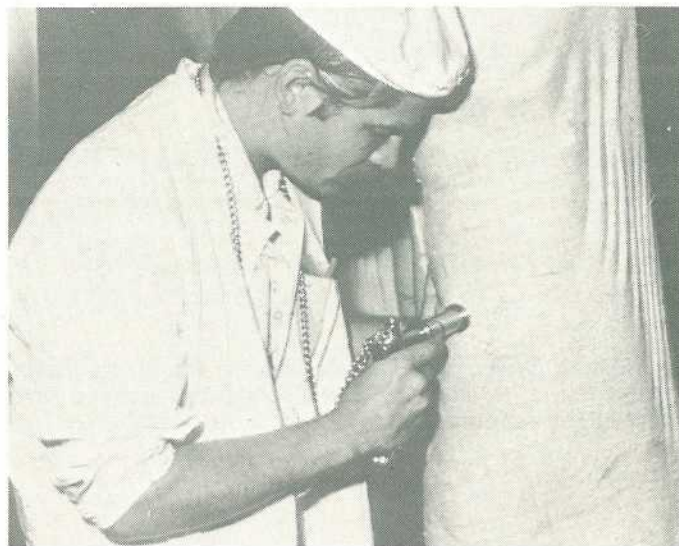
The sales are arranged by the Queensland Pork Producers' Organisation, in conjunction with Dalgety-Winchcombe, and are held in the Organisation's Brisbane office each Thursday afternoon. An average of more than 600 pigs per week has been sold since the auctions started in early September 1981.

Similar auction sales are held in New South Wales and South Australia. The South Australian system has operated since October 1980. Sales are expected to start soon in other States.

Procedures

At the Queensland auction, buyers bid for each lot in cents per kilogram carcass weight on the basis of the description given in the pre-circulated sale catalogue. The lot description is provided by the *producer* and must indicate the number of pigs, the breed, and the estimated carcass weight and fat class. Sex must also be indicated for entire males weighing more than 70 kg carcass weight and sows must be identified as such. The producer must also indicate where and when he is willing to deliver the pigs.

In contrast to sale yard auctions, *the pigs remain on the farm until sold and are not seen by buyers at the time of sale.* Producers can and do set reserve prices.



Producers are paid after the pigs have been slaughtered at approved abattoirs. If the pigs have been correctly described the producer receives the bid price. The price of incorrectly described pigs is adjusted by a set formula. The producer is charged a sale commission (1.5% of the gross price + 2.5c per kg) and also pays the meat inspection and other levies.

There are 11 weight classes and 5 fat classes. The weight classes are defined in terms of the hot unadjusted weight of the precisely defined carcass. The fat classes are defined in terms of millimetres of fat measured at a fixed point over the eye muscle at the last rib. This point is known as the P2 measurement site. The fat depth is measured with an introscope (optical probe) by an officially trained abattoir employee, as illustrated in figure 1. The accuracy of the measurements is checked regularly by State meat inspectors. Measurers and checkers must achieve defined levels of accuracy. Details of the weight and fat classes are shown in table 1.

Producers can use up to 2 weight and fat classes to describe each lot; for example G/H 2/3 indicates that the carcasses will weigh from 60.5 to 80 kg and have a P2 measurement from 12 to 21 mm.

Advantages

Auctioning pigs by carcass description is convenient and has two main advantages for producers. Firstly, prices are determined by open competition between buyers and, secondly, producers are paid for the precise amount and quality of carcass produced. The feedback of the carcass information also assists producers to make well-informed management and marketing decisions. By using individual pig tattoos producers can relate the carcass information to individual pigs and use it as a basis for determining feeding and breeding programmes. (The individual tattoos are additional to the compulsory registered brands.)

Importantly, the auction sale by description provides producers and the meat trade with comprehensive, accurate and timely market information.

Experience so far has been that 1 000 pigs can be sold at the Queensland auction in about 25 minutes only. The high speed of the sale and the low cost of attending are important advantages for the increasing number of buyers. A recent development has been the successful use of telephone bidding by interstate buyers.

Auctioning agricultural products on the basis of defined descriptions is not a new idea. However, it has been difficult to establish for livestock, mainly because of problems in determining and accurately using carcass and animal descriptions. These problems have largely been overcome for pigs as a result of the

commercial acceptance of an objective carcass fat measurement, the adoption of a precise carcass definition and the ability of producers to estimate the weight and fatness of live pigs accurately.

The successful establishment of auction sales of pigs by carcass description is likely to lead to increased interest in, and work on, similar marketing systems for cattle and lambs.

Table 1. Weight and fat classes

Weight class	Hot carcass weight ranges	Fat Class				
		1	2	3 P2 fat depth (mm)	4	5
A	30.0-35 kg	6 and less	7-9	10-12	13-16	17 and over
B	35.5-40 kg	7 and less	8-10	11-13	14-17	18 and over
C	40.5-45 kg	8 and less	9-11	12-14	15-19	20 and over
D	45.5-50 kg	9 and less	10-12	13-15	16-20	21 and over
E	50.5-55 kg	10 and less	11-13	14-16	17-21	22 and over
F	55.5-60 kg	10 and less	11-14	15-17	18-23	24 and over
G	60.5-70 kg	11 and less	12-16	17-19	20-24	25 and over
H	70.5-80 kg	13 and less	14-18	19-21	22-27	28 and over
I	80.5-90 kg	14 and less	15-20	21-23	24-29	30 and over
J	90.5-105 kg	16 and less	17-21	22-25	26-31	32 and over
K	105 kg-and over	19 and less	20-23	24-28	29-35	36 and over

Changes to the Queensland tick line

A number of changes have been made to the Queensland 'Tick Line', Primary Industries Minister, Mike Ahern, MLA, announced recently.

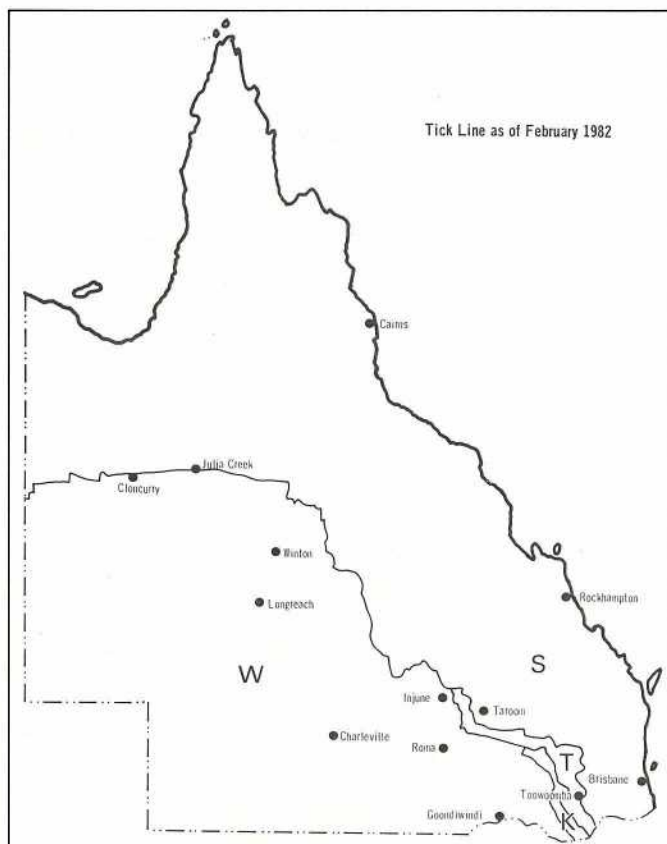
The Tick Line defines scheduled areas of cattle tick infestations and operates in the control of stock movements between infested and clean areas and interstate.

Major changes, which recently came into effect, were in the Darling Downs area where the T and K Lines have been moved eastwards. Mr Ahern said this reduced the Schedule T area and would allow many producers to move cattle to New South Wales markets with fewer treatments, and perhaps none.

In the area to the west and south of Mt Isa, the Tick Line has been moved south in recognition of permanent cattle tick incursions at a number of properties. This change makes it possible to transport by road untreated slaughter cattle from country west of Mt Isa to coastal meatworks.

'The Tick Line from Cloncurry to Hughenden has become aligned with the Great Northern Railway line. This would help to overcome administrative problems caused by the old "Give and Take" system back and forth across the railway line. Untreated cattle may be railed to the coast from Cloncurry, but the loop into the Schedule W area between Mt Isa and Cloncurry still necessitates treatments for cattle railed over this section,' Mr Ahern said. In central Queensland a small number of properties shown to be tick free for many years have been included in tick free Schedule W.

Stock owners welcomed the resulting advantages, especially the easing of restrictions in moving cattle from the Darling Downs to New South Wales. The



Minister advised that any stockowner requiring further information on the Tick Line, scheduled areas or stock movements should contact his local stock inspector.

Capture and handling of red and fallow deer in Queensland

A. K. Searle and M. S. Parker, National Parks and Wildlife Service

BOTH red and fallow deer are being increasingly taken from the wild in Queensland by those interested in farming these animals.

Introduction

Red deer and fallow deer were introduced into Queensland primarily as a source of food and recreation. Both species have spread from their original release points (see Searle *Queensland Agricultural Journal*, March–April 1980 and January–February 1981) but distribution now appears to be stable. Figures 1 and 2 map areas where deer are now found.

Both species have been hunted since the early 1900's with greater interest in the red deer as the more attractive game animal. Since the proclamation of the Fauna Conservation Act of 1952, under which they were protected, much of this hunting has been done illegally, the exception being during a limited open hunting season on red deer in 1976. Taking of both species has always been permitted, however, under pest destruction permits issued where they have caused significant problems to farmers.

The interest in deer by trophy hunters and meat shooters is now rivalled by the interest in deer farming. Many landholders within the deer ranges (figures 1 and 2) who once regarded these animals as tolerated pests or private game animals now see them as potential breeding stock for deer farms, and deer stalking has in consequence taken second place to deer trapping.

Deer in Queensland are the property of the Crown under the Fauna Conservation Act of 1974 but may be trapped under permit issued by the National Parks and Wildlife Service to persons intending to farm deer within the known deer distribution range.

Capture

Red and fallow deer like most animals are creatures of habit and before any trapping programme is

initiated a knowledge of their seasonal movements, resting and grazing areas and favoured routes is needed to provide a basis for deciding which capture technique to use and where to use it. Local knowledge of the proposed trapping area over a period of years is an advantage, as deer frequently disappear suddenly and later, when they may be thought to have

disappeared completely, reappear just as suddenly.

Figure 3 shows the normal yearly behaviour of red and fallow deer including the times when deer group, either as mixed or as all male or all female and young groups. The best trapping time is during winter, when native pasture is normally scarce and the deer are

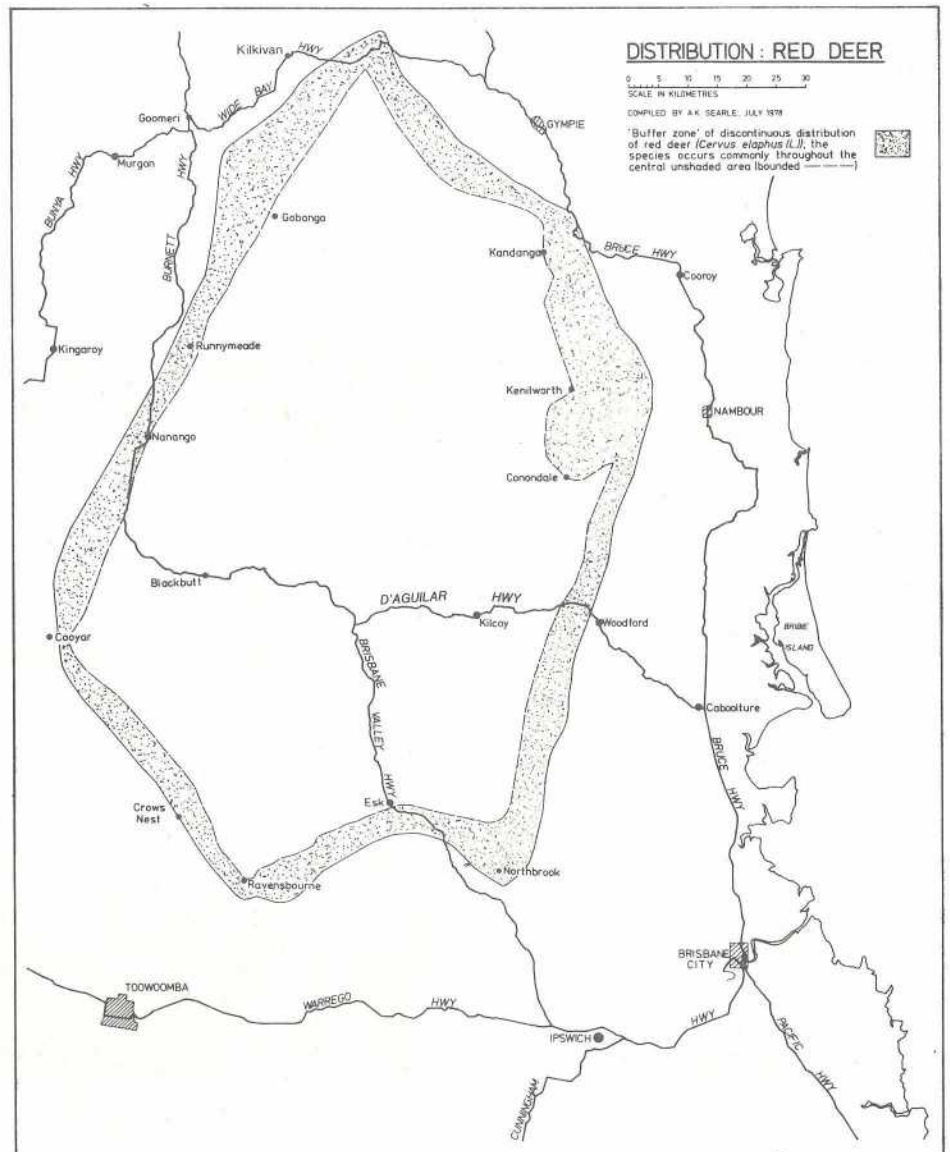


Figure 1. The distribution of red deer in Queensland.

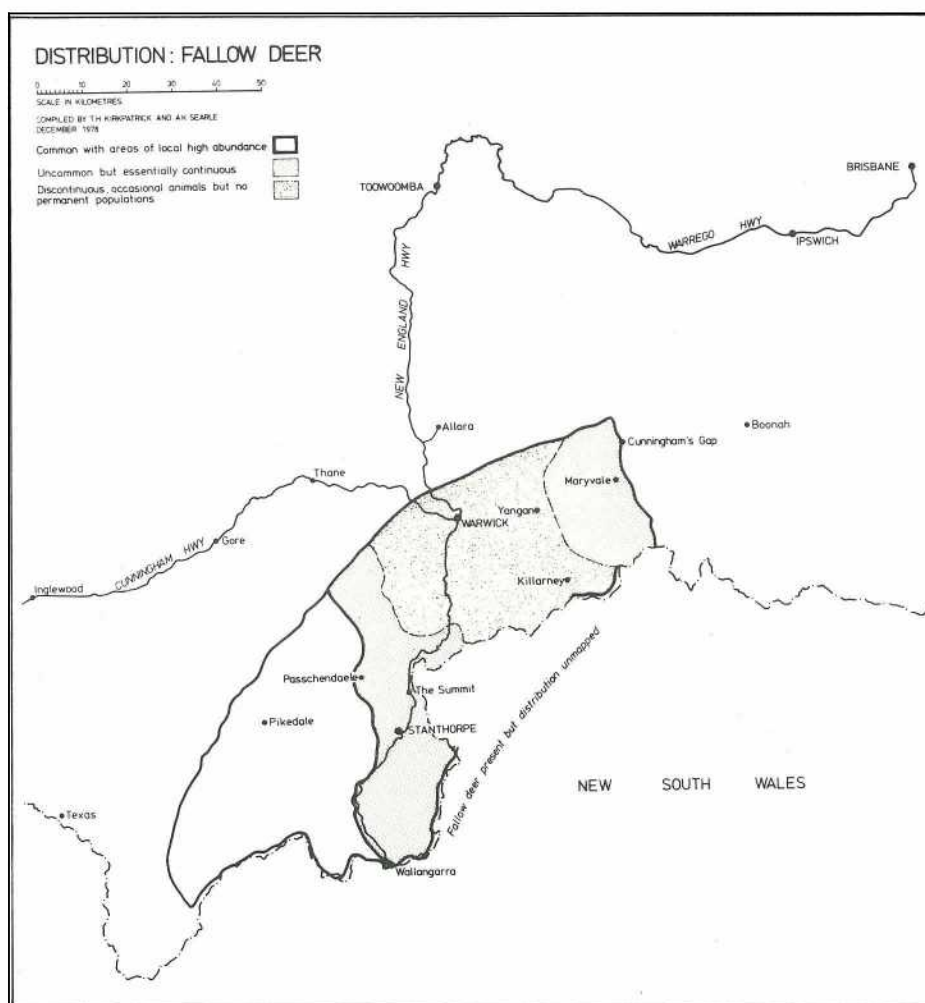


Figure 2. The distribution of fallow deer in Queensland.

attracted to crops and improved pastures, appearing to have preferences for both areas to graze and routes for entry and retreat. Summer crop trapping, however, may have more potential in certain areas.

The following techniques (see figure 3) have all been used to capture deer, and are discussed in detail.

- 1 Fawn catching
- 2 Feed trapping
- 3 Caller trapping
- 4 Water trapping
- 5 Route trapping
- 6 Net capturing
- 7 Darting
- 8 Helicopter

1 Fawn catching

Between late November and the first week of January the female fallow (doe) and red (hind) give birth to normally one young (fawn) which may be caught fairly easily in the first week of life by using a hand net

of coarse mesh on a wire ring about 1 m diameter. Commencing in late November, a search is made for any lone female which, when alerted, runs and repeatedly stops to look

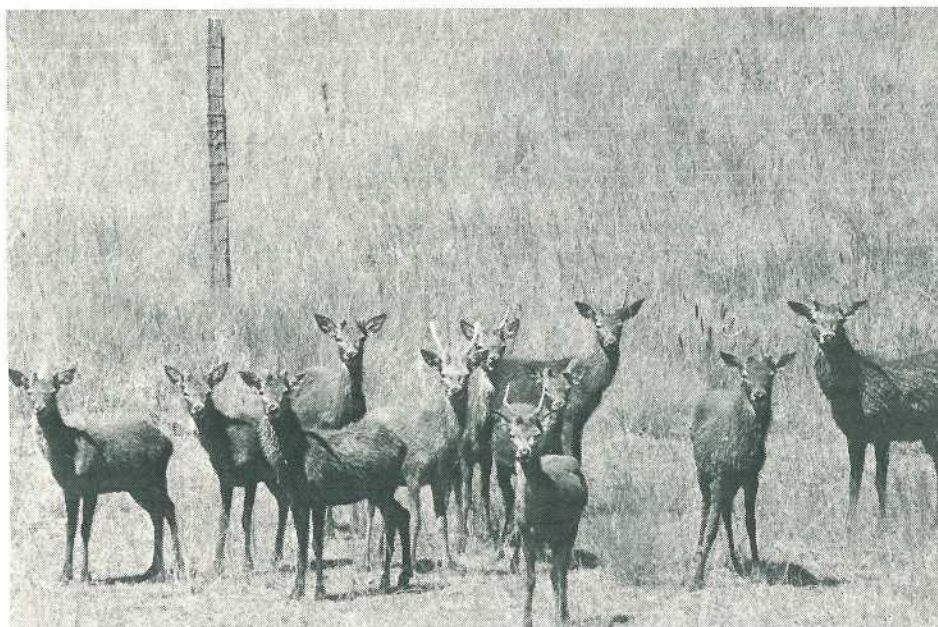


Plate 1. Interest in deer farming is increasing in the State.

back to where she came from, behaviour which suggests the presence of a newly born fawn. The location from which she came is searched and, if a fawn is present, it is usually lying in a clump of grass or under a low bush. Once detected, capture requires a careful approach (avoid looking directly at the fawn, if possible) and, when close enough, fast use of the net. A captured fawn should be placed in a dark crate with straw bedding. Hand rearing is simple but tedious, and the fawn must be force fed for the first 1 or 2 days. A proven feeding programme is as follows (quantities are for red deer; fallow fawns take less, about half the quantity).

First week: For the first 2 days, 5 feeds daily of 90 mL cow's milk
5 g glucodin powder
3 drops Pentavite, Abdec or other vitamin mixture
Pinch of Terramycin powder

Remainder of week: 5 feeds daily of 150 mL cow's milk
15 g dried full cream milk
2 drops Pentavite
Pinch of Terramycin powder

Second week: 4 feeds daily of 250 mL cow's milk
50 g dried full cream milk
3 drops Pentavite
Pinch of Terramycin powder

Third week to 3 months: 3 feeds daily of 400 mL cow's milk
100 g full cream milk

Reduce to two daily 400 mL feeds of this last mixture at 3 months, to one at 3½ months, and wean at 4 months. Fawns begin to eat grass at 3-4 weeks old.

ANNUAL ACTIVITY AND APPROPRIATE CAPTURE TECHNIQUE

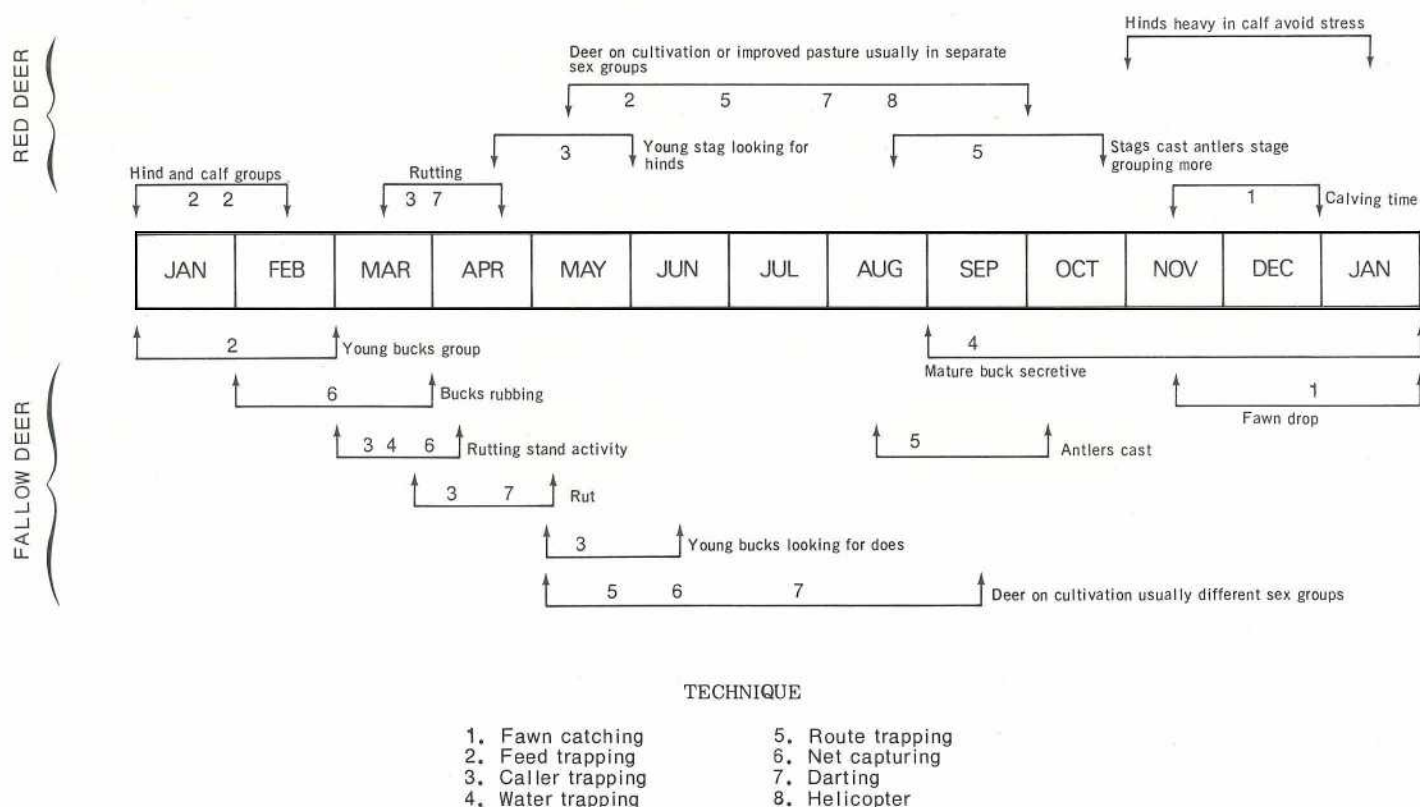


Figure 3. Annual activity of deer and methods of capture.

A draught free weather proof shed approximately 4 × 2 m is adequate to house a fawn for 6–8 weeks, after which it may be allowed to run in a small yard, for example 20 × 10 m.

2 Feed trapping

Once the winter grazing area is located, a trap may be constructed using netting (for instance arc-mesh, 6 ft K-wire or 6 ft heavy gauge marsupial netting). The mesh must be small enough to prevent the entry of both small marsupials such as red necked wallabies, which may feed on and prevent establishment of the trap crop, and dingoes and feral dogs which may harass, and even kill trapped deer. Smaller mesh netting has the additional advantage of preventing captive deer from injuring or killing themselves by pushing their heads through the mesh under pressure.

Normally fences are supported by round wooden posts (125 mm sap free) at approximately 12 metre intervals interspaced with 240 cm steel pickets. Strength in supporting the mesh is important; deer have been known to jump at a fence supported only by pickets and escape with resulting bent pickets, a lowered fence height and escape of

all deer. All posts should be located externally as deer tend to run the fence line and obstructions may cause injury, particularly on the capture or loading night. Gates are constructed of 20–25 mm water pipe and covered with the same size mesh as the fence. All traps should have

water, a suitable handling yard and a loading race unless the intention is to capture by darting.

The area fenced may be any size, preferably larger than 0.4 ha, and construction is recommended well before the winter to allow deer to



Plate 2. Fawns can be captured using a simple hand net.



Plate 3. A gate on a feed trap may be either shut by hand or operated on a simple automatic system using a trip wire.



Plate 4. If regular monitoring is possible, a permanently strung small net attached to a fallow buck's rutting stand can be an effective capture technique.

accept it. Usually one entrance of 4–5 m width is sufficient. Once the construction is completed the trap should be planted as early as possible with a winter pasture, for example oats, or a mixture suitable for the district. The gate, if suitable approach cover is present, may be shut by hand once deer have entered and are feeding, or a simple self-shutting type may be arranged. If the gate is swung offset from the post so that, when it is opened and released it will shut by itself (plate 3), then automatic shutting may be arranged using a release mechanism consisting of a trip wire which sets off a rabbit trap, which releases a latch. The disadvantage of automatic shutting is that a leading animal may set off the gate leaving the rest of the group outside.

3 Caller trapping

A feed or crop trap is constructed with provision for holding captured deer in a subdivision. This technique is useful for catching young bucks and stags after the rut if a female is used as a caller. A male is not a desirable caller as fighting may take place through the fence resulting in a wrecked trap.

4 Water trapping

During summer months, if water is in short supply, a small dam or known watering place for deer may be fenced and used in the same way as a feed trap, including the provision (if desired) for a caller deer. Such a trap may be small in area, and a self-shutting gate is recommended, to prevent overcrowding of captured animals.

5 Route trapping

This involves locating the approach or retreat routes of deer in any thickly timbered or heavy brush area and erecting a concealed netting trap using the path as the middle of the trap. The ends are sliding drop gates made of string mesh net. In the centre of the trap is a trip wire which releases the gates. This trap may be used all year. Another variation of the route trap is the fencing of any area of 0.5–1 ha near cultivation on which deer are feeding. The trap site should be adjacent to existing retreat routes and include a gully or hill. One or two entrances may be allowed for, with a width of at least 20 and preferably 80 m. These are located in such a way as not to advertise the trap fences when the

deer approach them; for example the entrances may be just over the crest of a hill or at the mouth of a gully.

A few days before the trap is to be used, black plastic sheeting is hung across most other known retreat routes, to force the deer to use the trapped route. The trap is then visited early in the morning with several vehicles which are used to herd the deer in the direction of trap entrances. Once the deer have entered the trap, the vehicles may close in rapidly and a hessian curtain is hung in the entrance while the fence is completed. This method has been used successfully in capturing numbers of fallow deer at one time.

6 Net capturing

Barramundi type nets (that is strong net with a 125 mm mesh and with a drop of 3 m, at least 100 m long) can be successfully used in catching fallow deer. The net may be used as a fouling net at night on any cultivation where it is possible to use a vehicle to drive the deer into it. A number of small nets may be used in any one paddock. The net is strung at a height of 1.2 m about 20 m from the existing fence. The deer are then located at night

from a vehicle with a spotlight and slowly moved into the net. When the deer hit the net some will get entangled in the belly of it and quick action is necessary. Young bucks are readily caught whereas does need to be acted upon rapidly when they first hit the net otherwise they will back off and be lost. It is important to colour the net black (tyre paint is an effective dye) to reduce its visibility.

Small nets may be used prior to the rut when bucks are rubbing small trees and marking their stands (plate 4). The net is hung between a rub tree and another 6–10 m away. The object is to entangle the buck as he rubs the tree. Such sites need to be visited regularly.

7 Darting

These may be tried where deer are relatively quiet or their subsequent movements may be followed easily. Generally, their use is recommended only for capturing trapped deer (see below). With the development of radio transmitter darts this technique may now be used more in the field.

8 Helicopter

Deer may be successfully run into traps provided the local topography is suitable. Wings are constructed leading into the trap entrance and the deer are driven in. Suitable wings can be made from ordinary fencing materials and/or a combination of black plastic and hessian sheeting.

The use of helicopters has met with mixed feelings among landholders due to supposed ease of poaching deer but nevertheless, where property owners agree, this method may prove successful in a combined trapping operation.

Other methods of catching which have been considered but may be uneconomic include the use of darting and netting from a helicopter.

Handling trapped deer

The two important rules of handling are: work at night, and work quietly. Trapped deer should be left until night time when they may be immobilized by use of a suitable drug applied either from a dart gun or, if caught in nets, by injection. The usual procedure is to approach the deer in a vehicle equipped with a spotlight, allow them to settle and then dart them. Three or four may be darted comfortably in any one night. Drugs commonly used are Fentaz, Rompun, Ketalar and Scoline. Fentaz is a useful drug as its

action may be reversed if complications occur, and its induction period is 8–10 minutes only, which may be reduced to 4–5 minutes by the addition of Hyaluronidase. Rompun on its own is not recommended because the darted animal when approached will rise and move off, and it is usually mixed with Ketalar or Scoline. A safe mixture and effective tranquillizer is a 50/50 mixture of Rompun and Ketalar, effective doses being 150 mg of each for a yearling fallow, 200 mg of each for an adult fallow, 150 mg of each for an adult red. To mix the drugs, add 5 mL Ketalar (100mg/mL) to one 500 mg bottle of Rompun (dry), and shake the bottle well until the Rompun is dissolved. Each millilitre of this mixture contains 100 mg of Rompun and 100 mg Ketalar. Thus for a yearling fallow, 1.5 mL of mixture is used and for a mature fallow 2 mL. This mixture usually takes 15–25 minutes to immobilize a deer. The Rompun-Scoline mixture is a relatively fast acting combination but dangerous, indeed sometimes fatal, when too much Scoline is used. Recommended rates of use are:

Yearling fallow bucks, all does: 40 mg Rompun plus 5 mg Scoline

Mature fallow bucks: 80 mg Rompun plus 7 mg Scoline

Red stags: 100 mg Rompun plus 14 mg Scoline

Red hinds: 100 mg Rompun plus 12 mg Scoline

Another useful mixture is a combination of Azaperone, Rompun and

Scoline. For a mature red stag the dose is 100 mg of Rompun plus 40 mg of Azaperone and 14 mg of Scoline. The mixture is made by adding 5 ml of Stresnil (Azaperone) to 10% solution of Rompun. Every millilitre of this mixture has 100 mg of Rompun and 40 mg of Stresnil. If weights are known, the general rule for Rompun is 1 mg per kilogramme of body weight when used in combination with another drug.

After capture, deer may be restrained with leg straps and a blindfold (plate 5) and placed in a covered-in trailer or crate. The use of leg straps is recommended, as when the deer recovers and is released, it will then stand quietly for 5–10 minutes before being able to move easily, which reduces the likelihood of a 'blind' dash on release and possible injury. All immobilized deer must be placed on the sternum to avoid bloating, especially when Rompun has been used.

Yarding and loading

A small forcing yard and loading race may be used for untranquillized deer providing these are at least 2.5 m high. If completely covered in, deer may be yarded and loaded during the day. A suitable temporary covering is black plastic and hessian.

A black plastic and/or hessian wing is run out from the loading yard and the deer are forced into it by bringing the wing around behind them and moving it up steadily until the animals enter the yard. Once the



Plate 5. After darting, deer may be restrained using leg straps and a blindfold.

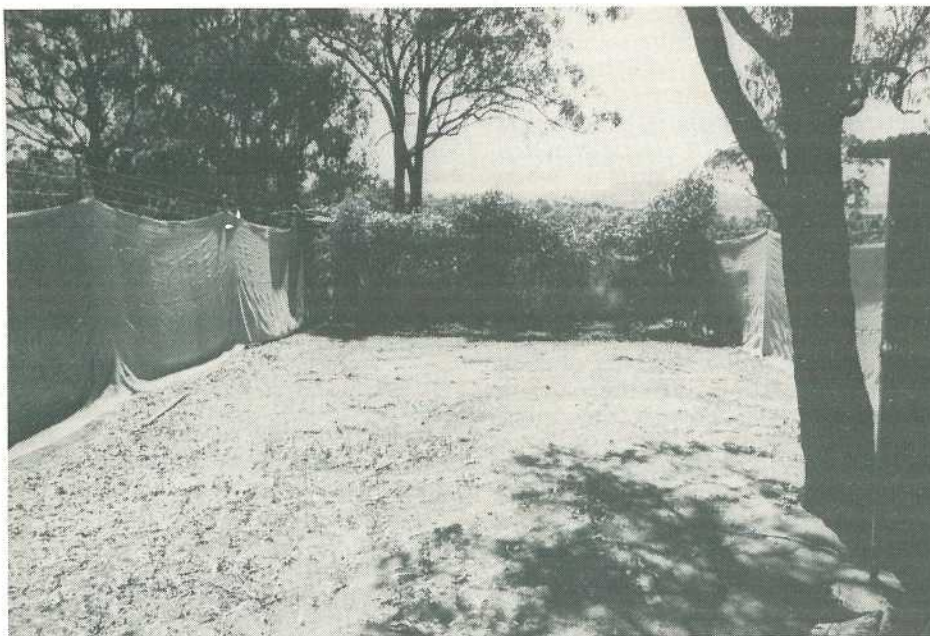


Plate 6. A small yard suitable for acclimatizing captured deer to fences and people.

deer are yarded, the entrance is covered so that the yard and race are quite dark inside. The deer may be forced up the race by two handlers moving a sheet of ply or chain wire covered with hessian up behind them. The deer are loaded either into a truck or float which is similarly covered in. Usually this operation requires at least two and preferably three persons.

Transporting deer

Transport is best undertaken at night, and provision should be made to keep the animals from overheating. The removal of antlers from stags at capture reduces the likelihood of injury when transporting mixed sexes, especially if not drugged. The only other problem that may occur is bloat, a remote possibility which must, however, be allowed for.

Adjustment to captivity

Deer should preferably be introduced into a small hessian-draped yard of approximately 40 × 10 m with a brush shelter at one end to allow them to become acclimatized to fences and people (plate 6). This reception yard is best situated near a home or other area of human activity. The captured deer should be released into this yard, preferably at night, and then visited daily for the first week and thereafter at least twice daily. After a month or so these deer will have become more approachable, and may be moved into a larger yard. If red deer are released straight into a large holding paddock, as is the custom of some

red deer farmers, there should be ample shade, water and especially wallowing areas.

Wild caught pregnant hinds require special consideration when handling and providing suitable pre- and post-calving environment. Some farmers have released their hinds into rather bare paddocks resulting in loss of foetuses, poor calving and loss of young calves.

Introduction into an established yard colony where a 'peck order' has been established must be carefully

watched as the new arrivals may be attacked with resultant injury or even death. Certain times of the year are more suitable for introductions than others; for example stags are best introduced during September to December when antlers are in velvet. Females are usually tolerated at any time, but if they are not soon accepted they should be moved and held in an adjacent yard for one or two weeks.

Wild caught deer quickly respond to a daily routine of supplementary feeding, which may be grain, deer cubes or lucerne hay, a practice that greatly assists in helping them to become accustomed to their new situation.

Provision for calving

Suitable cover is necessary to minimize stress during the immediate pre- and post-natal periods October–January, to provide shade and retreat for adults and hiding places for calves. A small area of brush trees is ideal, but if not present a small area, for example 0.25 ha, may be planted to barner grass in a hedge maze pattern with smaller grasses or shrubs planted between the barner grass rows. In an intensive farm, a smaller area of this cover area may be fenced so as to allow calves access and exclude adults.

Regulations

1 A person wishing to commence deer farming in Queensland must first be the occupier of

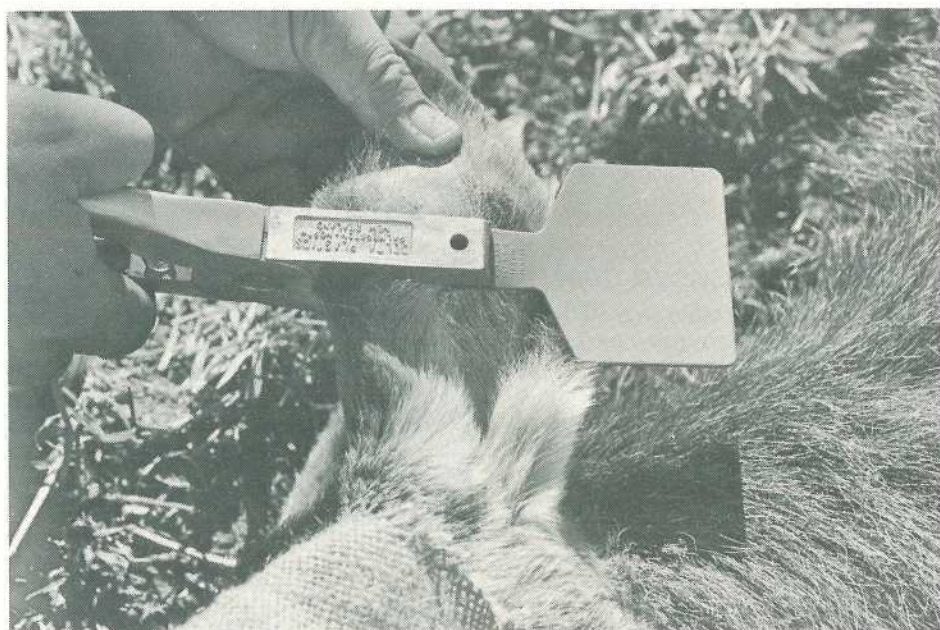


Plate 7. Ear tagging is used by many deer farmers to denote ownership and manage breeding.

sufficient land to support a viable deer farm. Application must then be made to the National Parks and Wildlife Service for a permit to take and a permit to keep deer under the Fauna Conservation Act 1974-1979. The fee for each permit is \$10. These permits are usually issued after suitable holding and handling yards have been inspected and approved by an Officer of the Service. The permit issued allows each individual occupier or owner so licensed to take a limited number of breeding stock. Initially 20 deer may be taken per licence; however approval may be given to take progressively 50, 100, 150 and finally 250 animals.

2 The trapping of red deer is permitted between April and November and all deer trapped must be ear tagged with a NPWS tag (plate 7). The holder of such a

permit is expected to keep a register of trapped deer, recording his own identification number with the corresponding Service ear tag number. A royalty of \$50 per head is payable on each trapped deer.

3 The number of deer traps per permit is limited to five, and each site must be registered and display a registration number. Provision for deregistering and resiting a trap is allowed for.

4 All movements of deer are subject to stock permits by the Department of Primary Industries and permits to remove by the National Parks and Wildlife Service. The permit to take allows the movement of trapped deer from the point of legal capture to the authorized place of keeping within Queensland.

5 At present all species of deer in Queensland may be moved intra- and interstate for zoo purposes. For farming, all species except red deer may be moved intra- and interstate. Wild caught red deer are only farmed within their distribution range, whereas farm bred progeny may be farmed outside the distribution area provided fencing is adequate.

6 Any new and inexperienced applicant is advised not to trap a large number of deer initially for a number of seasons, until suitable deer husbandry skills are acquired, otherwise both the potential farmer and animals may suffer loss.

7 Anyone interested in farming deer is well advised to contact experienced deer farmers and their association, as well as the National Parks and Wildlife Service.

DPI activities in western Queensland sheep areas

The Minister for Primary Industries, Mr Mike Ahern, MLA, has announced the formation of a committee to review Departmental activities in the traditional pastoral sheep areas of western Queensland.

Mr Ahern said he had invited two landholders and two Departmental officers to serve on this committee.

He said, 'Mr John Heussler, Denton, Morella, has agreed to chair the committee. Other members of the committee will be Mr Hal Slaney, Flora Valley, Reid River and Mr Pat Thurbon, a DPI Supervising Husbandry Officer. Mr Arnold Wissemann, a DPI Extension Officer, will act as the committee secretary.'

Mr Ahern added that the terms of reference of the committee would include:

- Examining the research and extension needs of those graziers who have sheep interests in the south west, central west, north west and Maranoa regions of the State.

- Formulating recommendations about the major directions for future Department of Primary Industries activities in the research, extension and administrative fields.
- Recommending specific Departmental programmes and indicating priorities for action, having regard to the current situation, the resources available and existing commitments.

Mr Ahern said that the investigation was being carried out because of the changes which had taken place in the grazing industry in western Queensland during the last 20 years. During this time, persistent droughts, coupled with economic and social pressures, had yielded a situation where sheep members had fallen from 22 million head to about 10 million head today. At the same time, beef cattle numbers in the area had increased by about 10% to a total of 3 million head.

The committee will submit a report within 9 months.

Cattle will drink at saleyards

Jennifer R. Wythes, Beef Cattle Husbandry Branch, and Ben Ball, Queensland Meat Industry Organization and Marketing Authority

FOR welfare reasons alone, cattle should have access to water, whenever possible, to reduce the chances of animals becoming dehydrated.

Yet how often do you hear the comment 'Cattle will not drink at saleyards'? The reasons given include brackish, bore or chlorinated water supplies and that the water is always dirty because of dogs cooling off in it. While there may be some truth in these remarks, it is only recently that actual water intakes have been measured at saleyards.

The controversy over dry and wet curfews for selling cattle on liveweight emphasized the question of how acceptable to cattle is water at saleyards. Research has demon-

strated that allowing cattle continuous access to water will greatly reduce the variation in liveweight and dressing percentage between sale lots and, in turn, improve the efficiency of pricing cattle. In addition, fewer animals should be dehydrated at sale and cattle will be in better order.

In a trial in May, 1980 Hereford yearlings drank 0, 1.9 and 6.0 L per head of chlorinated Brisbane water overnight after being off feed and water for 12, 36 and 60 hours, respectively. Next day they drank an average of 5.8 L per head. On another occasion in July 1980, Hereford cows drank 1.7 L per head after only 6 hours without water and another 3.7 L per head during the next 22 hours.

It is frequently stated that bullocks from the Channel Country will not drink from troughs or touch strange water. However, after 30 hour journeys in summer, different consignments of bullocks drank 33 to 43 L per head on arrival at Cannon Hill saleyards. They drank a further 8.3 to 25 L per head during the next 22 to 25 hours.

In a study by the Roma Bungil Showgrounds and Saleyard Board in September 1981, they reported that steers drank 3 L per head and yearlings 4.5 L per head after 6 hours off water. The saleyard uses bore water, which has a sulphurous smell as the trough fills, but seems to disappear after the water settles.

It is important that cattle drink water at abattoirs to avoid being dehydrated at slaughter. Dehydration of the muscle tissues greatly reduces carcass weight. After 6 hours without feed and water, Sahiwal $\times$ Hereford steers drank 3.1 L per head before slaughter at F. J. Walker's abattoir, Maryborough, in September 1980. Steers from the same property drank 12.8 L per head when consigned to the Metropolitan Regional Abattoir, Brisbane, in October 1981. They had been without feed and water for 18 hours.

Observations at Cannon Hill

The Cannon Hill saleyard is one of the major selling centres in Queensland and draws cattle from throughout the State. Concern over the number of cattle dying on trains to Cannon Hill and the debate on dry curfews focused attention on cattle sent to this saleyard from western and northern Queensland. When trains arrived late at Cannon Hill, cattle to be sold on liveweight were not offered water before penning. These cattle were already considered to be on curfew. Apart from welfare considerations, it is important to know how much lighter these cattle were at sale than if they had been offered water. Moreover, would they drink if offered water?



The authors inspect one of the water troughs installed in the selling pens at the Cannon Hill saleyards.

Table 1. Water intake by cattle at the Cannon Hill saleyard

Observation	Origin	Number and sex of animals	Time off water prior to trial (hours)	Duration of trial (hours)	Mean water intake (L per head)					Total intake (L per head)
					0-3	3-6	6-9	9-12	12-18	
1	Barcaldine	69 mixed	41	12	24.3	0.6	1.4	2.7	..	29.0
2	Longreach	48 bullocks	42	12	24.7	4.2	0	4.6	..	33.5
3	Hughenden	20 mixed	50	10.5	30.1	1.3	..	..	..	31.4
		20 heifers	50	10.5	22.4	1.7	..	..	..	24.1
		20 cows	50	10.5	31.7	4.1	2.0	0	..	37.8
4	Quilpie	66 steers	25	18	10.8	0.4	0.1	1.0	2.8	15.1

Between October 1979 and February 1980, four consignments of cattle were observed until the normal curfew time of 8.30 p.m. on the evening before sale day. On arrival at the saleyard, each consignment was bulk-weighted immediately and again on completion of the total period on water. Water consumption was measured using meters on the troughs. The saleyard uses chlorinated water from the Brisbane domestic supply.

Most cattle drank 20 to 30 L per head during the first 3 hours they were on water, except those from Quilpie. Although animals had access to water for another 3 to 15 hours, they drank very little. The lower intake of the Quilpie group was probably influenced by the wet

weather, since this was the only occasion it rained during these observations. A group of Longreach cattle was fed hay, but this did not increase their total water intake above that of the cattle on water only; in fact they drank less during the first 6 hours after arrival (23.6 as against 30.5 L per head). Table 1 summarizes the results of the four observations.

In addition, a group of Barcaldine, Hughenden and Quilpie cattle was denied water for the 12 hours while the others had access to water. At the end of this time, the groups without water were 27, 12 and 6 kg per head lighter, respectively, than those on water. The difference was least for the Quilpie cattle, because

the lower water intake of those permitted to drink limited the extent of rehydration of their body tissues.

Observations at Warwick

At Warwick we observed cattle coming from different areas to the saleyard during November and December 1980. Water for the saleyard comes from a nearby bore. On arrival, each consignment had access to water until the curfew commenced at 7.00 p.m. Mr David Llewelyn, Beef Cattle Husbandry Officer at Warwick, noted the proportion of cattle drinking and recorded the total water consumption for each group. Afterwards each owner was contacted to find out how long his cattle had been without water before trucking.



Most cattle drank if they were not disturbed by other saleyard activities and noise.

Most animals drank provided they were not disturbed. Water intake tended to rise as the time increased since the cattle last had an opportunity to drink. Table 2 summarizes the results.

Conclusions

The available evidence clearly shows that cattle will drink at saleyards. They usually satisfy their

thirst at the first opportunity after arriving and then seem to drink only small quantities. Generally, the longer animals were without water, the more water they drank on arrival at the saleyards. Naturally, weather conditions also have an effect, with intakes increasing in hot weather but falling in wet or cold weather. Our observations show that it is most important for cattle not to be disturbed by other saleyard activities when they first have access to water.

This point must be considered when saleyards are designed, as it is preferable for cattle to drink the largest quantities of water while they are still in the holding yards.

The introduction of wet curfews at a number of saleyards will undoubtedly improve the welfare of these cattle and minimize dehydration losses resulting from transportation.

Table 2. Water intake by cattle at the Warwick saleyard

Origin	Number and description of animals	Time off water (hours)	Mean water intake (L per head)	Proportion of animals drinking
Mungindi	22 Shorthorn bullocks	21.5	2.4*	few
Cunnamulla	22 Droughtmaster steers	18	12	most
Cunnamulla	42 Droughtmaster cows	18	12	most
Texas	20 Shorthorn steers	11.5	0.5†	few
Texas	38 Hereford steers	8	11	most
Nanango	36 mixed cattle (ex feedlot)	6.5	12	most
Texas	32 Shorthorn cows (off oats)	6	4	few
Stanthorpe	71 Angus steers and heifers	4.5	1	few
Killarney	25 Hereford × Santa bullocks	3	2	few
Yelarbon	37 Hereford steers	2	5	most
Junabee	22 Hereford and Santa bullocks (off oats)	1	0	nil

* Frequently disturbed while drinking.

† Frequently disturbed while being observed but drank 10 L per head next morning.

New suppliers entering dairying

The Minister for Primary Industries, Mr Mike Ahern, MLA, announced today that new suppliers to the State's dairying industry in south-east Queensland will be permitted under controlled conditions of entry.

Mr Ahern said that Cabinet had accepted the guidelines for controlled entry recommended by him after consultation with the Queensland Dairymen's Organisation.

He said, 'A major requirement to set up a new dairy farm will be a recommendation to me, as Minister, from the Directors of a cooperative factory following approval of its shareholders. A new supplier will not confer an advantage on a cooperative in the distribution of the present Milk Entitlements Committee milk pool and subsequent pool. The cooperative will be required to accommodate new suppliers through its own market milk involvement. New suppliers will compensate present suppliers for their share of the cooperative's

market milk access at the current Milk Entitlements Committee rate which is \$50 per litre.'

On the matter of transferability of producer market milk entitlements, Mr Ahern said that where a producer elected to divert from one processor to another and the processor was willing to accept supply, the Milk Entitlements Committee will administer the transfer.

Mr Ahern added that the transfer procedures were recommended to the Government by the Queensland Dairymen's Organisation and the Milk Entitlements Committee. The Chairman of the Committee, Mr Beatty, will announce full details to the industry later this week. A producer will be able to transfer only 50% of his market milk supply with the remaining 50% being negotiable by his former factory.

'The re-distribution of market milk through farmers leaving the industry and market growth will continue according to the present formula through the Milk Entitlements Committee,' Mr Ahern concluded.

Wheat varieties for Queensland—1982

P. B. Wylie, Agriculture Branch and staff of the Queensland Wheat Research Institute

SEVEN varieties are recommended in Queensland by the Department of Primary Industries in 1982. The recommendations are based on agronomic, disease resistance and quality characteristics.

Table 1. Wheat varietal selection according to time of planting

District	Region	Varieties in order of preference for each line in different maturity groups	Planting period (approx. weeks)																							
			MARCH				APRIL				MAY				JUNE				JULY							
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4				
1	Central Highlands and areas west of the Dawson–Callide Valleys	Oxley Cook Banks, Kite Gatcher, Songlen			A	A			B	B	B	C														
									A	B	B	B	C	C	C	C	C	C								
											B	B	C	C	C	C	C	C	C	C						
															C	C		C	C	C	C					
2	Dawson–Callide Valleys and North Burnett*	†Oxley Cook, Banks, Kite Gatcher, Songlen										C	C													
														C	C	C	C	C	C							
																C		C	C	C	C					
3	Western Downs and Maranoa	Oxley Cook, Banks, Kite Gatcher, Songlen									B			C	C	C										
															C	C		C	C	C	C	C		C		
																		C	C	C	C	C	C	C	C	
4	South West, St. George and Goondiwindi	Oxley Cook, Banks, Kite Songlen, Gatcher									B			C	C	C										
															C	C		C	C	C	C	C	C		C	
																		C	C	C	C	C	C	C	C	
5	Sub-coastal	Shortim Cook Kite, Banks									B			C	C	C	C									
															C	C		C	C							
															C	C		C	C	C	C	C	C	C	C	
6	Northern Darling Downs and South Burnett	†Oxley, Shortim Cook Kite, Banks												B	C	C	C									
																B		C	C	C	C	C	C	C	C	
																		C	C	C	C	C	C	C	C	
7	Central and Southern Darling Downs	†Oxley, Shortim Cook Kite, Banks													C	B	C									
																		C	C	C	C	C	C	C	C	
																		C	C	C	C	C	C	C	C	

* Earlier plantings similar to district 1 may be suitable on slopes with low frost risk.

† There is a high risk of stem rust damage to Oxley in these districts.

Table 1 provides a guide to the selection of the best yielding wheat varieties for different planting times. (The A, B and C ratings indicate the risk of frost damage from planting in the weeks indicated. See the section on frost damage below.) The districts described in the table are shown in the accompanying map, figure 1.

Frost damage

Earlier planting of wheat can provide more planting opportunities and the chance of higher yields. However, the risk of frost damage increases and may offset the higher yield potential of earlier planted wheat. In table 1 A, B and C ratings indicate the risk of frost damage.

- A** Wheat should flower before the main frost period. Wheat may go to head quickly when planted early and high planting rates of 40–60 kg per ha could be required.
- B** Wheat will flower during the main frost period. Plantings at these times should only be

made on sloping areas which do not receive heavy frosts. Frost damage can still occur if the winter is severe. The risk of damage can be spread by planting more than one variety at different times.

- C Wheat will flower after the main frost period. Late frosts can still affect yields in some years.

Herbicide damage

To avoid crop injury, herbicides should be applied only in accordance with recommendations on the manufacturer's label. Cautionary notes are given on labels when using Avenge and Mataven on Kite, Avenge on Gatcher, and dicamba on Cook wheat.

Diseases and pests

Resistance or tolerance to major diseases and pests is summarized in table 2.

Stripe rust was detected in Queensland in 1981 for the first time and is a potentially serious disease. Fortunately, all recommended varieties are reasonably resistant.

All varieties are susceptible to the leaf disease, yellow spot, which can be a problem in wetter seasons where wheat is planted into wheat stubble. All current varieties are resistant to flag smut.

Root-lesion nematodes may be a problem on the fine, self-mulching, plain soils of the Darling Downs. While yields of all varieties can be reduced by nematodes, Gatcher and Banks are particularly affected. Planting wheat following wheat should be avoided where nematodes are a problem.

Notes on varieties

Tables 3 and 4 present a summary of agronomic features, and the quality characteristics of our present varieties.

Shortim

Shortim is the slowest maturing variety in current use, and has not produced good yields. Heavy tillering with short straw, it could be sown in situations where a slow maturing variety with stem rust resistance is required. This variety was released by the University of Sydney in 1977.

Oxley

Oxley has high yield potential but is susceptible to stem rust. It has medium maturity in central Queensland and western areas where it is useful for early planting. In colder

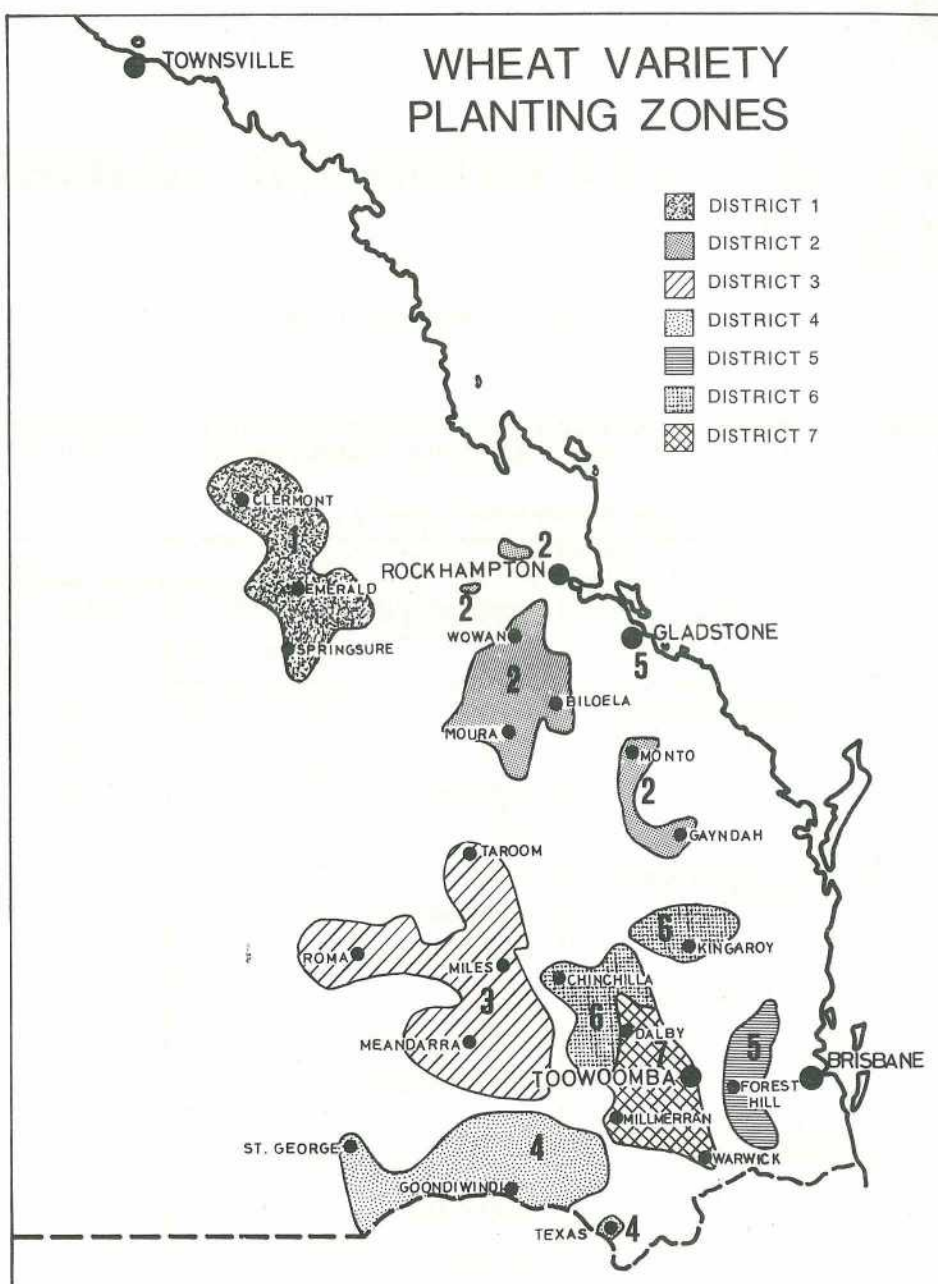


Figure 1. Wheat variety planting districts, 1981.

districts (6 and 7) Oxley is slightly faster maturing and can be used in a period 1 to 2 weeks before other varieties are safe to plant.

Late planting should be avoided in all districts because of a risk of losses from stem rust. Crown rot resistance is also low and Oxley should not be planted where the disease was present in the previous crop. This variety was released by the University of Queensland and the Queensland Department of Primary Industries in 1974.

Cook

Cook has confirmed its place as one of the top wheat varieties suited to main season plantings in all areas. It is a high yielding, heavy tillering variety with good disease resistance.

Cook was released by the Queensland Department of Primary Industries in 1977.

Kite

Kite is a quick maturing, awnless wheat suited to main season planting in all areas. Although suitable for 1H classification only, it has advantages of lodging resistance, some tolerance of ear frosting and some resistance to weather damage at harvest time. Kite was released by the New South Wales Department of Agriculture in 1974.

Banks

Banks is a quick maturing wheat which has performed well, particularly in the drier areas of the wheat belt. Banks is susceptible to crown rot and root-lesion nematode

Table 2. Resistance or tolerance to diseases and pests

Variety	Resistance to stem rust	Resistance to leaf rust	Resistance to stripe rust	Resistance to crown rot	Resistance to common root rot	Tolerance to root-lesion nematodes
Shortim	v. high	medium	v. high	high	low	low
Oxley	low	high	v. high	low	medium	medium
Cook	v. high	low	v. high	high	medium	medium
Kite	v. high	v. low	medium	medium	high	low
Banks	high	v. high	v. high	low	medium	v. low
Songlen	v. high	high	high	medium	low	low
Gatcher	medium	v. low	medium	medium	medium	v. low

attack. It is susceptible to frost damage in early growth stages, so areas liable to heavy frost should be avoided. Banks was released by the Queensland Department of Primary Industries in 1979.

Songlen

Songlen is a very quick maturing variety which in most districts does not yield as well as Cook, Kite and Banks. It could be considered for late planting times in the drier wheat growing areas of the state. It is susceptible to frost damage in early growth stages. In some seasons dark

pigmentation on ear and stem (genetic black chaff) may develop. This variety was released by the University of Sydney in 1976.

Gatcher

Gatcher is a very quick maturing variety, with lower yield potential than Cook, Kite and Banks. It is useful for late plantings in the drier wheat growing areas. Gatcher has a long straw and is susceptible to lodging. In some seasons it may develop genetic black chaff. It was released by the University of Sydney in 1969.

New varieties

Three varieties—Harrier, Sunkota and Hybrid Titan—are undergoing further testing for yield and quality. Seed will not be generally available for the 1982 season. Harrier is a slow maturing variety from southern New South Wales, suitable for earlier plantings than normal for Oxley in southern Queensland. Sunkota is a slow maturing variety recently released by the University of Sydney. Hybrid Titan is a quick maturing hybrid released in New South Wales by DeKalb Shand.

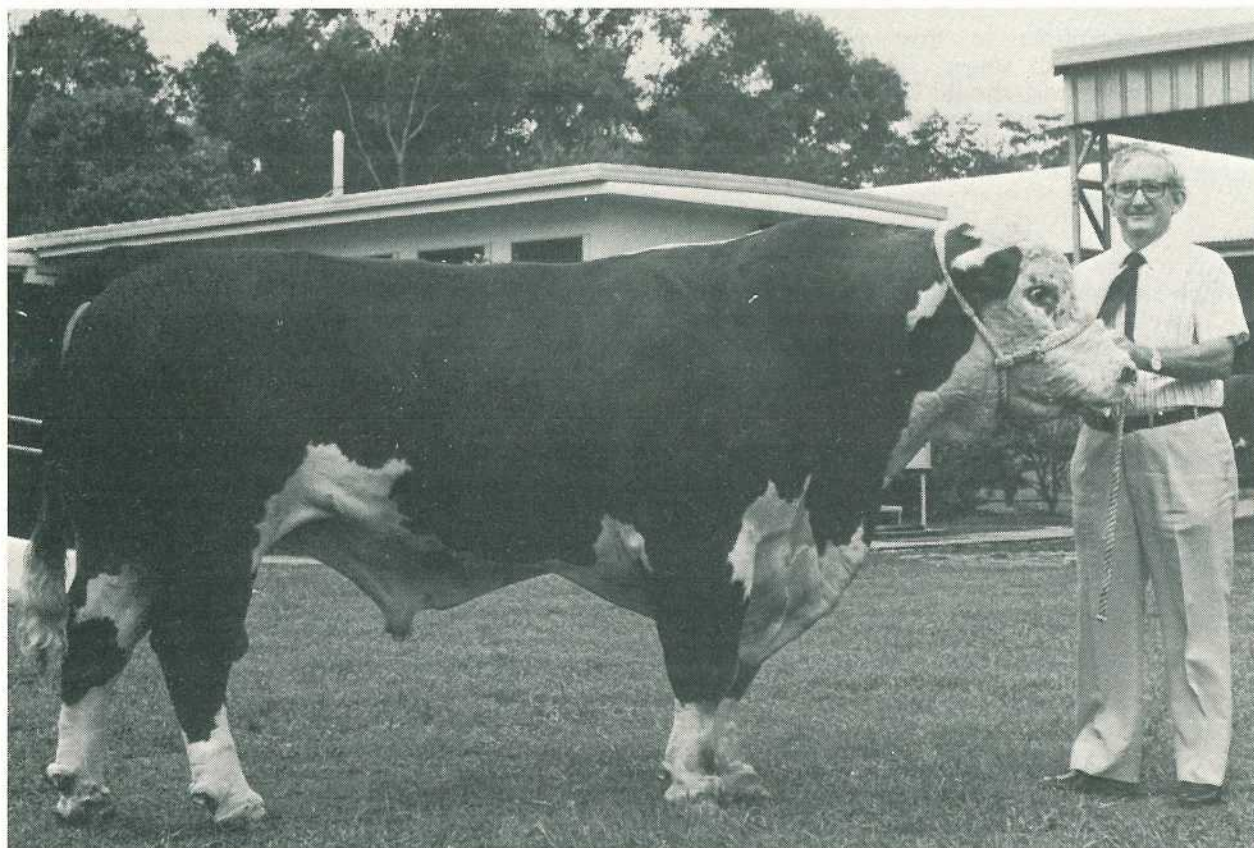
Table 3. Agronomic characteristics of varieties

Variety	Maturity	Yield potential	Height	Awns (beard) present	Resistance to lodging	Resistance to shattering	Frost resistance
Shortim	slow	medium	v. short	yes	v. good	good	v. low
Oxley	medium	high	medium	yes	good	good	low
Cook	quick	high	medium	yes	medium	medium	low
Kite	quick	high	medium	no	v. good	v. good	medium
Banks	quick	high	medium	yes	good	good	low
Songlen	v. quick	medium	medium	yes	good	good	v. low
Gatcher	v. quick	medium	medium	yes	good	good	low

Table 4. Grain quality

Variety	Grade	Test weight	Resistance to weathering	Protein %
Shortim	PH	medium	nil	medium
Oxley	PH	medium	nil	medium
Cook	PH	high	low	medium
Kite	1H	medium	medium	medium
Banks	PH	medium	nil	low
Songlen	PH	medium	nil	high
Gatcher	PH	medium	nil	low

Imported bulls arrive in Queensland



Dr Graham Alexander, Director-General of the Department of Primary Industries, parades Poll Hereford bull, Beartooth Advancer 12H, at the DPI A.I. Export Centre at Ormiston, near Brisbane.

Beartooth Advancer is one of seven bulls recently imported from America via the Australian Government's new \$6m Cocos Island Quarantine Station. The bulls are undergoing further health checks at the DPI before being released to their owners.

They are part of a consignment of fifty stud animals recently imported from America and are the first imports from the USA since 1956. Advancer, weighing 1 360 kg, was purchased for US\$311,000 and is the most expensive bull to be imported into Australia. He was purchased by a syndicate headed by Don Anderson of Inverary Stud, Yandilla.

Other bulls presently undergoing DPI health checks are Beartooth Marker imported by Gary Perritt and Don Anderson; Beartooth Dynamite, Mrs Sue Thiele of Roma; Beartooth Mindaribba, Warwick Pont of Sydney;

two hereford bulls, KCCLI Milkman 81M and EXL 4001 Total 16M, Roy Reynolds of 'Moorlands', Rosalie Plains and Ian Watson, Hamilton, Victoria, together with a Santa bull, Cherokee Bulcan, Terry Russell, 'Swan Hill', Blackall.

Owners have placed the sires with the DPI to enable licensed semen to be collected for sale and distribution in Australia and overseas.

The Minister for Primary Industries, Mr Mike Ahern, MLA, said that his Department's artificial breeding services make a major contribution to improving the nation's beef and dairy herds as well as those in overseas countries. Each year, the Department produces about 100 000 doses of semen for export as well as a similar quantity for local use. This production comes from bulls of twenty different beef breeds and eight dairy breeds.

Insect and mite pests of winter cereals

R. H. Broadley, Entomology Branch

IN 1979–80, the predominant winter cereal crops in Queensland were wheat (845 000 tonnes) and barley (345 000 tonnes). In the same year approximately 8 700 tonnes of oats and 5 300 tonnes of canary seed were also produced.

The gross margin of profit on these crops is not high. For example, that for wheat on parts of the Darling Downs in 1979–80 was as low as \$73 per hectare. Growers therefore should give careful consideration to the potential losses which insect pests may cause and the economic benefits which can flow from control.

Armyworms

Severe armyworm (*Pseudaletia convecta* (Walker)) outbreaks occur approximately once in ten years in winter cereals in south Queensland, the last being in 1978. Smaller outbreaks of varying magnitude are experienced in intervening years. The species most frequently encountered in winter cereals is the common armyworm (90% of larvae).

The life cycle of the pest involves egg, larval, pupal and moth stages. The female moth cements eggs together in clusters among withered leaves at the base of the plant. Incubation primarily depends on temperatures, and usually takes four or five days. During the daytime larvae congregate among organic material at the base of the plant or in crevices in the soil, and ascend the plants at night to feed. Larger larvae are variable in colour, being striped in either green, pink or brown. Heavy populations can defoliate crops, with up to 120 larvae per square metre having been recorded. While loss of leaves can be important, the head cutting activity of larger larvae (usually greater than 30 mm long) is the most serious form of damage. As crops ripen the leaves wither leaving the node below the head as the last soft moist tissue on the plant. Larvae concentrate their feeding here, with the result that the heads are often severed and toppled to the ground. Severe yield loss can result. Pesticide recommendations for control of armyworms and other pests discussed below are given in table 1.

Pupation occurs within a chamber in the soil and after a short period of development the moth emerges. One insecticide application is normally

sufficient for control as it is rare for more than a single generation to occur in any individual crop. In south Queensland, populations peak in September and October, that is the months when many crops are ripening.

Barley is the most frequently attacked winter cereal. Apparent differences in susceptibility of barley varieties to armyworm attack are probably related to stage of crop growth, planting dates or nutritional status rather than to any inherent plant resistance characteristics. Table 2 has been prepared to assist growers make decisions on whether or not to control head cutting armyworms in Clipper barley. It is based on *anticipated* head loss per square metre, and the control measures must obviously be applied before such damage has occurred.

Brown wheat mite

A major outbreak of brown wheat mite (*Petrobia latens* (Müller)) occurred in winter cereals during 1980 and while infestations of that magnitude are sporadic, when they do occur, losses can be considerable. The pest occurs in wheat crops every year, but it is only during periods of prolonged dry weather that populations build up. Under such conditions, some thousands of mites per plant may occur and it is impossible to separate their injury from associated moisture stress symptoms. The combination, however, causes serious crop damage. Even moderate rainfall is sufficient to result in substantial mortality of the mites and, where favourable growing conditions occur after heavy infestations and crop growth is not too advanced, high yields can still be obtained.

Mites are found on both upper and lower leaf surfaces, stems and even on the seedhead awns when infestations are severe. They feed with piercing-sucking mouthparts, by rupturing plant cells and sucking the contents. Numerous feeding punctures give leaves a stippled appearance. Although lower leaves are preferred, these may wither and die, and mites are forced onto the upper parts of the crop canopy. When disturbed, they fall to the ground, so that when assessments of populations are being made, plants should be disturbed as little as possible.

The life cycle of the brown wheat mite involves egg, nymph and adult

stages. Eggs are usually located among soil particles at the base of the plant, but may also be found on vegetation. Both short term and long term eggs are deposited. Short term eggs are red, subspherical and lightly ribbed, while long term or diapausing eggs are white. Long term eggs will not hatch during hot dry conditions. Adult female mites may lay approximately 80 short term eggs over a period of 3 weeks, but only about 30 long term eggs are produced. The time from egg hatch to adult appearance depends on temperature, but may occur in as little as 8 days.

A winter cereal–winter cereal cropping cycle provides a favourable environment for build-up of the brown wheat mite. Consequently, heavier mite infestations occur in situations where rotations are not practised. The brown wheat mite also attacks barley and other small grain crops as well as wheat.

Blue oat mite

As its common name implies, this mite (*Penthaleus major* (Dugés)) is frequently recorded on oats, but wheat and barley are also suitable hosts. The life cycle of the blue oat mite involves the egg, immature and adult stages. As with the brown wheat mite, two separate types of eggs are laid, those with a short development period and those with a much longer (diapausing) development period. When first deposited, ovoid eggs are orange–pink, but later change to a straw colour. Both immature and adult stages feed directly on leaf tissue in a similar manner to the brown wheat mite. Adults are dark in colour, with red mouthparts and legs. High populations cause crops to become silvery in appearance, and if feeding is prolonged the plants may die. Since feeding occurs predominantly at night, the presence of greyish patches within the crop may initially indicate the presence of blue oat mite.

A characteristic of the blue oat mite is its preference for cool conditions. Under optimal conditions, the development time from oviposition to death is about 100 days, considerably longer than for the brown wheat mite.

Rotations are helpful in minimizing blue oat mite infestations but when a serious problem develops insecticide treatment is necessary. An assessment of blue oat mite

Insect and mite of winter

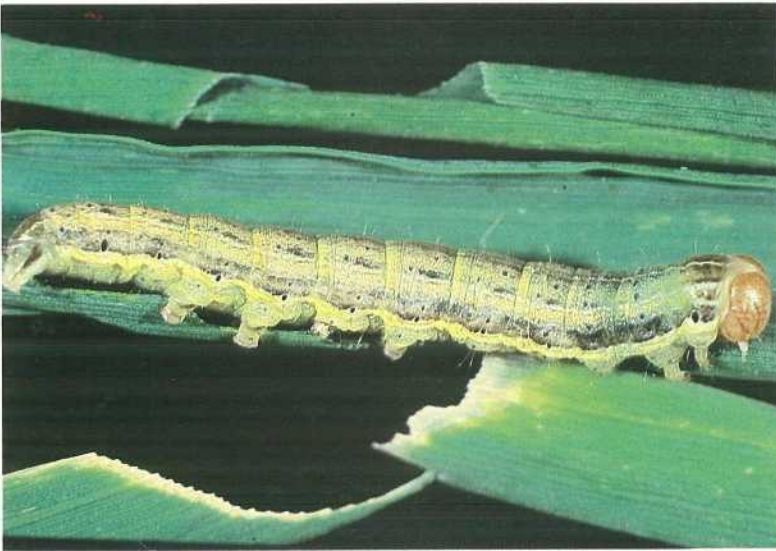


Plate 1. Common armyworm larva, *Pseudaletia convecta*, and its damage to wheat leaves.



Plate 2. Brown wheat mite, *Petrobia latens* (about 1.5 mm length) on wheat.



Plate 3. Blue oat mite, *Penthaleus major* (about 2 mm length) on wheat.

pests

cereals

Plate 4. Cutworm larvae, *Agrotis* spp. on soil.

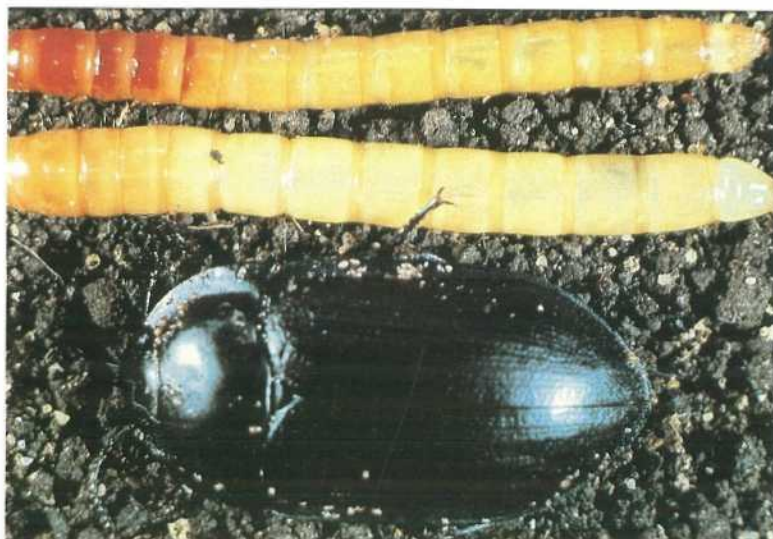


Plate 5. False wireworm, *Pterohelaeus darlingensis*, larvae and adult beetle on soil. Also known as the tortoise beetle.



Plate 6. Australian plague locust, *Chortoicetes terminifera*, adult female.

Table 1. Insecticide recommendations for control of pests of winter cereals

Pest	Pesticide	Rate of commercial preparation per hectare	Rate of active constituent	Withholding period (days) (harvest) (grazing)		Remarks and safety precautions
armyworms	chlorthrifos	700-900 mL of 500 g/L	350-450 g/ha	10	2	use lower rate where only small larvae are present
	chlorthrifos ULV }					
	trichlorfon	900 mL of 600 g/L	540 g/ha	14	2	do not dilute ULV products with water
	maldison ULV	700 mL of 1 180 g/L	826 g/ha	3	1	
blue oat mite	methidathion	90 mL of 400 g/L	36 g/ha	42	7	
	chlorthrifos	70 mL of 500 g/L	35 g/ha	10	2	
	azinphos-ethyl	90 mL of 400 g/L	36 g/ha	14	14	
brown wheat mite	dimethoate	90 mL of 400 g/L	36 g/ha	28	7	
cutworms	chlorthrifos	900 mL of 500 g/L	450 g/ha	10	2 }	spray late afternoon
	trichlorfon	900 mL of 600 g/L	540 g/ha	14	2 }	
false wireworms	chlorthrifos 25W	160 g of 250 g/L w.p./ 100 kg of seed	40 g/100 kg of seed	not required		use as seed treatment at planting, use rubber gloves when mixing
locusts (Recommendations for Aust. Plague locust listed)	carbaryl	1.2-1.4 L of 500 g/L	600-700 g/ha	3	1	use lower rate on smaller nymphs
	diazinon	700 mL of 800 g/L	560 g/ha	14	2	
	chlorthrifos ULV	560 mL of 500 g/L	280 g/ha	10	2	
	diazinon ULV	550-700 mL of 980 g/L	539-700 g/ha	14	2	
	fentothion	325 mL of 1 000 g/L	325 g/ha	14	7	
	maldison ULV	550-700 mL of 1 180 g/L	650-826 g/ha	3	1	

infestation prior to an insecticide application must take into account that the mites fall to the ground when disturbed, and also that they often secrete themselves at the base of plants during the warmer part of the day.

Cutworms

Cutworms (*Agrotis* spp.), the soft bodied larvae of a night flying moth, live in the soil by day, emerging at dusk to feed. Seedlings are most susceptible to cutworm damage, and larger larvae may sever young seedlings at ground level. Such seedlings are then partially dragged below the soil surface, where feeding continues.

The life cycle of the cutworm involves egg, larval, pupal and adult stages. Dark bodied moths deposit most of their white sub-globular eggs on low growing, winter-annual

weeds and among organic debris on the soil surface. Young larvae hatch from the eggs and feed on plant tissues. They are brown to grey, while older larvae vary from light grey to black, with a lighter stripe down the abdomen. Fully developed larvae measure up to 50 mm in length and characteristically curl up when disturbed. The red-brown pupa from which the adult moth emerges is formed in the soil.

Good agronomic practices which reduce the number of weeds found in paddocks prior to planting will also reduce the probability of cutworm attack. However, if cutworms are present they may be controlled by insecticide, preferably applied in the late afternoon before larvae commence feeding. Early signs of cutworm activity may be the disappearance of seedlings, often in patches. With continued pest feeding, these affected areas expand in size, and may coalesce with one another.

False wireworms

False wireworms (*Pterohelaeus darlingensis* (Carter) and other species) are sporadic pests of seedling stands of winter cereals, and their damage can on occasion warrant crop replanting. They are readily identifiable because of their soil dwelling habits, their characteristic elongated cream-brown bodies and their tough leathery skins. Several species are found in southern Queensland, the largest growing to 50 mm. Adult false wireworms are dull, inconspicuous beetles.

False wireworms, the larvae of Tenebrionid beetles, should not be confused with the less common 'true wireworm' which are larvae of click beetles. The former tend to be more abundant in soil with large amounts of crop residues or stubbles.

Pre-planting inspections or soil sampling is advisable, particularly in areas which have a history of false wireworm problems. Where an infestation is detected a seed treatment at planting will minimize losses. Presently there is no recommendation available to give control of larvae after plants are established. To minimize the probability of false wireworm damage every effort should be made to ensure optimal germination and growth of young seedlings.

Aphids and thrips

High populations of aphids (*Rhopalosiphum padi* (Linnaeus) and other species) and thrips (*Thrips tabaci* (Lindeman)) sometimes cause concern, but their feeding rarely causes damage and chemical control measures are therefore unnecessary. Thrips are found in the flowering heads or on developing grain, while aphids are more likely to be found at the base of the plant, on leaves or on roots beneath the soil surface.

Locusts

Locusts (*Chortoicetes terminifera* (Walker) and other species) and grasshoppers occasionally invade winter cereals in very large numbers. An insecticide application under such circumstances is essential.

Table 2. Spray decision making for control of head cutting armyworms in Clipper barley

Estimated price per tonne (\$)	Total insecticide and application costs/ha (\$)	Spraying economically justified if anticipated head loss/m ² exceeds *
100	5	5.7
	10	11.4
	15	17.0
110	5	5.2
	10	10.3
	15	15.5
120	5	4.7
	10	9.5
	15	14.2
130	5	4.4
	10	8.7
	15	13.1

* Based on average grain weight per head of 0.88 g.

Dip construction and management

J. F. Kearnan, Veterinary Services Branch, T. McEwan, Biochemistry Branch, and T. J. Reid, Veterinary Services Branch

A dip is the least mobile and most expensive feature of a cattle yard. It therefore demands the utmost care in planning, construction and use.

One of the practical problems in using chemicals to control the cattle tick is their application to the tick. When plunge or spray dips are used for this purpose, the design and construction of the dips are of prime importance in the achievement of efficiency control. In this article, the discussion will include the design, construction and management of plunge and spray dips and will briefly consider the impact of these dips on the environment.

Plunge dips

Plunge dipping is the most expeditious, convenient, efficient and practical method of controlling the cattle tick. However, many of the advantages of plunge dipping can be lost if adequate attention is not paid to selection of a site, to design and management factors, and actual construction of the vat.

The site

The site selected for a plunge dip should meet the following requirements:

- 1 There should be firm, level ground preferably with a slight slope which can be used to give a natural fall from the draining pen. A light soil on uniformly sloping ground is very suitable as it allows for easy disposal of waste and rain water.
- 2 The approaches must be on hard ground as usually the surrounding vegetation will be destroyed, leading to soil erosion.
- 3 The soil must not be too permeable (sand or silt), nor must it be too rocky.
- 4 It must be as near as possible to the centre of the property to avoid long droving to and fro.
- 5 It must be near abundant water (river, creek, bore, dam, well), but not so close as to run the risk of flooding. The vat must never be sited in a place that involves cattle swimming to or from dipping. Any land featuring natural depressions causing drainage difficulties or land subject to flooding is unsuitable.

Design

A plunge dip consists of an approach, a vat and a draining area. The dipping vat is laid out so that cattle enter and leave it on the uphill plane.

Crush and approach

The crush or race from the forcing and receiving yards to the dipping vat can be up to 12m (12 yards) long and no greater than 68 cm (2ft 3in) wide. It must be narrow to prevent animals from turning around in it. Strong posts approximately 25 cm (10in) in diameter are necessary at the beginning and end of the race.

It is preferable to install two sliding gates in the crush, one at the point of entry and the other immediately at the approach proper. A concrete block 30 cm (12in) high across the width of the crush at the slide gate near the jump-in helps to prevent pollution by stopping dirt being dragged into the dip. It causes stock to step over it.

A footbath or a grid mesh or both is incorporated into the crush to clean the feet of cattle and reduce contamination of the dip. A footbath should be at least 3 m (3 yards) long and 20 cm (8in) deep with a corrugated bottom. It must be kept clean to be efficient. A more effective technique to combat pollution is to incorporate a panel of expanded metal (grid mesh) in the crush floor. 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.



The jump-in approach will vary in length from 1.4 to 2.0 m. It should be no longer as, once the slide gate is closed, stubborn cattle must not be given room to move backwards or forwards. The approach must also be level. Level jump-ins have been successful in overcoming the problem of dry heads. Cattle appear to lift their heads on sloping approaches and avoid complete immersion.

The jump-in projects 25 cm (10in) over the dipping vat. This projecting lip is very effective in reducing splash onto the approach and prevents heavy surge along the dip. The jump-in is 45 cm (18in) above water level. Five threads or grips 50 mm (3/16in) high by 65 mm (1/4in) wide, spaced 25 cm along the approach, provide a safe and positive take-off.

The vat

The vat is divided into two sections, a well and a ramp. A standard sized dip is described here.

The well or deep end is 4.5 m long so that the animal is forced to swim for a short distance to wet the



coat thoroughly. A sloping ramp meets the end of the vat. Stairs are built on the ramp to allow cattle an easy exit. The ramp rises at an angle of 20° and is 7.5 m long. The overall length of the vat is 11.5 m. A 15 cm (6in) ledge at the top of the ramp prevents foreign matter entering the dip directly from the draining pen. The dip is filled to a depth of 2 m.

There is a dead space under the point where the animals jump in. Not only dirt but chemicals accumulate here and the latter can only be redistributed by shovelling. To eliminate this space, it is recommended that the profile of the dip at this point be filled in with concrete. It is rounded off beginning 60 cm (24in) above the floor level and extending 60 cm (2ft) along the floor in the direction of the exit.

The walls of dips usually taper outwards from the bottom so that the width is greater at the top. Widths are usually 61 cm (12in) at the bottom and 1.05 m at the top.

Splash walls

The height of the walls is usually greater than 1 m (about 3 ft) above ground level. They extend the entire length of the dip to avoid losses through splashing as the animals jump into the dip, and through shaking as they leave it. With the level jump-in, a large splash occurs in the middle of the dip so the splash wall height can be increased in this area.

Roof

Every dip should have a simple roof. This cover prevents dilution of the dipwash by rain water and checks evaporation. Hot, dry or windy weather can

remove 400 L a week from the dip. A flat roof 13 m long, 3.5 m wide and 2 m high will cover the dip and approach. A fall of 18 cm (7in) to one side can be allowed if water is required.

Capacity

Dips vary in capacity from 9 000 L for small herds to 18 000 L for large herds. A standard sized dip in Australia for herds of 500 cattle is 11 000 L. A dip with a greater capacity can handle more cattle before replenishment is required.

Draining area

The draining pen at the exit from the dip can be single or double according to the number of cattle regularly dipped. It is usual to allow 1.2 m² per head of mature cattle, that is 5 × 5 m will hold 20 head comfortably and up to 30 head if the animals pack up. The animals are confined long enough to allow all excess fluid to drain from their coats. The floor is concreted with a fall towards the vat.

As an alternative to a draining pen, a properly graded and sited draining race may be constructed. The race is curved and the end is open to allow cattle to proceed unhindered. The outlet is so sited that the cattle do not rush out of the open race. The first cattle leaving tend to stay in close to the outlet and restrain the others still in the race. The curvature of the race helps to slow the walk-out. Cattle proceeding unhindered to the exit do not foul the race. The race can be constructed of a roughly dished concrete floor graded to the dip, enclosed with galvanized pipes supporting 2.45 m × 0.92 m lengths of heavy gauge weldmesh panels. Normally a race is 20 m long.

Any fluid lost by the draining race is compensated for by greater efficiency of the wash and longer intervals between successive cleanings.

Sump

Provision is made to separate the larger particles of dirt, hair and vegetable matter from the dipping fluid as it returns from the draining pen to the dipping vat. The outlet from the draining pen leads into a sump or collecting tank which, in turn, has two outlets, either of which can be closed independently. One conducts the fluid back into the dip, being kept open while the dip is in use, while the other allows rain water to escape when the dip is idle.

A sump can effectively remove some of the active ingredient as the chemical in most modern dipping fluids is not dissolved in the water, but is in suspension as minute particles. These particles may settle during the passage of the returning fluid through the sump and are then lost when it is cleaned out. If the chemical lost is not replaced during topping up, the concentration of the fluid will be lowered. The significance of this effect increases with sump size.

Management

Management is directly concerned with maintaining an effective, and uniform, concentration of medicament in the dipping vat, and ensuring that cattle receive an adequate treatment with the fluid. In discussing management, it is essential to understand the meaning of the various terms used. In this section, we define terms as follows:

Charging is the initial mixing of a chemical with water at the manufacturer's recommended dilution rate to prepare a dipping fluid at a recommended concentration.

Acaricides are chemicals used to kill cattle ticks. Most modern acaricides will not dissolve in water and are formulated as concentrates, which allows them to be dispersed in water either as tiny droplets or as very small particles.

Replenishment is the addition of concentrate plus water, usually at a higher ratio than the charging rate to allow for stripping. This operation is also known as topping-up.

Stripping is the process whereby concentration of the acaricide in the fluid is reduced through loss of particles filtered from the dipping fluid by cattle hair.

Continuous replenishment is a new and improved technique. A side tank is filled at the replenishment rate and is allowed to run fresh fluid into the dip continuously during dipping to maintain a constant volume.

Reinforcement is the addition of concentrate to the dip without addition of water. This compensates for stripping and maintains a constant concentration as the dip volume is reduced. When reinforcement is carried out correctly, any additions of water should incorporate concentrate at the charging rate.

Capacity is the volume of fluid in the vat when it is filled to optimum working level. Dip capacity must be measured accurately and this volume marked on the vat permanently.



There are three methods of measurement but, whichever is used, the level of each 200 L of water must be marked on the side wall of the dip or on a measuring rod. The different methods are:

- 1 By water meter fitted to the dip's water supply (most accurate).
- 2 By measuring water into the vat from a tank of known capacity.
- 3 By mathematical calculation from the vat dimensions, as in the example.

If length at waterline is A cm, length at bottom of well is B cm, width at waterline is C cm, width at bottom of well is D cm and depth of water is E cm, then

$$\text{Volume} = \frac{(A + B)(C + D)E}{4 \times 1000} \text{ litres}$$

To maintain adequate control of a dipping vat, a manager must be aware of the factors which influence dip efficiency and of the properties of the acaricides used.

Efficiency

The efficiency of a cattle dip is affected by a number of factors which will be considered in sequence.

Concentration of acaricide is very important. At the correct concentration, control is good and cost reasonable. If the concentration becomes too high, expensive chemical is being wasted, problems from pesticide residues in the animal may arise and there may be a toxicity hazard. If the concentration is low, then control of the tick is likely to be lost, so that the labour of mustering and dipping the animals is partly wasted.

Concentration of the fluid can be altered by flooding during periods of heavy rain, by evaporation during hot weather, by leakage through poor construction as well as by stripping. In addition, poor sampling causes wrong analytical results and subsequent incorrect adjustments to the dip fluid concentration.

Excessive pollution adversely affects dip efficiency. Modern acaricides are less effective in dirty dips than in clean ones. In addition, pollutants such as dung, soil and hair increase stripping and so cause a rapid lowering of the acaricide concentration.

General fouling of the vat is reduced by appropriate design and maintenance of its approaches. Hair tends to float on the surface and should be skimmed off with a sieve before stirring the vat at commencement of dipping. Although some acaricide is removed with the hair, the overall efficiency of the vat is improved by hair removal.

Other debris is best removed following dipping. Allow the vat to stand for a short time (1–2 hours in most cases) and then remove sludge from the bottom with a long handled shovel or a back-hoe.

Stirring of the vat fluid is necessary to distribute the particles or droplets of acaricide uniformly through the fluid. Mechanical stirring, followed by 30 head of cattle dipped as stirrers and then re-dipped for treatment, is important whether a dip is freshly charged, replenished or standing idle. It is necessary to stir mechanically whenever large quantities of chemical are added, so that the concentrate is mixed uniformly. If this is not done, the top layer of fluid will be many times the recommended concentration and the first animals passing through could be poisoned.

Sampling and analysis are required to maintain dip concentration. The analytical result at best can only be as good as the sample. Samples must be taken:

- 1 After thoroughly stirring the vat.
- 2 While the last animal is moving through the vat.
- 3 At the jump-in end, 1 m (3ft) below the surface.
- 4 Using the sampling device.
- 5 Using a wide mouthed jar (*not dip concentrate containers*).

The sample must then be carefully labelled with owner's name and address, location of vat, acaricide in use, capacity of vat and volume of the fluid at time of sampling. Details of relevant dip history may also be included.

Three or four samples should be submitted during the dipping season. It is most important to obtain a sample before the dipping programme begins. When the analytical result is reported, advice is normally included to show the amount of concentrate which should be added to bring the fluid in the dip to correct strength. This advice may be checked by calculation.

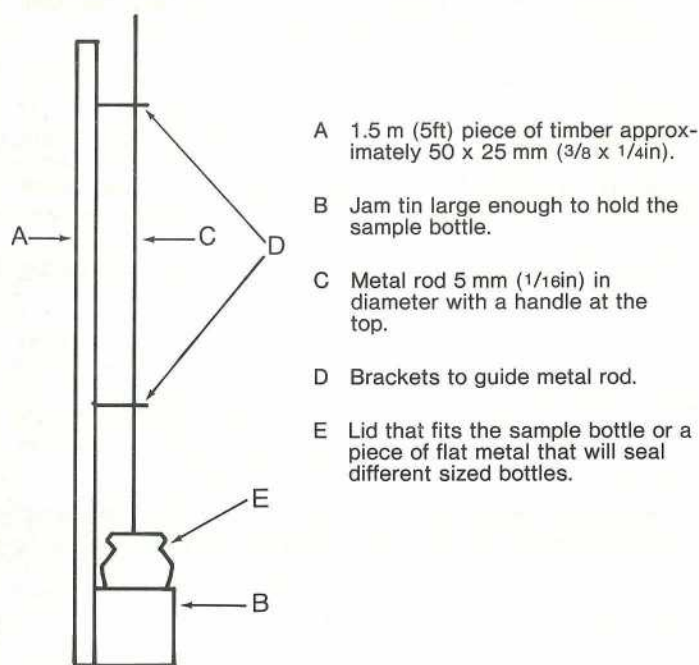


Figure 1. Dip sampling device.

If the concentrate is diluted at 1 : X L of water to give the recommended concentration, and Y L is the volume of the dip fluid at time of sampling, then the amount (A) in litres of concentrate required to bring the fluid to recommended concentration is given by

$$A = \left(\frac{\text{Recommended concentration} - \text{Analytical result}}{\text{Recommended concentration}} \right) \frac{Y}{X} \text{ litres}$$

This value, A L, is the amount required to bring the fluid in the vat to the recommended concentration; it is the reinforcement amount. If water is being added as well, extra concentrate should be provided at the charging rate for that amount of water.

As mentioned earlier, it is necessary to know accurately how much fluid is in the dipping vat. It is even more important to be able to measure accurately the correct amount of concentrate to be added. A suitable graduated container should be kept for this purpose. This measuring container should never be used for other purposes because dip concentrate is toxic. It must never be used for sampling the vat fluid because a very small residual amount of concentrate makes a large difference in the analytical result.

Records of dip history must be kept for management control and so that the concentration can be maintained at the correct level. A reasonable format for a dip record is shown in table 1.

Table 1. Possible format for recording dip use

Date	Dip volume at start of dipping (L)	Number of cattle dipped	Water added (L)	Concentrate added (L)	Analytical result (%)	Dip volume at end of dipping (L)
1.9.78	11 000	300	1 000	2.0	0.025	10 250
18.9.78	11 000	175	750	1.5	0.025	10 550
5.10.78	11 000	250	450	0.9	0.025	10 350

Correction for evaporation, flooding or leaking follows detection of these losses by examination of the dip record. The accepted method of making corrections is:

- 1 Record the level of the dipping fluid at the end of each dipping.
- 2 Before dipping, check the level and compare it with that at the end of the previous dipping.
- 3 If the level has fallen because of evaporation, add water only to bring it to the level at the completion of the previous dipping, unless otherwise recommended by the manufacture of the chemical.
- 4 If the level has risen because of flooding, siphon down to dipping level, stir, sample and adjust the concentration when the analytical result is received.

Old dips are particularly subject to leakage. Consistently low levels of fluid probably indicate leakage, with the need to empty the vat for repair or replacement.

Correction for stripping can be made accurately on the basis of regular analysis only. Topping up advice on concentrate containers provides an average compensation for stripping but individual vats can vary widely from the average. Correction can be by reinforcement, replenishment or continuous replenishment. Replenishment at frequent intervals is advisable to avoid wide variations of dipping strength. Frequent replenishment helps to control stripping because the stripping rate increases as the dipping volume decreases. It is recommended to replenish before the volume has declined by 1 500 L. Continuous replenishment has practical advantages over the older methods in that:

- 1 It reduces the adverse effects of stripping.
- 2 Fresh mixture increases efficiency.
- 3 It is safer for stock as optimum volume is maintained.
- 4 It is more economical.

Stock handling during plunge dipping must be undertaken with care. This applies particularly to very young calves. For best results with a minimum of stress to the animals, avoid over-handling the stock before and after dipping by:

- 1 Moving stock during the cool of the day.
- 2 Providing plenty of room for the mob, shade and time to cool off before dipping.
- 3 Not holding stock in yards for long periods.
- 4 Providing water and allowing the animals to drink before dipping.
- 5 Permitting young calves a clear swim through the dip before the next adult beast is allowed to enter. If necessary, draft off calves before dipping and treat them separately.

- 6 Keep atropine sulphate (the antidote for organic phosphate poisoning) on hand. The usual symptoms of poisoning are salivation with thin saliva, stiffness in walking or standing (more pronounced in the hindquarters), trembling of muscles, breathlessness (gasping with open mouth) and diarrhoea, sometimes bloodstained.

Dip concentrates are mixtures containing the acaricide plus agents to disperse it in water. Since most acaricides are not soluble correct mixing ensures formation of particles or droplets of the right size. Liquid chemicals are mixed by adding small quantities into 20 L of water and stirring briskly. This creates a fine emulsion which can be spread more easily over the dip. Powder chemicals are placed in small quantities into a container with enough water to make a thick paste. Mix with a stick and stir, adding more water until a mixture the consistency of thin cream is obtained. Then add it to the dip. Paste chemicals are melted on an open fire, stirring continuously. The liquid is then mixed directly into the dip.

No other materials should be added to the dipping fluid unless specifically required for the concentrate being used. In particular, wetting agents should not be added, because all tick killing preparations contain sufficient wetters in their formulation. Additional wetters in dips limit efficiency by reducing the amount

of chemical deposited on the hair. It is also possible that the added wetting agent could be antagonistic to the original concentrate, thus causing additional problems.

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.

Dip construction

A dip is the most immobile and expensive item in a cattle yard. It is essential that the total yard complex is designed before the dip is positioned and pegged out. The dip is the first section of the yard complex to be built because, if excavation difficulties arise, the dip position can still be changed.

The vat may be constructed of concrete, fibre glass, concrete bricks, steel or timber, but the most generally acceptable is of concrete. Making good concrete, reinforcing it and curing it are essential to construct such a vat and are discussed in detail. Plans for the vat are given. In the text, measurements are given in Imperial units with metric equivalents in brackets, while Imperial units only are used in the diagrams, figures 2 and 3.

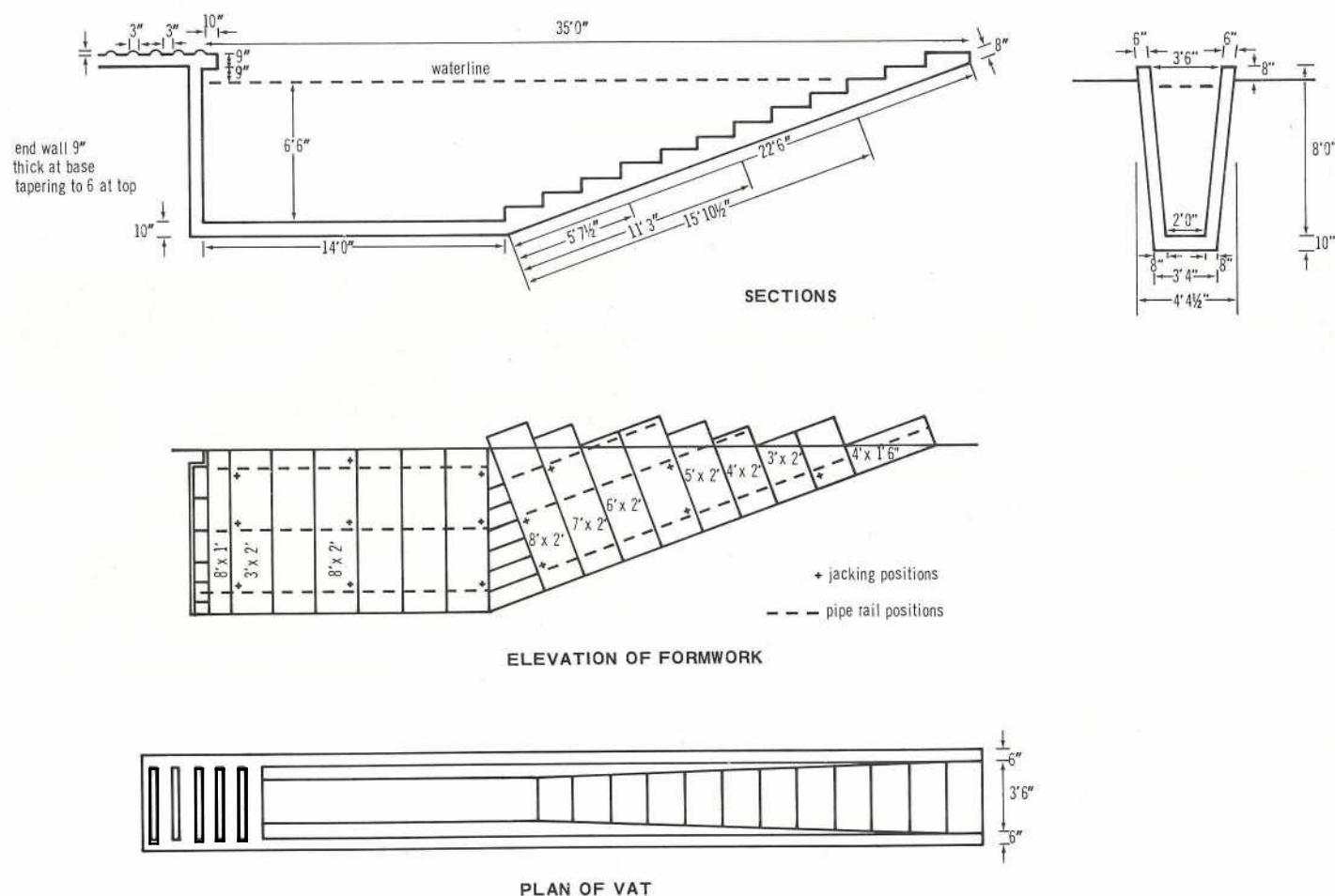


Figure 2. Plans of a plunge dip: sections, elevation of form work and plan.

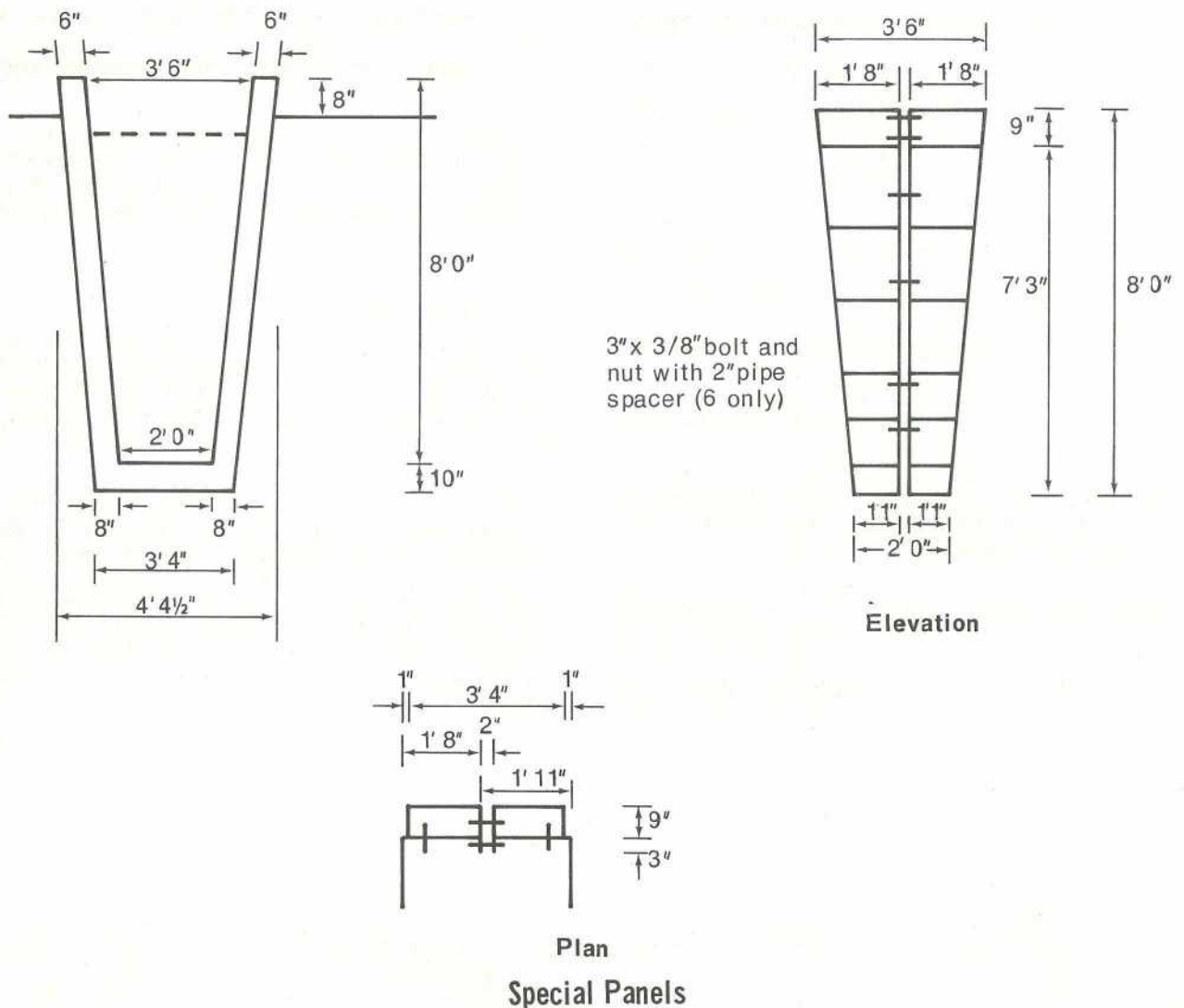


Figure 3. Plans of a plunge dip: elevation and plan of special panels.

The excavation

The success and the ease of construction largely depend on the accuracy and neatness of the excavation. Before digging, the hole is pegged out squarely. When it is completed, it is very important that the angle of the walk-out is correct and that the sides have an even taper. If the walk-out angle is not correct, it will be difficult to fit the walk-out mould sections into position. Care must be taken in digging a hole as deep as 8 ft (2.4 m) because there is always a threat of a cave-in. This threat is greater in some types of soil, but is increased always by rainfall, traffic around the edges and the length of time it has been dug. The hole is best dug just before construction.

Excavation specifications

A section 35 ft 9 in (10.89 m) long and 4 ft 6 in (1.38 m) wide is pegged out. The excavation is dug to a depth of 8 ft 2 in (2.49 m) at the jump-in end, while the sides taper in to 3 ft 6 in (1.06 m) at the bottom. This continues from the jump-in end for a length of 14 ft 9 in (4.49 m). At this point, the walk-out is tapered up to the 35 ft 9 in (10.89 m) peg and the batter on the wall is kept even. The use of a plumb bob will help to ensure correct wall taper. A top view of the dip is shown in figure 4. These specifications are for ideal conditions. The tendency for soil to fall in will marginally increase

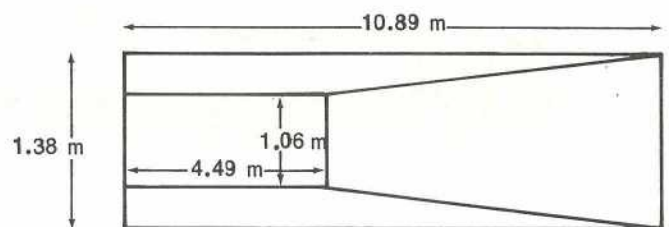


Figure 4. A top view of the dip.

the width in varying places. Double boxing is required if large sections of soil break away.

The profiles are set up to the height the dip is required above ground level, usually 8–12 in (20–30 cm). The profile pegs are set 2 m from the hole so that they are not disturbed and do not impede work around the excavation. String lines running between the pegs maintain the correct shape of the hole. A back-hoe is the most common machine used for excavation. The sides are trimmed manually.

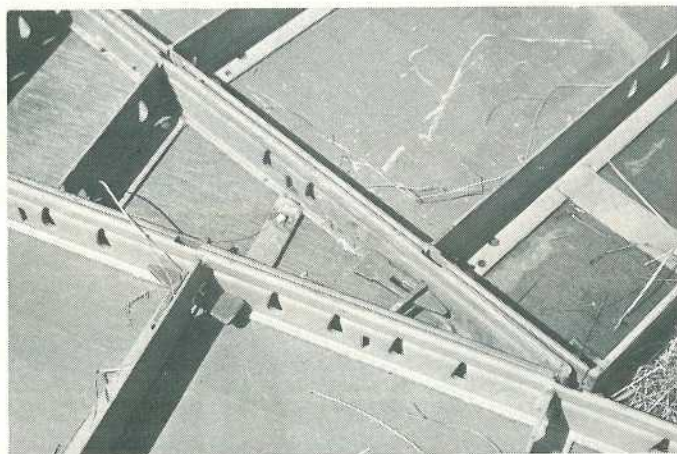
Dip moulds

Dip moulds create a formwork system which offers a more rational and flexible approach to building a concrete dip. The simplicity of the system allows a contractor to use semiskilled labour with a minimum of supervision so that construction is at high speed and low cost. Timber framework can be substituted for the moulds, but the cost of timber and increased time to erect it make this both expensive and wasteful of materials. The moulds are made up of the components described below.

The 'U' form panels. The 'U' form with all its strength and capabilities is lightweight, averaging only 6 lb per ft² (30 kg per m²). The working face is made up of 1/2 in (12 mm) resin bonded plywood. The plywood edges are fully protected against site damage by the special rolled perimeter section. The panel depth is 2 3/4 in (70 mm) and panel dimensions are given in table 2.

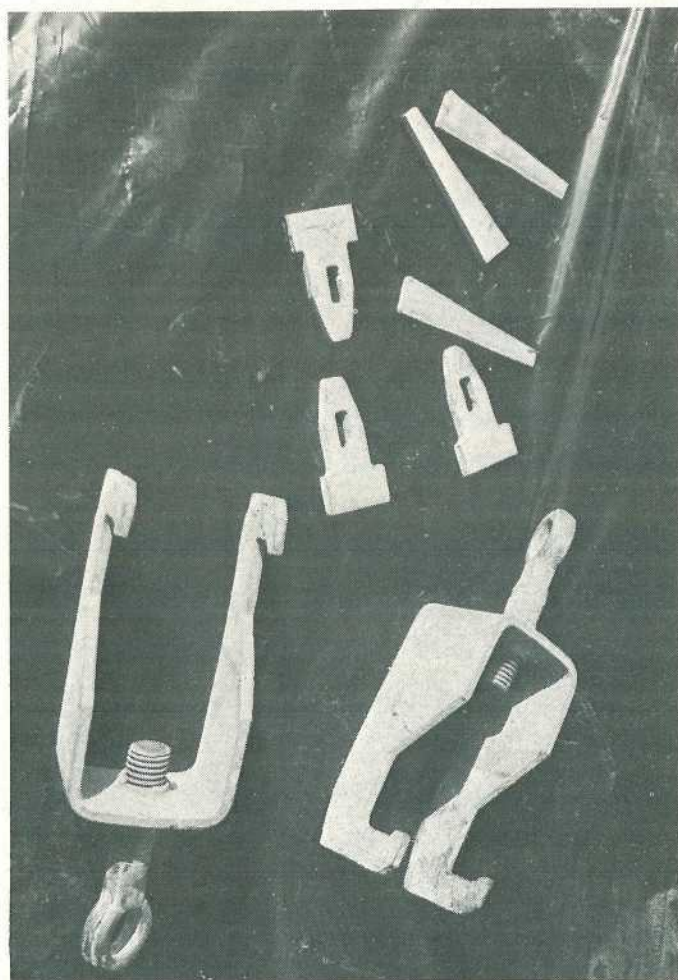
Table 2. Dimensions of U form panels

Number of panels	Length	Width
2	8ft (244 cm)	1ft (30 cm)
14	8ft (244 cm)	2ft (61 cm)
2	7ft (213 cm)	2ft (61 cm)
4	6ft (183 cm)	2ft (61 cm)
2	5ft (152 cm)	2ft (61 cm)
2	4ft (122 cm)	2ft (61 cm)
4	3ft (91 cm)	2ft (61 cm)
2	4ft (122 cm)	1ft 6in (45 cm)



There are also two triangular panels of 8ft × 7ft 6in × 2ft 9in (244 × 229 × 84 cm), and two special end panels 8ft long (244 cm), 1ft 8in (50 cm) wide at the top and 11in (27.5 cm) wide at the bottom.

Keys and wedges. These are easily handled and secure the panels in one operation, requiring only the use of a hammer. A key is placed between every rib of the panel and the next.



Clips. These single clips will connect the standard scaffold tube to the back of the 'U' form panel in the horizontal position. The pipe is clamped by the clips at every panel section. The pipe is aligned along the first, fourth and seventh ribs.



Jacks. The jacks are made of high tensile steel with damage resistant square threads and double arm nuts that withstand abuse on site. They are designed for ease and speed of erection, for stability and safety under load. They provide a quick, safe, reliable method of jacking with all steel trenching formwork. The high load capacity permits maximum spacing. There are no loose parts and the jacks are simple to set by one man. Special linking devices ensure that the thread remains captive in the outer barrel and cannot drop out.

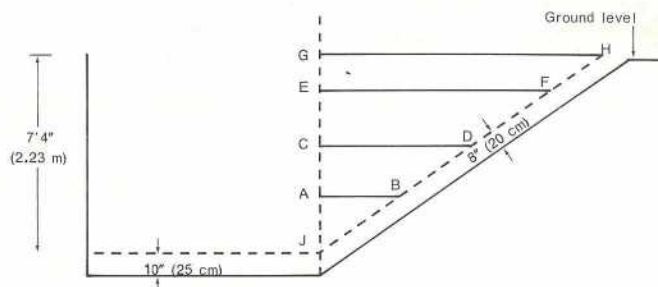


Figure 5. Pegging out a concrete area.



The correct oil for formwork should be purchased. When the oil is applied as directed, it provides quick, easy release. Application as a thin coating to formwork before pouring ensures clean stripping, no sticking or concrete build-up. This means minimum cleaning down, with forms ready for instant re-use. The oil ensures a better, smoother, stain free concrete surface, free of air and moisture voids. No residues of oil are left and the oil does not adversely react with the concrete.

Pegging the proposed concrete surface

Form work protrudes 8 in (20 cm) above ground level. The slope of the walk-out can be checked by measuring the distances marked on figure 5. These should be: A-B 5 ft 3 in (1.60 m); C-D 10 ft 6 in (3.20 m); E-F 15 ft 9 in (4.80 m); and G-H 21 ft (6.40 m). Distances J-A, A-C and C-E are 2 ft (0.61 m).

The use of the polythene shroud

Independent of the soil type, it is a safe precaution to use a polythene shroud to prevent any soil falling onto the base or into the wall space during pouring. Even when using extreme caution, there is still a likelihood of some soil falling into the newly placed concrete. This creates air voids, thus causing a dip to leak.

Polythene sheeting (0.006) is used with an overlap of 6in (15 cm) per sheet with about 3ft (1 m) projecting from each side of the excavation. The sheeting is laid across the excavation, 150ft (50 m) of 6ft (2 m) wide polythene being sufficient. This is the ordinary polythene used for building application and should be available from local builder's suppliers.

Reinforcing steel fabric schedule

The quantity and size of reinforcing steel and mesh required for the dip are listed in table 3 and it is bent or cut to the shape quoted. Bars are $\frac{5}{8}$ in (15 mm) in diameter for sections A-F, $\frac{1}{2}$ in (12 mm) for section G, and $\frac{3}{8}$ in (9 mm) for section H. Shapes of rods, with dimensions marked as small letters, are given in figure 6.

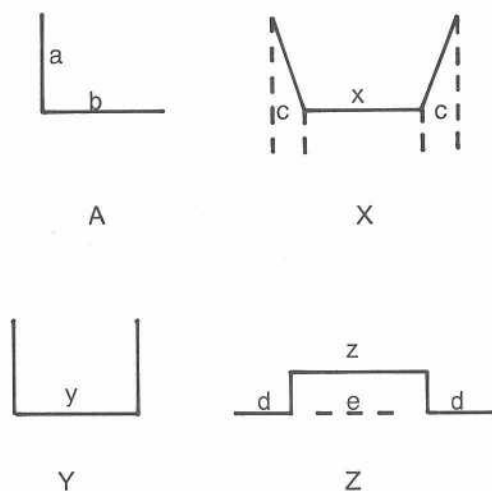


Figure 6. Shapes of reinforcing rods.

Table 3. Quantity and size of reinforcing steel and mesh

Section	Number	Shape	Overall length (mm)	Dimensions (mm)
A	22	X	2 360	x= 900
B	7	X	2 510	x=1 050
C	7	X	2 660	c= 50 x=1 200
D	3	A	1 650	c= 50 a= 900 b= 750
E	3	straight	2 330	y= 900
F	1	Y	3 240	y= 940
	1	Y	3 280	y= 970
	1	Y	3 310	y=1 010
	1	Y	3 350	y=1 050
	1	Y	3 390	y=1 090
	1	Y	3 430	y=1 120
	1	Y	3 460	y=1 160
	1	Y	3 500	y=1 200
	1	Y	3 540	
G	8	straight	6 000	z= 500
H	24	Z	1 120	d= 200 e= 110

Reinforcing mesh is placed in the walls as noted in the marking plan, figure 7. Two pieces of each section, one for each side of the vat, are required. These are

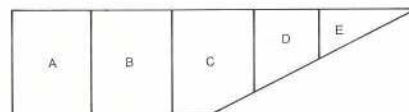


Figure 7. A plan for the reinforcing mesh.

obtained by cutting four sheets of F304 mesh, 6 × 2.4 m, into the shapes shown in figure 8. One hundred bar chairs of 10 cm (4in) each and 2 000 tie wires of 15 cm (6in) length are also required.

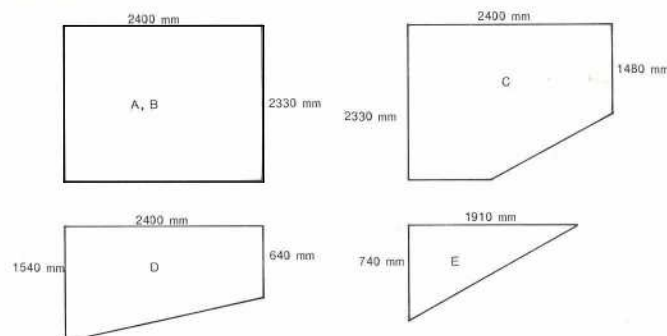
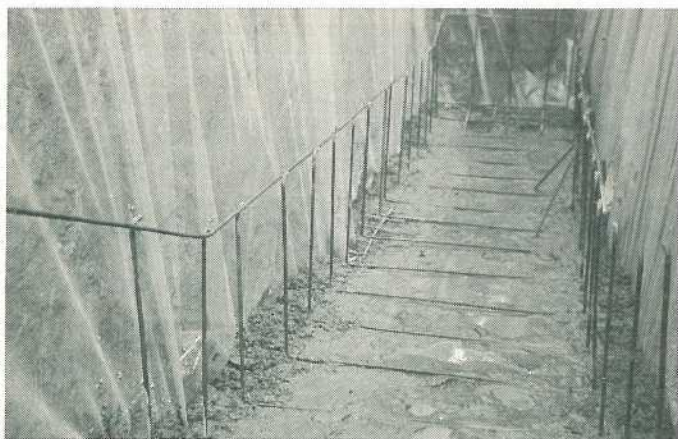


Figure 8. Dimensions of the reinforcing mesh.

Floor construction

After laying the polythene shroud, the floor or base reinforcing steel can be fixed into position. The floor reinforcing is made up of steel rods only. All rods and mesh are tied together using the supplied 15 cm (6in) tie wires and a wire tying tool. Rods listed A, B, C, D, G and H in the fabric schedule, table 3, are used in the floor. Follow the sequence below.

- 1 Wire the bar chairs at equal spacing to the 8 rods labelled G, at ground level. There are 12 or 13 to each rod. The bar chairs serve to keep the rods in the correct position above the ground and therefore in the concrete when it is poured.
- 2 Four G rods are placed on their chairs at approximately equal spacing across the width of the well and the remaining four similarly on the walk-out. The well rods continue up the walk-out for about 2 m so they must be suitably bent at the walk-out junction. The rods are kept 7 cm from the jump-in wall, and 8 cm from the side walls.
- 3 The cross steel A, B and C is tied across the G rods at 30 cm (12in) spacing beginning from the jump-in end with A rods, and then B and C. Three different sizes are necessary since the walk-out becomes wider as it nears the top. If there is difficulty in making the cross rods fit, they can be tied at an angle to ensure an even line.
- 4 At the jump-in end, tie the three L-shaped D rods into position at equal spacing between the uprights of the first A rod. One arm of the L-shape is in the vertical position at the jump-in wall leaving the other arm horizontal along the floor.
- 5 The step reinforcement, H, is fixed by tying two H rods across the G rods for every step. The H rods are placed at the approximate centre of each step. The first step is centred 11in (28 cm) from the junction of the well and walk-out, with the remaining steps 1ft 10½in (58 cm) from the first centre.



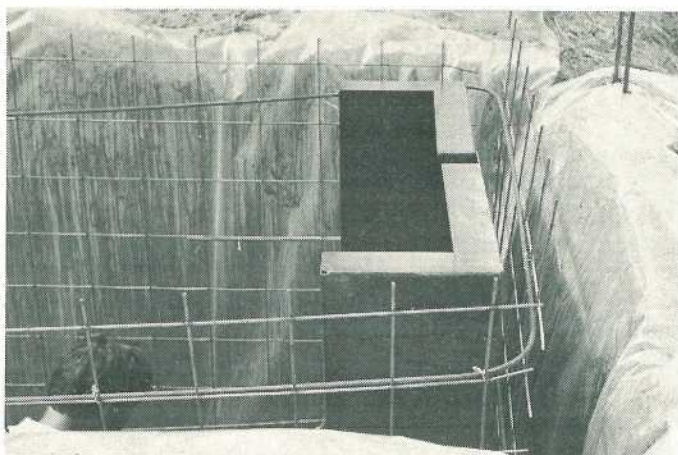
- 6 The floor is poured. The thickness of concrete is 10in (25 cm) on the base tapering to 8in (20 cm) at the end of the walk-out. The concrete mix should be fairly dry on the walk-out slope to prevent 'creep'. The step reinforcement will protrude 10 cm (4in) above the floor surface after pouring. (Steps are completed after the moulds are removed.) While the concrete is wet, form a key in the floor. This is done by pushing a 3 × 2in (8 × 5 cm) timber into the wet concrete along the length of the dip where the walls will meet the floor. It is only to ensure a firm joint when the walls are poured. The timber is removed before the concrete sets.



Wall construction

The vertical reinforcement remaining to be fitted consists of the rods labelled E and F and the pre-cut mesh. One E rod is tied vertically to each D rod at the jump-in end.

Starting 5 cm (2in) above floor level, the F rods are tied at even spacing up the jump-in wall. The base 'Y' is parallel to the jump-in wall and the arms extend parallel to the dip walls in the direction of the walk-out. The base is tied to the uprights of the first A rods and D rods, where available, and to the E rods. The arms are tied to section A of the mesh. The mesh is tied to the upright of A, B and C rods in accordance with the marking plan. The mesh will overlap.



Placing the dip moulds into position

Moulds are first oiled with form oil. The moulds are placed into position according to the plan, figure 2. The two large end moulds are positioned first at the jump-in end and bolted together with short spacer pipes and 3 × 3/8in (8 × 1 cm) bolts. This end mould fixes the dip width at top and bottom. The distance between the outside edge of this mould and the well/walk-out join is 14ft (4.25 m). The 8 × 1ft mould is bolted to the end piece and then the remaining moulds in this order: six 8 × 2ft, the special triangular mould, one 8 × 2ft, one 7 × 2ft, two 6 × 2ft, one 5 × 2ft, one 4 × 2ft, two 3 × 2ft, and one 4 × 1 1/2ft lying down on its length.



The mould's panels are joined by key-wedges placed at about 1ft (30 cm) intervals on each of the joined panels.

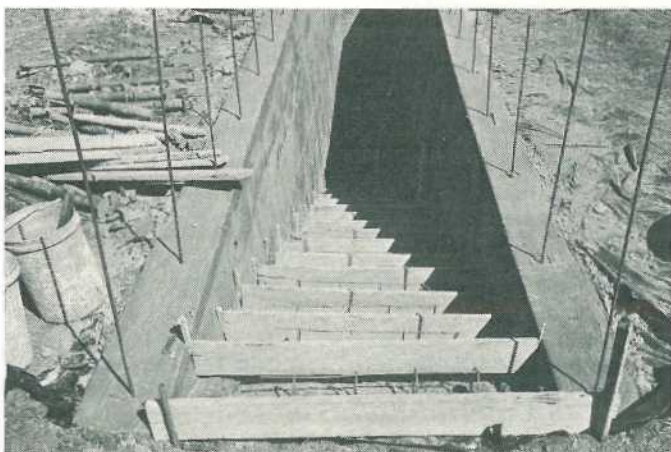
Piping rail or scaffolding pipe is attached to each mould panel section by special clamps. The dotted line in figure 2 indicates this position on the plan. There are twelve pipes, six for the well and six for the walk-out section.

Trench props or jacks are fitted across the dip between the scaffolding tubes at the points on the plan marked with a cross, see figure 2. There are fifteen. The jacks are adjustable and prevent inward movement of the moulds when the walls are being poured. Before the jacks are fitted, spreaders are used to keep the tops of the moulds at the correct distance apart. External formwork will be needed for the outside face on that portion of the dip protruding above the ground for the full length, as well as at the start of the crush and the approach.



Pouring the walls

To secure a good join between floor and walls, pour a cement and water slurry between the moulds and the polythene. The sides are then poured. As the moulds are flexible, it is essential to pour evenly around the walls or the moulds will move and cause distortions. The concrete is vibrated or tamped as it is poured. This mix is wetter than the base mix. Provision is also made for the draining pen, sump and crush, and bolts are set in the top of the concrete walls to allow for a base for the splash walls. The moulds can be removed within 24 hours.



Making the steps

The steps are completed merely by boarding across the base and filling with concrete. The reinforcement left protruding above floor level should be completely covered.

Roof, draining pen, sump and crush

The dip accessories can be completed according to yard plan. All concrete should be cured.



Concrete construction and reinforcement

Making good concrete

Concrete is made by binding together particles of stone, crushed rock or other substances, known collectively as aggregate, with a paste of cement and water. The aggregate in concrete generally consists of sand (fine aggregate) and crushed rock or natural gravel larger in size than $\frac{3}{16}$ in (4 mm) (coarse aggregate).

During mixing, the cement and water form a paste which should coat the surface of every piece of aggregate and fill the spaces between the coarse particles. When mixed, placed in position and compacted, concrete should consist of a solid mass in which every aggregate particle is coated with cement paste and which should be free of large voids or spaces.

When cement and water are mixed together a chemical reaction, known as hydration, occurs. This causes the cement paste to act as a glue and harden, thus binding the aggregate particles together. The quality of concrete depends largely on the binding qualities of the cement paste. Like most glues, the paste will be weak if it is too diluted with water.

The quality of concrete can be varied by altering the amount of water added to each bag of cement. As the proportion of water to cement (water:cement ratio) is reduced, the strength of the cement paste, and so of the concrete also, is increased.

Concrete materials

In Australia, three types of Portland cement are commonly manufactured, but normal Portland cement is used in the majority of structures.

Water for use in concrete should not contain excessive amounts of salts, dissolved organic matter or other impurities which will interfere with the hydration of the cement. Water fit to drink is the most satisfactory. Salty water should not be used since it promotes corrosion of the reinforcement.

Aggregates for concrete should consist of clean, hard, durable particles, strong enough to withstand the loads to be imposed. In general, they should consist of either natural sands or gravels or crushed rocks, although some manufactured aggregates such as blast furnace slag, or expanded shales and clays, can be equally satisfactory. Commonly used crushed rocks include basalts, diorites, dolerites, granites, quartzites and the

harder varieties of limestone. Materials generally unsatisfactory include slates, shales and soft sandstones. Concrete aggregates should be:

- 1 Strong and hard to produce concrete of the required compressive strength and to resist abrasion or wear.
- 2 Durable to withstand action of the weather and cycles of wetting and drying.
- 3 Chemically inert so that they do not react with the cement and cause deterioration of the concrete.
- 4 Clean or free from impurities. Organic matter inhibits setting and hardening; excessive silt and clay weaken the concrete; pieces of wood or coal weaken and cause surface blemishes; soft particles break down when exposed to the weather; and excessive clay or other weak material loosens the bond between the aggregate and the cement paste.

Graded aggregates produce more workable concretes which are less prone to segregation and bleeding. A good aggregate should be either rounded or roughly cubical in shape. Flaky and elongated particulars are best avoided and should be limited to less than 10%.

Batching and mixing

Before the dry materials are delivered to the site, select a flat area as close to the work as possible where they may be deposited. Clean away all rubbish, loose materials and debris so that the sand and aggregate do not become contaminated. It is a good idea to deposit the sand and coarse aggregate on sheets of iron so that the bottom layer is not wasted.

Arrange the materials in heaps so that they are convenient to the mixer and ensure that ample water and containers in which to measure it are available. All materials should be measured accurately (*not* by the shovelful) to ensure uniformity. Concrete is best mixed in a power mixer, its size depending on the scope of the job and the manpower available.

Concrete should be placed in position and compacted as soon as possible after it has been mixed, at the most half an hour, so it is undesirable to mix too large a quantity at the one time. In placing the materials in the mixer it is a good idea to add the coarse aggregate and a little of the water first to clean the drum of any concrete which may be clinging to it. The sand, cement and the remainder of the water may then be added.

Placing the concrete

As soon as the materials are properly mixed, placing should begin without delay to be completed within half an hour. If a longer time passes, the concrete will begin to stiffen and become difficult to place and compact. As far as possible, concrete should be placed in one operation and succeeding batches poured one against the other before hardening starts. Each batch of concrete should be well rodded to compact it and weld it with the preceding batch. When it is not possible to place all the concrete in one operation a construction joint should be made between the partially hardened and the fresh concrete.

Finishing the concrete

After the concrete has been poured into position, it should be screeded or struck off with a straight edge (a piece of 4 x 2 in (10 x 5 cm) timber will do), by using alternately a chopping and then a sawing action to move excess concrete to one end of the forms. Low spots in the surface should be filled in and re-tamped.

Further finishing should then be delayed until the water sheen has disappeared from the surface and the concrete has begun to harden. Premature finishing brings cement and sand to the surface and makes it less resistant to abrasion. When the water sheen has disappeared, about 1 or 2 hours after placing, the concrete surface should be floated with a wooden float to produce an even gritty finish. On areas which may become slippery in wet weather or which livestock have to use, a wood float finish is all that is required. Where a very smooth finish is required, a steel trowel is better.

Reinforced concrete

Good concrete is very strong in compression, that is it will resist forces or loads which tend to crush it. However, it is hard and somewhat brittle and under some circumstances will tend to crack. This is particularly the case when the load placed upon it bends or stretches it. When concrete is subjected to bending or stretching, it may be necessary to strengthen it by embedding steel in it. When strengthened in this manner, it is known as reinforced concrete. It is essential that the right amount of steel be used and that it is placed in the correct position in the concrete mass.

Reinforced concrete is designed to combine concrete and steel into one structural entity, in such a manner as to use to the best advantage the characteristics of each material. Concrete is plastic and mouldable when fresh and, once hardened, has a high compressive strength, a low tensile strength and a high resistance to fire. It is inexpensive. Steel can be made into rods and mesh suitable for embedding in concrete. Steel has both high compressive and tensile strength, but a relatively low resistance to damage by fire and is expensive.

The aim of reinforced concrete design is to combine steel reinforcement with concrete in such a manner that just enough of the expensive steel is used to resist tension forces and excess shear forces, while the comparatively inexpensive concrete is used to resist compressive forces. Steel and concrete combine successfully because of the following factors:

- 1 Upon hardening, concrete bonds firmly to steel reinforcement so that the two act as though they are one when a load is applied. This means that any tendency for the concrete to stretch and crack in a region of tensile stress can be directly counteracted by steel rods embedded in that area.
- 2 When subjected to changes of temperatures, concrete and steel expand or contract equally. If this were not so, they would separate because of differential expansion and no longer act as one material. In this case, the lack of bond between concrete and steel would prevent tensile stresses in the concrete being transferred to the steel reinforcement and the concrete would crack and collapse.
- 3 Concrete, having a high resistance to damage by fire, protects the steel reinforcement embedded in it, preventing it from buckling and twisting at high temperatures.

The design of reinforced concrete

The designer of a structure examines how it bends under the design load. He determines where tensile stresses and excessive shear stresses occur, and places sufficient steel reinforcement there to counteract them. In the construction of concrete cattle dips, steel reinforcement should be placed as close as possible to the centre of the concrete mass.

Bond and anchorage

The effectiveness of reinforced concrete depends upon an adequate bond developing between the concrete and steel reinforcement, to transfer stresses from the concrete to the steel. Good bond can be achieved by thoroughly compacting concrete around clean reinforcing bars and mesh. Higher strength concretes generally have a better bond to steel.

Reinforcing steel

Various types of reinforcing steel—plain bars, round or square and welded fabric—are used for dip construction.

Accepting delivery

Before accepting a supply of reinforcing steel on a job, it should be checked for:

- 1 Correct type, size and quantity.
- 2 Damage to reinforcement by bending.
- 3 Heavy rusting which can be loosened with a hard brush.

Cleaning reinforcements

Reinforcing steel must be free from loose rust, scale, mud, mould, oil, paint and any other debris. A wire brush or sand blasting may sometimes be needed to remove such materials. If the use of rusted steel is being considered, the following points should be kept in mind:

- 1 Loose, flaky or soft rust will prevent the concrete bonding to the steel reinforcement and must be removed.
- 2 Heavy corrosion reduces the effective size of the reinforcement. Extreme cases should be referred to an expert for a decision regarding their use.
- 3 Rust which cannot be removed by the normal means or which merely causes pitting of the reinforcement's surface is generally considered to have no adverse effect. As the quantity of reinforcement used in dip construction is not great it is recommended that only new material be used.

Stacking reinforcement for storage

Stacked reinforcing steel must be protected from rain, mud, oil, paint or any material which would foul the surface. It should be stored conveniently, according to size and length.

Bending reinforcement

Bar bending requires experience and skill besides efficient bending machines. Bars should be bent cold wherever practicable, with a slow and regular movement so as not to cause a fracture. Bars which depend for their strength on cold working, twisted bars for example, should never be heated. When bending hot bars, a cherry red head (not exceeding 155°F) should be used. Bars bent hot should not be cooled by quenching. Bars must be bent accurately to the dimensions shown on the bending schedule, table 3.

Fixing reinforcement

Reinforcement must be securely fixed in the formwork so that the bars are not displaced either by workmen walking over it, or during the placing of concrete. To ensure the correct cover to reinforcement, spacers can be used to hold the reinforcing steel a fixed distance from the forms. The specified concrete cover is essential in order to protect the reinforcement from either rusting or chemical attack.

Where reinforcing rods cross or where there is a lapped space, the rods should be tied together with soft iron wire, 16 or 18 gauge being suitable. Welding, including 'tack' welding for fixing purposes, must not be used with hard grades of reinforcing steel. Welding of other grades should be done only after consulting an expert.

Curing concrete

The desirable properties of concrete are improved by curing. These properties, namely strength, watertightness, wear resistance and volume stability, improve with age as long as conditions are favourable for continued hydration of the cement. Two conditions are required: the presence of moisture and a favourable temperature.

Water must be present to hydrate the cement. Evaporation of water from newly placed concrete can cause the cement hydration process to stop too early. This weakens the concrete, makes it less watertight and abrasion resistant, and surface cracking could result.

Hydration proceeds at a much slower rate at low temperatures; there is practically no chemical action between cement and water near or below freezing point. It follows that concrete should be protected so that moisture is not lost during the early hardening period and concrete should be kept at a temperature favourable for hydration.

The moulds should be removed as soon as possible after the completion of construction and one of the curing methods described below started without delay.

Ponding

The dip can be filled with water. As well as preventing loss of moisture from the concrete, this is also effective in maintaining it at a uniform temperature. The top exposed concrete surfaces must also be covered with a wet covering.

Wet coverings

Wet coverings such as hessian or other moisture retaining fabrics are extensively used for curing. They should be placed as soon as the moulds are removed, that is 24 to 48 hours after completion of construction. Care should be taken to cover the entire surface including the top surface of the wall above ground level. The coverings must be kept continuously moist so that a film of water remains on the concrete throughout the curing period.

Waterproof paper or plastic sheets

Curing paper assures suitable hydration of cement by preventing loss of moisture from the concrete. It seals the surface. The widest practical width paper should be used, and edges of adjacent sheets should be overlapped and tightly sealed with tape. One important advantage of this method is that periodic additions of water are not required.

Length of curing period

Since all desirable properties of concrete are improved by curing, the curing period should always be as long as practicable. Ideally, the concrete in a plunge dip should be kept moist for at least 7 days and in hot, dry weather curing for this period is advisable. In cooler weather, moist curing may be abandoned after 4 or 5 days.

Prevention of shrinkage cracking

Cracking sometimes occurs in the surface of fresh concrete soon after it has been placed, usually in very hot weather. It can happen whenever circumstances aid rapid evaporation of moisture from the concrete surface. Such cracks appear when evaporation exceeds the rate at which 'bleed' water rises to the surface of the concrete. The following conditions increase evaporation of surface moisture and the possibility of plastic shrinkage cracking:

- 1 High concrete temperature.
- 2 High air temperature.
- 3 Low humidity.
- 4 High winds.

The precautions listed minimize the possibility of this type of cracking:

- 1 Dampen the subgrade and forms.
- 2 Dampen the aggregates if they are dry and absorptive.
- 3 Erect windbreaks to reduce wind velocity over the concrete.
- 4 Build sunshades to reduce concrete surface temperature.
- 5 Lower the fresh concrete temperature during hot weather by using cool aggregates and mixing water.
- 6 Avoid overheating the fresh concrete during cold weather.
- 7 Protect the concrete with temporary wet coverings during any appreciable delay between placing and finishing.
- 8 Reduce time between placing and start of curing by improved construction procedures.
- 9 Protect the concrete during the first few hours after placing and finishing to minimize evaporation.
- 10 Keep concrete surfaces damp by spraying water with a fog spray nozzle.

These precautions are most important if checking and cracking are to be prevented.

Fibreglass dip construction

Materials and labour for dip construction can make a dipping vat an expensive proposition. A precast fibreglass vat can be constructed with considerable cost savings. A Brisbane firm (Fontana Products, Banyo) have built a fibreglass dip which has been installed and operated for eight years without observable deterioration.

Fibreglass dips

The fibreglass dips are made of a high grade polyester resin reinforced with low alkali-type glass fibres. The wall is built up starting with a gelcoat layer on the mould surface, followed by laminate and finished with a protective coat called a surface coat. The gelcoat is made of polyester resin without glass reinforcement. It is heavily pigmented and contains some mineral fillers for improved abrasion and impact resistance.

The laminate is a conglomeration of glass fibres and polyester resin. The fibres are distributed at random or oriented in the direction of the maximum load. Correct laminate thickness, glass orientation and glass:resin

ratio are the critical factors for strength. The surface coat is similar in composition to the gelcoat and protects the exposed glass fibres from chemical attack.

The walls are $\frac{1}{8}$ in. (3 mm) thick or slightly greater. Ribs have been built in at intervals along the dip's length to give added strength.

Advantages

The advantages of a fibreglass dip are numerous.

Speed of installation. The dip can be installed in less than a day in a prepared excavation. If the site is not too rocky, a back-hoe can prepare the hole in 4 hours.

Lightweight. The dip is made in two pieces. Its total weight is 600 kg (1 320 lb) and can be handled easily by four men which obviates the need for heavy handling equipment. Its light weight gives great savings in freight costs.

Movability. If desired, the dip can be pumped out, removed from its location and re-installed at another site.

Ease of repair. One of the greatest advantages of fibreglass articles is that, in case of damage or injury, repairs can be carried out on the spot quickly and cheaply. Special skill or expensive equipment is not needed. Repair kits with instructions are supplied.

No corrosion or rust. Chemicals used in tick control will not corrode fibreglass. Also, fibreglass will not rust.

No leakage or seepage. The dip is leakproof. The walls of the dip protrude above ground level to prevent flooding.

Pliability. The properties of fibreglass are such that it will not crack with earth movement.

No corners. The curvature at the dip's bottom ensures that dirt accumulates in the centre of the dip. This makes for easy cleaning. This curvature reduces the dip's capacity as it eliminates corners.

Simple to install. Skilled labour is not required to install the dip; but the instructions should be followed carefully.

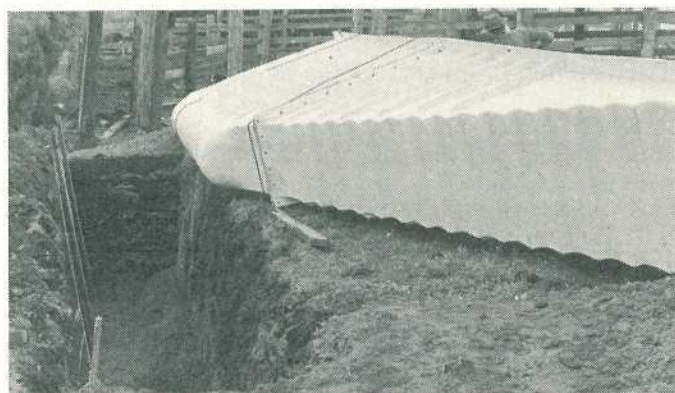
Disadvantages

If there are any disadvantages, they are not yet clear. There have been problems associated with other types of prefabricated dips, mainly with their ability to withstand the pressure of the earth after rain. There is a possibility that slight buckling of the walls could occur.

Installation

The initial step is to prepare an area of level ground approximately 38 x 6 ft (12 m x 2 m). Care should be taken to peg the excavation squarely, to have the angle of the walk-out correct, and to have an even taper on the excavation sides. The excavation dimensions are shown in the instructions.

To prevent the adverse effects of soil contraction and expansion, it has been found with similar projects that the structure is best packed in sand. Therefore, once the hole is dug, a 6 in (15 cm) layer of sand should be placed on the bottom.



The next step is to align the two halves of the dip beside the excavation. The dip is supplied in two pieces to save freight and for easier handling. Leave a 4 in (10 cm) gap between the mating flanges. Material to join the halves is supplied. A hardener is mixed in the putty which putty must be used within 1 hour after mixing, although this does depend on the temperature. The putty is distributed freely over the flange area and the two pieces are pulled together with bolts and nuts which are fitted into predrilled holes. The heads of the bolts and nuts are covered with surplus putty.

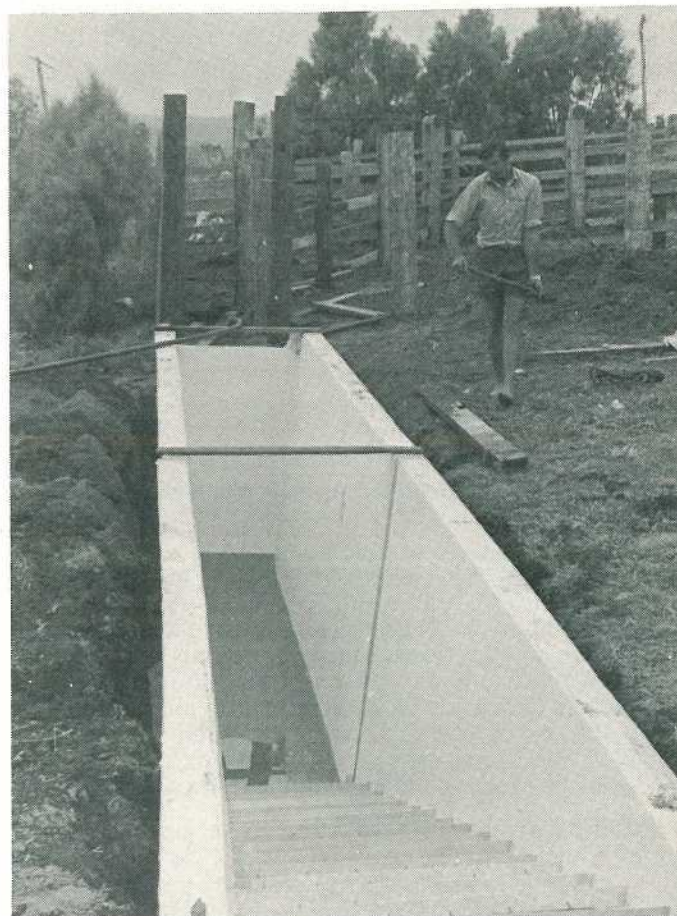
The dip is now ready to be turned on its side and lowered into the excavation. It is important that no more than 2 hours pass between the time of mixing the putty and when the dip is resting in the ground.

The joint is sealed by using resin and fibreglass tapes. To do this, hardener is mixed with resin which is firstly painted over the joint. The fibreglass tape is then laid on the painted strip. More resin is applied to this tape until it is thoroughly saturated. A second layer of tape is then applied in the same fashion as the first. The dip should be well protected from moisture and left overnight to harden.

When satisfied that the dip is level, fill with water to a depth of 2 ft (60 cm). This amount of water will still leave the steps dry. Sand is added to the hole until the water level is reached. The sand is then compacted by adding water.

The next step in the installation is to fill the steps with a 6:1 concrete mixture. Steel reinforcement has already been cast into the steps. A fibreglass retaining wall on each step is supplied to make a satisfactory mould. Once the concrete is set the water level is raised in increments of 2 ft (60 cm), similarly backfilling with

sand. When the dip has been set into the ground, the concrete work connected with the jump-in and draining pen can be finished.



Dimensions

The overall length of the fibreglass dipping vat is 35 ft (10.7 m). The width at the top is 3 ft 6 in (105 cm) tapering to 2 ft (60 cm) at the bottom. The deep section is 14 ft (4.3 m) long and the walk-out 22 ft 6 in (6.8 m). The jump-in is level to promote efficient head wetting.

The dip allows a 30 ft (9 m) swim and the depth of water at working level at the jump-in end is 6 ft 6 in (2 m). The capacity is approximately 2 400 gal (11 000 L).

Concrete masonry dip construction

In cattle dip construction, it is important for the walls and floor to be structurally integrated to ensure maximum strength and a permanently watertight structure. The combination of a reinforced concrete floor and reinforced concrete masonry block walls achieves these objectives. The blockwork consists of hollow block walls with steel reinforcing rods placed in the hollow cores, which are then completely filled with concrete.

An important part of this construction method is that the floor slab should be poured and the walls filled with concrete in one continuous operation, so that the floor and walls become a single reinforced concrete structure.

Manufacturers of concrete masonry can provide the four block types required; see figure 9. An open block of type A is used for the bottom course. The large openings made by these blocks allow easy removal of all mortar dropping from cores, facilitate placement of steel reinforcing rods and permit a strong concrete bond between walls and floor.

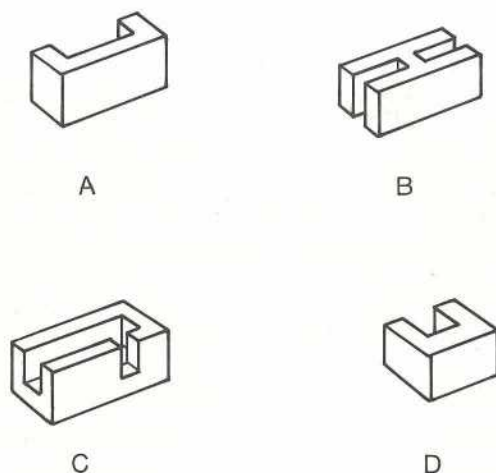


Figure 9. The four block types of concrete masonry.

The walls are built using blocks of type B laid in running bond. As these blocks have open ends they form large cavities down which concrete is easily poured and, as there are no mortar joints continuous from inside face to outside face, there is little chance of leaks. The corners of the dip are constructed with type C blocks. The knock-outs allow horizontal steel to turn the corners. One type D block is used in each course.

After excavation, the walls can be set out to modular dimensions in the normal way for blockwork. Conventional footings are not required, but a firm and level base is necessary so that walls will be plumb and

straight. This can easily be provided by forming a concrete pad 100 mm thick and 220 mm wide on which the first course is laid.

Subsequent courses are laid with type B blocks, using one type C block at each corner with the appropriate end and side knocked out. Horizontal steel reinforcement is placed as the walls are built up.

After blockwork is complete, a layer of bedding sand about 50–70 mm ($\frac{1}{4}$ – $\frac{1}{2}$ in) thick is laid and the mesh reinforcement for the floor is placed on top. Vertical steel is then set in the walls and tied to the floor mesh using starter bars bent to the correct shape.

Rapid placement of the floor and wall concrete in a continuous operation is important, and it is recommended that concrete be pumped into place starting with the floor. At this stage reinforcing must be lifted 50 mm ($\frac{1}{4}$ in) clear of the sand bed.

When ordering premixed concrete, it is most important to tell the supplier that the concrete will be pumped. Concrete for the floor should have a 50–75 mm ($\frac{3}{16}$ – $\frac{5}{16}$ in) slump and be vibrated into place. The bottom course of the walls should be completely filled with concrete. The floor can be left forming a curve at the floor-wall junction. As soon as the floor concrete is in place, fill the walls with 125–150 mm ($\frac{3}{8}$ – $\frac{5}{8}$ in) slump concrete. Concrete in the walls should be rodded to ensure that no air pockets remain. Vibration of concrete in the walls should not be necessary if the correct slump is used. If a vibrator is used in the walls it should be no larger than 25 mm ($\frac{1}{16}$ in) and care must be taken not to disturb the blockwork.

The mechanical spray race

The mechanical spraying of cattle for control of cattle ticks by means of specially constructed, power operated spray races as an alternative to plunge dipping has a few factors to commend it.

The spray race consists of a system of pipes fitted with spraying nozzles fixed on a concrete base between sheet metal walls. The spray is drawn up from a sump and forced at pressure through the pipes to the spray nozzles by means of a pump driven by either a stationary petrol engine, an electric motor or the power take-off of a tractor. Detailed plans are provided in figure 10.

It is recommended that the race operates at low pressure delivering a high volume, for instance 140 kPa (20 lb per in²), delivering 90 000 L (20 000 gal) per hour.

Site

The site on which the spray race is to be built should be chosen with care. Factors to be considered include:

- 1 It should be as close as possible to a permanent water supply.
- 2 The race should be erected across a slight slope with the sump on the lower side.
- 3 It is preferable to build at least 50 m (50 yd) from the dairy buildings.
- 4 It is ideal if the race is erected at right angles to the direction of the prevailing winds, so as to keep down loss of spray wash through drifting.
- 5 Build clear of trees to avoid leaves and debris falling into the sump and causing nozzle blockage.

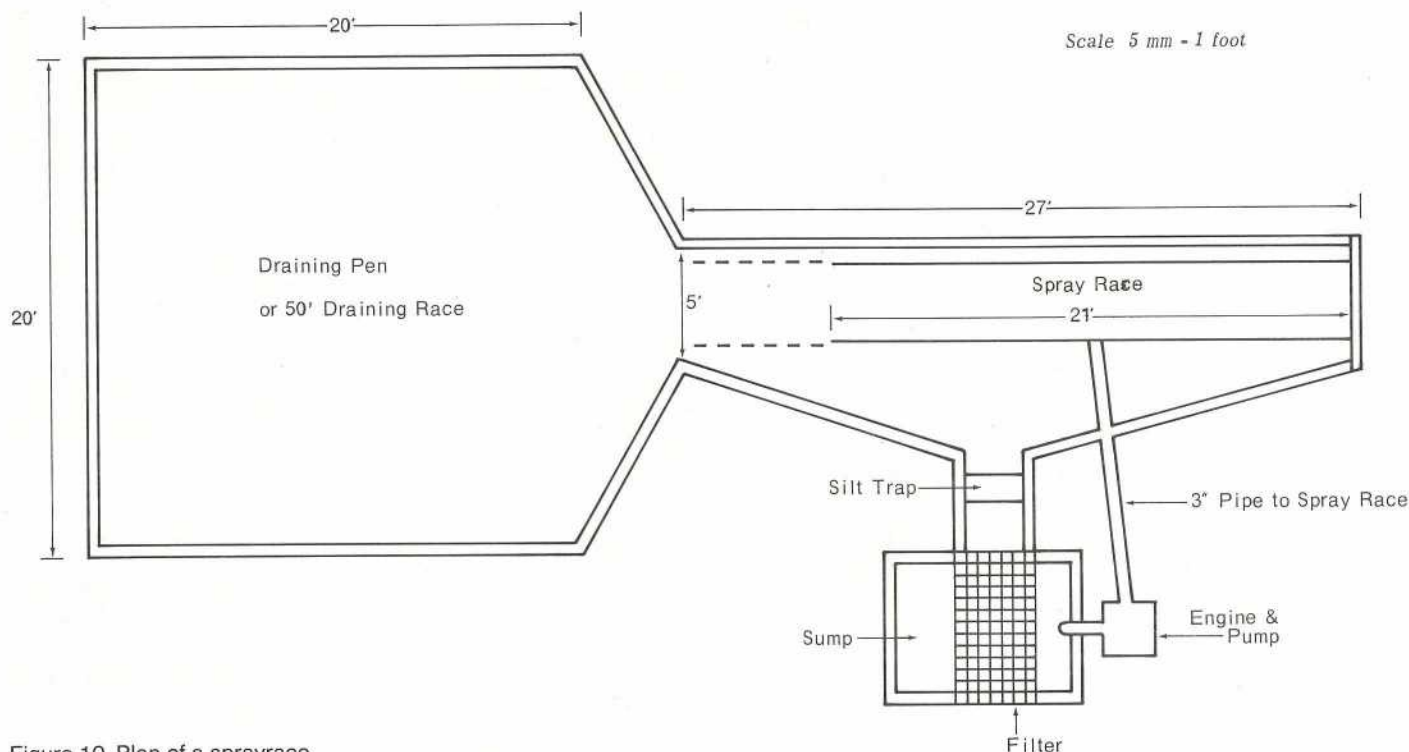


Figure 10. Plan of a sprayrace.

Construction

The requirements for a spray dip are considered in turn.

Pump

One which delivers 90 000 L (20 000 gal) per hour at 320 kPa (45 lb per in²) pressure at pump head. This capacity will conceivably deliver 81 000 L (18 000 gal) at 140 kPa (20 lb per in²) at duty point or nozzle tip, for example a 100 × 80 mm (4 × 3 in) centrifugal pump.

Engine

It may be electric, stationary petrol or tractor driven. An electric motor must have a 10% power margin over the design load and a diesel motor must have a 15% power margin. For example, the pump mentioned above requires an electric engine with a non-overloading horsepower of 15 kW (20 h.p.).

Pipelines

Requirements in this respect are: One (1) yoke 3 in (approximately 8 cm) internal diameter at centre point of sprayrace. Eight (8) spraylines 1½ in (about 4 cm) internal diameter (all lines are 6.5 m (21 ft) long). Thirty-five (35) ½ in sockets for nozzle fitting. One (1) 'T' piece for overhead line. One (1) connecting pipe from yoke to floor line.

Nozzles

Thirty five (35) brass nozzles are required: sixteen (16) × ½ U 80–200 with ⅛ in orifice to deliver 11.7 gal per minute, plus nineteen (19) × ½ U 80–100 with ¼ in orifice to deliver 5.89 gal per minute. All nozzles spray a fan pattern.

The code ½ U denotes ½ in union while 80 denotes angle of spread of fan.

Walls

These consist of 16G flat galvanized iron supported by 38 mm angle iron framework. A cover strip on the bottom edge protects cattle from cutting their legs if their feet slip sideways.

Filter

A filter made from flat steel gauze 2 × 1 m fitted with an upward incline above the sump.

Sump

A 2 000 L concrete sump is required. A smaller sump may be constructed if a side tank is installed beside the sump for continuous replenishment.

A small shed can be erected over the sump to keep out leaves and debris. It may be of a size to store other materials and equipment used during the spraying operation.

Roof

A roof may be erected over a race. It helps to curb the tendency of cattle to plunge when entering the race. It also reduces loss of wash through wind drift. It may or may not be fully enclosed.

Overall plan

The plan with dimensions is shown as figure 10. There is a choice between a draining pen and draining race. The floor area is concreted to a thickness of 4 in.

The floor of the race has a slight longitudinal and transverse fall towards the sump. It is extended 15 cm beyond the wall on the opposite side to the sump. This side has a concreted edge 15 cm high to prevent loss of fluid on that side.

On the sump side, it is very important that provision be made for an expanse of concrete. This permits the large volume of dipping fluid to spread out. Flow to the sump is via a narrow section which funnels the fluid over a silt trap as it returns. The mouth of the narrow section must not be less than 80 cm (2 ft 8 in) wide. If these provisions are not made flooding will occur within the race as well as in the draining pen and crush areas. The silt trap is 25 cm (10 in) wide. It is constructed in the spillway to catch heavy foreign material. The wash then passes through a coarse filter, which must be kept unblocked, into the sump for recirculation.

There is also a fall in the concrete draining area so that the wash draining from the sprayed animals returns to the spray race and thence via the filter into the sump. An efficient drainage and return wash system contributes to economical use of dipping fluid.

The plan requires that a railed panel leads from the exit of the race to force cattle to walk out in a straight line. This ensures the efficiency of the two outside overhead nozzles.

Figure 11 gives a view of the spray race looking from the entrance.

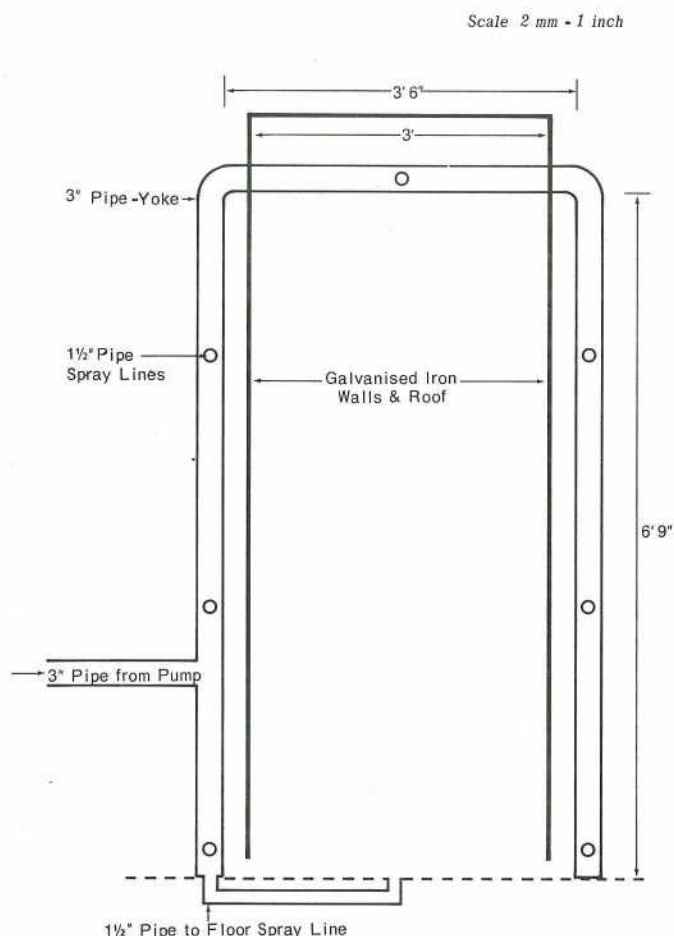


Figure 11. View of the sprayrace from the entrance.

Floor line

The spray line is recessed into the concrete floor as in figure 12. Six nozzles $\frac{1}{2}$ U 80-200 protrude about 7 cm (3in) above floor level. This height is necessary to prevent flooding from the large volume of fluid being distributed from the spray race nozzle system. Otherwise, flooding would interfere with the spray pattern from the floor nozzles.

The protruding nozzles are protected from damage by building concrete cones around them. All nozzles are directed to spray in a fan across the unit. The first two nozzles at the entrance end are angled 45° towards the exit or in the direction that the cattle are travelling. The middle two nozzles spray straight upwards. The last two nozzles at the exit end are angled at 45° towards the entrance. Large nozzles are used to wet the more difficult areas of the under part of cattle where most ticks attach themselves.

Three spray lines constitute the spraying system on each side wall as illustrated in figures 13 and 14. The spacing between nozzles on the nearside varies from that of the offside, so that the nozzles are staggered. Four nozzles are fitted into each line. Those on the bottom lines are the larger $\frac{1}{2}$ U 80-200 ones. The bottom line is fitted close to the floor and the nozzles angled at 30° - 45° to permit wetting underneath the flanks and lower sides. It is important to wet smaller cattle effectively in that area.

The fan of spray from the bottom line actually spreads from straight up the side wall and across the race to the extent of its width. The first nozzle's spray pattern is angled towards the exit, the middle two are directed straight upwards and the last one, at the exit end, is angled towards the entrance.

The nozzles on the centre line are similarly placed except that the middle two nozzles spray straight outwards. The angle of the nozzles at each end of this line and the top line is 45° . The remaining two large nozzles $\frac{1}{2}$ U 80-200 are fitted at the exit end on the centre line on each side wall. Nozzles on the top line are directed to spray inwards and downwards.

Figure 15 illustrates the overhead line. The direction of the spray pattern is consistent with the general principle in other lines. However, it is normal behaviour for cattle to raise their heads and bend their necks backwards as they enter the race. This position is held until the animals pass the last nozzles on the side

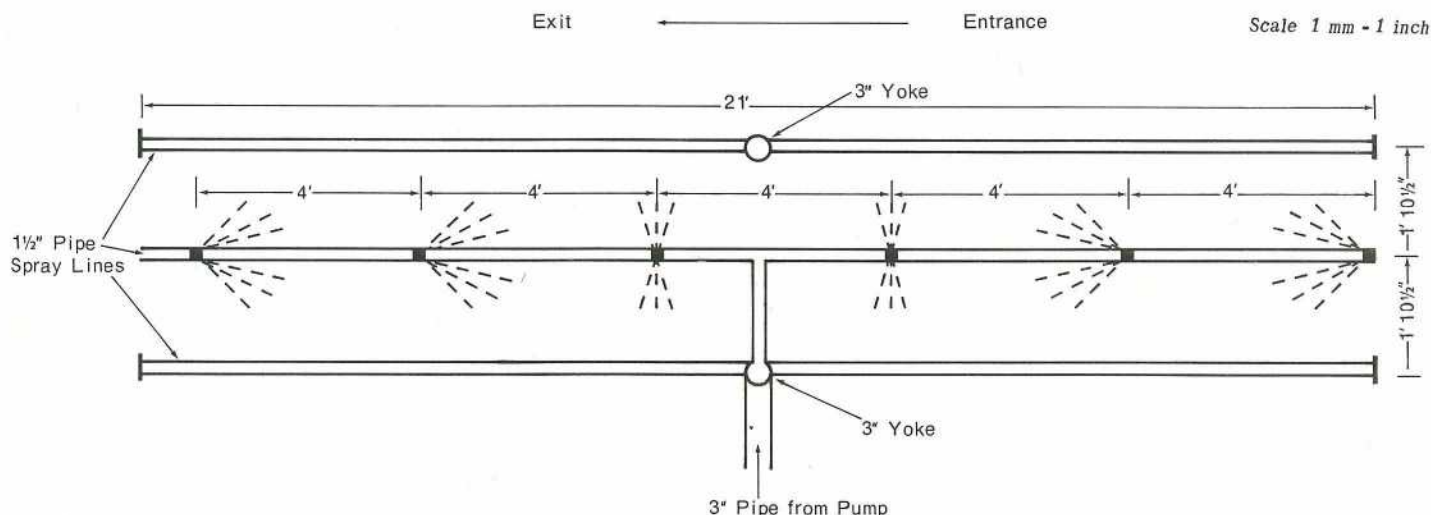


Figure 12. The floor line of the sprayrace.

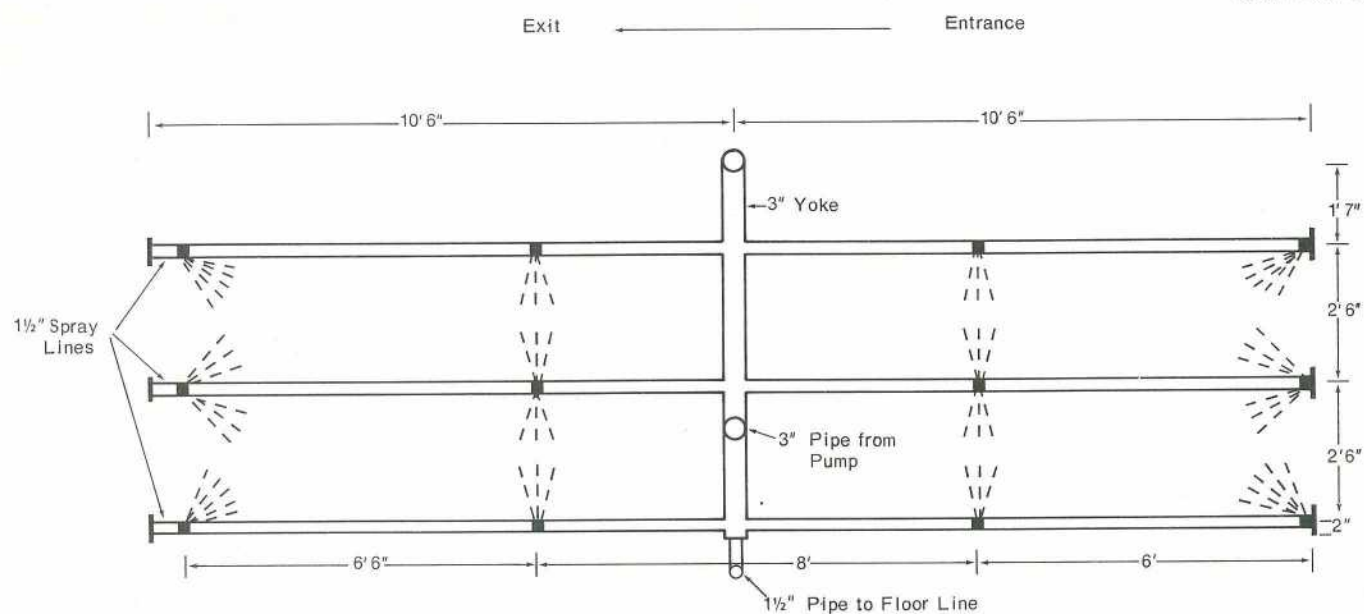


Figure 13. Spray lines on the nearside.

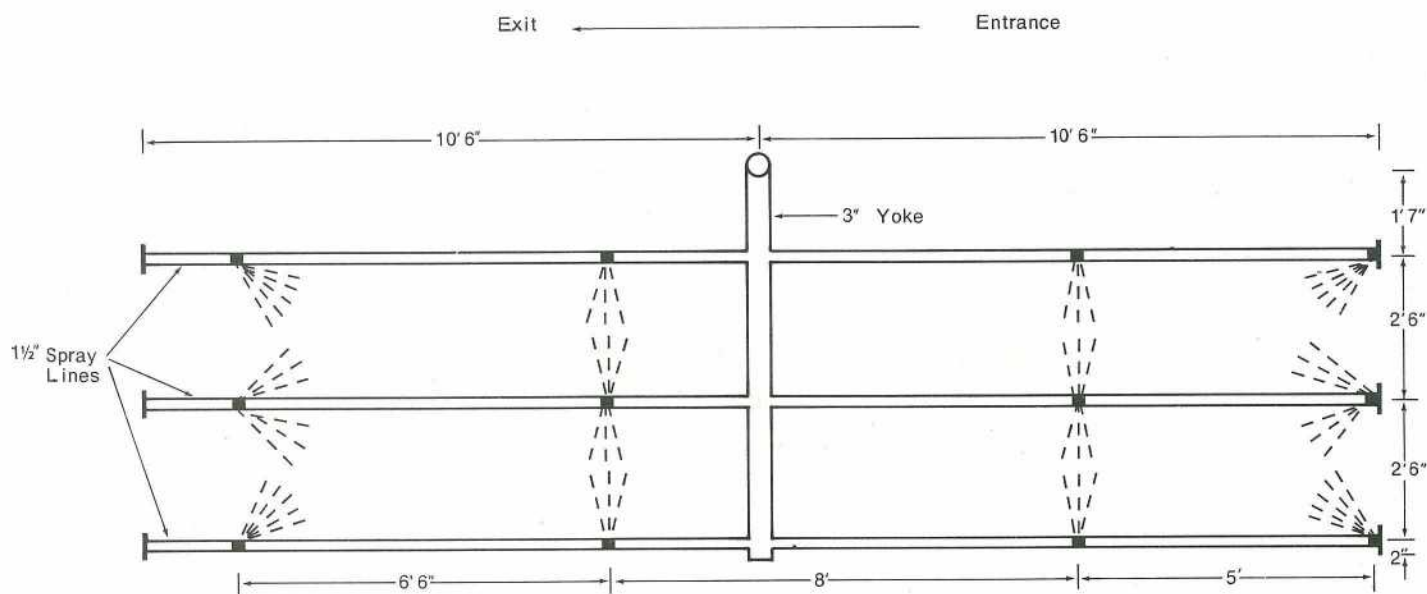


Figure 14. Spray lines on the offside.

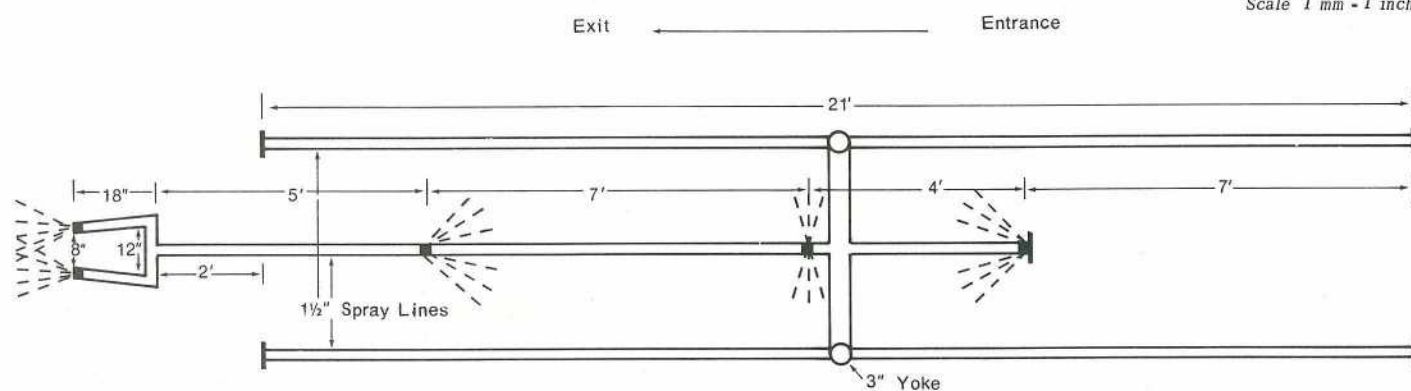


Figure 15. The overhead line.

lines. Their heads are then lowered to the normal carriage. Therefore, the method designed to wet the heads, ears and necks thoroughly is to install two nozzles onto a 'T' pipe at the end of the race. They spray at a point slightly greater than a metre past the last nozzle in the spray. The spray pattern is actually directed into the draining area. It is essential to widen the race at this point to ensure no fluid is lost.

Nozzle angles are shown in figure 16.

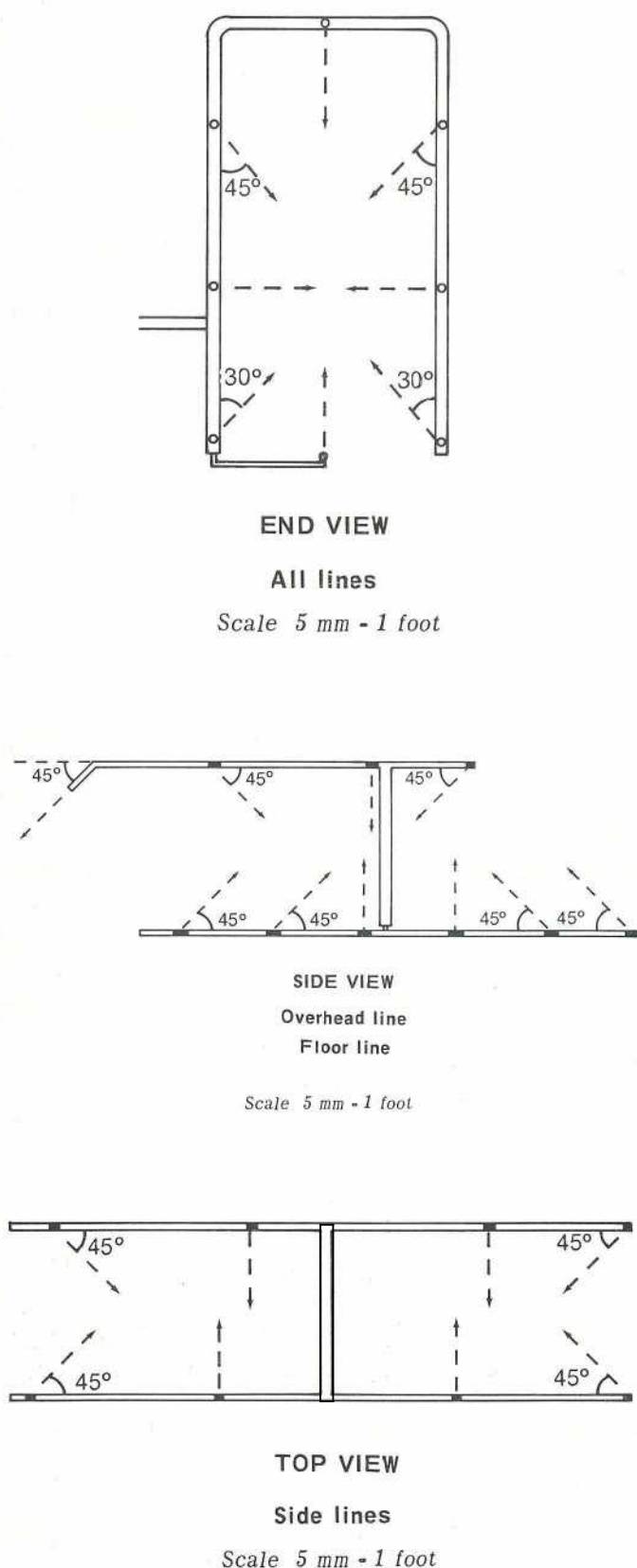


Figure 16. Nozzle angles.

Management of a spray race

Aspects of spray race management are now considered.

Calibrating the sump

The sump of a spray race must be calibrated every 200 L by using a water meter, or by adding measured volumes of water and marking the side of the sump or a vertically suspended dip stick.

Preparation of spraywash

The sump is filled with water to the level needed for the number of animals to be sprayed. The correct volume of the chosen acaricide is mixed with a little water, poured into the sump and hand stirred. It can then be mixed by rapid circulation through the pump and back into the sump. Time of mixing varies from 5 minutes in low volume to 2 minutes in high volume units.

The amount of wash to be made up is based on a calculation of what each animal will remove plus the volume required to cover the foot valve and run the recirculating unit efficiently. At all times there must be enough wash to maintain the desired pressure within the spray system.

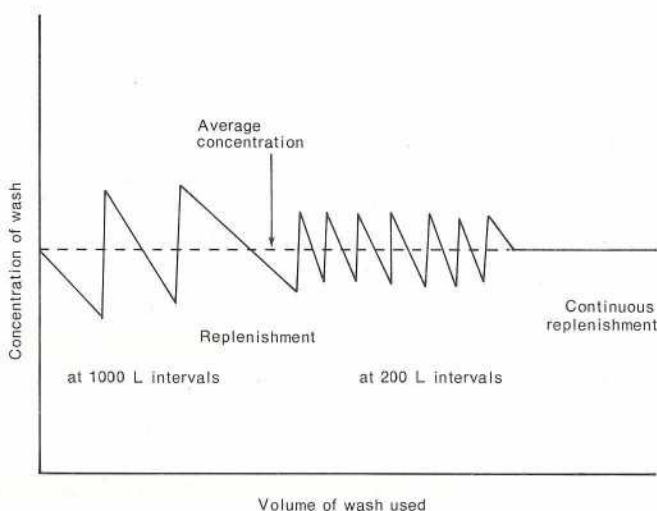


Figure 17. Comparison of replenishment and continuous replenishment.

The spraying operation

One of the greatest disadvantages of a spray race is that excessive 'stripping' or 'exhaustion' of wash occurs. Graziers usually combat stripping by overcharging, reinforcement, replenishment or continuous replenishment. Overcharging is the practice of making the dipping mixture initially to a higher concentration than is recommended by the manufacturer. This could lead to poisoning and is wasteful. The other methods have been mentioned in discussion of management of plunge dips. Continuous replenishment is the most effective method of counteracting stripping. In field trials the following procedure was adopted.

- 1 A side tank with a gate valve was placed beside the spray race sump.
- 2 As small a volume as possible, that is the volume necessary to cover the foot valve and recirculate through the spray lines, was placed in the sump and charged at the recommended concentration.
- 3 The additional volume estimated to complete the spraying operation was placed in the side tank and charged at the recommended strength.

- 4 The flow from the gate valve in the side tank was adjusted to allow fresh dipping fluid to run continuously into the spray race sump at the identical rate the cattle were removing it. (A float valve could be installed in place of the gate valve.) Dipping fluid samples were collected from the nozzle tip and sump after spraying every 25 head in a group of 220 cattle. Analysis revealed that there was little variance in dip strength from start to finish.

Effects of continuous replenishment and replenishment on dip wash concentration are compared in figure 17.

Checking the race

It is essential that the spray race carries a pressure gauge and the spraying is done at the recommended pressure by a unit of adequate power. If the pressure is too low or too high, it will affect the wetting properties of the spray and result in inefficient tick control. When pressure is too high, misting rather than wetting occurs. The delivery and settings of each nozzle must be checked before spraying begins by running the spray at half pressure and observing the pattern of the spray and the performance of each nozzle.

Stock management

The width of the crush leading to the entrance of the spray race should be such that cattle enter in single file. As long as a beast does not cause delay, it should be allowed to pass through the race in its own time. Animals allowed to do this lift their tails during spraying so that under-tail wetting takes place.

Young calves being sprayed for the first time can be encouraged to pass through the race with the pressure reduced, or else passed into the race with the spray off and then showered with full sprays. Calves once treated in a race rarely give further trouble.

The spray race should not form a part of the crush when veterinary treatments or other husbandry practices are being administered.

After spraying

If the remaining wash in the sump is badly fouled, it should be pumped out and the whole spray unit thoroughly cleaned by the circulation of clean water and the clearing of nozzles. A few inches of clean water may be run into the sump to keep the foot valve moist and prevent cracking of the sump floor. Finally, the return wash pipe at the exit of the spray race must be plugged and the storm water outlet opened to get rid of flood water.

Efficient spraying of cattle depends on the attention given to the construction and operational instructions listed in this article. The spray race is a mechanical device and its usefulness reflects entirely the skill and care with which it is operated. A well managed race is a boon to the farmer but mismanaged becomes a liability. Unless the farmer is prepared to install and operate his unit with care, he would be well advised to construct a plunge vat instead.

The advantages of a spray race could be said to include:

- 1 It is feasible and comparatively inexpensive to dismantle and transport it to a different site if necessary.
- 2 It is safer to cattle than dipping, with less chance of serious injury to valuable pedigree cattle and is kinder to cows in calf, cows with calf, and the udders of heavily producing milk cows.

- 3 It is possible to use freshly made up spray wash of a known concentration, ensuring maximum wash efficiency.
- 4 Only the required quantity of spray wash need be made up at any one time.
- 5 It is easy to change a chemical at any time without suffering the financial loss of having to discard large volumes of wash.
- 6 It is a faster process once operators become familiar with the use of the spray race and the cattle have become accustomed to passing through the unit.
- 7 It is possible to use such unstable chemicals as Imidan.
- 8 It is easier to treat small numbers of cattle.

The disadvantages on the other hand are:

- 1 Wetting is less effective than in plunge dipping.
- 2 The efficiency depends on the pump, strainer and nozzle system. Sensitive mechanical devices such as these, as well as the motors that drive the pumps, require above average mechanical ability in maintenance.
- 3 Its efficiency depends on the skill and care of the operator.
- 4 An engine and pump are expensive equipment if used only for the purpose of tick control.
- 5 Spray races need more fluid than plunge dips for a given number of animals.
- 6 Maintenance costs are higher than for plunge dips.
- 7 If not correctly managed, 'stripping' is rapid, leading to poor tick control through under strength spraying.
- 8 Chemicals such as arsenical preparations cannot be used since the drifting spray causes long term contamination of the surrounding vegetation.
- 9 Spraying is more hazardous to the health of the operator through possible inhalation of the acaricide.

Dipping programmes

In Queensland, planned dipping remains the most efficient chemical method of tick control for cattle highly susceptible to ticks. European breeds and crossbreeds with less than 3/8 Zebu blood are very prone to tick infestation.

Most cattlemen control their ticks by conventional dipping. The emphasis of this method is placed solely on killing the ticks that are attached to cattle at the time of dipping. Little thought is paid to keeping the pasture relatively free of seed ticks. In comparison with conventional dipping, planned dipping can reduce the tick burden by another 80%. It also limits cost by reducing the number of dippings and therefore the cost of labour and chemicals. A further, very significant, cost factor is also ignored because it is too difficult to measure. The useful life of a tickicide is reduced each time cattle are dipped. When it loses its effectiveness, it may be replaced by another which, in all probability, will be more expensive. It is therefore imperative that the maximum control is obtained with as few dippings as possible.

Planned dipping is based on employing available dipping fluids efficiently in a control programme that exploits knowledge of the tick's life cycle. It is aimed entirely at the parasitic stage.

In southern Queensland, female ticks which drop between mid-April and early July produce virtually no progeny. The numbers of larvae available to infest cattle during July to October are reduced because of the absence of reproduction during winter.

The engorged female ticks dropped in the early autumn are most important in the overwintering of the parasites. Some of their larvae survive to attach to cattle in late winter or early spring, engorge and drop off. It is the tendency of their progeny to hatch at about the same time in the late spring which produces the 'spring rise'. This is the first of the four generations ticks produce in a year. The 'spring rise' usually occurs in mid to late October.

Planned dipping is particularly effective if it is timed to catch the spring rise. The programme consists of six dippings at 21 day intervals, commencing at the time of the spring rise or shortly afterwards, and ending in January. These dippings break the life cycle and prevent engorged females from dropping off to lay eggs and re-infest the pasture. Thus, the devastation of the first generation prevents the build-up of the second, third and fourth generations. It has been found that ticks take a long time to build up numbers again after the completion of this strategic programme. Sometimes another dipping is required before winter in a specially tick-favourable paddock.

This programme does not apply to Zebu or Tropical breeds. These cattle are tick resistant and need only to be dipped during the autumn months when their natural resistance tends to wane.

In central Queensland, tick reproduction continues throughout the year with a slowing down during the winter. In northern Queensland, the wet season interferes with tick reproduction. Therefore, dipping programmes can only be planned in the light of knowledge of the tick's ecology in any given area. The advisory dipping programmes for Queensland are set out below.

A *Bos taurus* and low grade *Bos indicus* cross:

1 South East Queensland

Six dippings commencing in mid-October with a maximum interval of not more than 21 days between dippings. There is no need for further treatments unless tick infestations build up to an extent where a further dipping may be required before winter.

2 Central Queensland

Four dippings, starting in first week in October on the coast, while two such dippings for sub-coastal areas, followed by five dippings for both areas commencing in March according to local weather conditions.

3 North Queensland

(a) *Dry and Wet Tropics* Six dippings commencing at the end of the wet season, that is commencing in late March, early April and possibly two dippings during the spring period.

(b) *Atherton Tablelands* Six dippings September/December should be sufficient for the year, although autumn infestations may require monitoring and possible treatment.

Maximum interval between dippings in all programmes is 21 days.

B *Bos indicus* infused cattle, that is 50% and greater *Bos indicus*:

1 South East Queensland

No need for spring rise dippings. One or two dippings at end of April or early May may be required. Tick susceptible heifers and cows should be culled before the end of February.

2 Central Queensland

Opportunity dipping only as necessary with the culling of susceptible females.

3 North Queensland

Minimal dippings as tick infestations warrant it. 75% *Bos indicus* infusion is required for biological tick control in the wet tropics.

Successful programmes require that:

- 1 Ticks are killed by the chemical in use.
- 2 Dipping facilities wet cattle thoroughly and are correctly managed.
- 3 All cattle are dipped including calves.
- 4 There is good fencing to prevent the entry of excessive numbers of tick infested straying stock.

Environmental impact

Cattle dipping either by plunge dip or spray has little impact on the environment in comparison with the general impact of the livestock industry of which the dipping is a small part.

Erosion problems around a dip are very localized and can be eliminated by careful planning and judicious use of concrete. Application of pesticide to the animals by plunge dipping contributes negligible quantities of pesticide to the environment because animals are kept in the draining pen for sufficient time to allow excess fluid to drain back to the dip. Spray dips may allow appreciable amounts of misted fluid to spread over the local area. Such losses should be minimized by correct setting of operating pressure, by siting the race at right angles to the prevailing wind and by installing a roof over the spray race. When correctly sited, no pesticide should reach any natural watercourse.

The only time significant amounts of pesticide can enter the environment from a dip is when it is emptied for recharging. Although it is possible with good management to empty and recharge a dip only once in 20 years, in practice this operation occurs, on average, once every four or five years. Development of the resistance of ticks to the pesticides in use, combined with less than perfect management, contribute to an increased frequency of emptying and recharging. This means that once every 4 or 5 years each plunge dip will discharge about 10 000 to 15 000 L of fluid containing about 5 kg of pesticide into the environment. Most of these pesticides break down fairly rapidly and so produce only a short term contamination. An exception is sodium arsenite from arsenical dips. This compound may be converted to other derivatives of arsenic but the arsenic remains permanently, although it can be dispersed to the point where its effect is negligible. In any case the quantity of pesticide involved is small and has little impact except in sensitive areas. Consequently,

provided adequate care is taken in disposal of dip fluid, no significantly adverse effect should be caused to the environment.

Dip contents disposal

When the contents of a cattle dip are to be discarded, care must be taken to ensure that watercourses are not contaminated. For those dips in which the acaricide is in suspension, the vat should be allowed to settle for a few weeks. Supernatant fluid is then pumped off and sprayed over a suitable area of land. This fluid should contain very little acaricide. Sludge from the bottom of

the vat is then shovelled into containers and buried in an area where water seepage will not cause contamination of water supplies.

Arsenic dips should be treated with quicklime (calcium oxide) or slaked lime (calcium hydroxide) to convert the arsenic to insoluble calcium arsenite. Approximately 2-3 kg (4½-6½ lb) should be used for each 1 000 L of fluid containing 0.2% arsenite. After settling, the sludge is buried in an area selected for absence of water seepage. Such sludge may also be discarded in a Noxious Materials Dump if one is available.

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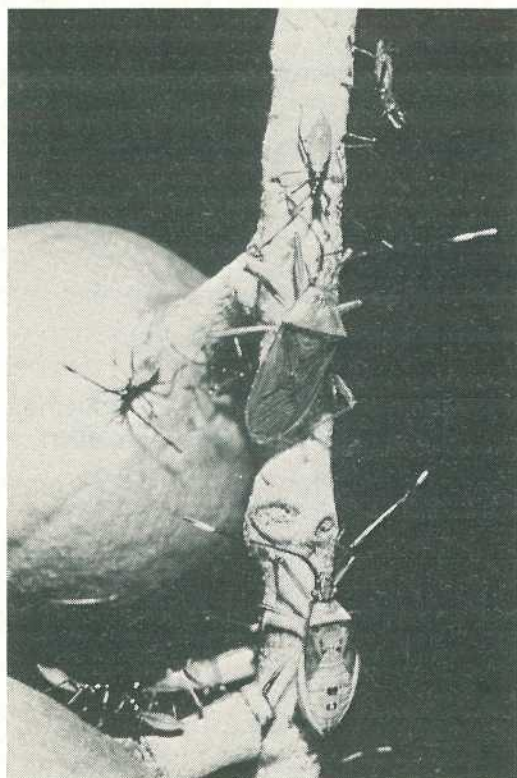
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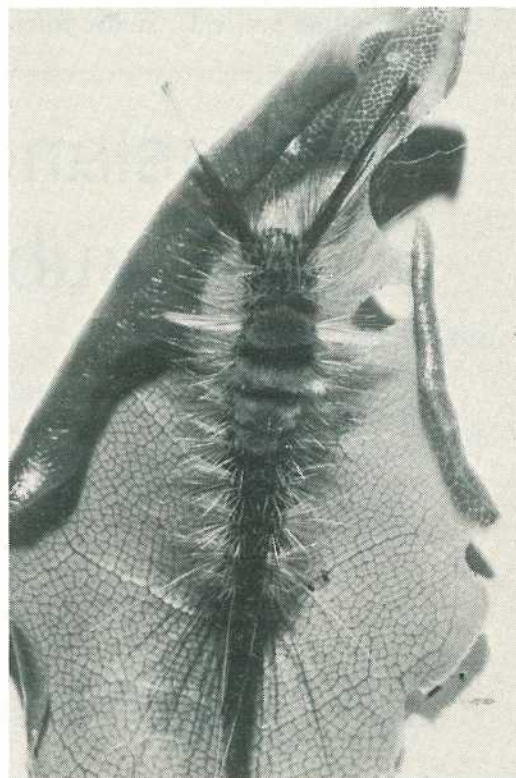
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Insect pests of macadamia in Queensland



Fruitspotting bug adult and nymphs on macadamia nuts



Brown tufted caterpillar on a macadamia leaf

In the context of rapidly expanding macadamia nut production in Queensland, and on the north coast of New South Wales, the Department of Primary Industries has prepared a booklet on the crop's insect pests. Entitled *Insect Pests of Macadamia in Queensland*, it has been compiled by D. A. Ironside, an entomologist in the DPI.

As it is intended as a colour-illustrated guide and source of information on all the important, and some of the less well-known, insect pests of macadamia, there is considerable emphasis on the use of full-colour plates. These will make certain recognition of a given infestation very easy for the grower, whether commercial farmer or home gardener. And this will be true equally whether the damage is being caused by an adult insect, its larvae or pupae, or whether the only evidence of actual or threatened damage is the presence of eggs, blemishes to nuts or leaves, withered racemes, fruitspotting or similar suspicious signs.

These colour plates are supported by textual descriptions of the life history, habits, host plants and

seasonal distribution of all stages of the insects, compiled with notes on the natural predators and parasites. In some cases they alone will achieve adequate control. A recognition of the habits and damage caused by various insect pests will permit the grower to apply timely control measures.

There are several insects, though not occurring in all districts, which uncontrolled are capable of destroying much of a crop. They include the macadamia flower caterpillar, the fruitspotting bug, the bananaspotted bug as well as others. However, other factors may be relevant. One is that minor pests may be important locally. Again, as macadamia growing expands and insecticide use becomes more widespread, the relative importance of the various pests may change. In this situation, as always, forewarned is forearmed. This publication will enable the grower to be forewarned.

The booklet is available from the Information Centre, Floor 10, Mineral House, George Street, Brisbane (postal address GPO Box 46, Brisbane, Q. 4001). The price is \$5.00 post free.



Sorghum black layer: a valuable visual aid in harvesting decisions

R. F. Brown, Agriculture Branch

How seeds develop

Seeds develop by drawing nourishment from the parent plant through the equivalent of an umbilical cord until they reach maturity. The remains of this link can be found at the pointed end of cereal grains.

While the seed is growing, nutrients flow from the parent through a fine network of tubes connecting the two. Once the seed reaches its maximum size, the tubes are permanently blocked off in a matter of hours.

Figure 1 shows the changes in both moisture and starch contents of seeds between flowering and the production of mature, air-dry grain. Initially, the seed has a very high moisture level, which explains the term 'milky dough'. As the seed fills with starch, some of the water is lost. Water can no longer move in from the parent plant after tube blockage occurs, so the seed dries out. Over the next 2 or 3 weeks, depending on the weather, seeds typically drop from around 30% moisture to the air-dry level around 10%. Further drying does not normally occur.

The starch content of seeds steadily increases during grain filling, reaching a maximum when tube blockage occurs. After this, a slight decline in the starch content occurs while the seed dries out, after which there are only negligible changes. The reason for the small decline is that, at high moisture levels, the young seed is quite active and respiring at a high level (as anyone who has felt the heat build-up in a pile of moist grain will appreciate). During drying, the seed has to use some of its own reserves to keep itself alive. This causes a small drop in the amount of starch in each seed.

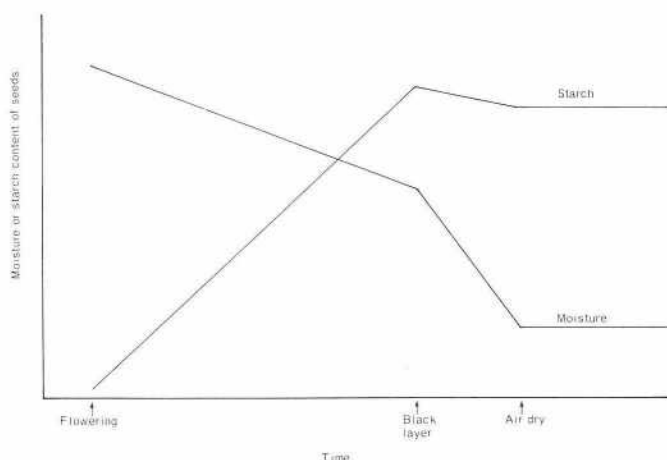


Figure 1. Changes in moisture and starch contents of sorghum seeds after flowering. (Not drawn to scale.)

The black layer

When the tubes between plant and seed cease functioning, some plants give a very clear signal in the form of a dark closing layer. Both sorghum and maize do this and, while this article discusses only sorghum, some of the considerations are equally applicable to maize.

The plate (back cover) shows the development of the black layer in 5 pairs of seeds. Pairs 1 to 4 were picked on the same day from different positions on the same head. Pair 5 came from an older, air-dry head. The first two pairs, from the lower half of the heads, are both at the soft dough stage. Where they join the parent plant is a small, greenish, light-brown region. This is where the connecting tubes are found. While the bottom of the seed stays that colour, nutrients are still flowing into the seed. Once tube blockage commences, the colour quickly darkens, as illustrated by the third pair. These two seeds are at soft to medium dough stage and have just had their nutrient flow stopped. Within a matter of hours, they will be as dark as the fourth pair of seeds, at medium dough stage, picked from the top of the head. The fifth pair, at hard dough, were originally as big as the other seeds. Their smaller size is a result of drying out.

Detecting black layer formation

Recognizing black layer formation is as simple as picking seeds from the head and looking for the dark patch at the pointed end. The black layer appears first in grain at the top of the head and appears in progressively lower seeds over a period of a week or so. Once mastered, black layer recognition is a very useful tool in growing sorghum, especially as it is so quick and requires no special equipment.

Uses of black layer formation

Until it is harvested, grain is exposed to various risks which can result in serious yield losses. A few days of delay in harvesting can mean losing a crop to a hailstorm, strong winds, birds or rodents. Similarly, late rain will delay harvesting as well as increase the likelihood of fungal attack and grain sprouting in the head. Late tillering may follow with its attendant mixture of grain moisture levels, causing further harvesting problems. Clearly, harvesting should always occur as soon as practicable.

For most purposes, the grain will still be too moist for immediate harvest and storage when the black layer is first observed. Its significance lies in being irreversible and giving a clear signal that drying has commenced. This can be an invaluable aid to planning close monitoring of moisture levels with a moisture meter.

Irrigation

Irrigation after black layer development is obviously a waste of time, water and fuel. It can only cause problems by promoting unwanted tillering.

Artificial drying

An increasing number of farmers are choosing to harvest grain at a high moisture content and dry it artificially. Not only does this give the potential for a better yield through harvesting slightly heavier grains with smaller shattering losses, but also minimizes the risks of losses to pests and weather which arise during the 2 or 3 weeks before grain is properly air-dry. Obviously, artificially dried grain can be harvested at any convenient time after the black layer is observed.

Premature grain maturity

It is often assumed that varieties do not mature before their nominal maturity time has elapsed. However, stressed plants can mature quite early. Only a few days of water shortage, usually caused by high temperatures, or a few days of unseasonably cold weather can induce early black layer formation. As nutrient flow to the seed is irreversibly cut off, harvesting should be advanced accordingly. Insufficient is known about the precise amount of stress each variety will tolerate before premature maturity occurs to make accurate forecasts. However, regular inspection of heads rapidly reveals the presence or absence of the black layer, and harvesting plans can be made to suit.

High moisture grain

Fattening cattle in feedlots is well established in the United States and becoming more widespread. Grain, especially sorghum, forms a major portion of the diet and can be fed with a moisture content up to 30%. Cattle fed high moisture grain can have 15 to 26% better feed conversion than cattle fed dry grain. In some Queensland trials with cattle fed high moisture sorghum, savings in the cost of feed have been as great as 21%, although allowance needs to be made for the associated increased storage costs.

High moisture grain can be made either by reconstituting normally harvested grain with added water or by harvesting grain before it has dried out. Both types are stored in a similar fashion to silage. Black layer formation is the obvious time to harvest high moisture sorghum and has the dual advantages of obviating the need to reconstitute as well as ensuring that harvest coincides with the time of peak starch content, thus maximizing the dry matter yield per hectare.

Conclusion

Black layer formation is a major milestone in the development of grain sorghum. It signals the attainment of physiological maturity and maximum grain weight. An understanding of its significance can prove a very valuable aid in making harvesting decisions.



Black layer development at the base of sorghum seeds. The middle pair are at the transition stage, those to the right have developed a distinct black layer, those to the left have yet to do so. The ends of the seeds directed towards the centre of the photograph are where the seed attaches to the parent plant and where the black layer forms. At the other end of the seed are the remnants of floral parts which fall off as the seed dries.