Animal Industries Workshop
Lincoln College 1982

Farmers Handbook

Internal Parasites of Sheep

CONTROL OF
Internal Parasites of Sheep

FARMERS HANDBOOK

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July 1982
Lincoln College

Sponsored by
Lincoln College
Veterinary Services Council
Ministry of Agriculture and Fisheries

Printed by Lincoln College Press.
Published by Animal Sciences Group,
Lincoln College.

Printed: June 1982.
Reprinted: August 1982.

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Cover design: Dianne Lenz

INTRODUCTION

Drenching sheep when they look as though they need it is not a satisfactory way to control internal parasites.

This short handbook is written for farmers. It describes parasitic worms and their control in sheep.

The "message" is that effective drenching programmes have to be well planned and the best parasite control programmes do not rely on drenches alone.

When designing a parasite control programme for a farm it is wise to check the plans with a vet or farm advisor.

Tony Ross
Lincoln College
July 1982.

ACKNOWLEDGEMENTS

This handbook has been sponsored by Lincoln College, the Ministry of Agriculture and Fisheries and the Veterinary Services Council of New Zealand. It is largely composed from information provided by R.V. Brunsdon, W.A.G. Charleston, H.J. Jagger, P.R. Kettle, A.M. Nicol, D.P. Poppi, A.R. Sykes, K.F. Thompson and A. Vlassoff and was typed by Miss Julie Lassen.

CONTENTS

Parasite Control Programmes

Parasites

PARASITE BIOLOGY

Types of Parasites

Roundworms (nematodes) are by far the most economically important internal parasites of sheep. Liver Flukes (trematodes) are a problem in some areas of New Zealand but tapeworms (cestodes) are usually of minor importance. The gastrointestinal roundworms of sheep and cattle in New Zealand which cause significant production losses are listed in Table 1. They are typical of the range of parasites found in most cool temperate climates.

Table 1: The most important roundworm parasites of the stomach and intestines of sheep and cattle in New Zealand.

Sheep	Cattle
Haemonchus (stomach)	Ostertagia (stomach)
Ostertagia (stomach)	Trichostrongylus (stomach)
Trichostrongylus (stomach and small intestine)	Cooperia (small intestine)
Nematodirus (small intestine)	
Cooperia (small intestine)	

Geographic Distribution

There are no important geographical variations in the prevalence of roundworms of sheep throughout New Zealand except for *Haemonchus* and *Nematodirus*.

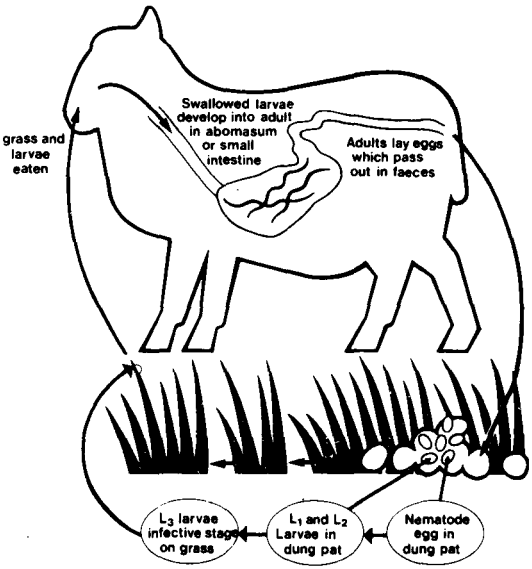
Haemonchus requires a higher range of pasture temperatures for development than other nematodes and therefore it is much more important in the warmer North Island. *Nematodirus* on the other hand is more of a problem in the South Island. It prefers cool short summers and its larvae survive cold winters on pasture to infect

young lambs in spring and early summer.

Life Cycle

All the important roundworms of sheep and cattle have the same life cycle which is shown in Figure 1.

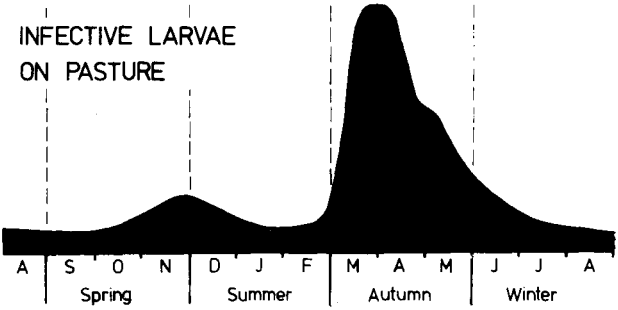
Figure 1: Life cycle of typical gastrointestional roundworm in sheep.



Adult worms in the abomasum (fourth stomach) or small intestine lay eggs in the faeces which contaminate the pasture. Under warmer conditions (spring, summer, autumn) many eggs hatch and larvae begin to develop through their various stages (L1 → L2 → L3).

Most developing eggs and larvae are easily killed by hot dry weather (summer) or cold (winter) weather. Mild moist conditions (spring and autumn) favour survival of larvae so their numbers on pasture increase. Once larvae reach the infective stage (L3) they may migrate from the dung pat to the soil or on to pasture. The seasonal pattern of larvae on pastures is shown in Figure 2.

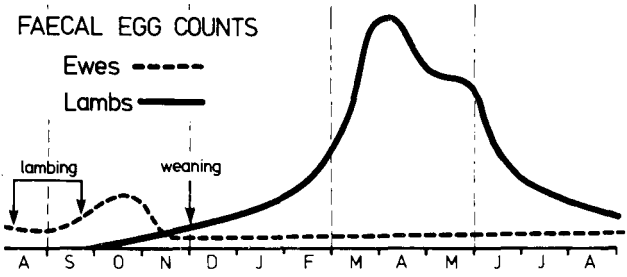
Figure 2: Season pattern of larvae on pasture.



Nematodirus is unusual in that it can survive winter by completing its development inside the egg shell. When warmer weather comes its infective larvae finally hatch out of the egg and from there on behave like other types of roundworms.

When pasture contaminated with infective larvae is eaten by a susceptible (growing) sheep the larvae immediately develop through the final larval stage to the adult worm, mate and produce eggs. This begins the cycle again. The seasonal pattern of worms in sheep reflects the levels of pasture larvae they are eating and is illustrated by seasonal levels of eggs in the faeces in Figure 3.

Figure 3: Seasonal pattern of roundworms in sheep as indicated by worm eggs in their faeces.



During the part of the life cycle inside the sheep, larvae and adult worms irritate and inflame the lining of the gut. They may cause mild to severe illness and death depending on the number of worms present. In favourable seasons the life cycle is completed in a matter of a few weeks and parasite numbers increase both in the animal and on pasture. During less favourable weather, parasite numbers on pasture may fall but those in the sheep will remain high unless treated.

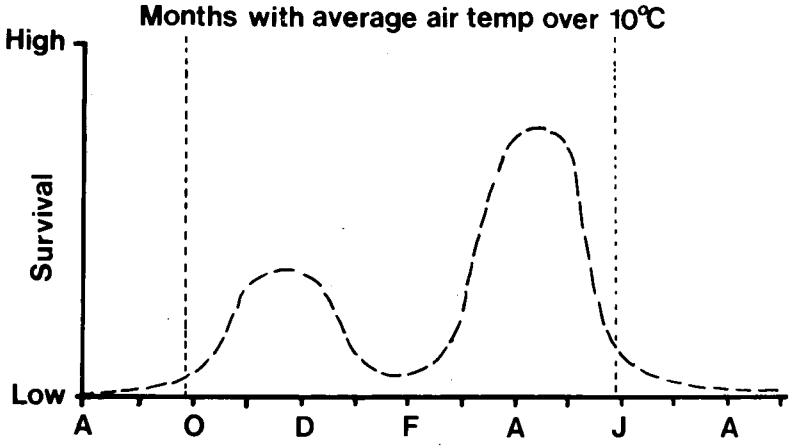
Parasites on Pasture

SEASONAL FLUCTUATIONS

Climate

Figure 4 illustrates the seasonal survival rate of parasites on pasture. Gastrointestinal parasites complete their life cycle fastest in warm wet conditions. Therefore numbers build up through summer and early autumn but drop if hot dry weather occurs.

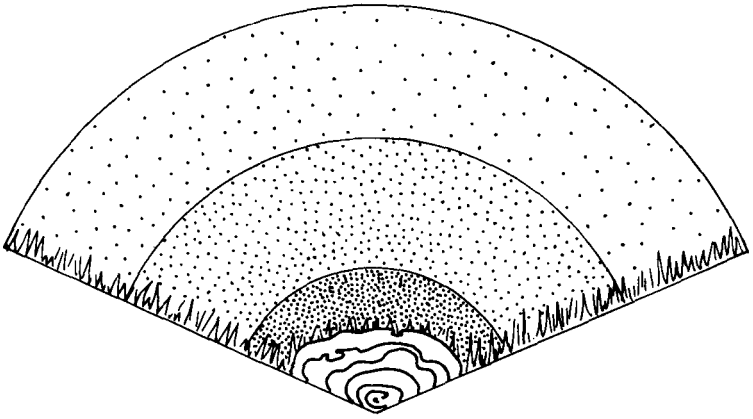
Figure 4: Seasonal pattern of survival of parasite eggs and larvae on pasture. Note the very low survival rates in winter and mid-summer.



Most eggs and larvae on pasture die during cold weather (when average air temperature is less than 10°C). A few eggs and larvae over-winter successfully and together with parasite eggs shed by ewes after lambing initiate the build up in parasite numbers over the next spring/summer/autumn period.

Figure 5: The migrating pattern of larvae onto pasture away from a dung pat. Larvae are represented by small dots.

The Horizontal Distribution of Infective Larvae on Herbage

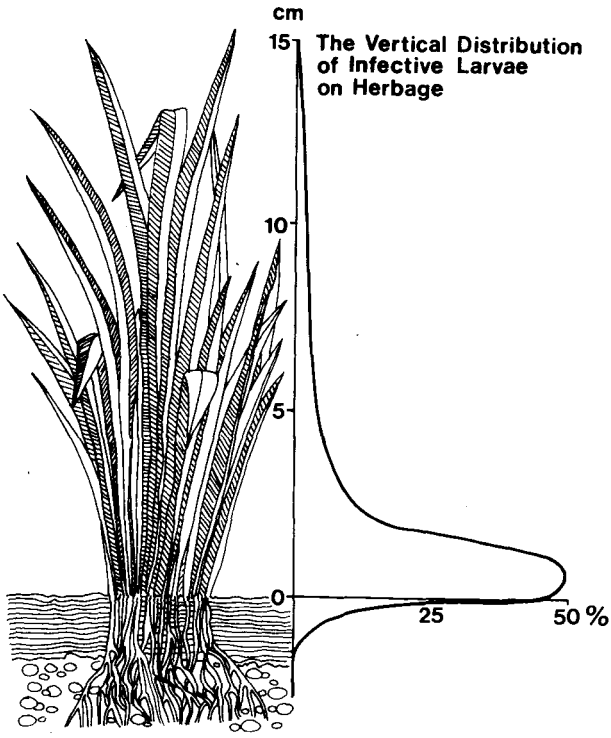


Pasture

Larvae emerge and migrate from the dung pat to nearby pasture (Figure 5). Most larvae are found in the first 2 centimetres of pasture height or in the first 1 centimetre of soil (Figure 6).

Length of pasture affects the rate at which dung pats dry out and eggs and larvae die. For example a short pasture resulting from intensive grazing produces a less suitable environment for larval survival than a longer pasture.

Figure 6: The distribution of larvae on pasture plants.



Grazing Management

On the other hand intensive grazing exposes animals to a higher level of larval intake than animals lightly grazing the same pasture. Amounts and patterns of dung deposition and therefore numbers and distribution of parasites on pasture will vary with type of grazing management used.

Danger Periods

The number of larvae on the pastures of New Zealand sheep farms varies throughout the year and is highest in autumn. Danger periods extend from spring to early winter with extreme danger from March to July.

Self Assessment: Contaminated Pastures

Effective parasite control programmes can only be planned with an understanding of where parasites in the sheep come from and what affects their levels on pasture. Only then can effective and safe programmes be planned for individual farms.

In Figure 7 (below) the level of parasite eggs in ewe and lamb faeces are shown in the top graph above a graph of the l of parasitic larvae on pasture.

Draw in a series of arrows to demonstrate your understanding of how parasite levels in the sheep and on the pasture are interrelated.

You can assess your understanding by inspecting th mpleted diagram together with the explanation on the next page.

Figure 7: Seasonal patterns of parasite levels in sheep (top graph) and on pasture (bottom graph).

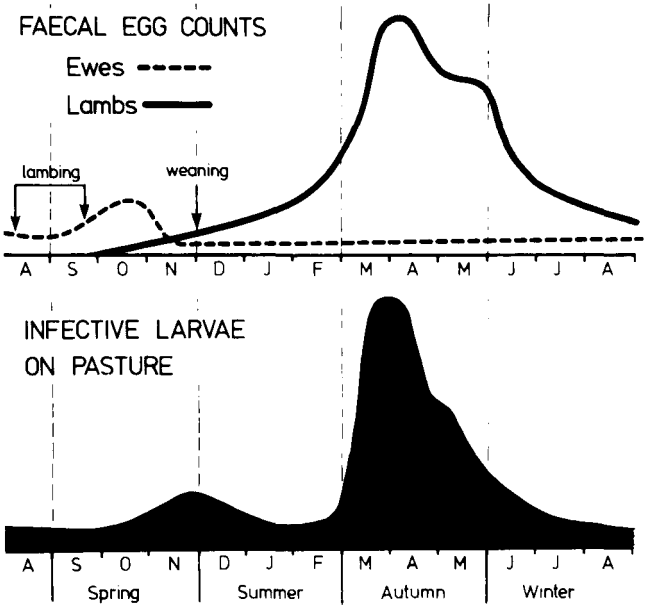
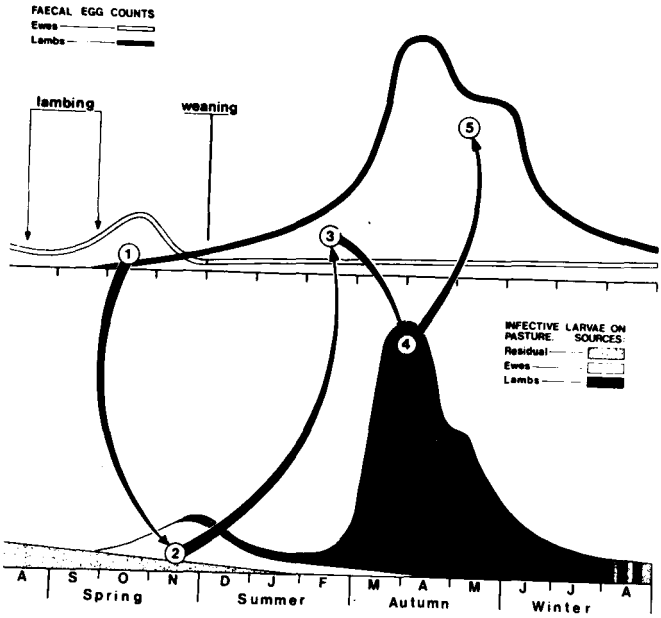


Figure 8: Seasonal patterns of parasite levels in sheep and on pasture showing how they are interrelated.



Eggs and larvae originating from ewes after lambing (1) plus those which successfully over wintered produce mild contamination of pasture in spring (2).

They develop with the warmer weather and infect susceptible young lambs in spring.

Most larvae grow to adulthood inside the lambs and by summer their dung contains increasing numbers of eggs (3).

Large numbers of eggs are deposited on pasture in late February and early March.

Survival of larvae increases with the wet milder weather of late summer and autumn and soon there are very high numbers on pasture (4).

When eaten by lambs this autumn pasture produces parasitic infections in late autumn and winter (5).

Parasites in the Sheep

THE SHEEP

Species

Sheep and goats are affected by the same parasites but for all practical purposes gastrointestinal parasites in cattle do not infect sheep and vice versa. This means that alternative grazing of sheep and cattle is a useful grazing management method to make the pastures less contaminated and safer for both species. The longer the interval between successive groups of sheep the more effective the results.

Age

As sheep get older they develop the ability to resist the establishment of new gut infections and expel most or all of the worms already there. This is very similar to the way animals become immune to infections of bacteria and viruses.

In practical terms this means that sheep older than 10-15 months can safely eat pasture heavily contaminated with larvae. Most larvae do not develop to adults in the gut. This is why adult sheep and cattle are "resistant" to the effects of worms and growing sheep are "susceptible" to them.

Health

Animals subject to malnutrition or other diseases are less able to protect themselves from serious parasite infections.

Post-Lambing Decline in Resistance

For a month or two after lambing the ewe's immunity to parasitic infection is reduced. She does not become visibly ill but there is a marked increase in eggs in her dung. The lactating ewe is an important source of parasitic infection for the new generation of spring lambs.

EFFECTS OF PARASITES ON SHEEP

Growing Sheep

Production decreases caused by large parasitic infections of growing sheep can be very severe and result in reduced body weight gain, reduced wool, scouring and death. However, moderate to low numbers of parasites cause less obvious problems which nevertheless reduce productivity.

After being swallowed, the larvae burrow into the wall of the gut causing irritation and inflamation which can result in digestive upsets, ulcers and bleeding. The effects on metabolism and performance are wide ranging and include:

* depression of appetite → reduced intake
* changes in mineral metabolism → smaller skeleton
* reduced protein metabolism → lighter animal
* digestive upset → scouring

These effects can be confused with and may exaggerate the effects of several nutritional deficiencies. A consequence is illthrift which is a severe reduction in efficiency of utilisation of feed as well as reduced growth rate.

In New Zealand, excellent results from controlling parasites in growing sheep have been demonstrated. Increased lamb weight gains of up to 50% and increases in greasy fleece weights of up to 25% have been recorded. There is no doubt that effective parasite control in growing sheep is needed on the majority of New Zealand sheep farms.

Adult Sheep

The effect of parasites on productivity of adult sheep is less clear. Mature sheep are generally thought to be resistant, although some depression of wool quantity and quality in milk yield has been

seen in ewes eating parasitic larvae during lactation.

In addition pre-tupping drenching has produced small, variable but often positive increases in lambing percentages.

A post-lambing drench may slightly improve wool quality. A drench at this time will also reduce pasture larval contamination and hence may increase lamb productivity. However these production responses are usually small and may only cover the cost of the drench. In addition drenching ewes may increase drench-resistance in worms.

Drenching

USES AND LIMITATIONS OF DRENCHING

Types

There are two "action-families" of drenches currently available in New Zealand (see Table 2). Thibenzole was the first of these "white drenches" but there are now many others.

The second "action-family" contains the "clear drenches": Exhelm E, Nilverm and Ripercol. The two "action-families" act on parasites in different ways.

Table 2: Currently available broad-spectrum drenches for sheep listed in their two "action-families".

Family 1		Family 2
Anthelworm	Systamex	Exhelm E
Bonlam	Telmin RLT	Nilverm
Nemafax	Thibenzole	Ripercol
Panacur	Topclip	
Rintal	Valbazen	
Supalamb	Wormguard	
Synanthic		

How Drenches Work

Both "action-families" of drenches are absorbed from the gut (or the injection site) into the sheep's blood. They then pass into the gut wall and act on parasites at this stage.

The benzimidazoles (family 1) act on vital functions inside the worm. They are highly effective against roundworms and also kill the worms' eggs.

The second "action-family" consists of quite different chemicals

which, because they act in the same way, are put into one "action-family". These chemicals effectively paralyse worms but do not kill their eggs.

The Gut Trigger

This refers to the fact that in sheep (and other ruminants) liquids may sometimes pass the first stomach (rumen) and go quickly to the fourth stomach (abomasum). If white drench goes to the fourth stomach it will be absorbed and excreted more rapidly. However under normal circumstances there will be no appreciable difference in antiparasitic effect.

How Long Do They Last?

It is important to remember that the chemicals in drenches are excreted from the animal's body very quickly. That is, they are only effective over a few hours and have no carry-over effect.

Future Drenches

There is a third "action-family" of drenches which is being introduced to the New Zealand market. It is called the avermectin family. To date this family of drench is only available for cattle (Ivomec).

However, because it is becoming more and more expensive to develop new products, including drenches, new drenches will not become available in the future at the rate they have over the last 20 years.

Therefore, it is important to delay the development of drench resistance by conserving the useful lifespan of existing drenches for as long a possible. This can best be done by minimising the number of drenches used each year.

DRENCH RESISTANCE

What is Resistance?

Drench resistance occurs when exposure to a normal dose of drench does not kill most worms. Worms that are resistant to one drench in an "action-family" are likely to be resistant to all drenches in that "action-family". Drench resistance is inherited from one worm generation to the next.

Resistance in New Zealand

A recent nationwide survey revealed that resistance is not yet a major problem in sheep. However three strains of resistant *Haemonchus* have been found and other resistant worms may be developing now. Similar resistance problems are present in other countries. Scientists warn that it is important to plan drenching practices which will slow the development rate of resistance.

How to Reduce Resistance

Knowledge of how to control resistance is incomplete. As we can expect very few new "action-families" of drenches to replace the current ones, conservation of the useful life of today's drenches is essential. Dr Peter Kettle of Wallaceville Animal Research Centre suggests this can be best achieved by:

* decreasing use of all drenches
* increasing use of other control methods
* rotating drenches between "action-families"

Available evidence suggests that as long as both "action-families" are not used on a single generation of worms then it makes little long term difference whether:

1. "action-families" are changed each year, or
2. one "action-family" is used for several years and only replaced by the other when resistance occurs to the first.

Parasite Control Programmes

CURRENT DRENCHING PRACTICES

A 1980 survey of 614 sheep farms was conducted throughout New Zealand by MAF scientists.

Drenching Frequency

They found that during 1979/80 drenching frequency was higher than the previous year and:

* lambs were drenched an average of 6.3 times usually at weaning and then at roughly monthly intervals through summer and autumn. Fewer drenches were given between July and October.
* 1 to 2 year old sheep were drenched an average of 1.8 times. 20% of farmers did not drench 1 to 2 year olds.
* adult sheep were drenched on average 1.2 times. The most common times were pre-tupping and pre or post-lambing. 29% of farmers did not drench adult sheep.
* average annual expenditure on drenches was approximately $1,000 per farm.

Lack of Knowledge

The survey results indicate that many farmers did not understand the function, advantages and limitations of drenches. In particular knowledge was poor concerning the types of worms killed by each drench, the need to use recommended dose rates and the fact that current drenches have no effect against re-infection by worms.

It is clear that to avoid wasting money, farmers must increase their knowledge of drenches and read the labels more thoroughly. In general they were not aware of how to reduce worm contamination of pasture by combining drenching, pasture management and stock management techniques.

Limitations of Current Drenching Practices

The survey showed that farmers were relying on drenching young stock by:

* *preventive drenching* - to prevent build up of parasites on pasture and in the animal by drenching regularly throughout the year or,
* *protective drenching* - to protect animals against the worst effects of worms during the period of greatest risk only or,
* *curative drenching* - to cure lambs after the appearance of scouring or illthrift.

Preventive Drenching is Better Than Curative Drenching

Protective drenching and *curative drenching* reduce production losses in lambs by treating lambs after they are infected.
These methods reduce the number of worms in the animal (briefly) but do nothing about the high numbers on pasture. They have been out of date for some time and should be avoided.

By preventing lambs becoming infected *preventive drenching* is more effective than the other two methods. It avoids production losses by keeping the number of larvae on the pasture and therefore in the animal, low. Lambs are not being continually reinfected by eating pasture containing large numbers of larvae.

Effective Drenching Programmes

Under ideal conditions parasitic larvae eaten by the lamb can become adults and shed eggs in the faeces within 4 weeks. So as to avoid contaminating pastures with parasite eggs, lambs must be drenched at intervals of less than 4 weeks.

Drenching every 3 to 4 weeks is the basis for a good drenching programme but because it is very costly and will increase the risk of drench resistance some compromise is necessary.

A well planned drenching programme reduces the levels of parasites in the animal and on pasture. At some times of the year the weather (cold weather below 10°C and hot dry weather) will kill many parasites on pasture. If pasture levels are low, the lamb is reinfected more slowly and drenching programmes should make use of this fact. Therefore a mixture of drenching and using the weather to kill parasites can achieve good results with a reduction in the amount of drench required.

Examples

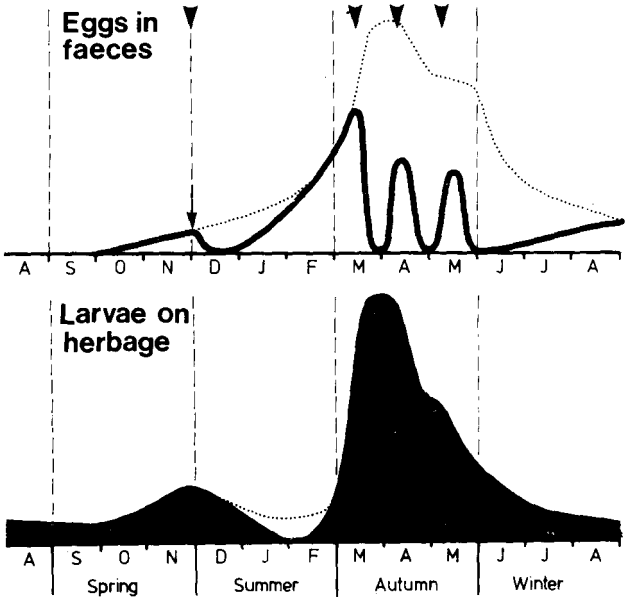
Two examples will now be discussed to illustrate that *preventive drenching* is far more effective than protective and curative drenching. To fully appreciate this example you will need to understand the earlier section on contaminated pastures.

Example 1: *Curative Drenching*

In Figure 9 four drenches (marked with arrows) were given to lambs as one drench at weaning and three drenches in autumn at 28 day intervals. This is still a farily common farming practice but its aim is to cure infected animals not to prevent animals becoming infected.

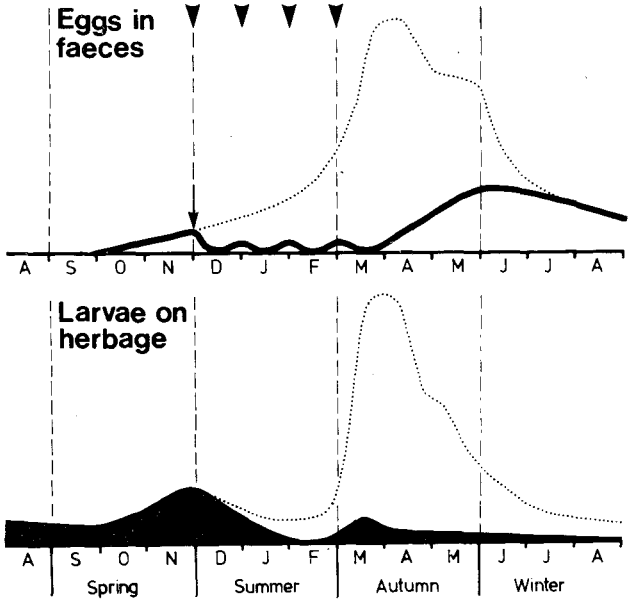
The weaning drenching has little lasting effect on the worms in the animal or on pasture when given by itself. The 3 autumn drenches greatly reduce the output of eggs in the dung but do nothing about the high levels of larvae on pasture. So the effect of each drench is brief as lambs continually become reinfected by eating pasture with high larval levels.

Figure 9: The effect of four curative drenches, the first given at weaning and the other three given in autumn at 28 day intervals. Note the good but brief reduction in worm numbers in the animal and the absence of any reduction of worm numbers on pasture.



The reason that the autumn drenches did not produce "safe pasture" is because the larvae originated from faecal egg contamination deposited earlier (during summer and early autumn). If you do not understand this point go back and study the section on contaminated pasture.

Figure 10: The effect of four preventive drenches given from weaning at 28 day intervals. Note the large reduction (especially in autumn) of worm numbers both on pasture and in the animal.



Example 2: *Preventive Drenching*

In Figure 10 we see four drenches used in a *preventive* way. The first drench was again given at weaning and followed at 28 day intervals by 3 further drenches (indicated by arrows).

This resulted in far fewer worms contaminating pasture with eggs in summer. In turn this meant that the number of larvae on pasture in autumn was low and lambs were eating "safe" pasture and did not need autumn drenching.

The production responses of these two lamb drenching programmes were compared by Drs Vlassoff and Brunsdon of the MAF at Wallaceville and at Kaitoke in 1978/79. The *preventive* programme of summer drenches produced better results than other (curative or protective) programmes of autumn drenches.

Financial Returns

At 12 months of age lambs which had the summer drenches were 4.9 kg heavier at Wallaceville and 5.7 kg heavier at Kaitoke. In addition greasy fleece weights were also heavier by 0.64 kg at Wallaceville and 0.69 kg at Kaitoke.

These results show that control of pasture contamination by drenching in summer means that drenching in late autumn and winter is not needed.

When farmers adopt preventive summer drenching it is most important to have no more than a maximum of 28 days (4 weeks) between drenches. The interval should not be varied because of weather conditions. If the interval is longer, parasites can complete their life cycle, begin to lay eggs and contaminate the pastures.

RECOMMENDED DRENCH-ONLY CONTROL PROGRAMMES

Firstly, it should be said that the best control progammes minimise drenching to reduce costs and drench resistance. Such programmes mix (integrate) other control methods into the programme. These other methods such as spelling and grazing with cattle are also aimed at producing "parasite-safe" pasture.

This mixture of methods is known as integrated control and is discussed later in this handbook. Integrated control progammes will have different drench recommendations to those appearing below.

However if a drench-only control programme is planned the following recommendations are made by the MAF experts. As conditions may vary a little between farms it is a good idea to check your drenching programme with your veterinarian or farm advisor.

Lambs

Preventive summer drenching programmes are recommended. There must not be more than 28 days between each drench. In fact scientists at Wallaceville Research Centre currently recommend a five drench programme. A drench at weaning → 21 days → 2nd drench → 21 days → 3rd drench → 28 days → 4th drench → 28 days → 5th drench.

Do not expect rapid weight gains immediately after the summer drenches. The value of this programme is the good progress lambs will make in autumn whilst grazing "parasite-safe" pasture.

Hoggets

If hoggets in spring are well grown and have come through their first winter in good condition there is probably no need to drench them. However, if they are not in good health, it is probably worth asking your vet to check their parasite levels. A drench before a move to safe pasture may be warranted.

Ewes

Due to the limited amount of research work it is difficult to be precise about drenching ewes. One school of thought recommends that as production responses to ewe drenches are usually low and as drench resistance may be a future problem it is best not to drench ewes at all.

Another school of thought suggests that a pre-tupping drench may sometimes (but not always) slightly increase the lambing percentage. Although measured responses to pre-lambing drenching are usually nil or very slight, some research work has shown the value of a drench approximately 2-3 weeks after lambing. Wool quality and lamb growth rates were improved. There may also have been some effect on milk production.

In addition a post-lambing drench would reduce the numbers of eggs shed by ewes onto the pasture during lactation. This may be important for control of worms in lambs.

INTEGRATED CONTROL

Flexibility

"Integrate" is a jargon word which means "mix". A farmer who uses integrated parasite control selects various methods and combines them to provide a balanced control programme. Basically, suitable methods of producing "safe" pasture for lambs are combined with a preventive drenching programme.

Integrated control is a flexible idea which can be tailor-made for each farm. In the early stages the farmer may need help from his farm advisor and vet to put the best mixture of methods together.

Adopting an integrated control programme is not a revolutionary step. It is just another example of farmers using modern information and methods to control an old problem.

Expected Returns

Changing to an integrated control programme aims to:

* increase farm income by improved lamb productivity and
* decrease the rate of development of drench resistance by reducing drenching frequency.

Worms are a major problem for lambs on most New Zealand sheep farms. Therefore effective control of worms will increase body weights and wool weights. The results of the recommended programmes will not be obvious through the summer. It is during autumn and early winter that the benefits will be seen.

PRODUCTION OF SAFE PASTURE

What is Safe Pasture?

Safe pasture is not parasite free but it has too few larvae to allow an increase in parasite numbers while it is being grazed by lambs.

Safe pasture is required for two important periods:

* Safe Pasture for Summer Use must be available at weaning in late November or early December. It is pasture which has not been grazed by ewes and lambs between the start of lambing and weaning.
* Safe Pasture for Autumn Use is pasture available in late February and early March which has not been grazed by lambs since weaning. Safe pasture may be produced by several methods which are now described.

Grazing with Adult Sheep

Adult sheep can be used to prepare safe pasture for lambs in the same way as cattle are used. Lactating ewes cannot be used for this purpose unless drenched first. Rising two-tooth sheep should also be drenched prior to being used for this purpose.

Grazing with Cattle

Pasture can be made safe for lambs by grazing with cattle and vice versa. The effect will be better the longer the cattle have been grazing a pasture before lambs are reintroduced. For example in spring, cattle could either be run on their own or with ewe hoggets to provide safe summer pasture available for lambs at weaning. During summer the cattle could be preparing the area to be allocated to the lambs in autumn.

Drenching

"Preventive" summer drenching of lambs produces safer pasture for lambs to graze in autumn. The way to achieve this has been described in the earlier section on Effective Drenching.

Hay and Silage Regrowth

Making hay or silage removes and kills larvae on pasture. Subsequent pasture regrowth can be used as safe pasture.

New Pastures and Fodder Crops

Cultivation and sowing of new pasture or a fodder crop will make the new area safe. Direct oversowing or conservation tillage may be less effective at producing safe pastures but no information exists to confirm this statement.

On farms moving towards all grass wintering, the contribution to safe pasture from cultivation will be limited. On specialised cropping properties where practices such as white clover undersowing of cash crops occur - the potential for producing safe pasture can be good.

Pasture Spelling

The spelling time necessary to allow larvae and eggs to die varies with climatic conditions. It may be as short as 2 months during hot dry or very cold conditions and as long as 6 months during mild to warm moist conditions.

Spelling for up to 2 years may be needed to kill *Nematodirus* eggs.

When pasture growth during a spelling period is high it can be conserved as hay or silage.

Chemical Sterilisation of Pasture

Chemical destruction of eggs and larvae on pasture is not economic at present. Although it may be technically feasible it is likely to be very expensive.

Experiments have shown that heavy applications of superphosphate (750 kg/ha) prevented eggs developing but 230 kg/ha of ammonium suphate had no effect.

ESTIMATING DEMAND FOR SAFE PASTURE

Which Animals Need It?

Lambs.

When Is It Needed?

The recommended system for lambs requires safe pasture for:

Summer Phase: Give one drench at weaning before a move onto safe pasture. To be safe a second drench should be given 21 to 28 days after the first.

Autumn Phase: After 12 weeks on the summer phase area one drench is given in late February or early March before a move onto fresh safe pasture. Again to be safe a second drench 21 to 28 days later is recommended.

So for planning safe pasture a farm may be divided into 2 areas. The first area is used from lambing to weaning, the second from weaning to early March, then the first area is used again from March onwards.

Lambs must never be allowed into the next area being prepared for them. However, if required other stock can be used for pasture control in the area being grazed by lambs. Safe pasture is provided by moving lambs from area 1 to area 2 then back to area 1.

It is important for parasite control to stick to the 12 week grazing period for the summer phase pasture and also to make the change to autumn phase pasture in early March.

Whether lambs are rotationally grazed or set stocked is not important.

There are two further recommendations:

1. On farms where *Nematodirus* worms cause an annual problem in lambs attempts should be made to avoid rearing lambs to weaning on the same area in successive years.
2. It is desirable but not essential that lambs are not reared to weaning on areas grazed by lambs in the previous autumn and winter.

How Much Is Required?

The demand for safe pasture on a farm is estimated by feed budgeting. It must take into account:

1. initial demand by all weaned lambs.
2. changed demand as lambs are drafted off as stores or export lambs.
3. the demand by ewe lambs kept as replacements.

It is not difficult to calculate how much safe pasture is required each month if stock numbers are known.

PLANNING SUPPLY OF SAFE PASTURE

Summer Phase Safe Pasture

This is pasture which is not grazed by ewes and lambs from lambing to weaning. It is required for 12 weeks between late November and late February and must be sufficient to meet the demands of all lambs for those 12 weeks after weaning.

If the estimated supply of summer phase safe pasture is below the demand then either the supply must be increased or the demand decreased. Making the summer phase pasture last the 12 weeks is one of the most difficult aspects of integrated control.

Autumn Phase Safe Pasture

This is grazed with ewes and lambs between August and December - that is from lambing to weaning. It is desirable (although not essential) that this area has not been grazed by lambs during the previous autumn and winter. It is then "spelled" from lambs for 12 weeks starting at weaning. After that (i.e. in early March) it is used for lambs again as Autumn Phase Safe Pasture.

Increasing the Amount of Safe Pasture

To increase the amount of safe pasture a number of possibilities can be considered. These include:

* increasing the number of two-tooths retained
* using hay or silage regrowth
* using cattle
* producing safe pasture by drenching lactating ewes.

The demand for safe pasture may be reduced by using safe pasture for only some of the lambs. This would be much better than exposing all lambs to safe pasture for a short time and then having to expose them all to contaminated pasture. The favoured lambs could be either

the ewe replacements or a proportion of the export lambs.

Possible Problems

There are a range of possible practical problems which may be encountered during the course of an integrated control programme. Some of these with suggested solutions include:

	Problem	Solution
1.	Difficulty in identifying paddocks.	Paint gates an identifying colour.
2.	Desire in spring to put ewes and lambs on area being prepared for safe summer pasture.	Resist temptation! Appreciate bodyweight gains in other animals preparing the safe pasture.
3.	Unable to produce enough summer (post-weaning) safe pasture.	Accept lower growth rates in summer and compensate later in year or move some or all lambs on to non-safe pasture and drench at 21 to 28 day intervals or reduce lamb numbers by early drafting.
4.	Quality of summer safe pasture declining.	Put cattle and or two-tooths back into this area to clear up pastures. If not enough feed for lambs see *3.* above.
5.	Shortage of autumn safe pasture	as for *3.* above.

RECOMMENDED INTEGRATED CONTROL PROGRAMMES FOR LAMBS

As integrated control is an idea, there is not one complete set of recommendations that cover every farm.

The farmer must adopt a sound planning scheme to produce safe pasture and use the pasture together with a preventive drenching programme (for details see relevant sections).

Once an individual farmer has designed a control system every effort must be made to stick to it. The increased stock performance under integrated control programmes is likely to be worth the additional effort.

SUMMARY

At the present time too many sheep farmers in New Zealand are wasting money by using drenches at the wrong times. They are also increasing the risk of producing drench resistant worms.

More effective parasite control and increased stock performance can be achieved by either:

1. Preventive drenching programmes which use drenching at especially effective times or
2. Integrated control programmes which combine preventive drenching with pasture management and grazing management.

The first method is good the second is better.

Farmers adopting either method should seek help from their veterinarian and farm advisor in order to plan a safe and effective control programme. They can look forward to reduced drench costs, increased lamb performance and a reduced risk of drench resistant worms.