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Drench resistance and sheep worm control

Stephen Love

Veterinarian/State Worm Control Coordinator, Extensive Industries Development, Armidale

Summary

Internal parasites are a major problem of Australian sheep. Anthelmintics have been the mainstay of sheep worm control, but their role is increasingly threatened by resistance in the target parasite species. There have been no enduring solutions to the problem of anthelmintic resistance, and the problem is getting worse.

One option, perhaps the only option, is to sidestep the problem by significantly reducing reliance on drug-based worm control.

Introduction

Resistance aside, modern anthelmintics are highly effective, easy to use and relatively cheap. As a result they have become the centrepiece of worm control in sheep and other farmed animals. However, this heavy emphasis on drenches may be unsustainable for three main reasons:

- Drug resistance is a major problem, and becoming worse.
- Entirely new drench groups are unlikely to come onto the market in the near future.

Table 1. Drench resistance – how common is it? Resistance to sheep drenches is widespread with 90 per cent or more of farms affected.

Drench or drench group	Prevalence of resistance*
Benzimidazole (BZ, 'white')	Approximately 90% of properties.
Levamisole (LEV, 'clear')	Approximately 80% of properties ('scour' worms**); resistance no longer rare in *Haemonchus.*
BZ + LEV combination	Approximately 60% of properties ('scour' worms).
Macrocyclic lactone (ML, '-ectin') (Avermectins (ivermectin, abamectin) and milbemycins (moxidectin))	Becoming more common. About 70% of sheep farms in WA have ML-resistant *Ostertagia (Teladorsagia)*. ML-resistant *Haemonchus* in northern NSW and southern Queensland is now common (about 70% of farms). ML-resistant *Ostertagia* occur on around 30% of farms in southern NSW and other non-seasonal to winter rainfall areas of south-eastern Australia
Naphthalophos	Resistance rare. Two recorded cases in Australia (goats, Queensland) –Green and others 1981 (*Haemonchus*), Le Jambre and others (2005) (*Trichostrongylus*).
Closantel	Resistance in *Haemonchus* is common in northern NSW and SE Queensland. Some isolates are also ML-resistant. Small number of resistant strains of liver fluke in Australia.
Triclabendazole	Small number of resistant strains of liver fluke in Australia.

* Drench efficacy < 95 per cent. Prevalence of ML-resistance: these estimates refer to avermectins (ivermectin, abamectin) resistance. The prevalence of resistance to moxidectin, which is more potent, is currently lower.

** Scour worms: mainly *Trichostrongylus* and *Ostertagia* spp

Sources: J Lloyd (1998), Palmer and others (2000), Love and others (2003); Besier and Love (2003), and J Boray, GW Hutchinson, RB Besier and R Woodgate, BF Chick, PI Veale, M Lyndal-Murphy and D Hucker (personal communications).

- Society increasingly expects food and fibre production with minimal 'chemical' inputs.

Modern anthelmintics – a two-edged sword

There is no doubt that modern anthelmintics have many good points. However, this is not without cost.

As a general rule, within a given farming system, **the better the control through drenching, the greater the selection for resistance in worms to the drench group used.**

Time line – drenches and drench resistance in Australia

The table on page 4 outlines the history of new drench releases and the development of drench resistance in sheep worms.

Sheep worms generally evolve resistance fairly quickly to each new drench group. Resistance to the newest family of broad-spectrum anthelmintics – the macrocyclic lactones (the MLs) – is now common. This is the case for example in northern NSW and south-eastern Queensland where resistance to closantel is now widespread. (Closantel is a narrow-spectrum drench with persistent activity against *Haemonchus*).

In these areas, broad-spectrum anthelmintics increasingly are being used to control *Haemonchus,* as was the case prior to the launch of the first version of WormKill in 1984. The broad-spectrum anthelmintics now commonly being used are the MLs.

Low rainfall areas and drench resistance

Some think that drench resistance is only a problem of the higher rainfall sheep raising areas of Australia. More frequent drenching is required in these areas and this, combined with occasional under-dosing – and drenching when there are few worms on pasture – produces greater selection for resistance in worm populations.

However, drench resistance in western NSW may be more prevalent than previously realised. Selection for resistance appears to be stronger in dry environments and during droughts. (Recent work in the Deniliquin and Corowa areas of south western NSW suggests around one in three farms now have ivermectin-resistant *Ostertagia* (H Suddes and D Salmon, pers comm.)

In Western Australia, virtually all of the confirmed cases of ML resistance (all *Ostertagia* spp.) were found in areas with hot and dry summers rather than in more temperate areas, despite considerable testing for resistance. Brown Besier, veterinary parasitologist with WA Department of Agriculture, further reports that in the dry areas, one drench per year was typical, and resistance had evolved on these farms after 4–6 years.

In the higher rainfall areas of Western Australia there were farmers who used MLs for eight years in a row, 2–4 times per year, with no evidence of a problem. It is believed that this reflects the relative potential for dilution of surviving resistant worms with non-selected ones, which is a function of the environment.

In short, one should consider the environment as well as treatment practices when looking at the relative likelihood of the development of resistance.

Worms: Who's Who	
Round Worms (Nematodes)	
Haemonchus	barber's pole worm
Trichostrongylus	black scour worm
Ostertagia (*Teladorsagia*)	small brown stomach worm
Nematodirus	thin-necked intestinal worm
Chabertia	large mouth bowel worm
Oesophagostomum	large bowel worm, (*O. venulosum*); less commonly nodule worm (*O. columbianum)*
Trematodes (flukes)	
Fasciola hepatica	liver fluke
Paramphistomes	stomach fluke
Flat Worms (Cestodes)	
Tapeworms	

The problem – solve or sidestep?

In the mid-1980s, with the introduction of programs such as WormKill, then DrenchPlan, there was a leap from ad hoc and tactical drenching to less frequent and strategic drenching. It was hoped that this would delay the onset of resistance.

Clearly it is time for another major shift away from drug-centred worm control to an integrated and 'robust' system employing several control methods as outlined in the current versions of the WormKill, DrenchPlan and FarWestWorm programs. (These can be classed as 'modified' strategic programs). However, it is likely that drenches will continue to be important in worm control in the foreseeable future.

There have been no enduring solutions to the problem of anthelmintic resistance. The following comments (below) from Douglas Gray, formerly Principal Research Scientist with CSIRO, are still relevant.

'The … problem of preventing (ML) resistance gets smaller – still remaining unsolved – when there is less reliance on them for worm control. If there was a choice between solving the current problems or making them irrelevant, … making them irrelevant is the most sensible option.

From Nemesis[1] surveys, the concept of reduced reliance on drenches was the favourite future benefit perceived to come from breeding worm-resistant sheep. I wonder if making anthelmintic resistance irrelevant … would be another way of saying the same thing? Since the late sixties and the appearance of BZ resistance, a huge effort has been directed at solving the drench resistance problem. From time to time I need to be reminded that worms are the problem, not anthelmintics. **Reduced reliance on drenching makes drench resistance increasingly irrelevant.** (The emphasis is mine.)

[1] Nemesis was a program (CSIRO and others) that aimed to encourage the breeding of sheep that are more resistant to worms.. A number of studs still breed worm-resistant rams.

Integrated worm management is:

- **The right drench at the right time**.
  (Note: most producers do not accurately know which drenches work on their property.)
- **Grazing management**
  Creating safer pastures for susceptible sheep. The lambing paddock is usually the worst one for weaners. Rotational grazing generally produces better worm control than set-stocking.
- **Nutrition**
  Good nutrition which may include 'strategic' supplementation for young sheep in particular. Stunted weaners have poor immunity. Fat/condition score 3 ewes – and their progeny – often have substantially lower worm burdens than ewes in poorer condtion.
- **Flock and weaner management**
  'Compact' joining and lambing, and weaning by 12–14 weeks after lambing starts. Good ewe management to minimise the effects of the peri-parturient relaxation of resistance to worms.
- **Breeding resistant sheep**
  Use rams that have favourable breeding values for resistance to worms, as well as production traits.
- **Fine-tuning based on sound information**
  - Regular worm egg count (WEC) monitoring (WormTests).
  - Regular resistance testing (DrenchTest), ideally every two years, supplemented by regular "DrenchChecks' (a WEC 10-14 days after a routine drench).
  - Expert advice.
- **Future strands**
  - **Vaccines**. Research on vaccines continues but there is no prospect of a commercial product in the near future.
  - **Nematophagous fungi**. These are fungi that trap and destroy worm larvae inside sheep faecal pellets. CSIRO and a commercial partner have researched a product using this technology (not yet available).

References

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Palmer DG, Besier RB and Lyon J (2000). Anthelmintic resistance in Western Australia: a point of crisis? Proceedings of the Australian Sheep Veterinary Society, AVA Conference.

Primefacts on sheep worms

For a comprehensive range of Primefacts on internal parasites in sheep, see the NSW Department of Primary Industries web site at: www.dpi.nsw.gov.au/reader/sheep-internal Titles at that site include:

- Combinations of sheep drenches, resistance and refugia
- DrenchPlan
- DrenchPlan 2005
- WormKill and FarWestWorm (currently (Feb.07) undergoing revision)
- Hydatids – you, too, can be affected
- Identifying liver fluke snails
- Laboratory tests for worms – prices and availability

Drenches and drench resistance – Australia

Year	Drench release	Drench resistance discovered/reported
1961	Thiabendazole (TBZ)	
1966		TBZ (*Haemonchus*) NSW
1968	Levamisole (LEV)	
1972	Second generation BZs	
1977		1st New England Survey: 18% of farms had TBZ-resistant *Haemonchus*.
1979		LEV (*Ostertagia*) – NSW, LEV and BZ – Vic.
1982	Closantel	
1984	(WormKill launched July, northern NSW)	2nd New England survey: LEV and BZ resistance widespread (*Haemonchus*, *Trichostrongylus*, *Ostertagia*)
Dec 1985	(DrenchPlan launched southern NSW)	
1987		Ivermectin (*Haemonchus*) – South Africa and South America. Closantel (*Haemonchus*) – northern NSW.
1988	Ivermectin (Ivomec®) (WormPlan launched – Victoria)	
1989	(Proprietary) BZ + LEV combinations	
1987–1991		Combination (BZ + LEV) resistance common northern NSW.
1990	Albendazole capsules	
1993		Ivermectin (*Haemonchus*) – northern NSW.
1994		Ivermectin (*Ostertagia*) WA. Ivermectin and moxidectin(*Ostertagia* – goats from NZ) – NSW.
1995	Moxidectin (Cydectin®)Naphthalophos re-released (Rametin®; recently Combat® also)	
1996		Closantel (*Haemonchus*) prevalent, northern NSW.
1997	Ivermectin capsule	Several ML-resistant strains (*Haemonchus*) including one also resistant to closantel – northern NSW.
March 1998	(WestWorm/FarWestWorm launched)	
2000		About 40% of WA farms have ML resistance. ML-resistant *Haemonchus* becoming more common in northern NSW/southern Queensland. First reports of ML resistance (*Ostertagia*) in sheep in southern NSW.
2001		Multi-drug, including moxidectin resistant isolate of *Haemonchus* found in northern NSW (Love and others 2003).
2003–2005		About 60% of WA farms have ML-resistant *Ostertagia* and about 30–60% of northern NSW farms have ML-resistant *Haemonchus*. ML-resistant *Ostertagia* becoming more common in southern NSW and other non-seasonal or winter rainfall areas of Australia.
2005		Moxidectin (and other) resistant *Haemonchus* and *Trichostrongylus colubriformis*; goats, south-eastern Qld (Le Jambre and others 2005).
March 2005	WormBoss launched www.wormboss.com.au	
2007		About 70% of WA farms and possibly 30% of farms in south-eastern Australia (winter or non-seasonal rainfall areas) have ML-resistant Ostertagia, a similar proportion of northern NSW/south-eastern Qld farms have ML-resistant Haemonchus.

- Liver fluke disease in sheep and cattle
- Quarantine drenching – don't import resistant sheep worms
- Registered drenches for sheep worms
- Drench resistance and sheep worm control
- Sheep worm control: Summer vs Winter drenching in southern NSW
- Stomach fluke (paramphistomes) in ruminants
- Turning The Worm Newsletter
- Worm control regions
- WormBoss
- WormFax NSW
- WormTest for livestock, and guide to egg counts

Many of these publications are also available as hard copy through NSW DPI and Rural Lands Protection Boards.

For further information about worms and worm control, contact your veterinarian or other professional adviser.

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