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WORM CONTROL PROGRAM

East Coast

A regional worm control program for goats from WormBoss

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WORMBOSS WORM CONTROL PROGRAM

East Coast

Authors: Maxine Lyndal-Murphy (industry consultant), Sandra Baxendell (Goat Veterinary Consultancies—goatvetoz), Lewis Kahn (ParaBoss), Deborah Maxwell (ParaBoss), Lewis Kahn (ParaBoss), and Stephen Love (NSW DPI).

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Contents

Program summary

The WormBoss worm control program for the east coast areas of Queensland, New South Wales and Victoria has five components that are most effective when used in combination.

A summary of the components is below (see further chapters for details).

Note: an *Australia Smallholders Program* and an accompanying *Drench Decision Guide* exists for goat owners who can regularly monitor and treat individual goats.

1. Use grazing management to create low worm-risk paddocks

- Prepare low worm-risk paddocks for kidding does and weaners.
- Prevent contamination with worm larvae in the 2-3 months before they are needed:
  - Spell paddocks
  - Graze cattle or horses, grow browse, crops, hay or new pastures or graze with goats or sheep for up to 3 weeks after the protection period (when it is killing worms) of an effective drench[1].
- Where it is not possible to use grazing management, feedlotting of goats can be practiced. Feeders and waterers should be designed so there is no faecal contamination.
- Where scour worms are more prevalent, use Smart Grazing.
- Choose the least contaminated kidding paddocks for the most susceptible kidding does.
- Provide adequate browse where possible.

2. Breed and feed for goats resistant and resilient to worms

- Use bucks with better than average worm egg count Estimated Breeding Values (WEC EBVs) in KIDPLAN by choosing the more negative values.
- Maintain good nutrition to enhance the goat's immunity to worms.

3. WormTest at recommended times

- Does prior to kid marking and weaning and then *WormTest* at 4–6 week (summer) or 6–8 week (winter) intervals after a short-acting drench. If using a persistent drench then see Effective use of long-acting drenches.
- Kids from weaning to their first kidding: *WormTest* at 4–6 week (summer) or 6–8 week (winter) intervals after a short-acting drench. If using a persistent drench then see Effective use of long-acting drenches.
- Bring forward *WormTests* if there has been significant rain (20+ mm) that also has follow-up rain (10+ mm) in the following few weeks. Do separate tests for adults and weaners.
- Bucks at 4–6 week (summer) or 6–8 week (winter) intervals after a short-acting drench and ensure a *WormTest* occurs one month before joining.
- Dry adult goats should still be monitored at 4–8 week intervals.
- If *DrenchTest* results are not available conduct a *DrenchCheck* 14 days after treatment.
- And at other non-routine times as suggested in the *Drench Decision Guide*.
- If you have only a small herd of goats, worm egg count testing can be supplemented with monthly body condition scoring and checking the eye mucous membrane colour at weekly (summer) and monthly (winter) intervals.

4. Drench[1,2] strategically at recommended times

- Quarantine drench all introduced goats with an effective short-acting drench that provides (for meat goats) four drench groups including one from either of the most recently available products or (for dairy goats) fenbendazole and abamectin which are registered for use where milk is for human consumption.
- Breeding does pre-kidding (as they temporarily lose their immunity).
- If kidding is spread out over months and does are not separated from the rest of the herd, still give a pre-kidding drench to individual does 4 weeks prior to kidding if due dates are known. This pre-kidding drench will not be as effective compared to the doe being drenched and moved to a low worm-risk paddock.
- Kids at weaning.
- Drench individual goats showing obvious signs of worm-related illness and WormTest the rest of the goat herd.
- At other times, use the *Drench Decision Guide*, and the *WormTest*.

5. Manage drench resistance

- Conduct DrenchTests every 2–3 years. Use DrenchChecks between DrenchTests or if there are not enough goats in your herd to conduct a DrenchTest.
- Avoid unnecessary drenching by restricting treatment to recommended times or in response to WormTest results.

- Use effective drenches and multi-active[3] combinations where possible. Note: multi-active combination and other drenches are not registered for use in goats. In some states and territories they can only be used with an off-label prescription from your veterinarian.
- In general, use short-acting treatments with long-acting products reserved for specific purposes or high worm-risk times and with an off-label prescription from your veterinarian.
- Calibrate your drench guns, dose to the heaviest goat and follow the label or your veterinarian's instructions.

[1]This drench must be tested and shown to be effective on your property
[2]Drench refers to anthelmintics regardless of route of administration
[3]Drench groups are the chemical family to which an 'active' belongs. An 'active' is the chemical in a drench responsible for killing worms. Some drenches contain more than one active and are called 'multi-active' or 'combination' drenches. See Appendix F: Drench groups and actives.

Introduction

This is an up-to-date, integrated regional worm control program for goats for the east coast regions of Queensland, New South Wales and Victoria. It builds upon earlier programs (including from the state departments of primary Industries: NSW DPI and Qld DAFF) and accumulated knowledge, as well as new information from the Integrated Parasite Management in Sheep project, funded by Australian Wool Innovation.

The program aims to improve the profitability and welfare of your goats through:

- fewer deaths and illness from worms
- fewer drenches, particularly long-acting drenches
- improved productivity
- prolonged life of drenches

Where is the East coast region?

This region runs south from Cooktown, Qld to Melbourne, Vic. It covers several climatic regions and generally lies east of the Great Dividing Range, with much of the region receiving rainfall in excess of 1000 mm per year. The relative importance of worm types differs within the region due to differences in maximum and minimum temperatures.

A map of the region is shown below.

Figure 1. The East coast region

What worms are covered in this program?

Roundworms

Northern areas (generally north of Sydney)

The most important roundworms in this region:

- Barber's pole worm *Haemonchus contortus*
- Scour worms
  - Black scour worm *Trichostrongylus colubriformis*
  - Brown stomach worm *Teladorsagia circumcincta* (NSW)

Less important or only occasionally seen worms:

- Large bowel worm *Oesophagostomum venulosum* (NSW)

Southern areas (generally south of Sydney)

The most important roundworms in this region:

- Barber's pole worm *Haemonchus contortus*
- Scour worms
  - Black scour worm *Trichostrongylus colubriformis* and *T. vitrinus*
  - Brown stomach worm *Teladorsagia circumcincta*
  - Thin-necked intestinal worm *Nematodirus* species (in young goats)

Less important or only occasionally seen worms:

- Small intestinal worm *Cooperia* species

Liver fluke

Liver fluke *(Fasciola hepatica)* is an internal parasite that occurs throughout this region where there are colonies of the intermediate host snail (*Austropeplea* (*Lymnaea*) *tomentosa*). It can affect goats severely, sometimes causing deaths. The life cycle differs from the simple life cycle of roundworms, so control strategies are different. Liver fluke should be considered if there are cases of anaemia or bottle jaw in goats that are not associated with barber's pole worm.

This program relates to roundworms. To control liver fluke, see Appendix A. Liver fluke control.

Other worms

Gastro-intestinal parasites of minor importance, such as stomach fluke and tapeworm, are not covered.

Grazing management

Sheep and goats carry the same worms and when grazed together goats carry heavier worm burdens than do sheep, especially in the absence of browse. It is best to not run sheep and goats together, except in the pastoral zone where worms are not as important and where goats have access to browse, which they prefer. If you do run both goats and sheep in higher rainfall zones, run goats on different areas of the property from sheep. Goats also share common worms with alpacas. Goats can be successfully run with horses and cattle.

NOTE: goats can also be infected by the brown stomach worm (*Ostertagia ostertagi*) from cattle, unlike the situation with sheep and lambs. Use adult cattle that are resistant to worms.

Grazing management techniques that reduce the exposure of goats to worms are based on these four steps:

- Avoid grazing on paddocks heavily contaminated with worm larvae.
- Reduce contamination of paddocks with worm eggs.
- Allow time for most of the eggs and larvae on the pasture to die.
- Where possible, provide adequate browse.

If these practices are not practical then consider feedlotting and ensure that feeders and waterers are designed to avoid faecal contamination.

Which goats are most susceptible to worms?

- Weaners in the months after weaning until about 18 months of age, when they develop a higher level of worm immunity. Paddocks used by young goats should be of the highest quality pasture as the first priority, ideally they should also be of low worm-risk. Bucks remain as susceptible as young goats.
- Late pregnant and lactating does are highly susceptible to worms as their worm immunity is reduced in late pregnancy and through early lactation. This can contribute to the seasonal increase in worm numbers and later infection of kids at foot.
- Adult or not lactating (dry) goats remain susceptible to worms as their immunity develops more slowly than it does in sheep, and is often incomplete.
- Rangeland goats moving into higher rainfall areas are highly susceptible to worms as they have little experience of worm infection and hence their immunity is poorly developed. Paddocks used by these goats should be of low worm-risk.

How are low worm-risk kidding and weaner paddocks prepared?

Whether the paddock is for kidding does or for weaned kids the method of preparation is the same. However, the length of preparation will vary according to the time of the year the paddock first needs to be used. Refer to Factors contributing to pasture contamination to find out how long you need to prepare your paddock.

What if grazing management is not practical on my small farm?

- The most effective grazing management under this constraint is to feedlot your goat, which separates them from pasture that contains the infective stage of worms. Many goats in small herds or kept in backyards already receive a lot of supplementary feed so when worm control costs are taken into account, going to a zero grazing (feedlot) situation may be cost effective, especially if existing pastures can be converted to growing browse for cutting and feeding.
  - There must be absolutely no grazing in the feedlot area by spraying out the grass and replacing with gravel, pine-bark or similar or leaving as compacted dirt.
  - Feeders and waterers must be designed so that there is no manure contamination of the feed by the goats' feet or manure. Waterers must also be kept clean and in good order.
  - Grass can sometimes grow around waterers that leak and these plants should be removed as they would have high numbers of worm larvae.
- Feedlotting is used by many commercial dairy goat producers due to milk withdrawal times and penalties associated with milk residues. It can also reduce the spread of Johne's disease, which occurs in some dairy goat herds.
- Feedlotting can also protect against dog attacks and paralysis ticks, which are also common problems in goats kept in peri-urban areas.

Preparing a low barber's pole worm-risk paddock

Prepare low worm-risk paddocks for kidding does and weaners by preventing contamination with worm larvae in the 2–3 months before they are needed. Preparation will typically require 3 months if conducted during autumn and winter and 2 months if conducted during spring and summer.

Preparation to prevent contamination can use any of the following practices:

- Spell paddocks from goats*
- Graze with cattle or horses
- Grow browse, crops, hay or new pastures
- Graze with goats or sheep treated with an effective drench for up to 3 weeks after the end of the protection period (when it is killing worms).

*Where goats are referred to, include sheep and alpacas, as they can carry goat worms. While cattle also carry some goat worms, adult cattle tend to have very low burdens and contribute very little to contamination of pastures with worms affecting goats.

An alternative method of kidding paddock preparation is 'Smart-Grazing', see Appendix E. Smart grazing to control barber's pole worm in lambing ewes.

Other ways to prepare low barber's pole worm-risk paddocks include rotational grazing with short graze periods alternated with sufficiently long rest periods which can greatly reduce the number of worm larvae on pasture, especially barber's pole worm. Common watering points contained within small areas (e.g. up to 1 ha) that are grassed (i.e. not bare or gravel surface) should be avoided as these can become high worm-risk areas. While these systems (e.g. planned grazing, cell grazing, techno-grazing and intensive rotational grazing) are outside the scope of this publication, they use the principles found in Appendix C. Factors contributing to paddock contamination with worms.

Preparing a low scour worm-risk paddock

Grazing management will be less effective in the parts of this region and times of the year when scour worms might be more prevalent and Smart Grazing may be of greater value.

The paddock(s) that will be used by the most susceptible goats after the autumn break should previously only be grazed by goats or sheep that have received an effective summer drench, or adult cattle (over 12 months old). To minimise contamination with worm eggs, graze for a maximum of 30 days after each effective drench is given (after which treated animals can begin to excrete higher levels of worm eggs from reinfection). A similar stocking rate to the continuous stocking will be achieved by stocking at 2½–3 times your normal stocking rate.

If there is excess feed, the summer drenches can be 'staggered' for different mobs so as to provide a longer intensive grazing period, as removing excess feed (i.e. graze down to at least 3 cm) enhances the kill of worm larvae due to higher temperatures, especially in the southern parts of this region. See Appendix D. Smart grazing to control scour worms in weaner sheep.

To find out more see: Appendix B. Roundworm life cycle and larval survival and Appendix C. Factors contributing to paddock contamination with worms.

Breed and feed for resistance and resilience

Breed for worm-resistant goats

Genetic selection can be used to increase the resistance of goats to worms.

To increase the genetic resistance of your herd to worms use bucks with better than average worm resistance as measured by Estimated Breeding Values (EBV) for worm egg count (WEC) in KIDPLAN. Research has shown that progress will be made, but may be slower than for sheep.

Resilience is independent of worm resistance so must be selected separately by choosing better production performance such as growth, fat and eye muscle depth.

What is the difference between resistance and resilience?

Resistance to worms

Goats that are resistant to worms have lower worm egg counts by reducing worm development and growth, and the rate of egg production of the female worms established in the gut. Reduced larval establishment and expulsion of adult worms are not often observed in goats.

Resilience to worms

Goats that are resilient to worms can grow and produce successfully, despite being infected. It is independent of worm resistance and therefore unrelated to worm egg count. When comparing two animals with similar EBVs for growth, a more resilient animal will perform better than a less resilient animal when both have high worm burdens.

Drench resistance

Drench resistance is the ability of a worm to resist the effects of a drench. Drench resistance is a genetic characteristic of the worm and differs from an animal's resilience and resistance to worms. Worms can be resistant to more than one group of drench.

Scouring

The propensity to scour has a substantial genetic component that is independent of both resistance and resilience to worms. Only fibre goats will show dags, but meat and dairy goats can display soiling of their hindquarters and under their tails, but these effects do not last long. Dag as an indication of scouring is not available as an EBV for goats.

Coccidiosis also causes scouring. It is more common in young animals, and under intensive conditions with build-up of manure and moist conditions. It often occurs after management events that cause stress (such as transport), and goats of all ages can be affected and produce scours.

How can a buck be selected for worm resistance?

1. Choose bucks from studs that provide EBVs for worm egg counts (WEC EBV).
   - Raw WEC values alone are not reliable enough to use in selection as they do not account for environmental differences or pedigree data (which are included in WEC EBVs).
2. Ensure that selection for worm resistance is balanced with other performance traits.
   - Select better than average WEC by choosing the more negative values.
   - At the same time, select better than average EBVs for performance traits (e.g. growth) that are important to you. A compromise regarding the various traits will be required.
3. Note: when extra traits are included in a selection program, the progress that can be made with each individual trait may decrease slightly, however progress with your breeding objective can still be high.
4. Choose the WEC EBV age that corresponds to the time of most worm-challenge on your property, e.g. weaning (WWEC), post-weaning (PWEC), yearling (YWEC).

What are Estimated Breeding Values (EBV)?

EBVs are an estimate of an animal's genetic merit rather than its visual or phenotypic merit. The effects of factors such as birth type, dam age, nutrition and management are removed to reveal an animal's genetic breeding value: what can be passed onto its progeny. EBVs are calculated and reported by Sheep Genetics, the national genetic analysis service for the sheep and goat industry. Buck breeders who are members of KIDPLAN will have WEC EBVs available for their goats if they are measuring WEC.

More detailed information on using Estimated Breeding Values to select for worm resistance—note that this article is on Australian Sheep Breeding Values, but the principles are the same for goat EBVs.

FAMACHA© Scores

If you are regularly recording individual goat FAMACHA© scores as part of your barber's pole worm management, then it is possible to select for low FAMACHA scores and this is a method of selecting for resilience and resistance. Breed from animals with consistently low FAMACHA scores (i.e. deep pink to red colour of the mucous membranes of the lower inner eyelid) and these animals may require fewer drenches. Cull animals with consistently high FAMACHA scores.

Feed for resilience and resistance to worms

Young growing animals in their first year, and does during late pregnancy and early lactation are most susceptible to worms and have increased requirements for protein and energy. Protein is most important for regulating the resistance of goats to infection, but both protein and energy are equally important for improving resilience to infection.

To provide an adequate diet, ensure that

- Young animals and kidding does have sufficient pasture (at least 1,000 (3 cm) –1,500 (5 cm) kg green pasture dry matter per hectare; more for higher production) or browse
    - Late pregnant and lactating does have a 2.5–3.0 fold increase in nutritional requirements.
    - Does need to be in the optimum body condition (CS 3.0 or slightly better) at kidding.
    - Weaners need to be at least 40% of adult body weight going into winter.
- Pasture quality is improved by the inclusion of legumes, improving soil fertility and grazing management.
- Include browse wherever possible.
- Energy-rich supplements such as cereal grains, lupins or oilseeds or (less effectively) hays and silages, will boost nutrition.
- Goats of any age in poor body condition are very susceptible to worms.

More information on body condition scoring.

When to *WormTest* and when to drench

Why check worm burdens in goats?

Checking worm burdens with a WormTest is essential for correct and timely drenching decisions and to confirm that your worm control program is on track. The result is healthy goats, without unnecessary drenching.

WormTests are the best basis for drenching decisions (Drench Decision Guides):

- To confirm whether signs of ill-health are likely to be due to worms. Many signs are not specific to worms, e.g. weight loss and poor growth rates, a weaker tail group lagging behind the others, scouring and possibly deaths. These signs occur well after production losses from worms are occurring in the herd.
- To check whether worm burdens are causing production loss, even though signs of worms are not present. Reduced weight gains and fibre growth occur well before signs of ill-health are seen.
- To show whether the number of worm eggs being passed onto pasture is too high for a particular time of year.
- To give early warning to prevent significant production losses (or where barber's pole worm exists, the risk of deaths).

Drenching based on WormTests is also the most cost-effective ongoing option for worm control in this region, as unnecessary drenching is expensive in both drench and labour costs, and contributes to the development of drench resistance.

How are worm burdens tested?

1. Using a WormTest

- Checking worm burdens throughout the year using WormTests is a critical part of the WormBoss worm control program. Most WormTests are done through a laboratory.
- Worm egg counts (but usually not larval cultures) can be done by producers if they have the equipment and skills. Ideally, producers should have their preparation and counting technique reviewed by an accredited laboratory and perform ongoing quality control checks, just like an accredited laboratory to ensure their results are correct.
- Seek professional advice where worm egg count results are not simple to interpret.

2. Checking on farm

Where it is not practical to conduct WormTests, FAMACHA© (for barber's pole worm only), Body Condition Scoring (BCS) and scouring can be used to indicate if treatment is required.

- For FAMACHA, check the conjunctiva (inside the lower eyelid). Normal healthy goats have a dark pink to red conjunctiva. Goats suffering from anaemia, which can occur with barber's pole worm and liver fluke, will have paler membranes; in severe cases they can be almost white. The FAMACHA© scoring system evaluates the level of anaemia in the individual animal.
- For BCS, check the back region—use the lumbar vertebra for condition scoring in meat goats. A condition score of 2.5–3.0 is desirable, while a score of 2.0 is too low, and above a score of 3.5 is too high. Does need to be in condition score 3.0 at kidding.
- Scouring. The consistency of faeces can indicate the need for treatment, however, there are other common causes of scouring. Look for watery (score 5) diarrhoea.

When using anthelmintic products in goats, a veterinary prescription is often required because:

- **Goats require a different dose rate and withholding period than specified on most products, even for many registered goat drenches.**
- **Most sheep drenches are useful, but not registered for use in goats.**

While cattle drenches can be used at the label rates on goats in South Australia and sheep drenches on goats in Victoria, a veterinary prescription is still required for dose rates recommended for goats.

When should WormTests and drenches be routinely done?

WormTests can be done at any time; however there are certain routine times to WormTest, shown below. Use the results with the Drench Decision Guide to decide whether to drench and when other WormTests should be done. A larval culture (larval differentiation) with the WormTest is particularly useful in areas or seasons in which summer rainfall occurs and barber's pole worm is a risk.

Routine WormTest times

- Before goats are in the yards for management purposes a *WormTest* should be considered.
- Does prior to kid marking and weaning and then *WormTest* at 4–6 week (summer) or 6–8 week (winter) intervals after a short-acting drench. If using a persistent drench then see Effective use of long-acting drenches.
- Kids from weaning to their first kidding: *WormTest* at 4–6 week (summer) or 6–8 week (winter) intervals after a short-acting drench. If using a persistent drench then see Effective use of long-acting drenches.
- Bring forward *WormTests* if there has been significant rain (20+ mm) that also has follow-up rain (10+ mm) in the following few weeks. Do separate tests for adults and weaners.
- Bucks: *WormTest* at 4–6 week (summer) or 6–8 week (winter) intervals after a short-acting drench and ensure a *WormTest* occurs one month before joining.
- Dry adult goats should still be monitored at 4–8 week intervals.
- If *DrenchTest* results are not available, conduct a *DrenchCheck* 14 days after treatment.
- And at other non-routine times as suggested in the *Drench Decision Guide*.

If you have only a small herd of goats, WormTests can be supplemented with monthly body condition scoring and checking the FAMACHA© score at weekly (summer) and monthly (winter) intervals. Records should be kept of which goats require drenching and the worst of these animals culled.

Routine drench times

Some drenches are 'strategic', and are given for either of two purposes.

1. At a critical time to reduce worm larval contamination of a pasture for the benefit of the whole mob or herd rather than just for the treated animals.
2. Irrespective of worm egg count at times when goats are expected to be more susceptible to worm infection.

Use an effective registered short-acting drench and follow label instructions when treating for worms.

- Pregnant does just prior to kidding when they enter their kidding paddock. Kidding is often at times when the worm challenge is about to rise and kidding does, which experience a temporary loss of immunity during lactation, can contribute to a large increase in paddock contamination and are a source of ongoing infection for themselves and their kids.
- If kidding is spread out over months and does are not separated from the rest of the herd, still give a pre-kidding drench to individual does 4 weeks prior to kidding if due dates are known. However, this pre-kidding drench will not be as effective as when the doe was drenched and moved to a low worm-risk paddock.
- Kids at weaning: weaned kids are highly susceptible to worms, mainly due to the stress of weaning. Drenching at weaning will help weaners to achieve the growth rates needed for survival.
- Drench individual goats showing obvious signs of worm-related illness and *WormTest* the rest of the goat herd.
- At other times, use the results of a *WormTest* in the *Drench Decision Guide*.

In all cases, use a drench known to be effective on your property. Preferably use a short-acting treatment, and where possible, use a multi-active combination or single active drenches can be used sequentially, i.e. up the race with one drench and then up the race with the other. After these drenches, move the goats into prepared low worm-risk paddocks (Appendix F: Drench groups and actives).

The use of vaccination against barber's pole worm

A vaccine to protect against barber's pole worm is available for sheep but is not registered for use in goats. Trials using the vaccine in goats have provided variable protection indicating the vaccine may not always be effective. In sheep, the vaccine provides a major alternative to drench-based control and will help manage drench resistance. If you wish to consider its use in goats, you will need to discuss the pros and cons of its off-label use with your veterinarian and obtain an off-label prescription.

When are other WormTests done and drenches given?

The timing of WormTests and drenches will vary between farms and seasons. Use the Drench Decision Guide (see below) to weigh up important factors when deciding when to drench or WormTest on your property. These factors include signs of worms, time since last drench, the persistence of the last drench, WormTest results, recent rainfall, and condition of animals and pastures/browse.

If drenching is done for other reasons (such as an early drench before holidays or harvesting), use the Drench Decision Guide to decide when to drench or WormTest again.

What samples should be collected for WormTests?

Animals do not need to be yarded for a WormTest. Collect warm fresh dung from the paddock (but make sure that samples from ewes/does are not combined with those of their lambs/kids).

To conduct a WormTest obtain WormTest kits or sample collection details from your testing laboratory or advisor.

If you do your own worm egg counts, use the bulk sampling method where dung is collected into a single container.

- Collect 3 pellets per pile of dung from at least 20 individuals if the mob has fewer than 200 animals and at least from 40 individual dung piles from larger mobs.
- Choose pellets of equal size so that each animal is equally represented.
- If dung consistency is runny, use a plastic spoon. Don't avoid runny or soft dung.
- Collect ewe/does and lamb/kid samples separately.

Avoid delays in transit (when worm eggs can hatch) by collecting and posting early in the week. Also ensure samples are kept cool (refrigerate but do not freeze) before sending, include an ice brick in transit in very hot weather and exclude as much air from the sample bags as possible.

More information:
Checking a mob of sheep or goats with a WormTest
Checking a mob of sheep or goats without a WormTest

The WormBoss Drench Decision Guide

The Drench Decision Guide helps to simplify decisions on whether and when to drench. There is a version of the Drench Decision Guide for each WormBoss region.

It considers:

- whether signs of worms are present
- the class of animal
- the WormTest results
- the condition of the animals
- the condition of the pasture
- the likely worm contamination of the paddock

The Drench Decision Guide will recommend:

- whether to drench now
- whether to use a persistent drench
- when to WormTest again

How to use the Drench Decision Guide

You can use the Drench Decision Guide at any time, whether you are contemplating drenching now or in coming weeks. Not all situations require a WormTest: the Drench Decision Guide will recommend when these should be done.

Each Drench Decision Guide is available as a separate 2-page printable version or can be used directly online.

Using the print-version:

1. Start on the page that shows the 'Drench Decision Guide Questions'.
2. Read Question 1.
3. Follow the 'go to' information on the right for the answer that applies to your goats.
4. Only go to the question or recommendation to which you are directed by your answer.
5. When you are directed to a letter, this is the final recommendation, and is shown on the next 'Recommendations' page.
6. Also, read the important information in the green boxes.

Using the web version

1. Agree to the terms of use and press start
2. Select an answer for the first question and you will automatically be taken to the next appropriate question.
3. Select an answer for each question and you will automatically be taken to the Recommendation, where your choices with also be shown as well as other important information.

See the online Drench Decision Guide.

Managing drench resistance

Never assume that a drench treatment will completely kill worms in your goats. Drench resistance is a result of worms having genes that enable them to survive treatment. It is likely that these genes were present in some worms before a drench was ever used. Drench resistance is now very common and in many cases severe for some drench groups, making testing for drench effectiveness a vital component of a worm control program.

Drench groups are the 'chemical families' of drenches and some groups contain a number of drench actives. For example the Benzimidazole group has the following actives: fenbendazole, oxfendazole, albendazole. When resistance is present for one of these actives, it is likely present for all other actives within the same group.

Selection for drench resistance happens when worms in the goat are exposed to a drench. Initially, there may be very few worms that survive the treatment (perhaps as few as 1 in 100,000) but these resistant worms lay eggs and their offspring constitute an increasing proportion of the worm population. In this way each treatment causes an increase in drench resistance because only resistant worms survive to reproduce.

Resistance may develop faster with more drenching and use of persistent products. Drench resistance is unlikely to be reversible, so not using a drench for a while will not permanently result in the worm population becoming susceptible again. While ever drenches are being used, drench resistance cannot be prevented, but the rate at which it occurs can be greatly reduced.

The first step is to know what drenches are effective on your property.

How can the effectiveness of drenches be tested?

Each property has its own drench-resistance profile based on its own drenching history and that of properties from which the goats were sourced. The profile of neighbouring properties can be quite different.

The extent of resistance is only known by testing. Obvious worm control failures may only occur when resistance is quite advanced.

A DrenchTest is needed to accurately test for drench resistance. Do these tests every 2–3 years. Test all single-actives (some of which may require an off-label prescription from your veterinarian) that are likely to be used. Effectiveness of multi-actives or from giving single actives sequentially (i.e. up the race with one and up the race again with the other active) can be calculated from efficacy of the single actives using the Combination Drench Efficacy Calculator.

A DrenchCheck is used to check individual drenches at any time and where a DrenchTest is not practical because of small herd size. This is a guide only to drench efficacy and resistance and is best used to monitor drenches between the times that full resistance tests (DrenchTests) are performed.

The DrenchTest (WECRT)

DrenchTest is the common name for the Worm Egg Count Reduction Test (WECRT). This assesses the drench-resistance status of worms on a property.

You can test as many individual drench actives (you will need an off-label prescription from your veterinarian if testing actives not registered for use in goats) as you like in a DrenchTest, providing you have enough goats for the different groups.

Select a mob of similar goats for the DrenchTest. From this mob, a group of goats is used for each drench and one group is left undrenched to act as a 'control' or comparison. Each of the groups is drenched (except the control group) and dung samples are collected from all goats 14 days later for a WormTest.

The worm egg counts and larval differentiations of each treatment group are compared with those of the undrenched control group. From this, the effectiveness of each drench against each worm type present is calculated.

Discuss the test with your adviser before setting up for a DrenchTest. For more detail see 'Testing drench effectiveness with a DrenchTest'

The DrenchCheck

This simple and inexpensive test gives an indication of drench effectiveness and whether it should be properly investigated using a DrenchTest.

The DrenchCheck involves two WormTests with larval differentiation

The first up to 10 days before drenching (usually at a routine WormTest time).

The second at 14 days after the drench. The second WormTest should be based on individual samples and not the Bulk Collection Method.

The results from the two WormTests are compared to gauge the extent that worm egg counts (sometimes based on the larval differentiations) have been reduced by the drench. Discuss the results with a worm control advisor.

See 'Checking for drench resistance with a DrenchCheck'.

How can drench-resistant worms be kept out of your property?

Keeping other people's drench-resistant worms out of your property is part of sustainable worm control.

Assume that purchased goats are carrying worms with some degree of drench resistance to one or more drench groups.

1. 'Quarantine' drench all goats (including bucks) new to the property.

- Discuss with your veterinarian which drench groups and how many can be used, their dose rates and withholding periods, including those drench groups not registered for use in goats, but which can be used with an off-label veterinarian's prescription. The quarantine treatment should ideally consist of:
    - Meat and fibre goats: four drench groups are recommended, preferably including one from the most recently available products.
    - Dairy goats whose milk will be for human consumption: the number of registered drench actives is limited to two (fenbendazole and abamectin).
- Do not mix different drenches unless the label states you can or under veterinary advice, as different products may be incompatible. Otherwise, use drench products concurrently—up the race with one product, then up the race again with the next.

2. Quarantine the goats after treatment.

- Hold the sheep in quarantine in yards (small mobs) or a secure paddock (larger mobs) for 1–3 days (1 day if feed is green, high quality, 3 if it is dry, low quality) to allow worm eggs present at the time of drenching to pass out of the gut.
- Provide adequate feed and water.
- Keep this paddock free from goats, sheep or alpacas for at least 3 months in summer or 6 months in cooler months.

When using anthelmintic products in goats, a veterinary prescription is often required because:

- **Goats require a different dose rate and withholding period than specified on most products, even for many registered goat drenches.**
- **Most sheep drenches are useful, but not registered for use in goats.**

While cattle drenches can be used at the label rates on goats in South Australia and sheep drenches on goats in Victoria, a veterinary prescription is still required for dose rates recommended for goats.

How can the development of drench resistance be slowed?

Choosing drenches

Use all 3 principles where possible.
They are equally important and greatly slow the development of drench resistance.

1. Use drenches most effective on your property. Drenches that reduce worm egg count by at least 98% are preferred. The more effective a drench is the fewer drench-resistant worms will remain in the animals after treatment. If drench effectiveness is unknown, conduct a DrenchCheck after drenching.
2. Use an effective combination of two or more drench groups, either in a multi-active product or using more than one product concurrently (up the race with one and then the other) to combine different drench groups. The higher the efficacy of each drench group and the more drench groups included in the combination, the greater the benefit for slowing drench resistance. The chance of a worm being resistant to all active ingredients in a combination is much lower than for each individual active on its own. For goats, be aware of what drench groups are registered or permissible with a veterinarian's prescription.
3. Use short-acting treatments and restrict the use of persistent products for specific purposes and high worm-risk times of year. Persistent products provide a long time during which ingested resistant larvae can survive and reproduce. There is little need to use mid-length or long-acting treatments if animals are being moved to low worm-risk paddocks.

A small benefit can be gained by rotating drench groups providing you also rotationally graze stock across the property so that paddocks are exposed to sheep that have received different drenches. However, if you set-stock, drench rotation will not slow the development of drench resistance.

While not affecting resistance, it is essential to choose a drench with an appropriate withholding period (WHP) and export slaughter interval (ESI) according to the time left before the animals may go to slaughter, or their milk may be used for human consumption.

Search for drenches based on the worms or other parasites targeted, drench group or active and product name.

Using drenches

Follow all 5 principles where possible:

1. Avoid unnecessary drenching, especially
   - during droughts or prolonged dry periods
   - immediately before or after moving goats onto very clean, low worm-risk paddocks (such as ungrazed cereal stubbles or paddocks that have been free from sheep or goats for extended periods). See points i) and ii) below for further discussion on this.
   - adult dry goats with low worm egg counts (refer to the Drench Decision Guide) or if WormTests are not practical then adult dry goats showing no clinical signs of worms based on eye mucous membrane colour (FAMACHA©) and adequate Body Condition Scores.
2. Calibrate drench guns to ensure the correct dose is delivered.
3. Calculate the dose based on the heaviest animals in the mob. Split mobs for drenching if there is a large weight range, so that heavy animals are not underdosed, and light animals are not overdosed.
4. Follow the label instructions to ensure correct dose and use of treatments.
5. After animals have been drenched, graze them initially on paddocks already contaminated with worms, not on paddocks that are being specifically prepared as low worm-risk. Eggs deposited on pasture from surviving drench-resistant worms in the animals will be diluted by eggs and larvae already on the paddock (these should be susceptible, or at least, less drench resistant).

If animals must be drenched onto low worm-risk paddocks, such as kidding, weaning or winter weaner paddocks, do both of the following:

I. When the goats eventually leave these low worm-risk paddocks, treat them with an effective drench that is from a different group to the drench used when the goats first went onto the paddock. The aim is to remove any drench-resistant worms surviving in the sheep after the first drench.
II. Ensure that the next time the paddock is grazed it is with a different mob of goats. This second mob should have a moderate to high worm burden and their last treatment must be different from the treatment used on the first mob that grazed the low worm-risk paddock. This will dilute drench-resistant worms already on the paddock with more susceptible worms that the second mob is carrying. Note that grazing with cattle will not dilute the proportion of drench-resistant worms, but they will decrease the total number of worm larvae on this paddock.

Using Barbervax® vaccine for barber's pole worm

The use of Barbervax should slow the rate of development of drench resistance because fewer drenches will be used. It is unlikely that barber's pole worm will develop resistance to this vaccination.

Note: This vaccine is only recommended in districts where barber's pole worm is a high risk for some months of the year. For more details see the Barbervax vaccination program.

How can persistent treatments be used effectively?

Note: There is no research to confirm the length of protection for goats provided by persistent products. It is well reported that, in relation to sheep, goats are able to more rapidly metabolise drenches and are less fat. Both of these features will reduce the exposure of worms to drench actives and likely shorten the length of protection provided by the persistent product.

Effective persistent treatments kill immature and adult worms at the time of treatment, as well as infective larvae eaten by animals (with pasture) during the period of protection of the treatment—for sheep, about 3 months for long-acting and 1–6 weeks for mid-length treatments (depending on the particular product).

Both may increase selection for resistance to the actives in those treatments for two reasons. Firstly, worms are exposed to the active ingredient for longer. This favours surviving resistant worms, which then reproduce. Secondly,

some persistent treatments have a period at the end of their protection period where the active concentration drops to a level where partly resistant worms may survive and reproduce.

The most commonly used persistent drenches contain the actives moxidectin or closantel. Some moxidectin and closantel products have a “Do Not Use” statement preventing use in animals that may be used to produce milk for human consumption.

Cattle pour-on or injectable products, or horse paste tubes should not be used on goats.

Use primer and exit drenches with long-acting treatments

Primer drenches clear the animal of any worms that are resistant to the long-acting treatment. A primer drench is an effective short-acting drench (preferably a combination) that does not include the same group as the long-acting product. Give a primer at the same time that a long-acting product is given.

Exit drenches are used two weeks after the end of the actual protection period. By this time the persistent treatment has declined to very low levels. The exit drench kills larvae that have survived the persistent treatment and developed into breeding adult worms. Another name for the exit drench is a ‘tail-cutter’.

An exit drench (like the primer drench) is an effective short-acting treatment (preferably a combination) that is from a different group/s to the persistent product.

Mid-length treatments need exit drenches

Resistance can develop to mid-length treatments in the same way as to long-acting treatments. While primer and exit drenches are desirable with mid-length treatments, they are rarely cost-effective because of the relatively short protection period compared to long-acting products. However, the use of an exit drench is highly recommended two weeks after the end of the protection period stated on the label.

Check the persistence of a product

The effectiveness of the persistent product on your property will be shown by the length of the protection period actually achieved (rather than what is claimed on the product label). Where the persistent product contains an active/s available in other products as a short-acting formulation (e.g. albendazole and abamectin) or with mid-length activity (e.g. moxidectin) then a DrenchTest can simply include these drenches rather than the persistent products.

The schedule to test the length of protection provided by persistent products on your property depends on if you know the efficacy of the drench active.

Where the DrenchTest results indicate that the active/s are effective on your property (i.e. reduced worm egg count by at least 98%) then conduct a WormTest at 30, 60 and 90 days after treatment. If it is shown to be ineffective at the earlier test, then the later tests will be of no value.

If you do not have current DrenchTest results you should do a WormTest at 10, 30, 60 and 90 days after treatment. If it is shown to be ineffective at one of the earlier tests, then the later test/s will be of no value.

When you send the samples, request a larval culture if there is a positive worm egg count because

- resistance may only be present in one worm species
- if moxidectin was used, the protection period against different worm species differs
- if closantel was used, it is a narrow spectrum drench, only for barber’s pole worm.

Note: Neither moxidectin nor closantel are registered for use in goats (see above for veterinary prescription).

If the treatment was fully effective, and you used a primer and exit drench, the product will probably have a similar length of effectiveness at the next use. However, it is best to check the effectiveness of long-acting products every year they are used by doing a WormTest at 30 and 60 days.

If a WormTest shows worm eggs are present before the end of the claimed protection period, drench resistance is likely. You should:

1. Immediately drench the animals with an exit drench (as described earlier), keep them in their current paddock for a further 3–4 days (while most eggs pass in the dung), then move them to another paddock. This will stop more drench-resistant worm eggs from contaminating the pasture.
2. Spell the pasture for at least 2 months to allow many of the drench resistant larvae to die. The next animals to graze this paddock should have a moderate worm burden, with their last treatment not being from the same drench group as the long-acting product. This will help to dilute the resistant-worm eggs already on the pasture.
3. Seek veterinary advice.

At any time that you are concerned that a mid-length or long-acting treatment is not providing protection, WormTest immediately and seek veterinary advice regarding drench resistance.

Appendix A: Liver fluke control

Liver fluke (*Fasciola hepatica*) only occurs where the intermediate host (the freshwater snails: *Austropeplea (Lymnaea) tomentosa* and in warmer areas, *Pseudosuccinia (Lymnaea) columella* are present. These snails are found where there are slow-moving creeks, swamps, springs or shallow irrigation channels and they can survive in mud when water flow temporarily stops. However, the snail is not necessarily present in all such areas.

Liver fluke may not be present on all paddocks or properties in a 'flukey' locality.

Roundworms are often specific to one type of animal, but liver fluke can infect many species including cattle, sheep, goats, alpacas and horses, as well as humans and wild animals.

Prevention

Grazing management can help prevent liver fluke infection. Unfortunately, there is currently no effective method to breed for host resistance to liver fluke.

If liver fluke is present on a property, infection can be prevented or minimised by:

- fencing the areas that harbour the snail, to keep stock out
- conducting earthworks to deepen shallow water, or to improve drainage
- repairing broken pipes and troughs that have resulted in permanent wet areas
- avoiding grazing of snail-infested areas by the most susceptible animals (sheep, goats, alpacas and young cattle)

Detection

Testing for liver fluke can be done using the dung samples sent for a WormTest. A fluke test, which uses a different method to that used for roundworms, must be specifically requested.

If you don't know whether your stock are infected with liver fluke, test three times a year (autumn, winter and summer) for at least two years (i.e. 6 tests).

Testing will show whether liver fluke is present and to what extent.

You can also determine which paddocks are affected by testing mobs that have only been run in a particular paddock since the last fluke-treatment.

If fluke egg counts for a particular paddock are frequently high (greater than 25–50 eggs per gram), there may be significant production losses. Reconsider your grazing strategies for the affected paddocks and see if fluke-affected areas can be fenced off.

If results at the three testing times are not always positive, then continue testing at the specified times to decide whether to drench.

If all six tests have been negative and the livers of dead or slaughter animals have not shown any signs of liver fluke, it is likely that the lymnaeid snails are not present on your property to act as a host for liver fluke. In this case, drenching for fluke will not be required (except to remove fluke from animals brought onto the property).

A blood test (antibody [ELISA] test) is also available from various laboratories, for example, the NSW Department of Primary Industries State Veterinary Laboratory at Menangle. Also, a faecal antigen test for fluke is available through Charles Sturt University's Veterinary Diagnostic Laboratory.

Response

Any positive fluke egg count is significant and indicates treatment is needed.

If testing for two years confirms that stock are infected at all test times, then ongoing testing can be stopped. In this case, three routine treatments for liver fluke should be given to stock that have been grazing the affected paddocks in:

- April–May
- August–September
- February

Some treatments for roundworms (scour worms and barber's pole worms) will control various stages of liver fluke. Check the label as some are only effective against mature fluke (see Table 1.).

The most important treatment is carried out in April–May and should be based on the flukicide, triclabendazole, which is effective against all stages of the fluke found in the stock. If treatments are also required in August–September and/or February, one or both of these treatments should be a flukicide other than triclabendazole (if this was used in April). This treatment rotation will reduce the rate of development of fluke resistant to triclabendazole.

When bringing in stock from another property, consider including a fluke treatment in the quarantine drench if their fluke status is unknown. Bear in mind that adult liver fluke can live for several years inside host animals (see Table 1).

Table A1. Fluke treatments and the age of fluke from which they are effective

Active	Age of fluke killed
Triclabendazole	All stages
Albendazole	From 12 weeks
Closantel	From 8 weeks
Closantel plus oxfendazole*	From 6 weeks
Closantel plus albendazole*	From 8 weeks
Oxyclozanide plus levamisole	From 12 weeks

Source: from Liver fluke disease in sheep and cattle, by J Boray (March 2007) NSW DPI Primefact 446
*No commercial products with this combination are currently available.
Note: only triclabendazole and albendazole are registered for use in goats.

When using anthelmintic products in goats, a veterinary prescription is often required because:

- **Goats require a different dose rate and withholding period than specified on most products, even for many registered goat drenches.**
- **Most sheep drenches are useful, but not registered for use in goats.**

While cattle drenches can be used at the label rates on goats in South Australia and sheep drenches on goats in Victoria, a veterinary prescription is still required for dose rates recommended for goats.

Table A2. Anthelmintics registered and commercially available for liver fluke control in goats.

Drench group	Brand name	Active	Company	WHP meat (days)	ESI (days)
BZ*	Alben	Albendazole (19 g/l)	Virbac	10	10
BZ*	WSD Albendazole	Albendazole (19 g/l)	WSD	10	10
BZ*	Beezed	Albendazole (19 g/l)	Landmark	10	10
BZ*	Valbazen	Albendazole (19 g/l)	Coopers	10	10
BZ*†	Flukare C	Triclabendazole (120 g/l)	Virbac	21	not set

*MILK: DO NOT USE in lactating animals where milk or milk products may be used for human consumption.

†DO NOT USE less than 21 days before calving, lambing or kidding in cows, ewes or does where milk or milk products from treated animals may be used for human consumption.

Where TRICLABENDAZOLE is accidently given within this period or cows, ewes or does calve, lamb or kid earlier than 21 days after treatment, milk will contain residues. This milk must not be used for human consumption, or supplied for processing for at least 21 days following treatment. Calves fed this milk should not be slaughtered for human consumption within10 days. Lambs or kids fed this milk should not be slaughtered for human consumption within 7 days.

Some BZ drenches containing albendazole are used at slightly increased dose rates to control liver fluke. Dose rates are displayed clearly on the product label.

The following drench actives do not control liver fluke:

- moxidectin, abamectin or ivermectin
- oxfendazole and fenbendazole
- levamisole
- naphthalophos and pyraclofos
- monepantel
- derquantel
- praziquantel

Resistance to flukicides

Resistance has developed to various flukicides. Rotate between flukicides from different chemical groups, beginning with triclabendazole for the April–May treatment.

More detailed information on liver fluke can be found at the NSW DPI web site:
http://www.dpi.nsw.gov.au/agriculture/livestock/sheep/health

Appendix B: Roundworm life cycle and larval survival

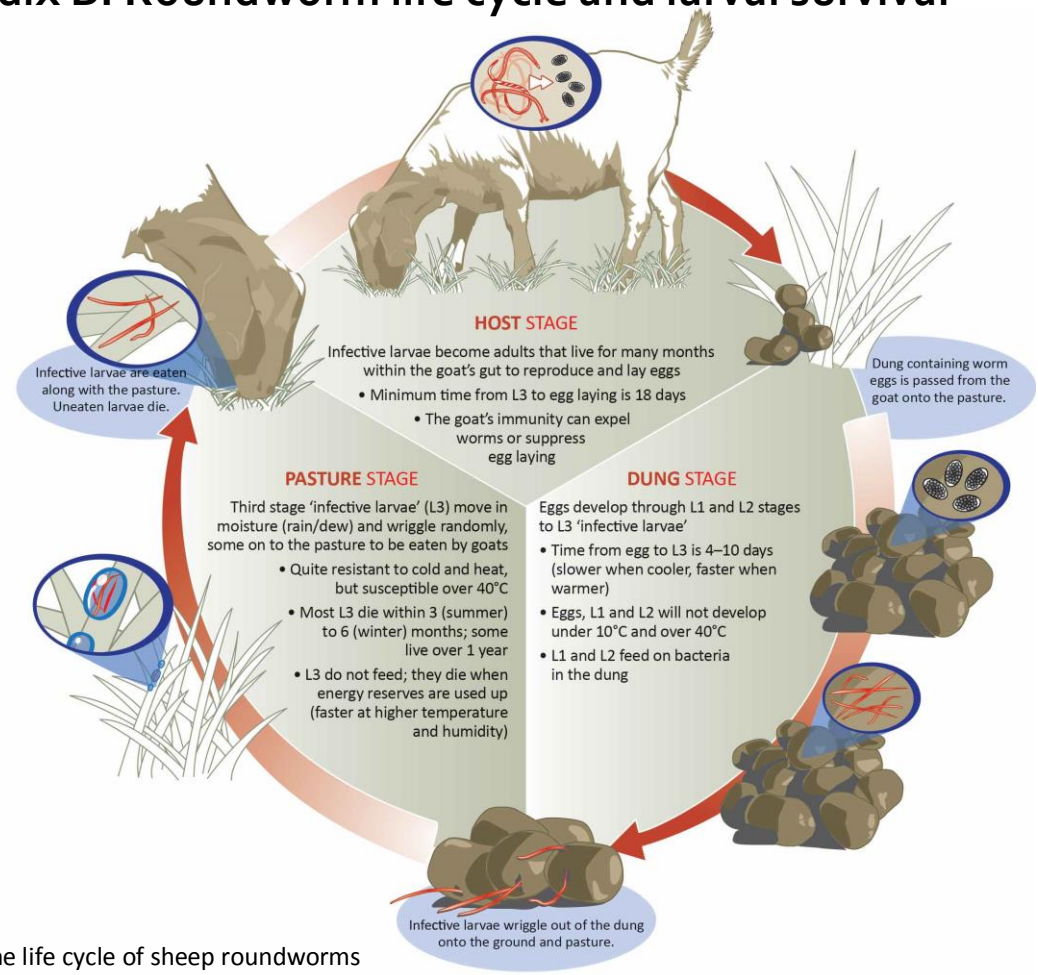
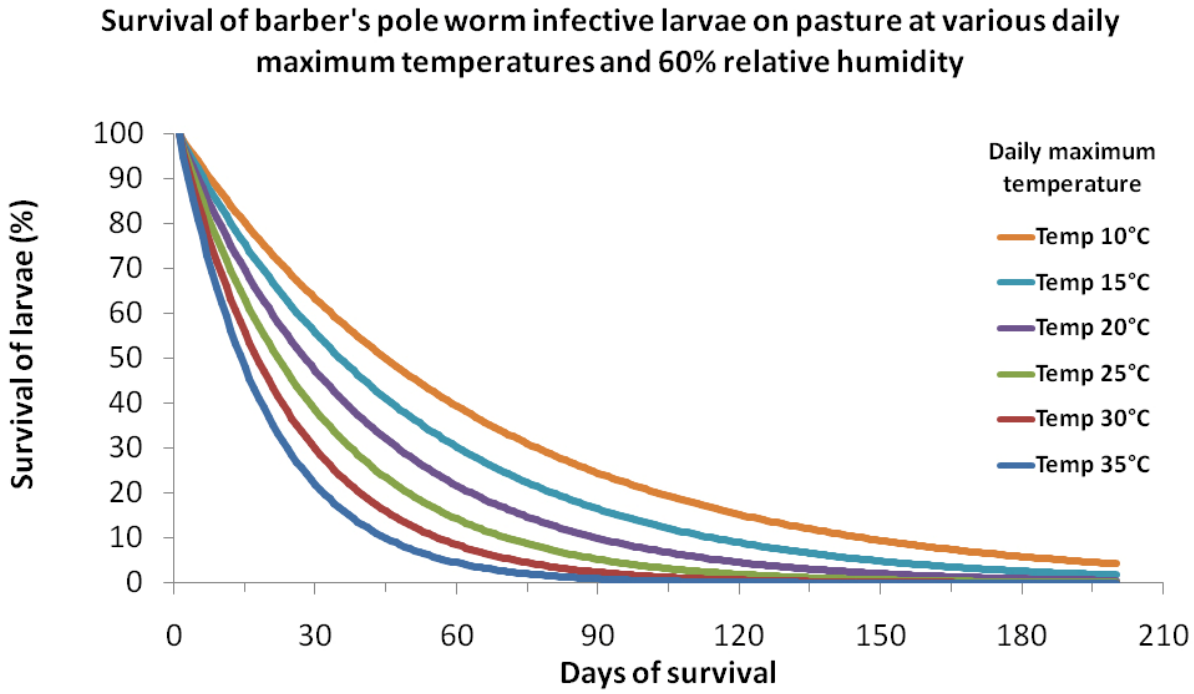


Figure B1. The life cycle of sheep roundworms



Source: Modeled from death rate of the L3 population in 'Simulation of pasture larval populations of *Haemonchus contortus'* by IA Barger, PR Benyon & WH Southcott. Proceedings of the Australian Society of Animal Production (1972) 9: 38

Figure B2. Survival of barber's pole worm infective larvae on pasture

Appendix C: Factors contributing to paddock contamination with worms

Table C1. The following table applies to brown stomach worm (*Teladorsagia circumcincta*), black scour worm (*Trichostrongylus* species) and barber's pole worm (*Haemonchus contortus*).

Factor	Time or conditions			Effect
Minimum time before worm eggs can become infective larvae.	4–10 days			Short graze periods (less than 4 days) prevent 'auto-infection' (animals becoming infected by larvae arising from worm eggs the same mob have recently deposited onto the pasture).
Conditions required for significant numbers of worm eggs to hatch and become infective larvae.	4–10 days of: **Brown stomach worm** Temperature: daily maximum >8°C[1] Moisture in this time: >10–15 mm rainfall[2] **Black scour worm** Temperature: daily maximum >15°C for *T. colubriformis* or >12°C for *T. vitrinus* Moisture in this time: >10–15 mm rainfall[3] **Barber's pole worm** Temperature: daily maximum >18°C[1] Moisture in this time: >10–15 mm rainfall[3]		**Notes:** [1]Some hatching of worm eggs of all worm species can occur below these daily maximum levels, but this is usually at a small and insignificant rate. [2]Brown stomach worm eggs can develop at low rates without rainfall even in a relatively dry faecal pellet. [3]Development to infective larvae may occur without rainfall if soil moisture profile is high.	Unsuitable conditions prevent eggs hatching and developing into infective larvae. **Note:** The eggs of the brown stomach worm are much more tolerant of cold and dry conditions, and in general, grazing management has less effect on its control.
Maximum time worm eggs can live awaiting suitable hatching conditions.	**Brown stomach worm**: 21 days Some brown stomach worm eggs may survive for longer periods. **Black scour worm**: 16 days **Barber's pole worm**: 5 days		**Notes:** Once hatched, infective larvae of both black scour and brown stomach worm can remain in the faecal pellet until conditions are more suitable.	Prolonged periods without the right conditions (temperature/moisture) for egg development will result in the eggs dying. This lowers the worm-risk of paddocks.
The time for about 90% of the barber's pole worm infective larvae (L3s) to die (making paddocks low worm-risk).		Maximum temperature (°C)	Time for 90% larvae to die	L3 larvae do not feed. While waiting to be eaten by sheep, they wriggle randomly in drops of moisture, more so in warmer conditions. Increased activity in warm weather depletes their energy reserves faster, hastening death. In extremely hot, dry and windy conditions, the larvae dry out and die. **Note:** larvae of brown stomach worm and black scour worm can survive longer because they can remain in the faecal pellet for extended periods.
	Cold	less than 15	4 months	
	Warm	about 22	3 months	
	Hot	about 35	1.5 months	
	Very hot	more than 40	1–2 weeks	
Minimum time for infective larvae eaten by animals to mature and lay eggs (the 'pre-patent period').	Sheep: minimum of 18 days for most sheep roundworms. Goats: minimum of 14 (typically 21) days for barber's pole worm and 21 days for scour worms.			Worm larvae eaten by animals soon after an effective drench will take at least 18 days (in sheep) or 14–21 days (in goats) before they can lay eggs. During this period after administering an effective drench, animals are not re-infecting the pasture.

Appendix D. Smart grazing to control scour worms in weaner sheep

NOTE: The research that led to the development of Smart Grazing was conducted with sheep. The basic principles underlying its benefit for reducing the number of worm larvae on pasture will remain the same, but its effectiveness in goats has not been established.

By Norman Anderson & John Larsen, Mackinnon Project, University of Melbourne
Source: Mackinnon Project website (10 December 2011)

Introduction

Smart grazing is an improved, yet simple and reliable strategy for the control of worms in weaner sheep during their first winter. It can counter the negative effects of summer rainfall that reduces the effectiveness of the '2-summer treatment strategy' in the winter rainfall areas of southern Australia.

The why and how of 'Smart grazing'

Merino weaners are very susceptible to worms in their first winter. Consequently, they need to graze pastures that have as few worm larvae as is practicable. 'Smart grazing' combines intensive grazing for 30 days with each of the 2 'summer' drenches to ensure that virtually no worm eggs are deposited on a chosen pasture from the first summer drench (November) until after the autumn break (March–April), when the weaners are put into these pastures.

Intensive grazing means using 2½–3 times the normal stocking rate for no longer than 30 days after each of the summer drenches are given. After the intensive grazing period, the paddocks are de-stocked to allow the pastures to re-grow. This means that the total stocking pressure for the 'Smart grazed' paddock will be the same as that for a paddock continuously stocked at the farms normal stocking rate.

The intensive grazing will reduce pasture residues to around 800–1000 kg DM/ha after the first summer drench, and around 600 kg DM/ha after the second. If there is insufficient feed, the periods of intensive grazing can be reduced. On the other hand, if there is excess feed the summer drenches can be 'staggered' for different mobs so as to provide a longer intensive grazing period or cattle can be used as well.

Finally, the weaners must be drenched with an effective drench before they start grazing the 'Smart grazed' paddock after the autumn break.

Smart grazing on a typical farm

A typical self-replacing flock of 5,000 DSEs in southern Australia is made up of 1,500 ewes, 1,500 wethers and 1,000 weaners, running at a winter stocking rate of 15 DSE/ha.

70 ha of 'Smart grazed' paddocks must therefore be prepared for the weaners. Thus, 2600 DSE (70 x 15 x 2.5) are needed to stock the 70 ha at 2½ times the normal stocking rate for each of the two intensive grazing periods—this uses all of the wethers and 70% of the ewes on the farm.

A timetable for 'Smart grazing'

OCTOBER: Select the 'Smart grazing' paddock—choose one with a history of good winter pasture.
NOVEMBER: Give the first summer drench (this must be an effective product), then intensively graze the paddock at 2½–3 times the normal stocking rate.
DECEMBER: Remove the sheep to another part of the farm after 30 days intensive grazing. Ideally, the pasture residue should be 800–1000 kg DM/ha (2–3 cm in height).
JANUARY: Paddock remains unstocked until the second summer drench.
FEBRUARY: Give the second summer drench, then intensively graze the 'Smart grazing' paddock with the drenched sheep (again, not for greater than 30 days).
MARCH: Paddock remains de-stocked until the autumn break.
AUTUMN BREAK (MARCH–APRIL): Drench weaners and set-stock on the 'Smart grazing' paddock when pasture is greater than 600 kg DM/ha (1.5 cm). Weaners can remain there until spring but monitor their worm egg counts every 4–6 weeks.

Why does smart grazing work?

The intensive grazing periods:

- Reduce the amount of pasture dry matter, making the pasture less suitable for the survival of worm larvae.
- Ensure that there is no deposition of worm eggs on the pasture from the time of the first summer drench until the autumn break.
- Probably allow the drenched sheep to 'vacuum' up infective larvae in much the same way as cattle do when they are used in alternate grazing programs with sheep.
- Have the same cumulative stocking pressure from November to March as set-stocked paddocks grazed continuously by wethers.
- Are quite flexible. What must not be changed is the need (i) not to exceed 30 days grazing after each summer drench, and (ii) for a fully-effective product to be used at the summer drenches.

What are the benefits?

Results from a controlled experiment over 2 years in western Victoria show that, compared to weaners grazing paddocks prepared the usual way (grazed by wethers over the summer/early autumn), weaners grazing 'Smart grazing' plots:

- grew 13% more clean wool (2.29 vs. 2.03 kg) which was 3.5% broader (17.1µ vs. 16.5µ)
- were 3 kg heavier in October (46.5 vs. 43.2 kg).

During winter, the egg counts from the 'Smart grazed' weaners didn't go higher than 250 epg, a trigger for drenching weaners used by many farmers and their advisers. In contrast, the weaners on the paddocks prepared by set-stocked wethers exceeded 400 epg in both years.

The numbers of worm larvae on the 'Smart grazed' pastures in winter were from one-half to a one-third of those on pastures in paddocks prepared by grazing with set-stocked wethers.

Appendix E. Smart grazing to control barber's pole worm in lambing ewes

NOTE: The research that led to the development of Smart Grazing was conducted with sheep. The basic principles underlying its benefit for reducing the number of worm larvae on pasture will remain the same but its effectiveness in goats has not been established.

'Smart grazing' is a system developed in Victoria by Dr Paul Niven to create low worm-risk autumn weaner paddocks in winter rainfall regions. This was adapted for the Northern Tablelands of NSW by Dr Justin Bailey, and is called 'Smart Grazing—summer rainfall'. Both versions are based on very short periods of intensive grazing at increased stocking rates.

The Northern Tablelands version takes advantage of a four-month cold period in winter (May-August) combined with two bursts of intensive grazing in summer and autumn. This results in an eight-month period where contamination of the paddock with worm eggs is prevented and most of the existing eggs and larvae die.

The process uses a high stocking rate during the grazing period, about four times normal, in order to rapidly reduce the pasture mass, thus increasing exposure of worm larvae to the elements to increase death rate.

The success also relies on the sheep used for grazing being treated with a fully effective drench and that they only graze the paddocks within the protection period of that drench.

Steps for 'Smart grazing—summer rainfall'

1. January/February: Graze the lambing paddock with sheep immediately after they have been treated with an effective short-acting drench and graze for no longer than three weeks after that drench. Stock at 3–4 times the normal stocking rate in order to reduce the herbage mass to about 1000 kg DM/ha (or about 3 cm in height).
2. March/April: Repeat step 1.
3. May, June, July and August:
    - In cold, tableland districts, when the mean daily maximum temperatures are consistently below 18°C, these paddocks can be grazed by any stock as it is too cold for the eggs of the major worm parasites, barber's pole and black scour worms, to hatch to infective larvae.
    - In warmer areas adjacent to the tablelands, this cold period will be shorter and Step 3 (from above) may be restricted to June and July. Review your local climate history (see Appendix D: Find your 'cold period') to find when the temperatures over a week will have daily maximums below 18°C.
    - In hotter areas, where the mean daily maximum temperatures are higher than 18°C, or below it for only days or a few weeks, step 1 can be repeated.

Appendix F: Drench groups and actives

Table F1. Drench groups and actives

Drench groups and actives	Worms	Brand names (actives)
BZ or benzimidazole group ('white')[B] albendazole fenbendazole oxfendazole	barber's pole worm, 'scour worms', adult liver fluke, nodule worm, aids control of intestinal tapeworm (*Moniezia*)	Alben, Valbazen, WSD Albendazole (albendazole) Beezed, Fenbender 25, Panacur 25, (fenbendazole) Beezed LV, Oxfen LV (oxfendazole)
LV or levamisole group ('clear')[B] morantel levamisole	barber's pole worm, 'scour worms', nodule worm	Oralject (morantel citrate) None registered (levamisole)
ML or macrocyclic lactone group[B] (sometimes called 'mectins') Ivermectin abamectin moxidectin	barber's pole worm, 'scour worms', nodule worm	None registered (ivermectin) Caprimec (abamectin) None registered (moxidectin)
AD or amino-acetonitrile derivative group[B] monepantel	barber's pole worm, 'scour worms'	None registered
SI or spiroindole group[M] derquantel	barber's pole worm, 'scour worms', nodule worm	None registered
OP or organophosphate group[M] naphthalophos (NAP)	barber's pole worm, 'scour worms'	None registered (OPs have lower or variable efficacy against 'scour worms' in the upper GIT and immature barber's pole worm)
TZ or benzimidazole group (flukicide)[N] triclabendazole	Liver fluke (all stages); not effective against round worms	Flukare C
SA or salicylanilides/phenols group[N] closantel	Liver fluke (> 9 weeks and adult) and barber's pole worm	None registered
IQ or isoquinolone group[N] praziquantel	Intestinal tapeworm (*Moniezia*)	None registered

*These are all of the commercial anthelmintics registered and commercially available for goats at August 2016. In most states of Australia, sheep drenches can be used in goats with an off-label veterinary prescription.

Breadth of activity across different worm species: B—Broad-spectrum; M—Mid-spectrum; N—Narrow-spectrum

Actives: An 'active' is the chemical in a drench responsible for killing worms. Some drenches have more than one active and are called 'multi-active' or 'combination' drenches.

Combination or multi-active treatments: Proprietary treatments containing more than one active. Formulated to be compatible as a mixture. Note: Do not mix your own drenches unless the labels state that you can.

Product formulation: All single actives are available as oral drenches. Moxidectin is also available in injectable products. Moxidectin is not registered for use in goats and an off-label prescription is required from your veterinarian. Pour-on products should not be used in goats for worm control.

Length of protection: Varies from short-acting ('knock-down' that kills susceptible worms within the animal) to mid-length (1–6 weeks) and long-acting (approx. 3 months), which not only kill susceptible worms already in the animals, but also infective larvae that the goats eat during the protection period.

'Scour worms': Mainly black scour worm and (small) brown stomach worm, but also others.

Label: Check product labels for full details. Follow the label or veterinarian's instructions.

Using sheep drenches in goats: Veterinarians can prescribe sheep drenches for goats, but must provide written details of withholding periods and dose rates.

Other parasites: 'Drenches' shows effectiveness of groups against other parasites of minor importance.

Legal use of drench products

There are strict regulations about veterinary medicines in Australia. However, veterinarians can prescribe the "off label" use of some worm drenches not registered for goats.

A veterinary prescription is required for use of most drenches for goats because

- Goats require a different dose rate and withholding period to that on the label (even on products registered for goats).
- Many drenches are not registered for use in goats.

It is particularly important that goats whose meat or milk is intended for human consumption are not treated with chemicals that could result in excess chemical residue levels in those meat or milk products.

Whilst most meat goats are run in the rangelands where drenches are infrequently used, it is the larger number of goat owners running smaller numbers of goats in the moderate to high rainfall areas that are likely to put the goat export market at risk through their misuse of drenches.

State legislation

Victoria

Victorians can use products sold "over the counter" in retail stores for major species (e.g. cattle and sheep) "off label" in minor species (e.g. goats and alpacas). Under this use, the Victorian authorities specify that this should not cause chemical residues in goat products to exceed Maximum Residue Limits and that the product must not be used at a higher dose rate than stated on the label. Therefore, to use the product at a different dose rate requires a veterinary prescription.

South Australia

South Australian legislation considers goats a 'minor trade species' and certain cattle products can be used on them, but cattle pour-on products should not be used on goats. Use at a dose rate different from the label requires a veterinary prescription.

New South Wales, Queensland, Tasmania, Western Australia, Northern Territory, Australian Capital Territory

In all states and territories other than Victoria and South Australia, veterinary medicines, including worm drenches, must be used strictly according to the label or according to a veterinary prescription.

Prescriptions must be in writing and must include details of the product name, the dose and the withholding period. Note: your veterinarian cannot override a "Do Not Use" statement on the label, e.g. Do Not Use in goats whose milk may be used for human consumption.

Veterinarians can only issue these prescriptions if there is a true client–veterinarian relationship and the veterinarian is familiar with your farm and your farm management practices. This normally requires a visit within the last 6–12 months.

If you participate in the on-farm food safety program: the Livestock Production Assurance (LPA) program, administered by Meat & Livestock Australia, you may be audited and will need to show copies of veterinary prescriptions for any worm drenches that have been used that are not registered for use in goats or have been used at a different dose rate from that on the label.

Sharing drench

Unless you are a registered veterinarian, it is illegal to take smaller amounts of product from the original package and repackage them in other bottles or containers.

wormboss

The WormBoss web site is the most complete and current source of information for producers, advisors and students on goat worms, drenches and worm control in Australia.

On the site you will find information and tools:

Regional worm control plans

A step-by-step guide to controlling worms practically, effectively and profitably on your property all year round.

Regional Drench Decision Guides

A tool to help you decide whether your goats need drenching now, and if so, what length of protection is required and when to check the goats again.

Drenches

Lists all of the drench groups and combinations as well as actives and brand names.

Tests and tools

'How to' guides are provided on WormTests, DrenchTests and more.

Worms

Describes the important worm species, their lifecycle and how they affect goats.

Subscription

Subscribe to the ParaBoss monthly e-newsletter to keep up to date on your regional worm situation and new information.

Legal use of drenches in goats

Control of worms in goats may require the use of drenches and with few drenches registered for goats, sheep drenches may be indicated.

When using drenches not registered for goats or any drenches at different dose rates than stated on the label, a veterinary prescription is generally required.

Legislation varies between states and territories, so advice should be sought from your relevant government department or your veterinarian.

It is critical that all goat producers use drenches responsibly, not only so they are both safe and effective, but importantly to prevent goat products entering the market with residues from drenches over the Maximum Residue Limits (MRL), as this would damage the goat industry's reputation and could result in an export market being closed. Responsible use will also help to slow the development of drench resistance.

Producers in the Livestock Production Assurance scheme need to keep their veterinarian's prescriptions for drenches in case they are audited.

See inside the back cover for more information.