Department of Primary Industries

primefact

Anthelmintics (drenches) for sheep, goats and alpacas

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Introduction

Drenches (anthelmintics) continue to play an important role in worm control for sheep, goats and other grazing livestock. However, resistance to drenches is widespread and sometimes severe. Drenches should only be used if tested and shown to be effective on a farm and then used as part of a good, overall worm control strategy. In this regard, WormBoss (wormboss.com.au), along with the animal health information on NSW DPI's website, is an invaluable resource regarding best-practice sheep worm management.

Following is an overview of the different drench types available. Note that most drenches are not registered for use in goats or alpacas. Sheep drenches can only be used in other species, for example, goats or alpacas, if you have written directions from your veterinarian. Remember that dose rates recommended for sheep are usually inappropriate for goats and alpacas. Seek veterinary advice.

Broad-spectrum drenches

Broad-spectrum drenches (Table 1) kill a wide range of susceptible round worms of sheep. This includes 'scour worms', notably small brown stomach worm (*Teladorsagia*) and black scour worm (*Trichostrongylus*), as well as barber's pole worm (*Haemonchus*). When resistance is present on a farm, fewer worms than normal will be killed as worms carrying 'resistance' genes increase in number relative to susceptible worms.

Benzimidazole drenches

These are also commonly known as 'BZ' or 'white' drenches. Examples include Valbazen®, Systamex®, Panacur® (Table 1). BZ drenches disrupt the cellular integrity of susceptible worms by 'inhibiting tubulin polymerization'. The end result is depletion of the worm's energy reserves and an accumulation of waste products. Scour worms on most Australian sheep farms have resistance to BZ drenches, with resistance to barber's pole worm also occurring on many farms.

Levamisole / morantel drenches (imidazothiazoles / tetrahydropyrimidines)

Commonly these are called 'LEV', 'LV' or 'clear' drenches. Examples include Nilverm® and Ripercol® (Table 1). This group paralyses susceptible worms, by acting as 'nicotinic acetylcholine receptor agonists'.

Scour worms on most Australian sheep farms have resistance to LEV drenches, with resistance to barber's pole worm now occurring on many farms, especially in summer rainfall areas of Australia.

Macrocyclic lactone drenches

These are also known as 'ML' or 'mectin' drenches, or 'avermectins / milbemycins'. Ivomec® and Virbamec Oral® (both of which are 'avermectins') and Cydectin® and Maximus® (moxidectin, a 'milbemycin') are examples (Table 1). These cause paralysis by binding to 'glutamate-gated chloride channel receptors' in nematode and arthropod nerve cells.

MLs became available for sheep in Australia in 1988, beginning with ivermectin. Moxidectin is usually more potent than abamectin, i.e. at the same dose rate, moxidectin kills more worms. In turn, abamectin is more potent ivermectin. If a short-acting ML is required, consider abamectin rather than ivermectin, due to abamectin's greater potency.

Moxidectin also has persistent activity against some susceptible worms, meaning it continues to kill ingested infective larvae for days or weeks – depending on the product – following administration. A first sign of resistance with longer acting products such as moxidectin is a reduction in the period of protection it normally affords.

Resistance of black scour worm to the MLs has been reported in Australia, but confirmed cases are still uncommon. Many sheep farms in Australia, especially in uniform and winter rainfall areas, have ML-resistant small brown stomach worm. Resistance of barber's pole worm to this group occurs on most properties in summer rainfall regions and commonly elsewhere.

AAD - amino-acetonitrile derivatives

Monepantel (Zolvix®) is the only commercially available amino-acetonitrile derivative. New Zealand was the first country in which it was released (2009), becoming available in Australia in 2010. Monepantel acts on a particular type of 'nicotinic acetylcholine receptor', which is unique in that it is found only in nematodes. Binding of monepantel to the receptor causes irreversible paralysis of nematodes. Resistance to this group has been reported on a few sheep and goat properties in Australia. Resistant worms have included barber's pole worm, black scour worm and small brown stomach worm, but the resistance profile has not been the same on all affected farms. For example, in the first reported case in Australia (goat farm, central western NSW (Love S, 2014)), monepantel remained effective against barber's pole worm but had reduced efficacy against scour worms. In other cases, barber's pole worm has been monepantel-resistant.

Spiroindoles

This group is represented in the market place by derquantel, which is actually a mid-spectrum drench, however it is only available in combination with the broad-spectrum ML drench, abamectin. The combination product (Startect®) was released in Australia in 2014, earlier in other countries. Derquantel acts on yet another type of 'nicotinic acetylcholine receptor', located at the nematode neuromuscular junction, and produces flaccid paralysis of nematodes. Resistance to abamectin is common. No resistance has been reported to derquantel. If severe resistance to abamectin is present, then in some cases the efficacy of Startect could be reduced from >95% to around 90%.

Drench combinations and mixtures

There are also products on the market which are combinations or mixtures of different actives, for example narrow- or mid-spectrum actives mixed with broad-spectrum actives. For more information on combinations and mixtures, see this article on WormBoss:
http://www.wormboss.com.au/news/articles/drenches/understanding-drenches-mixtures-combinations-and-both.php

As to combinations, they contain two or more unrelated active ingredients each of which target the same worms, probably with increased efficacy including kill rate of resistant worms.

To predict likely efficacies of combinations using drench resistance tests results for single actives, go to the calculator on WormBoss:

http://www.wormboss.com.au/tests-tools/management-tools/combination-drench-efficacy-calculator.php

Narrow and mid-spectrum drenches

These are also listed in Table 1.

Spiroindoles

See above.

Organophosphates (OPs)

Naphthalophos (NAP) is the OP drench active currently marketed in Australia. OPs disturb neuromuscular coordination in worms, by inhibiting many enzymes, especially acetylcholinesterase. On its own and at the currently recommended sheep dose rate (~ 35 mg/kg), it is effective (>95%) against adult barber's pole worm, but has lower efficacy (about 70-90%) against immature barber's pole worm and the scour worms, brown stomach worm and black scour worm. (Lower efficacy in some drenches can be due to reasons other than resistance).However, NAP is mostly used in combination with broad-spectrum actives. Resistance of barber's pole worm and scour worms to NAP has been reported but is thought to be uncommon. NAP has a narrower safety margin than many other drenches, so label directions should be followed carefully.

Triclabendazole (TCBZ)

Triclabendazole is technically a benzimidazole drench but, unlike others in the group, it is has a narrow spectrum of activity. TCBZ is effective against early immature, immature and adult liver fluke (*Fasciola hepatica*). Some cases of TCBZ-resistant fluke have been found in Australia and elsewhere, the first recorded case in the world being from Victoria (Overend and Bowen,1995).

Salicylanilides and phenols

These include closantel, nitroxynil and oxyclosanide, which have activity against 'bloodsuckers', namely liver fluke (except for early immatures) and barber's pole worm. These actives 'uncouple oxidative phosphorylation' in targeted worms, resulting in loss of cellular integrity. Most properties in summer rainfall regions of Australia, and fewer elsewhere, have barber's pole worm resistant to this group. Resistance of liver fluke to closantel has been found but is thought to be uncommon.

Isoquinolones

Praziquantel is an isoquinoline. It is effective against tapeworms, more effective than older 'tapewormers'. The mode of action of praziquantel is uncertain, but it causes tegumental ('skin') damage and paralytic muscular contraction of cestodes (tapeworms), followed by their death and expulsion (Merck). There are unpublished reports from New Zealand of resistance of *Moniezia* (sheep intestinal tapeworm) to praziquantel (P Mason, personal communication). Resistance is believed to be uncommon. Praziquantel is only available in a mixture with other actives in sheep drenches in Australia.

Table 1.Drench groups and actives

Drench groups and actives	Worms	Examples* of brand names / comments
BZ (benzimidazole) ('white') [B] albendazole fenbendazole oxfendazole	Barber's pole worm, 'scour worms', adult liver fluke (at higher does rate), nodule worm, aids control of intestinal tapeworm (*Moniezia*)	Valbazen (albendazole) WSD Fenbendazole (fenbendazole) Oxfen (oxfendazole)
LV (levamisole) ('clear')[B] levamisole	Barber's pole worm, 'scour worms', nodule worm	Nilverm, Levamisole Gold
ML (macrocyclic lactone)[B] (sometimes also called 'mectins') ivermectin abamectin moxidectin	Barber's pole worm, 'scour worms', nodule worm	Ivomec, Noromectin (ivermectin) Absolute, Vetmec, Paramectin (abamectin) Cydectin Oral, Moxitak (moxidectin)
A(A)D (amino-acetonitrile derivative) monepantel	Barber's pole worm, 'scour worms'	Zolvix[B]
SI (spiroindole) derquantel	Barber's pole worm, 'scour worms', nodule worm	Derquantel[M] is only found in a combination: Startect (abamectin[B] + derquantel [M])[B]
OP (organophosphate) [M] naphthalophos (NAP) (OPs have lower or variable efficacy against 'scour worms' in the upper GIT and immature barber's pole worm)	Barber's pole worm, 'scour worms'	Rametin[M], (naphthalophos, which is commonly used in combinations)
T(CB)Z or benzimidazole group (flukicide) [N] triclabendazole	Liver fluke (all stages); not effective against round worms	Fasinex, Tremacide, Exifluke
SA (salicylanilides/phenols) [N] closantel nitroxynil oxyclozanide	Liver fluke (> 6 weeks and adult) and barber's pole worm	Closicare, Sustain (closantel) Trodax (nitroxynil) (not currently available) Nilzan[B] (levamisole[B] + oxyclozanide[N])
IQ (isoquinolone) [N] praziquantel	Intestinal tapeworm (*Moniezia*)	Praziquantel[N] is only available in combination with broad-spectrum drenches. First Drench[B], Genesis Tape[B]

Source: Adapted from table in WormBoss / ParaBoss. * Neither ParaBoss nor NSW DPI endorses specific brands. The products listed are examples only. More information: http://www.wormboss.com.au/drenches.php or the Australian Pesticides and Veterinary Medicines Authority searchable database: https://portal.apvma.gov.au/pubcris

Breadth of activity across different worm species: [B=]Broad-spectrum;[M=]Mid-spectrum; [N=]Narrow-spectrum.

Length of protection: Varies from short-acting ('knock-down' that kills susceptible worms within the animal) to mid-length (1–6 weeks activity against incoming larvae) and long-acting (approx. 3 months).

The mid-length and long-acting drenches not only kill susceptible worms already in the animals, but also susceptible infective larvae that the sheep ingest during the protection period.

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. Do not mix your own drenches unless the product label or manufacturer state that you can.

Product formulation: All single actives are available as oral drenches. Moxidectin is also available in injectable products. Intra-ruminal/controlled release capsules are available with BZ and/or ML actives. Abamectin is also in a pour-on formulation for both lice and worm control.

'Scour worms': Mainly black scour worm and (small) brown stomach worm, but also others, including thin-necked intestinal worm (*Nematodirus*).

Label: Check product labels for full details. Follow the label.

Other drenches: Clorsulon (sulphonamide group) is a flukicide and is found in various cattle drenches. Nitroxynil is the active in Trodax®, which is not currently available, however nitroxynil is an active in the cattle drenches Nitromec® and Nitrofluke®. Because rumen bacteria metabolize and destroy the activity of nitroxynil, it must be injected (Merck).

Other parasites: See 'Drenches' in WormBoss.com.au for detail on the effectiveness of drench groups against parasites not listed above.

GIT: Gastro-intestinal tract.

Drenches for goats and alpacas?

As noted earlier, there are few drenches registered for use in goats, and none for camelids including alpacas. At times, unregistered products have been available for use in various animals, including camelids under 'minor use' permits. Currently there is a permit which allows the use of triclabendazole in camelids under certain conditions, i.e. animals being transported to Western Australia. More information: http://permits.apvma.gov.au/PER13882.PDF. Note that the inappropriate use of pour-on cattle drenches in other species can result in poor efficacy and increased selection for drench resistance.

Table 2. Drenches registered for goats

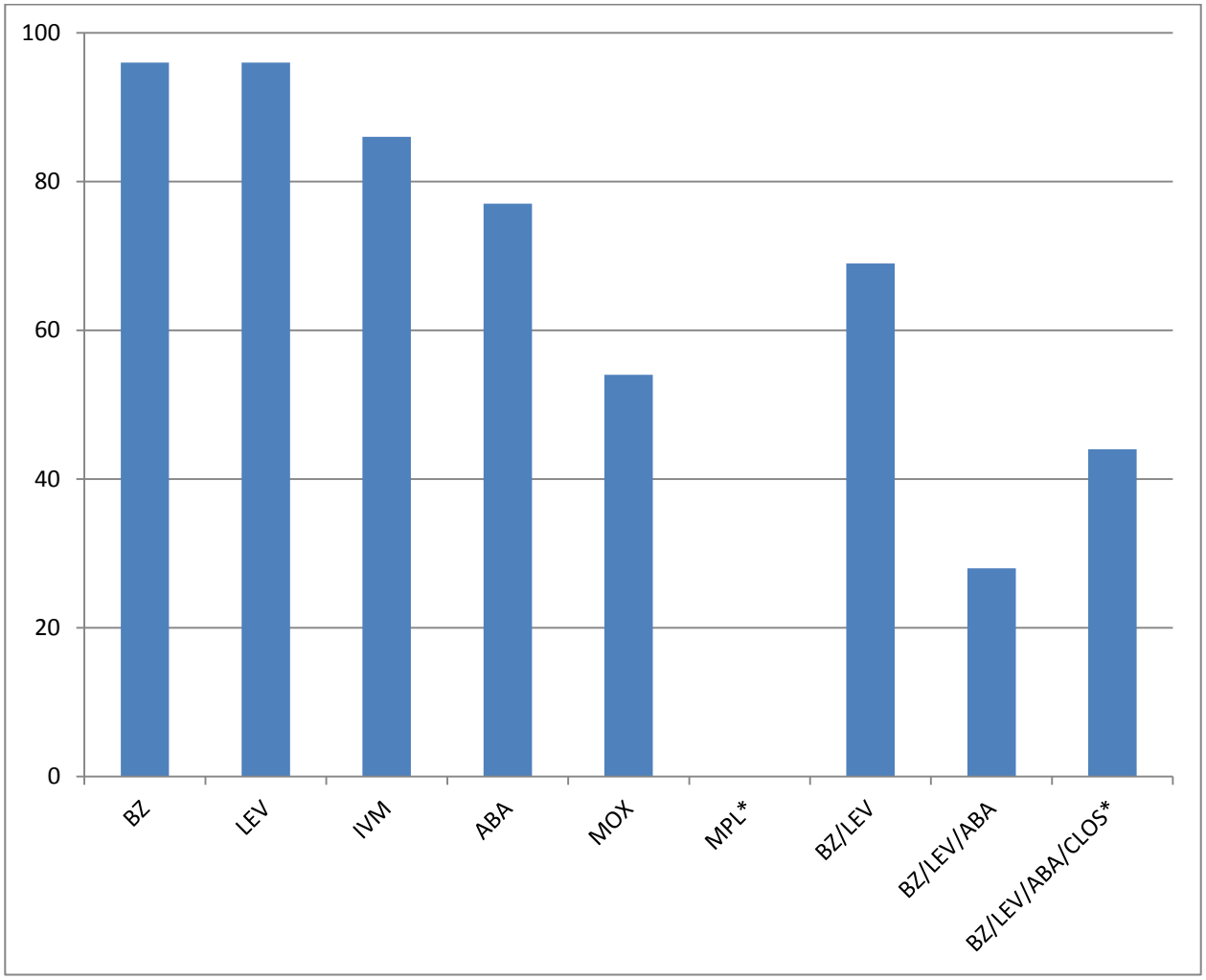
Drench groups and actives	Worms	Short brand names (examples)
BZ (benzimidazole)('white') [B] albendazole fenbendazole oxfendazole	Barber's pole worm, 'scour worms', adult liver fluke (at higher dose rate), nodule worm, aids control of intestinal tapeworm (*Moniezia*)	Alben, Beezed, WSD Albendazole, Valbazen (albendazole) Fenbender 25,Beezed LV, 4Farmers Fenbendazole, WSD Fenbendazole, Panacur 25 (fenbendazole) Oxazole, Oxfen (oxfendazole)
LV (levamisole) ('clear') [B] levamisole morantel	Barber's pole worm, 'scour worms', nodule worm	Oralject (morantel) There is no levamisole drench (e.g. Nilverm etc.) registered for goats.
ML (macrocyclic lactone) [B] (sometimes called **'mectins'**) ivermectin abamectin moxidectin	Barber's pole worm, 'scour worms', nodule worm	Caprimec (abamectin) No other ML registered for goats
A(A)D (amino-acetonitrile derivative) Monepantel (Zolvix®)	Barber's pole worm, 'scour worms'	None registered for goats
SI (spiroindole) Derquantel (Startect®)	Barber's pole worm, 'scour worms', nodule worm	None registered for goats
OP (organophosphate) [M] naphthalophos (NAP) (OPs have lower or variable efficacy against 'scour worms' in the upper GIT and immature barber's pole worm)	Barber's pole worm, 'scour worms'	None registered for goats. Previously trichlorfon (Neguvon) was available for use (against *Haemonchus*) under permit. Safety margin of NAP is lower in goats than in sheep.
TZ (a benzimidazole) (flukicide) [N] triclabendazole	Liver fluke (all stages); not effective against round worms	Exifluke, Fasinex, Flukare,WSD LV Triclabendazole, Young's Tricla
SA (salicylanilides/phenols) [N] closantel nitroxynil oxyclozanide	Liver fluke (> 9 weeks and adult) and barber's pole worm	None registered for use in goats
IQ (isoquinolone) [N] praziquantel	Intestinal tapeworm (*Moniezia*)	None registered for use in goats

For a complete and up-to-date list, consult the Australian Pesticides and Veterinary Medicines Authority searchable database: https://portal.apvma.gov.au/pubcris

Resistance to drenches

As mentioned earlier, resistance to drenches used in Australia for sheep, cattle, goats and alpacas is very common. The figure below summarises some of the results from Playford and others, 2014, who analysed laboratory data on drench resistance tests throughout Australia.

Figure 1. Proportion of drench resistance tests showing resistance: Australia, 2009 - 2012 (Playford and others, 2014)



Notes

The results are for 'all worm species' (i.e., 'undifferentiated strongyle egg counts'), which includes common sheep worms such as barber's pole, brown stomach and black scour worms. BZ = benzimidazole. LEV = levamisole. IVM = ivermectin. ABA = abamectin. MPL = monepantel. MOX = moxidectin. BZ/LEV = a BZ/LEV combination. BZ/LEV/ABA = an ML-based 'triple' combination containing ABA, BZ, LEV. BZ/LEV/ABA/CLOS = a 4-way combination which also contains closantel. An asterisk (*) against a drench indicates there were less than 50 tests for that drench, so results should be interpreted with caution. For example, the results do *not* say that 44% of sheep farms across Australia have resistance to the BZ/LEV/ABA/CLOS. Further, many of the tests for this 4-way combination came from the New England region. The results are based on samples submitted to laboratories across Australia, so this is not a survey of randomly selected sheep farms. Thus the figures are not to be taken as accurate estimates of the prevalence of resistance: the results are merely indicative. Since this analysis was done, a small number of cases of resistance to MPL on sheep and goat farms have come to light. Additionally there have been rare cases of reduced efficacy of Startect® (=derquantel+abamectin), to around 90%, instead of being >95%, as usual. This reduction in efficacy is believed to occur in situations where there is severe resistance to the abamectin component of the drench. As yet, resistance to derquantel is unknown.

Choosing and using a drench—general principles

Do a resistance test

Resistance to drenches is widespread. If you have not done a resistance test (worm egg count reduction test (DrenchTest)) in the last 2–3 years, your choice of drench will be based as much on guesswork as anything. Using a drench that is not effective may result in 10-50% losses in productivity and possibly

deaths as well. At the very least, do regular 'DrenchChecks', that is, monitor faecal worm egg counts (WECs or WormTest) on or just before drenching a mob of sheep and again 10–14 days later. This is to make sure the drench is effective (i.e. the WECs after drenching have been reduced by at least 95%). Getting a 'worm type' (larval culture and differentiation) with both worm egg counts is also recommended. See WormBoss.com.au.

Assume nothing. Regularly check the efficacy of drenches – old or new – that you use on your property.

The 'no drench' option

Don't guess—WormTest! Every time a drench is used, there is some selection for resistance to that drench. This is particularly the case when there are few worms 'in refugia'. Worms in refugia are those not exposed to a drench, usually those present as eggs or larvae on pasture, or worms in undrenched sheep. Examples of situations where there are few worms in refugia include droughts or prolonged dry spells, or when drenching and moving sheep to very clean paddocks, such as cereal stubbles in hot, dry summers. In these situations a higher proportion of the worm population are inside the sheep and thus selected for resistance when the sheep are drenched.

More information on refugia: http://www.wormboss.com.au/news/articles/drench-resistance/use-refugia-to-prolong-drench-life.php

Avoid drenching unnecessarily. Sometimes shifting sheep to a 'low worm-risk' paddock, which also has better quality feed, can significantly reduce worm burdens. If in doubt, WormTest.

Narrow-spectrum vs broad-spectrum

Ideally a narrow-spectrum rather than a broad-spectrum drench should be used when the former will suffice. For example, if a drench is required for liver fluke, do not also drench for roundworms unless a WEC or other indications of parasitism or the program you are following indicates it is necessary.

Short-acting vs long-acting

Generally, the more persistent an anthelmintic, the greater the selection for drench resistance. However, other factors also have a bearing on selection for resistance, including the 'potency' of the drench. Opinions on the relative importance of these factors vary. All this aside, the longer acting drenches may have advantages in certain situations, for example when conditions are very favourable for worms, especially barber's pole worm, and low worm-risk paddocks have not been prepared for vulnerable stock (lambing ewes, weaners). As with other drenches, resistance of worms to long-acting drenches is very common.

Consider combinations

Using combinations of unrelated drench actives – with similar spectrums of activity and similar persistency - can slow the development of drench resistance to those actives on your farm. Unless individual actives are fully effective on their own (increasingly unlikely), combinations are usually more effective than using the individual actives. This means a better kill of the worms in your sheep. However, there is now some resistance even to combinations. Assume nothing: also check (DrenchCheck) to see if the combinations you are using are effective.

Right drench, right time

The right drench is the one designed to kill the worms you are targeting, and which you have tested and found to be effective (>95%) on your farm. Most desirable is a drench or combination of unrelated drenches with >98% efficacy.

As to timing, follow the worm control program for your area and regularly monitor WECs. See 'Your Program' at WormBoss.

Follow the label

Use the right dose rate. Check drench guns for accuracy. Drench to the heaviest in the mob unless bodyweights vary considerably in which case you may, for example, have to draft off lighter sheep for treatment at a lower does rate, as specified by the product label.

Reduce feed before drenching (for some drench types)

For white (BZ), macrocyclic lactone (ML) and closantel drenches (but **not** clear (LEV) or organophosphate (OP) drenches), reducing feed but not water 24 hours before and several hours after treatment may make the drench more effective. Do not restrict feed or water in sheep that are heavily pregnant, stressed or in poor condition. Do not restrict feed or water before or after using OP or LEV drenches (Hennessy and Ali, ca. 1994).

Far more important than this is regular testing of drenches on your property and using those that are found to be >95% effective.

Place the tip of the drench gun over the animal's tongue

This ensures that more of the drench will go into the first stomach (rumen or paunch), thus extending drench availability. Drench that goes into the fourth stomach (abomasum) is less effective. This is more likely to happen when drench is deposited in the front of the mouth. Take care not to direct drench into the windpipe and lungs (Hennessy and Ali, circa 1994).

Integrated worm control

Good practice worm control is not just about drenches. An 'integrated' approach is needed. This involves combining timely, effective drenching with other control strategies. These include:

Grazing management

Prepare 'low worm-risk' pastures for susceptible sheep such as weaners and late pregnant or lactating ewes.

Nutrition

Well-grown weaners develop immunity earlier. Well-fed lambing ewes shed fewer worm eggs and produce more productive lambs.

Well-bred

Buy rams bred for increased resistance to worms. Select those with favourable Australian Sheep Breeding Values (ASBVs) for WEC as well as favourable values for the production traits you want.

Manage and monitor

Have a compact joining and lambing, combined with weaning at 12–14 weeks after lambing. Regularly monitor worm burdens and drench efficacy using WormTests.

References and more information

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More information

As well as NSW DPI's information on animal health, also consult WormBoss (wormboss.com.au). This is an invaluable and highly recommended resource for parasite management, along with sister sites, Flyboss and Liceboss, which are also under the ParaBoss umbrella.

Additionally, seek advice from a veterinarian or another adviser with expertise in livestock parasitology.

Also see the searchable database of veterinary chemicals ("PUBCRIS") at the Australian Pesticide and Veterinary Medicine Authority (APVMA) website: https://portal.apvma.gov.au/pubcris, or try the APVMA iPhone app: https://itunes.apple.com/us/app/apvma/id564121943

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