NSW GOVERNMENT Industry & Investment

FACTSHEET

Drench resistance and sheep worm control

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Summary

Internal parasites are a major problem of Australian sheep. Of the endemic diseases, they cost the most, closely followed by lice and flies.

Anthelmintics have been the mainstay of sheep worm control, but resistance of worms to them is widespread and often severe. 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:

Drench resistance – how common is it? Resistance to sheep drenches is widespread with 90 per cent or more of farms affected. Following is an overview of the current resistance situation.

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

Notes: * Drench efficacy < 95 per cent. Prevalence of ML-resistance: these estimates refer to avermectin (ivermectin, abamectin) resistance. The prevalence of resistance to moxidectin, which is more potent, is currently lower but approximately 30% of farms (moxidectin-resistant *Haemonchus*) in the New England region of NSW (Nielsen and Bailey, unpublished data). In addition, Nielsen's and Bailey's assessment of the data suggests that, on the great majority of properties in the NSW Northern Tablelands, worm eggs are re-appearing somewhat sooner after treatments with moxidectin products than used to be the case. **Scour worms: mainly *Trichostrongylus* (black scour worm) and *Teladorsagia* (*Ostertagia*) spp (small brown stomach worm).

Sources: J Lloyd, D Palmer, J Boray, GW Hutchinson, RB Besier, R Woodgate, R Nielsen (Veterinary Health Research, Armidale), JN Bailey, PI Veale, M Lyndal-Murphy and D Hucker (personal communications); Besier and Love (2003).

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- Drug resistance is a major problem, and becoming worse.
- Entirely new drench groups come onto the market very infrequently. There was a gap of over 20 years between the launch of the macrocyclic lactones (in Australia, ivermectin in 1988) and the launch of the next new group, the aminoacetonitrile derivatives (the AADS, represented by monepantel, released in New Zealand in 2009 and in Australia in 2010).
- Society increasingly expects food and fibre production with minimal 'chemical' inputs.

Modern anthelmintics – a two-edged sword

Modern anthelmintics have many good points. However, this is not without cost.

As a 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 macrocyclic lactones (the MLs), introduced in the late1980s and the 1990s, is now common. This is the case for example in the summer rainfall zones of northern NSW and south-eastern Queensland where resistance to closantel became increasingly widespread from the early 1990s. (Closantel is a narrow-spectrum drench with persistent activity against susceptible *Haemonchus*).

In these areas, with the demise of closantel on many properties, broad-spectrum anthelmintics were increasingly used to control *Haemonchus,* as was the case prior to the launch of the first version of WormKill in 1984. The broad-spectrum anthelmintics most commonly used were the MLs.

Low rainfall areas and drench resistance

Some think that drench resistance is only a problem in 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 the lower rainfall, pastoral zone of western NSW may be more prevalent than previously realised. Selection for resistance appears to be stronger in dry environments and during droughts. Field work several years ago in the Deniliquin and Corowa areas of south western NSW indicated that a third of the twenty or so farms investigated had ivermectin-resistant *Teladorsagia* (*Ostertagia) circumcincta* (H Suddes and D Salmon, personal communication).

In the south of Western Australia (WA), which has a Mediterranean climate, ML-resistant *Teladorsagia circumcincta* is now present on almost all farms. However, the prevalence varies considerably between the different ML actives because of differences in potency.

Drench resistance in WA is strongly related to the commonly-used "summer drenching" strategy, as during the long and extremely hot and dry summer period there is little pick-up of worms from pasture after drenching, and hence little dilution of surviving resistant worms with non-selected ones picked up from pasture (i.e., there are few worms 'in refugia'). Brown Besier, principal veterinary parasitologist with the WA Department of Agriculture and Food, reports that resistance to ivermectin was first found just 4 years after it was introduced, in situations where only 1 or 2 drenches were given annually - at least one being during summer.

Current recommendations in WA aim to increase refugia for non-resistant worms, by moving annual drenches for adult sheep from summer to autumn. In autumn there is some development of worm eggs and hence dilution of resistant worms present in sheep. Young sheep are still drenched in summer.

In short, the environment as well as treatment practices should be considered when assessing the likelihood of the development of resistance.

Worms: Who's Who

Round Worms (Nematodes)	
Haemonchus contortus	barber's pole worm
Trichostrongylus species	black scour worm
Teladorsagia (Ostertagia) circumcincta	small brown stomach worm
Nematodirus species	thin-necked intestinal worm
Chabertia species	large mouth bowel worm

Oesophagostomum species	large bowel worm, (*O. venulosum*); less commonly nodule worm (*O. columbianum)*
Trematodes (flukes)	
Fasciola hepatica	liver fluke
Paramphistomes	stomach fluke
Flat Worms (Cestodes)	
Tapeworms	

Note: Only the more important or common worms are listed in the table above.

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.

Since the mid 1980s, there has been increasing emphasis on shifting 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 comments (below) from Douglas Gray, formerly a Principal Research Scientist with CSIRO, are still relevant.

"The … problem of preventing 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.

Since the late '60s 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.)

Integrated Worm Management is:

- **The right drench at the right time.** (Most producers do not accurately know which drenches work on their property)
- **Grazing management** – creating safer pastures for susceptible sheep, notably lambing ewes and young 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 or pregnant ewes that fail to meet target weights or condition scores. Stunted weaners have poor immunity. Ewes with fat/condition score 3 – and their progeny – often have substantially lower worm burdens than ewes in poorer condition.
- **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 (worm egg count reduction test)), 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 little 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).

Managing drench resistance

Know what drenches are effective on your farm, by doing worm egg count reduction tests (WECRT; DrenchTest) every 2-3 years, with occasional DrenchChecks in between. (DrenchCheck is a worm egg count (WEC; WormTest) 10 days after a drench, and is a quick measure of drench efficacy).

Don't use drenches unnecessarily, especially in adult animals. WormTest first.

Particularly avoid unnecessary drenches when there are few worms 'in refugia', i.e. few worm eggs and larvae on pasture due to prolonged hot, dry conditions, or due to management practices,

e.g. harvesting a crop. Selection for resistance is stronger when there are few worms in refugia, because there are few, unselected worms on pasture to dilute the progeny of resistant worms surviving inside sheep after drenching.

Use drenches at the correct dose rate, using calibrated drench guns, and weighing a selection of sheep.

Consider using combinations of unrelated drenches, and rotate between drench types within season. This may mean rotating between different types of combinations if combinations are being used.

Avoid using long-acting drenches as a pre-lambing drench unless necessary. Good lambing paddock preparation reduces the need for long-acting drenches.

Reduce the need for drenching by using integrated worm management.

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Further information

WormBoss.

www.wormboss.com.au

Primefacts on sheep worms

For a comprehensive range of Primefacts on internal (and external) parasites of sheep, see the Industry and Investment NSW web site at: www.dpi.nsw.gov.au/agriculture/livestock/sheep/health

Table. Sheep drenches, resistance and worm control initiatives - Australia

1961	Thiabendazole (TBZ) released
1966	TBZ (*Haemonchus*) resistance reported, NSW
1968	Levamisole (LEV) released
1972	Second generation BZs released
1977	1st New England Survey: 18% of farms had TBZ-resistant (*Haemonchus)*
1979	Resistance reported: LEV (*Ostertagia, NSW*), LEV and BZ, Victoria
1982	Closantel released
1984	(WormKill launched July, northern NSW) 2nd New England survey: LEV and BZ resistance widespread (*Haemonchus*, *Trichostrongylus*, *Ostertagia*)
1985	CRACK[1] launched in WA (September); DrenchPlan launched, southern NSW (December)
1987	Resistance reported: ivermectin (*Haemonchus*) – South Africa and South America. Closantel (*Haemonchus*) – northern NSW
1988	Ivermectin (Ivomec®) released in Australia WormPlan launched – Victoria. Around this time, worm control initiatives were launched in other states eg WormBuster in Qld.
1989	(Proprietary) BZ + LEV combinations released
1987–1991	Combination (BZ + LEV) resistance now common in northern NSW
1990	Albendazole capsules released. WormWise (a planning group and newsletter) took over from CRACK in WA in the early 1990s.
1993	Resistance reported: ivermectin (*Haemonchus*) – northern NSW
1994	Resistance reported: ivermectin (*Ostertagia*) WA. Ivermectin and moxidectin (*Ostertagia* – goats from NZ) – NSW

[1] CRACK: Check worm resistance level; Reduce excessive drenching; Avoid broad-spectrum drenches where a narrow-spectrum will suffice (in the days when *Haemonchus* was important here); Correct dose rate; Keep resistant worms off the farm.

1995	Moxidectin (Cydectin®) released. Naphthalophos re-released (Rametin®; and later, Combat® as well)
1996	Closantel resistance (*Haemonchus*) prevalent, northern NSW
1997	Ivermectin capsule released 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*
2009	Amino-acetyl derivatives (AADs), represented by monepantel, launched (New Zealand, autumn 2009; then Australia, 2010)
2010	Spiroindoles, represented by derquantel (in combination with abamectin) launched in NZ, July 2010
2011	Development of WormBoss (launched 2005) continues

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

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