



# turning the worm

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## FROM THE EDITOR

Welcome to this issue of TTW. This edition is mainly taken up by interpretive summaries of a series of papers on anthelmintic resistance in cattle and sheep in the December 2006 issue of the New Zealand Veterinary Journal. You are encouraged to read the papers – and check the references - for yourself.

While highly relevant, these results may not be directly transferable to Australian situations, given differences, for example, in climate, and type of sheep (eg Romneys versus Merinos). However, the general principles apply.

## CATTLE WORM RESISTANCE – PREVIOUS REVIEW

Gareth Hutchinson gave an overview of anthelmintic resistance in cattle nematodes in Australia and elsewhere – with a follow up

comment – in Issues 11 (May 2003) and 12 (December 2003) of Turning the Worm newsletter. (Available on the NSW DPI website)

## DRENCH RESISTANCE ON BEEF CATTLE FARMS – NZ NORTH ISLAND

Waghorn and others (2006) recently reported on a study of calves on 62 beef farms in the North Island of New Zealand. Faecal egg count reduction tests were performed, evaluating oral formulations of ivermectin, levamisole and albendazole, at recommended dose rates.

The results are summarized in the table below.

	% farms with < 95% FECR		
	Albendazole	Levamisole	Ivermectin
All species	76	6	92
<i>Ostertagia</i>	33	9	9
<i>Trichostrongylus</i>	14	0	5
<i>Cooperia</i>	76	0	92

For each anthelmintic and worm species, the number of farms ranges from 21 to 62. FECR: faecal egg count reduction.

All species: undifferentiated faecal worm egg count.

Of the 27 species of nematodes recorded in cattle in NZ, three are considered important: *Ostertagia ostertagi* and *Trichostrongylus axei* because of their pathogenicity, and *Cooperia oncophora* because it is prevalent and widespread. With the advent of modern drenches, productivity increased as subclinical parasitism decreased.

The first report of confirmed cattle worm resistance in NZ was in 1987, and involved benzimidazole-resistant *Cooperia oncophora*. Things have progressed from there.

## Reference

- Waghorn TS, Leathwick DM, Rhodes AP, Jackson R, Pomroy WE, West DM and Moffat JR. Prevalence of anthelmintic resistance on 62 beef cattle farms in the North Island of New Zealand. NZ Vet J 54(6), 278-282, 2006.



## DRENCH RESISTANCE ON SHEEP FARMS IN NZ

According to this paper, anthelmintic resistance in nematodes of grazing livestock is one of the most significant issues facing animal production systems across much of the world (Kaplan 2004), cited by Waghorn and others 2006).

The first reported detection of benzimidazole (BZ)-resistant sheep worms in NZ was in 1979 (1966 in Australia; see NSW DPI PrimeFact 478 for a summary). The first NZ reports of macrocyclic lactone (ML) resistance were in 2000 (1993 in Australia). As with the situation in Australia, the prevalence and severity of resistance has increased somewhat since then, to the point that no actives can be assumed to be 'immune'.

In 2004, tests were conducted on 112 NZ sheep farms, the first such survey since 1980. Eighty farms were randomly selected, 41 from the North Island and 39 from the South, except from the alpine region where management practices are somewhat different. In addition there were 40 'ML-referred' farms; farms known or suspected to have ML-resistance.

Anthelmintics were tested at recommended dose rates, with the addition of a 'half dose' ivermectin treatment (0.1 mg/kg).

The results of undifferentiated faecal egg count reduction (FECR) tests are summarised in the table below.

Farm type	Anthelmintic (mg/kg)	% of farms with <95% FECR
Random (n=80)	Albendazole (5)	41
	Levamisole (LEV) (7.5)	24
	Ivermectin (0.2)	25
	Ivermectin (0.1)	36
	Albendazole(5) + LEV (7.5)	8
'ML-referred' (n=32)	Albendazole (5)	44
	Levamisole (7.5)	41
	Ivermectin (0.2)	34
	Ivermectin (0.1)	56
	Albendazole (5) + LEV (7.5)	6

A half-dose ivermectin group, used to detect emerging ML resistance, was included because

the prevalence of ML resistance was wrongly expected to be somewhat lower than the results later indicated.

For various reasons, the authors believe the study has produced an underestimate of the true prevalence of ML resistance on sheep farms in NZ.

(The current prevalence of ivermectin resistance in Australia is believed to be around 75% in Western Australia (*Ostertagia*) and northern NSW/south eastern Queensland (*Haemonchus*)).

The results for different nematode genera, based on differentiated faecal worm egg count reductions, are summarised in the next table.

	% of farms with <95% FECR				
	ABZ	LEV	IVM 0.2	IVM 0.1	ABZ + LEV
<i>Cooperia</i>	21	0	6	23	0
<i>Haemonchus</i>	8	0	0	0	0
<i>Nematodirus</i>	89	11	7	48	7
<i>Ostertagia</i>	40	21	27	48	4
<i>Trichostrongylus</i>	21	14	3	6	6

(Number of farms ranges from 24 to 70)

ABZ= Albendazole, LEV=Levamisole, IVM=ivermectin, IVM 0.1=ivermectin at half dose rate.

### Reference

Waghorn TS, Leathwick DM, Rhodes AP, Lawrence KE, Jackson R, Pomroy WE, West DM and Moffat JR. Prevalence of anthelmintic resistance on sheep farms in New Zealand. NZ Vet J 54(6), 271-277, 2006.

## MANAGEMENT PRACTICES AND ML RESISTANCE – SHEEP FARMS, NZ

The authors state that anthelmintic resistance poses a serious threat to sheep production in NZ, and cite Brunson who suggested that sheep production would fall by 33% without effective sheep drenches.

Resistance was first found in NZ sheep worms in 1979, with the first case of ivermectin resistance being found in 1999 (1993 in Australia<sup>1</sup>) 19 years after that drench was first registered in NZ. (Ivermectin was released in Australia in 1988). Resistance to moxidectin was reported in 2001

<sup>1</sup> For a time-line of significant drench and drench resistance events in Australia, see NSW DPI PrimeFact 478, 'Drench resistance and sheep worm control'.

(the same year as in Australia, 6 years after that drench's release).

This paper represents one of the few attempts to study resistance factors on commercial sheep farms. Others include that by Bartley and others (2003) in Scotland, who found no strong evidence of management factors being associated with thiabendazole resistance; Suter and others (2004) who found that 'years of farm ownership' and 'sales of sheep in 2000 relative to usual sales policy' were associated with ivermectin resistance on Western Australian sheep farms, and Rendell and others (2006), who identified a single treatment of lambs with moxidectin in early summer as being associated with increased risk of ivermectin resistance on south eastern Australia farms.

In this NZ study, the authors found the following to be associated with ivermectin resistance:

- the use of long-acting MLs in ewes pre-lambing for greater than 3 of the previous 5 years;
- having sheep representing less than 70% of total stock units mid-winter (depleted refugia of unselected sheep parasites due to 'excessive' grazing by cattle);
- purchasing more than 10% of the sheep present mid-winter (importing resistant worms);
- having a wool fibre diameter in the main flock <37 microns (possibly a breed of sheep effect, with Romneys and crosses possibly requiring less drenching).

It was concluded that farmers should aim to provide refugia for susceptible worms, and minimize the risk of introducing resistance through effective quarantine drenching.

#### Reference

Lawrence KE, Rhodes AP, Jackson R, Leathwick DM, Heuer C, Pomroy WE, West DM, Waghorn TS and Moffat JR (2006). "Farm management practices associated with macrocyclic lactone resistance on sheep farms in New Zealand." NZ Vet J 54(6), 283-288, 2006.

### CATTLE WORM RESISTANCE AND MANAGEMENT PRACTICES – NZ

This paper describes results of a questionnaire completed by 59 North Island beef cattle-rearing farmers.

Most ranked parasites highly, at about the same level as feed quantity and quality. In contrast, parasite resistance was not ranked highly, overall. Although all farms had planned worm control programs, decisions about drenching relied heavily on clinical signs. About one in three

farmers treated calves at marking, ~20% treated mixed-age cows, and ~ 50% treated rising 2-year-old cows pre-calving. One in four treated calves 8-12 times in their first year of life. Co-grazing with other species was rare, but follow-on grazing within 3 months after older cattle or sheep was common. On most farms, cattle grazing was restricted to part of the farm (with implications for worm control and persistence of larvae in refugia). In the preceding 5 years, macrocyclic lactones (MLs) or their combinations were used more than benzimidazoles (BZs), levamisoles (LEV) or BZ-LEV combinations. The prevalence of resistance to ivermectin was high (82%), but no plausible model of associations could be constructed from the data. The prevalence of resistance to albendazole was 60%, and the risk of resistance increased as the number of rising 1-year-old cattle present mid-winter increased, and decreased as the number of breeding cows > 2 years old present mid-winter increased.

#### Reference

Jackson R, Rhodes AP, Pomroy WE, Leathwick DM, West DM, Waghorn TS and Moffat JR (2006). "Anthelmintic resistance and management of nematode parasites on beef cattle-rearing farms in the North Island of New Zealand." NZ Vet J 54(6), 289-296, 2006.

### RESISTANCE AND DRENCHING ADULT EWES

Drenching adult ewes in NZ around lambing is common practice although trials have shown inconsistent production benefits. In a replicated farmlet trial run from 1999 - 2004, on pastures seeded with *Ostertagia (Teladorsagia)* and *Trichostrongylus* spp., the authors examined various ewe and lamb treatment regimens, testing the hypothesis, based on modeling, that treating ewes around lambing would accelerate the development of resistance more, compared to not drenching ewes, but giving an additional drench to lambs in the autumn (a drench at 18 weeks post-weaning, as well as drenches at weeks 0, 3, 6, 10 and 14).

(It perhaps should be noted that Australian Merinos have a greater and more protracted per-parturient relaxation of resistance than NZ Romneys).

The trial showed that a BZ capsule pre-lambing was most selective for resistance. An oral (short-acting) BZ drench given post-lambing was less selective than the capsule pre-lambing, but more selective than either of the lamb-only treatment strategies used. Leaving 15% of the heaviest lambs untreated resulted in a trend (not quite significant) for slower development of resistance to *Ostertagia*. The authors concluded that treatment of adult ewes around lambing should be reduced

with the likely benefit being reduced speed of development of drench resistance in NZ.

#### Reference

Leathwick DM, Miller CM, Atkinson DS, Haack NA, Alexander RA, Oliver A-M, Waghorn TS, Potter JF and Sutherland IA (2006). "Drenching adult ewes: implications of anthelmintic treatments pre- and post-lambing on the development of anthelmintic resistance." NZ Vet J 54(6), 297-312, 2006.

### ML RESISTANCE AND MOXIDECTIN USAGE

In this paper the authors describe analyses of faecal egg count reduction test data and drenching histories from 103 commercial sheep farms in southern South Australia and Victoria.

ML-resistant (in this study, ivermectin resistant) *Ostertagia* were found on 49.5% of properties. Among other things, the authors found the prevalence of resistance was lowest (23%) on properties on which moxidectin (MOX) had not been used, and significantly higher (64-77%) on properties on which MOX had been used for 2 or more of the preceding 5 years.

It was concluded that use of moxidectin for 2 or more of the preceding 5 years was associated with a higher prevalence of resistance to MLs by *Ostertagia* spp on sheep farms in south eastern Australia than the use of ivermectin.

#### Reference

Rendell DK, Rentsch TE, Smith JM, Chandler DS and Callinan APL (2006). "Evidence that moxidectin is a greater risk factor than ivermectin in the development of resistance to macrocyclic lactones by *Ostertagia* spp in sheep in south eastern Australia. NZ Vet J 54(6), 313-317, 2006.

### FIELD STUDIES OF ANTHELMINTIC RESISTANCE IN YOUNG CATTLE – NZ

Faecal egg count (FEC) reduction tests were carried out on five calf-rearing farms using pour-on formulations of levamisole, ivermectin, eprinomectin, and the simultaneous use of levamisole and ivermectin. Resistance of *Cooperia oncophora* to ivermectin and eprinomectin was found on all farms. There was some evidence of emerging resistance in *Ostertagia* spp to ivermectin but not eprinomectin, and in *Trichostrongylus* spp to ivermectin, eprinomectin and levamisole used separately. Levamisole was effective against *C. oncophora*, but had variable efficacy against *Ostertagia* spp. Simultaneous treatment with levamisole and ivermectin pour-on formulations was effective against all genera on all farms.

#### Reference

Turning the Worm, Issue , December 2007

Mason PC and McKay CH (2006). "Field studies investigating anthelmintic resistance in young cattle on five farms in New Zealand". NZ Vet J 54(6), 318-322, 2006.

### REPEATABILITY OF FECRTS

The authors conducted multiple faecal egg count reduction tests (FECRTs) on two farms, evaluating different methods (three different equations) of calculating efficacy, and variations within each method. (See paper for details).

The authors concluded that 'there was considerable variability in the outcomes of FECRTs and in larval culture results. Caution is warranted in interpreting the results of FECRTs when efficacy values fall into the 90-95% range. Further the possibility of a test returning a false-negative result is raised, indicating that even an efficacy estimated greater than or equal to 95% may not guarantee the absence of resistant worms.'

#### Reference

Miller CM, Waghorn TS, Leathwick DM, and Gilmour ML (2006). 'How repeatable is a faecal egg count reduction test?'. NZ Vet J 54(6), 323-328, 2006.

### REVIEW OF RESISTANCE IN NZ

In this article, Dr Pomeroy gives his perspective on recent findings, and options for the future. He notes that resistance of cattle and sheep worms in NZ have increased from low levels just a few years ago to disturbingly high levels, including multiple resistance to all three currently available action families of anthelmintic in *Ostertagia* (*Teladorsagia*) spp in sheep. (Resistance to a triple combination has been recorded on at least one farm in NZ).

Given this situation, he states that all cattle farmers and most sheep farmers (most of whom do not fully appreciate the problem) should be using a combination anthelmintic on most occasions to achieve effective worm control.

While drenches will remain the cornerstone of worm control for the foreseeable future, farmers need to maintain adequate reservoirs of unselected nematodes, ie worms in refugia, to minimize expansion of resistant populations.

Pomeroy states the following high-risk practices (in relation to selection of resistance) need to be avoided or at least minimized in NZ:

- Unnecessary treatment of adult animals
- Moving newly treated animals to 'clean' pasture

- Failure to effectively quarantine-drench bought-in animals
- In particular, sheep farmers should avoid treating ewes pre-lambing with long-acting anthelmintics.

In general, a balance between good worm control and sustainability of control options needs to be negotiated.

#### Reference

Pomroy WE (2006). 'Anthelmintic resistance in New Zealand: a perspective on recent findings and options for the future'. NZ Vet J 54(6), 265-270, 2006.

### ML RESISTANCE IN CENTRAL TABLELANDS (BATHURST, NSW)

The Central Tablelands Rural Lands Protection Board, head-quartered at Bathurst NSW, recently conducted a pilot survey of farms for macrocyclic lactone (ML) resistant sheep worms. The project was coordinated by Dr Jeff Eppleston, with Dr Bruce Watt collaborating.

Volunteering farmers collected faeces from 10 sheep in a mob 10-14 days after treatment with an ML. The results of these 'screening worm egg counts (WECs)' are summarized in the table below.

Drench	Number (and proportion) of flocks with 'resistance'
Ivermectin	14/25 (56%)
Abamectin	0/3 (0%)
Moxidectin	0/2 (0%)
Abamectin + closantel	0/1 (0%)
Q-Drench (abamectin + levamisole + albendazole + closantel)	0/1 (0%)
<b>Total</b>	<b>14/32 (44%)</b>

\*\*Resistance': positive worm egg count (WEC) 10-14 days post-drench, and with at least 2 out of 10 sampled animals having a positive WEC. Pre-drench (day zero) WECs, in addition to post-drench WECs, were obtained on all but 8 of the 32 farms.

Follow-up faecal egg count reduction tests (FECRTs) were conducted on two of the farms (flocks 'A' and 'B') with possible ivermectin resistance, detected by screening WECs.

FECRT results for flock A are summarized in the next table.

Flock A treatment groups	Faecal egg count reduction %
Untreated control (5868 epg; 97% <i>Haemonchus</i> )	-
Ivermectin*	4
Moxidectin	100
Benzimidazole (BZ)	47
Closantel	100
Levamisole + BZ	100
Naphthalophos	100

\* Given the low FECR (4%) for ivermectin on initial testing, this FECRT was repeated, using two different brands of ivermectin, and the FECRs were 50% and 65%. (98% *Haemonchus* in the untreated controls).

FECRT results for Flock B are summarized in the next table.

Flock B treatment groups	FECR%	FECR%	FECR%
	All worm species	<i>Haem</i>	<i>Ost</i>
Untreated controls (660 epg; 70% <i>Haem</i> ; 20% <i>Ost</i> )			
Ivermectin	64	83	89
Abamectin	87	83	98
Moxidectin	98	99	94
Levamisole (LEV)	86	100	52
Benzimidazole (BZ)	87	96	74
LEV + BZ	92	100	89
Closantel	75	100	75

FECR: faecal egg count reduction; *Haem*: *Haemonchus*; *Ost*: *Ostertagia (Teladorsagia)*.

### RESISTANCE IN OTHER REGIONS OF NSW

By way of 'recap', we have reported in 'Turning the Worm' (TTW) on other surveys in NSW for drench resistance on sheep farms.

These were based on faecal egg count reduction tests. While the surveys were not large enough to give a statistically valid estimate of prevalence, they nonetheless gave an indication of what was happening in the field.

In the **Riverina** (Deniliquin) and **Murray** (Corowa) Rural Lands Protection Boards (RLPBs) of NSW, Drs Dan Salmon and Harry Suddes found approximately 30% of farms tested had

ivermectin-resistant *Ostertagia*. (TTW Issue 19, December 2005).

In the **Coonabarabran** RLPB of NSW. Dr Steve Eastwood conducted a series of FECRTs and found the following proportions of flocks with *Haemonchus* resistance:

Drench	Coonabarabran flocks with FECR<95%
Untreated controls (dominated by <i>Haemonchus</i> )	-
Closantel (1/3 dose (2.5mg/kg))	38% (3/8)
Ivermectin	60% (6/10)
Levamisole	0% (0 ex 9)
Benzimidazole	55% (6 ex 11)

(TTW Issue 22, December 2006)

It's currently estimated that 70% or more of flocks in the New England region of northern NSW have ivermectin-resistant *Haemonchus*, with a similar proportion of farms in Western Australia having ivermectin-resistant *Ostertagia*.

## RESISTANCE IN VICTORIA

By way of reminder, below is an overview by Tricia Veale, sent to me in 2005 and published in Turning the Worm (TTW Issue 18, March 2005).

Tricia Veale until recently was the principal of Para-Site Diagnostic Services, Benalla, Victoria. She remains a consultant for the business.

Drench group/worms	Resistance – NE Victoria/southern NSW (sheep farms; 2005)
BZs	> 96% farms
LEV	>86 % farms
BZ+LEV combination	75-80%
IVM-resistant <i>Ostertagia</i>	79 farms
MOX-resistant <i>Ostertagia</i>	One in Vic., one in S.NSW
IVM-resistant <i>Haemonchus</i>	Six farms(Vic.-1, S.NSW-5)
ABM-resistant <i>Ostertagia</i> and <i>Haemonchus</i>	Seven farms (Vic.-3, S.NSW-4)
<i>Ostertagia</i> resistant to IVM+BZ+LEV combination	Three farms (Vic.-1, S.NSW-2)

BZ-benzimidazole; LEV-levamisole; IVM-ivermectin; MOX-moxidectin; ABM-abamectin. Resistance defined as <95% FECR.

## PRAZIQUANTEL-RESISTANT TAPEWORM

Paul Mason and colleagues reported on some interesting trial work on the sheep tapeworm, *Moniezia expansa*, in New Zealand several years ago.

The methodology and results will not be recounted in detail here, but most of the introduction to the paper is quoted below:

“The tapeworm *Moniezia expansa* in lambs provokes a more emotional response than nematodes in sheep, because farmers can see the very obvious expelled worms.

“Over the years there have been many investigations in New Zealand, all but one of which have failed to show any relationship between tapeworms and production loss.

“Earlier trials using niclosamide (Elliott, 1984; Mason, unpublished), found no benefits in terms of weight gain, faecal consistency, or dagginess between treated and untreated lambs. This supported the results of investigations carried out elsewhere and reviewed by Elliot (1986)

“The dissenting voice has been from Southworth et al. (1996), who reported the results of four controlled slaughter trials and one productivity trial, with the latter demonstrating a production response to the removal of tapeworm by praziquantel.

“The four controlled slaughter trials involved 93 naturally infected lambs, slaughtered 10-12 days after treatment. Praziquantel treatments were 99 – 100% effective at removing *Moniezia* when compared with the untreated controls. Albendazole treatments were 19 – 75% effective at removing *Moniezia* when compared with the untreated controls.

“(Southworth’s) productivity trial was conducted using 300 undrenched Romney wether lambs. Lambs were randomly assigned to one of three groups: untreated control, levamisole, and praziquantel/levamisole; and run together as one mob throughout the trial. The trial commenced with treatment at the end of October, lambs were then weighed and re-treated 4 weeks later, and weighed again 4 weeks after that at the conclusion of the trial. The levamisole treated lambs gained significantly more weight than the untreated controls, and the praziquantel/levamisole treated lambs gained significantly more weight than the levamisole treated lambs. The level of infestation of the trial lambs with *Moniezia* is not known from the information presented in the paper. There was no albendazole treated group in the trial.

“Albendazole has some affect against *Moniezia expansa*. Southworth et al did not use an albendazole treated group in their productivity trial. It is therefore, quite possible that there will be no

difference in weight gain if lambs are treated with either albendazole or a praziquantel / nematocidal combination drench.

(We decided) “that it could be constructive to compare the effects of albendazole and praziquantel against *Moniezia* in a productivity trial. Although praziquantel is more effective against *Moniezia* than albendazole, the efficacy of albendazole could be sufficient to adequately control *Moniezia* to prevent production losses. We also felt the need to again compare their efficacies against *Moniezia* in a controlled slaughter trial.

“The results we obtained surprised even us and are the reason for this paper.

“In this investigation we report on the results of a controlled slaughter trial comparing the efficacy of albendazole and praziquantel against tapeworm; and the results of 2 productivity trials comparing the activity of albendazole and praziquantel against tapeworm.”

In the slaughter trial there were four groups, treated as follows: untreated controls, albendazole, albendazole plus levamisole, and levamisole plus praziquantel. Lambs were slaughtered 12 days post-treatment and small intestines examined for tapeworms (number of scolices and volume of proglottids). All lambs in the control group had tapeworms. There were no significant differences in efficacy between albendazole and praziquantel (both approximately 50-60% reduction in scolices and proglottids); praziquantel clearly was not fully effective.

Two productivity trials, involving over 400 lambs, were conducted on two different properties (A, B) in the Wairarapa region. The faecal egg counts made at the commencement of both productivity trials show that more than 50% of the lambs were shedding tapeworm eggs, indicating a high rate of infestation. The control group received moxidectin only, the second group received levamisole plus praziquantel, as well as moxidectin, and the third group received albendazole plus levamisole, as well as moxidectin. All groups received moxidectin to eliminate possible differences between levamisole and albendazole in nematocidal activity.

At day 11 (Farm A) and day 7 (Farm B), no tapeworm eggs were seen in the samples collected from lambs treated with praziquantel, but were still present in samples collected from lambs in the other two groups on both farms. At days 63 and 59 respectively, no tapeworm eggs were seen in any of the faecal samples examined.

There was no significant difference in weight gain over the duration (approx. 80 days) of the trial between the controls and either treatment group.

Some of the authors' conclusions follow:

In the slaughter trial, “albendazole was as effective as praziquantel against *Moniezia*. This is the first report of lack of efficacy (resistance) of *Moniezia* to praziquantel. We have no idea how widespread this situation is throughout the country.”

The “two productivity trials involving over 400 lambs failed to show any response to treatment at all. Neither albendazole nor praziquantel produced a production benefit over the control group. So rather than demonstrating that albendazole is as effective as praziquantel in reducing production losses from tapeworm, we have shown that there was no production loss associated with tapeworm infection on the two trial properties.”

“What does all this mean? The trials of Elliot (1984), the six trials of Mason (pers comm), and these two productivity trials have shown no productivity response to the removal of tapeworms. Now why do these results differ from those of Southworth et al.? Is it pure chance, or does tapeworm only become a problem when you get up into the north of New Zealand? This has yet to be answered.”

In summary:

- “Lack of efficacy of praziquantel against the sheep tapeworm, *Moniezia expansa*, was found in a controlled slaughter trial. This may occur on other farms in New Zealand.”
- “In 2 productivity trials involving more than 400 lambs, lambs treated with either albendazole or praziquantel to control tapeworm performed no better than the control lambs.”

Reference

Mason P, Moffat J, Cole D (2002). Tapeworm in sheep revisited. Proceedings of the 32nd Seminar of The Society of Sheep & Beef Cattle Veterinarians. NZVA, Wellington, 22-24 May 2002. Pp. 147-151.

## FURTHER INFORMATION

### WORMBOSS

[wormboss.com.au](http://wormboss.com.au)

### NSW DPI

<http://www.dpi.nsw.gov.au/agriculture/livestock/sheep/health>

*[Turning the worm]* is a newsletter for those interested in the management of endoparasites of farmed animals.

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