

A topical drench containing abamectin and levamisole for control of gastrointestinal parasites and lice

Sean Daly BVSc
Inovata Ltd

Inovata is a New Zealand owned company that has prided itself on bringing innovative solutions to New Zealand farmers, making their lives easier and more profitable. In 2022 Inovata launched Tison (A11955), the first combination topical anthelmintic for sheep that epitomises these values.

Tison contains 15 g/L of eprinomectin and 26 g/L of levamisole and is given at a dose volume of 1 mL/2.5 kg. This equates to a dose rate of 6 mg/kg and 10.4 mg/kg for eprinomectin and levamisole respectively. Tison has a meat withhold of 16 days and 35 days for milk.

Since the launch of Tison Inovata have continued to invest in innovation with topical anthelmintics and have developed an abamectin based product which has displayed considerable efficacy against the sheep body louse *Bovicola ovis*. This product is called Tison Attack. Tison Attack's formulation is identical to Tison apart from the replacement of eprinomectin with abamectin. As well as improving efficacy against lice, the change to abamectin will also reduce the cost of the drench to farmers.

The story of the development and trial work supporting the registration of Tison were covered despite some technical difficulties in a presentation at the 2023 Sheep and Beef Cattle Veterinarian's Conference and the results are listed in those proceedings (Daly 2023).

The previously presented studies included two Total Worm Count Studies, two Faecal Egg Count based field studies and a proof of concept study carried out in the field against the sheep body louse *Bovicola ovis* for Tison. For Tison Attack, lice pen studies in long wool and off shears crossbred sheep and merinos off shears as well as a Total Worm Count study were also presented.

This report summarises further efficacy studies completed since these studies were presented in 2023.

1.Total Worm Count and Faecal Egg Count Efficacy Study, Fielding

This randomised negatively controlled dose confirmation study evaluated the efficacy of Tison Attack on a commercial sheep farm in Feilding. Primary efficacy against each nematode species and life stage was assessed by Total Worm Count Reduction (TWCR).

Method

Forty eight, mixed sex, approximately seven month old Romney-cross lambs were enrolled in the study. Thirty four of the lambs had been inoculated with a mixed infection of parasites on Day -22 which had been previously cultured from the group. The mean wool length of the lambs was 96 mm with a range of 75 to 125 mm. The 24 lambs with the highest Day - 2 Faecal Egg Count (FEC) were identified and 12 of these were randomly allocated into two treatment groups containing 6 animals. 8 animals were also treated with Tison Attack for a pharmacokinetic study, the results of which are not discussed here apart from these animals inclusion in the assessment of the safety of the test product.

On Day 0 Group A was treated with Tison Attack at the label dose rate of 2.5 mL per kg body weight. The treatment was applied directly onto the skin at two individual spots, using approximately half the volume at each spot. The spots were approximately 100–150mm apart, on the midline (i.e. along the backbone) and centred (cranio-caudally) in the middle of the back.

Animals were humanely euthanised on Day 8. For each animal, the abomasum, small intestine and large intestine were individually washed and the contents collected. Aliquots were examined to identify and quantify the nematode genus or species present.

Faecal samples for egg counting were taken at Day -2 and at slaughter.

Animals were monitored for any adverse events or safety concerns during the study including monitoring of the application site.

Data Analysis and Results

Arithmetic mean (AM) and geometric mean (GM) worm counts for Tison Attack and the control group were calculated. Efficacy was calculated using the formula:

$$TWCR\% = 100 \frac{(\bar{x}_c - \bar{x}_t)}{\bar{x}_c}$$

Where: $\bar{x}_c$ = Total Worm Count Controls
 $\bar{x}_t$ = Total Worm Count Treated

Adequate adult parasite infestation was observed for the abomasal parasites *Haemonchus contortus*, *Teladorsagia circumcincta* and *Trichostrongylus axei*, and small intestinal parasites *Trichostrongylus vitrinus*, *Trichostrongylus colubriformis*, *Nematodirus spathiger*, *Nematodirus fillicollis* and *Cooperia curticei*.

Table 1: Adequacy of infection: By group and parasite species, the proportion of animals positive, within group range, arithmetic mean and geometric adult mean worm count

	Abomasum			Small Intestine						Large Intestine	
	<i>H. con</i>	<i>Tel. cir</i>	<i>T. axe</i>	<i>T. vit</i>	<i>T. col</i>	<i>N. spa</i>	<i>N. fil</i>	<i>C. cur</i>	<i>C. onc</i>	<i>O. spp</i>	<i>T. ovi</i>
Tison Attack											
Number Positive	0	0	0	0	2	2	0	1	0	0	1
Min.					0	0		0			0
Max.					100	100		50			20
Arithmetic Mean					25	33		8			3
William's Mean					3	4		1			1
Control											
Number Positive	6	6	6	6	6	6	6	6	6	3	6
Min.	50	1,100	250	4,305	945	188	12	1,337	13	0	20
Max.	2,800	7,550	1,950	16,851	3,699	17,672	1,128	5,792	58	170	120
Arithmetic Mean	1,167	3,700	1,083	11,808	2,595	7,559	483	3,969	40	57	88
William's Mean	550	2,579	923	10,775	2,365	3,401	220	3,594	36	8	78

Based on efficacy criteria of (i) $\geq 95\%$ GM and AM TWCRs and (ii) a statistically significant difference ($p < 0.05$) in worm counts between Tison Attack and the control group, Tison Attack was effective against the following parasite genera:

- *Haemonchus contortus*
- *Teladorsagia circumcincta*
- *Trichostrongylus axei*, *T. vitrinus*, *T. colubriformis*
- *Nematodirus spathiger*, *N. filicollis*
- *Cooperia curticei*, *C. oncophora*
- *Oesophagostomum spp.* and
- *Trichuris ovis*

Table 2: Arithmetic and Geometric efficacy: Mean Total Worm Count Reduction

Abomasum			Small Intestine						Large Intestine	
<i>H. con</i>	<i>Tel. cir</i>	<i>T. axe</i>	<i>T. vit</i>	<i>T. col</i>	<i>N. spa</i>	<i>N. fil</i>	<i>C. cur</i>	<i>C. onc</i>	<i>Oes. spp</i>	<i>T. ovi</i>
Arithmetic Mean % Reductions										
100	100	100	100	98.9	99.6	100	99.8	100	100	96.1
Geometric Mean % Reductions										
100	100	100	100	99.8	99.9	100	100	100	100	98.6

N.B. Abbreviations for parasite species explained at the end of the document, Appendix 1.

The gross faecal egg counts gave an arithmetic mean efficacy of 99.8% and a geometric mean efficacy of 100% efficacy using the Henderson Tilton formula.

No systemic issues related to treatment were observed during the study. There was mild dermatitis $\pm$ erythema in 2/14 animals treated with Tison Attack on Day 2 of the study. By study day 6 this had become what was described as mild crusting on 8/14 animals treated with Tison Attack. These observations were consistent with what is described on the Tison label: *Tison may cause irritation at the application site in some sheep*; and what has been seen in the field since the release of Tison.

Conclusion

This study demonstrated that the dual active topical anthelmintic Tison Attack was safe and highly effective in treating clinically significant internal parasite species in sheep.

2. Faecal Egg Count Field Studies, Taumarunui

Faecal Egg Count Reduction (FECR) field studies in naturally infected lambs were conducted across four farms around Taumarunui between February and July 2021. The study was carried out in lambs born in the spring of 2020 and none of the lambs had been drenched within 40 days prior to Day 0. The animals were all unshorn except for one farm who were shorn 7 days before treatment. The efficacy of Tison Attack (Group A) was compared with negative controls (Group F) and four positive control groups. 14 or 15 lambs were included per treatment group at each farm.

Table 3: Treatment Groups

Group	Treatment	Active Ingredients and Concentration	Route of Administration
A	Tison Attack	Abamectin (6 mg/kg) and levamisole (10.4 mg/kg)	Topical
B	Switch Hi Mineral*	Abamectin (0.2 mg/kg) and levamisole (8 mg/kg)	Oral
C	Genesis Hi Mineral*	Abamectin (0.2 mg/kg)	Oral
D	Prolev + Minerals Oral*	Levamisole (8 mg/kg)	Oral
E	Panacur*	Fenbendazole (5mg/kg)	Oral
F	Untreated Control	-	-

*Product details listed in Appendix 2.

Table 4: Trial Farms and Study Population:

Farm	Breed	Shorn/Unshorn
1	Romney	Unshorn
2	East Friesian x Coopworth	Shorn on Day -7
3	Composite X Coopworth	Unshorn
4	Lacaune X (Dairy)	Unshorn

All animals remained on their home farm and were run as single mobs throughout the study.

Method

Faecal samples were taken on the day of treatment and Days 7, 14 and 21 for Groups A and F. For the positive control groups (Groups B to E) samples were only collected on Days 7, 14 and 21 post treatment. Eggs were counted using the standard McMaster counting technique with undifferentiated strongyle and *Nematodirus* spp. eggs counted. Group-level pooled coprocultures were performed on all samples.

Within-group arithmetic and geometric means were calculated at each time point. These summary parameters were used to calculate the overall and genera specific efficacy of the treatments compared to the untreated control group. Efficacy was calculated using both formulae 1 and 2 for comparing Groups A and F and formula 1 only for assessing the efficacy of Groups B to E.

Formula 1:

$$FECR_1\% = 100 \left(1 - \frac{\bar{x}_{t_1}}{\bar{x}_{c_1}} \right)$$

Formula 2:

$$FECR_2\% = 100 \left(1 - \frac{\bar{x}_{t_1} \bar{x}_{c_0}}{\bar{x}_{t_0} \bar{x}_{c_1}} \right)$$

Where:

$\bar{x}_{c_0}$ = control group mean FEC pre-treatment

$\bar{x}_{c_1}$ = control group mean FEC post-treatment

$\bar{x}_{t_0}$ = treatment group mean FEC pre-treatment

$\bar{x}_{t_1}$ = treatment group mean FEC post-treatment

Efficacy

Farm 1

There was a substantial pre-treatment parasite burden with arithmetic mean strongyle egg counts >2,000 epg in Treatment Groups A and F on Day 0. This burden remained high in the control animals for the duration of the study. Furthermore, coproculture indicated the presence of all major gastrointestinal nematode genera. The animals also had a significant *Nematodirus* burden.

Tison Attack was highly effective (>98%) against all strongyle genera on Days 7 and 14 post-treatment, with no *Haemonchus*, *Cooperia*, *Oesophagostomum* or *Chabertia* cultured at any time post-treatment.

Teladorsagia resistant to levamisole were identified. This strain was controlled by Tison Attack.

The efficacy of Tison Attack and Switch were very similar.

Table 5: Farm 1 Strongyle Burden and Overall Efficacy

Group/Day	Min.	Max.	AM	GM	N	Pos.	Efficacy			
							Eqn 1		Eqn 2	
							AM	GM	AM	GM
Tison Attack_D0	300	5800	2950.0	2368.6	15	15	.	.	.	.
Tison Attack_D7	0	50	7.1	0.8	14	2	99.7	100.0	99.8	100.0
Tison Attack_D14	0	50	7.1	0.8	14	2	99.7	100.0	99.7	100.0
Tison Attack_D21	0	200	40.0	8.3	15	8	96.8	99.1	97.4	99.3
Switch_D0	.	.	.	.	0	0	.	.	.	.
Switch_D7	0	50	3.3	0.3	15	1	99.9	100.0	.	.
Switch_D14	0	50	6.7	0.7	15	2	99.7	100.0	.	.
Switch_D21	0	150	33.3	3.5	15	5	97.3	99.6	.	.
Genesis_D0	.	.	.	.	0	0	.	.	.	.
Genesis_D7	0	200	26.7	2.3	15	4	98.9	99.9	.	.
Genesis_D14	0	100	23.3	2.3	15	4	98.9	99.9	.	.
Genesis_D21	0	150	33.3	6.0	15	7	97.3	99.4	.	.
Prolev_D0	.	.	.	.	0	0	.	.	.	.
Prolev_D7	0	350	76.7	9.2	15	7	97.0	99.5	.	.
Prolev_D14	0	200	73.3	15.5	15	9	96.5	99.1	.	.
Prolev_D21	0	350	76.7	15.3	15	9	93.8	98.4	.	.
Panacur_D0	.	.	.	.	0	0	.	.	.	.
Panacur_D7	0	650	336.7	202.7	15	14	86.7	89.9	.	.
Panacur_D14	100	3000	596.7	394.7	15	15	71.8	77.8	.	.
Panacur_D21	100	800	280.0	233.2	15	15	77.4	75.8	.	.
Control_D0	950	5050	2363.3	2056.6	15	15	.	.	.	.
Control_D7	250	6250	2530.0	2001.3	15	15	.	.	.	.
Control_D14	700	4250	2113.3	1775.6	15	15	.	.	.	.
Control_D21	200	2950	1236.7	965.3	15	15	.	.	.	.

Table 6: Farm 1 Genera Efficacy based on AMs and Control Group Mean Counts

Group/Day	Haem.	Tela.	Trich.	Coop.	Oeso./Chab.
Tison Attack_D7	100.0	99.7	99.1	100.0	100.0
Tison Attack_D14	100.0	98.3	99.7	100.0	100.0
Tison Attack_D21	100.0	67.7	94.3	100.0	100.0
Switch_D7	100.0	99.4	99.8	100.0	99.5
Switch_D14	100.0	97.6	99.9	100.0	100.0
Switch_D21	99.5	68.6	97.8	97.6	100.0
Genesis_D7	100.0	93.5	99.4	99.8	100.0
Genesis_D14	100.0	92.6	99.8	99.4	100.0
Genesis_D21	100.0	37.1	98.2	99.7	100.0
Prolev_D7	100.0	83.7	96.6	100.0	100.0
Prolev_D14	100.0	78.0	98.2	100.0	100.0
Prolev_D21	100.0	-17.8	93.5	99.8	100.0
Panacur_D7	91.3	63.1	79.8	99.5	86.7
Panacur_D14	80.2	34.1	66.9	94.4	100.0
Panacur_D21	70.2	17.0	67.7	98.6	92.5
Control_D0	827.2	118.2	709.0	685.4	23.6
Control_D7	809.6	328.9	683.1	683.1	25.3
Control_D14	422.7	253.6	972.1	422.7	42.3
Control_D21	272.1	37.1	494.7	395.7	37.1

Table 7: Farm 1 *Nematodirus* Burden and Efficacy

Group/Day	Min.	Max.	AM	GM	N	Pos.	AM Eff.	GM Eff.
Tison Attack_D0	0	450	210.0	71.6	15	12	.	.
Tison Attack_D7	0	50	3.6	0.3	14	1	97.8	99.6
Tison Attack_D14	0	0	0.0	0.0	14	0	100.0	100.0
Tison Attack_D21	0	150	13.3	0.8	15	2	80.0	94.3
Switch_D0	.	.	.	.	0	0	.	.
Switch_D7	0	0	0.0	0.0	15	0	100.0	100.0
Switch_D14	0	0	0.0	0.0	15	0	100.0	100.0
Switch_D21	0	50	3.3	0.3	15	1	95.0	97.9
Genesis_D0	.	.	.	.	0	0	.	.
Genesis_D7	0	0	0.0	0.0	15	0	100.0	100.0
Genesis_D14	0	0	0.0	0.0	14	0	100.0	100.0
Genesis_D21	0	100	10.0	0.8	15	2	85.0	94.7
Prolev_D0	.	.	.	.	0	0	.	.
Prolev_D7	0	50	6.7	0.7	15	2	95.8	99.1
Prolev_D14	0	0	0.0	0.0	15	0	100.0	100.0
Prolev_D21	0	50	3.3	0.3	15	1	95.0	97.9
Panacur_D0	.	.	.	.	0	0	.	.
Panacur_D7	0	350	136.7	67.1	15	13	14.6	12.1
Panacur_D14	0	550	163.3	42.8	15	11	-25.6	30.9
Panacur_D21	0	400	103.3	13.7	15	8	-55.0	4.7
Control_D0	0	550	163.3	75.3	15	13	.	.
Control_D7	0	450	160.0	76.3	15	13	.	.
Control_D14	0	350	130.0	61.8	15	13	.	.
Control_D21	0	200	66.7	14.4	15	9	.	.

Farm 2

There was a substantial pre-treatment parasite burden with arithmetic mean strongyle egg counts > 600 epg for Groups A and F on Day 0. The counts increased in the control animals during the study. Furthermore coproculture indicated the presence of all major gastrointestinal nematode genera. There was also adequate *Nematodirus* burden.

Tison Attack was highly effective (>98%) against all strongyle genera on all days post-treatment.

Teladorsagia and *Trichostrongylus* were cultured from all groups post-treatment. *Cooperia* resistant to abamectin and *Teladorsagia* resistant to levamisole were also identified. Importantly these resistant strains were controlled by Tison Attack, demonstrating the efficacy of both abamectin and levamisole components.

The efficacy of Tison Attack and Switch were very similar.

Table 8: Farm 2 Strongyle Burden and Overall Efficacy

Group/Day	Min.	Max.	AM	GM	N	Pos.	Efficacy			
							Eqn 1		Eqn 2	
							AM	GM	AM	GM
Tison Attack_D0	0	1750	660.0	235.8	15	13	.	.	.	.
Tison Attack_D7	0	0	0.0	0.0	15	0	100.0	100.0	100.0	100.0
Tison Attack_D14	0	100	10.0	0.8	15	2	99.6	100.0	99.6	99.9
Tison Attack_D21	0	50	6.7	0.7	15	2	99.6	100.0	99.6	99.9
Switch_D0	.	.	.	.	0	0	.	.	.	.
Switch_D7	0	0	0.0	0.0	15	0	100.0	100.0	.	.
Switch_D14	0	0	0.0	0.0	15	0	100.0	100.0	.	.
Switch_D21	0	50	3.3	0.3	15	1	99.8	100.0	.	.
Genesis_D0	.	.	.	.	0	0	.	.	.	.
Genesis_D7	0	100	16.7	2.0	15	4	98.7	99.8	.	.
Genesis_D14	0	50	10.0	1.2	15	3	99.6	99.9	.	.
Genesis_D21	0	50	16.7	2.7	15	5	99.1	99.8	.	.
Prolev_D0	.	.	.	.	0	0	.	.	.	.
Prolev_D7	0	200	53.3	12.7	15	9	95.7	98.7	.	.
Prolev_D14	0	200	53.3	5.9	15	6	97.9	99.7	.	.
Prolev_D21	0	350	123.3	49.2	15	12	93.4	96.8	.	.
Panacur_D0	.	.	.	.	0	0	.	.	.	.
Panacur_D7	0	400	123.3	34.6	15	11	90.1	96.4	.	.
Panacur_D14	0	1350	336.7	163.0	15	14	86.8	92.2	.	.
Panacur_D21	0	1650	440.0	200.9	15	14	76.6	87.1	.	.
Control_D0	0	2800	746.7	391.5	15	14	.	.	.	.
Control_D7	200	2500	1243.3	967.2	15	15	.	.	.	.
Control_D14	600	7200	2546.7	2084.9	15	15	.	.	.	.
Control_D21	700	6600	1880.0	1560.5	15	15	.	.	.	.

Table 9: Farm 2 Genera Efficacy based on AMs and Control Group Mean Counts

Group/Day	Haem.	Tela.	Trich.	Coop.	Oeso./Chab.
Tison Attack_D7	100.0	100.0	100.0	100.0	100.0
Tison Attack_D14	100.0	99.7	98.8	100.0	100.0
Tison Attack_D21	100.0	98.3	99.1	100.0	100.0
Switch_D7	100.0	100.0	100.0	100.0	100.0
Switch_D14	100.0	100.0	100.0	100.0	100.0
Switch_D21	100.0	99.3	99.5	100.0	100.0
Genesis_D7	100.0	98.2	98.3	55.8	100.0
Genesis_D14	100.0	99.7	99.8	95.4	100.0
Genesis_D21	100.0	97.2	99.0	80.5	100.0
Prolev_D7	100.0	80.0	87.4	100.0	65.7
Prolev_D14	100.0	94.3	95.0	100.0	96.6
Prolev_D21	96.9	88.2	91.1	86.9	41.0
Panacur_D7	93.6	86.8	79.6	80.2	70.2
Panacur_D14	86.3	94.3	93.8	96.2	26.0
Panacur_D21	79.2	81.3	83.0	88.3	-110.6
Control_D0	343.5	134.4	209.1	44.8	14.9
Control_D7	882.8	111.9	211.4	24.9	12.4
Control_D14	1298.8	178.3	764.0	178.3	127.3
Control_D21	1203.2	188.0	413.6	37.6	37.6

Table 10: Farm 2 *Nematodirus* Burden and Efficacy

Group/Day	Min.	Max.	AM	GM	N	Pos.	AM Eff.	GM Eff.
Tison Attack_D0	0	200	63.3	14.0	15	9	.	.
Tison Attack_D7	0	0	0.0	0.0	15	0	100.0	100.0
Tison Attack_D14	0	0	0.0	0.0	15	0	100.0	100.0
Tison Attack_D21	0	0	0.0	0.0	15	0	100.0	100.0
Switch_D0	.	.	.	.	0	0	.	.
Switch_D7	0	0	0.0	0.0	15	0	100.0	100.0
Switch_D14	0	0	0.0	0.0	15	0	100.0	100.0
Switch_D21	0	50	3.3	0.3	15	1	96.6	99.0
Genesis_D0	.	.	.	.	0	0	.	.
Genesis_D7	0	0	0.0	0.0	15	0	100.0	100.0
Genesis_D14	0	0	0.0	0.0	15	0	100.0	100.0
Genesis_D21	0	0	0.0	0.0	15	0	100.0	100.0
Prolev_D0	.	.	.	.	0	0	.	.
Prolev_D7	0	50	6.7	0.7	15	2	88.2	91.7
Prolev_D14	0	50	6.7	0.7	15	2	94.4	98.7
Prolev_D21	0	50	13.3	1.9	15	4	86.2	93.6
Panacur_D0	.	.	.	.	0	0	.	.
Panacur_D7	0	150	50.0	15.6	15	10	11.8	-87.5
Panacur_D14	0	250	73.3	19.0	15	10	38.9	64.6
Panacur_D21	0	100	33.3	6.2	15	7	65.5	78.7
Control_D0	0	200	63.3	14.0	15	9	.	.
Control_D7	0	150	56.7	8.3	15	7	.	.
Control_D14	0	350	120.0	53.8	15	13	.	.
Control_D21	0	350	96.7	29.0	15	11	.	.

Farm 3

There was a substantial parasite burden with arithmetic mean strongyle egg counts in Groups A and F >2,400 on Day 0. These counts remained significantly elevated in the control animals for the duration of the study. Furthermore coproculture indicated that adequate burdens of all important gastrointestinal nematodes, except *Oesophagostomum/Chabertia* were present. There was a low *Nematodirus* burden with arithmetic mean FECs of 35.7 in the untreated control group on Day 0 with 6/15 animals positive.

No treatment had efficacy >95% against *Teladorsagia* on any day post-treatment. Switch and Genesis had efficacies against *Trichostrongylus* of >95% on Days 7, 14 and 21. Prolev had efficacy against *Trichostrongylus* of >95% on Days 7 and 14. Tison Attack efficacy against *Trichostrongylus* ranged between 89 and 91%. Tison Attack, Switch and Genesis were highly effective (>96%) against *Haemonchus* and *Cooperia* and while in only low numbers also *Oesophagostomum/Chabertia* on all days post treatment. Similarly efficacy was 100% against *Nematodirus* for Tison Attack, Switch, Genesis and Prolev on Days 7 and 14 post treatment.

Table 11: Farm 3 Strongyle Burden and Overall Efficacy

Group/Day	Min.	Max.	AM	GM	N	Pos.	Efficacy			
							Eqn 1		Eqn 2	
							AM	GM	AM	GM
Tison Attack_D0	100	20850	3680.0	1896.3	15	15	.	.	.	.
Tison Attack_D7	0	350	70.0	11.3	15	8	96.1	98.8	97.4	99.2
Tison Attack_D14	0	400	140.0	46.8	15	12	91.5	71.8	94.3	81.8
Tison Attack_D21	0	350	69.2	4.1	13	4	95.2	99.5	96.7	99.7
Switch_D0	.	.	.	.	0	0	.	.	.	.
Switch_D7	0	100	10.0	0.8	15	2	99.4	99.9	.	.
Switch_D14	0	150	16.7	1.4	15	3	99.0	99.2	.	.
Switch_D21	0	200	35.7	3.9	14	5	97.5	99.5	.	.
Genesis_D0	.	.	.	.	0	0	.	.	.	.
Genesis_D7	0	150	36.7	4.9	15	6	98.0	99.5	.	.
Genesis_D14	0	200	30.0	2.4	15	4	98.2	98.6	.	.
Genesis_D21	0	150	32.1	3.9	14	5	97.8	99.5	.	.
Prolev_D0	.	.	.	.	0	0	.	.	.	.
Prolev_D7	0	100	30.0	5.9	15	7	98.3	99.4	.	.
Prolev_D14	0	300	60.0	7.7	15	7	96.4	95.4	.	.
Prolev_D21	0	950	300.0	149.7	11	10	79.0	82.1	.	.
Panacur_D0	.	.	.	.	0	0	.	.	.	.
Panacur_D7	0	650	139.3	17.6	14	8	92.2	98.1	.	.
Panacur_D14	0	2150	303.6	42.4	14	10	81.6	74.4	.	.
Panacur_D21	0	2500	319.2	45.6	13	9	77.7	94.5	.	.
Control_D0	100	12450	2478.6	1220.1	14	14	.	.	.	.
Control_D7	50	6650	1789.3	912.9	14	14	.	.	.	.
Control_D14	0	7750	1646.4	165.7	14	10	.	.	.	.
Control_D21	100	3600	1430.8	835.3	13	13	.	.	.	.

Table 12: Farm 3 Genera Efficacy based on AMs and Control Group Mean Counts

Group/Day	Haem.	Tela.	Trich.	Coop.	Oeso./Chab.
Tison Attack_D7	100.0	-95.6	89.1	100.0	100.0
Tison Attack_D14	100.0	-478.2	90.3	100.0	100.0
Tison Attack_D21	96.8	73.4	90.8	98.8	100.0
Switch_D7	100.0	70.9	98.5	100.0	100.0
Switch_D14	100.0	41.3	98.5	100.0	100.0
Switch_D21	99.9	80.0	95.9	96.9	100.0
Genesis_D7	100.0	-10.7	95.4	99.6	100.0
Genesis_D14	100.0	-20.3	97.8	100.0	100.0
Genesis_D21	99.9	83.2	95.9	97.4	100.0
Prolev_D7	100.0	-37.5	98.3	100.0	100.0
Prolev_D14	100.0	-140.5	95.6	100.0	100.0
Prolev_D21	82.7	58.1	84.8	66.8	100.0
Panacur_D7	96.0	-86.8	87.0	95.6	92.2
Panacur_D14	92.6	-416.3	85.5	82.7	72.3
Panacur_D21	82.5	66.5	69.6	77.7	77.7
Control_D0	694.0	247.9	1090.6	446.1	0.0
Control_D7	769.4	17.9	322.1	572.6	107.4
Control_D14	576.3	16.5	461.0	526.9	65.9
Control_D21	658.2	57.2	314.8	343.4	57.2

Table 13: Farm 3 *Nemotodirus* Burden and Efficacy

Group/Day	Min.	Max.	AM	GM	N	Pos.	AM Eff.	GM Eff.
Tison Attack_D0	0	150	23.3	2.2	15	4	.	.
Tison Attack_D7	0	0	0.0	0.0	15	0	100.0	100.0
Tison Attack_D14	0	0	0.0	0.0	15	0	100.0	100.0
Tison Attack_D21	0	50	3.8	0.4	13	1	87.5	87.9
Switch_D0	.	.	.	.	0	0	.	.
Switch_D7	0	0	0.0	0.0	15	0	100.0	100.0
Switch_D14	0	0	0.0	0.0	15	0	100.0	100.0
Switch_D21	0	100	7.1	0.4	14	1	76.8	86.7
Genesis_D0	.	.	.	.	0	0	.	.
Genesis_D7	0	0	0.0	0.0	15	0	100.0	100.0
Genesis_D14	0	0	0.0	0.0	15	0	100.0	100.0
Genesis_D21	0	0	0.0	0.0	14	0	100.0	100.0
Prolev_D0	.	.	.	.	0	0	.	.
Prolev_D7	0	0	0.0	0.0	15	0	100.0	100.0
Prolev_D14	0	0	0.0	0.0	15	0	100.0	100.0
Prolev_D21	0	0	0.0	0.0	11	0	100.0	100.0
Panacur_D0	.	.	.	.	0	0	.	.
Panacur_D7	0	150	21.4	1.6	14	3	0.0	31.6
Panacur_D14	0	250	21.4	1.0	14	2	79.6	91.1
Panacur_D21	0	150	11.5	0.5	13	1	62.5	83.9
Control_D0	0	150	35.7	5.4	14	6	.	.
Control_D7	0	100	21.4	2.4	14	4	.	.
Control_D14	0	550	105.0	10.8	10	5	.	.
Control_D21	0	200	30.8	2.9	13	4	.	.

Farm 4

There was a substantial parasite burden with arithmetic mean strongyle egg counts all > 1,200 on Day 0. These counts remained elevated in the Control group for the duration of the study. Coproculture indicated that *Trichostrongylus* was the dominant pre and post-treatment genera. There were marginally adequate burdens of *Oesophagostomum/Chabertia* and *Cooperia* and inadequate populations of *Haemonchus*. No *Nematodirus* eggs were observed.

Tison Attack was highly effective (>99.9%) against *Cooperia* and *Oesophagostomum/Chabertia* on all days post treatment.

Strains of *Teladorsagia* and *Trichostrongylus* markedly resistant to the combination of abamectin and levamisole, plus fenbendazole were observed.

The efficacy of Tison Attack and Switch were very similar.

Table 14: Farm 4 Strongyle Burden and Overall Efficacy

Group/Day	Min.	Max.	AM	GM	N	Pos.	Efficacy			
							Eqn 1		Eqn 2	
							AM	GM	AM	GM
Tison Attack_D0	0	4350	1253.6	432.9	14	13	.	.	.	.
Tison Attack_D7	0	2100	635.7	95.0	14	10	48.7	87.5	42.3	82.7
Tison Attack_D14	0	2200	596.2	76.9	13	9	57.4	89.5	52.1	85.4
Tison Attack_D21	0	2250	507.1	47.8	14	9	60.1	92.3	55.1	89.3
Switch_D0	.	.	.	.	0	0	.	.	.	.
Switch_D7	0	1850	576.7	208.2	15	13	53.5	72.6	.	.
Switch_D14	0	1350	723.1	183.3	13	10	48.4	74.9	.	.
Switch_D21	0	1600	657.7	344.5	13	12	48.3	44.2	.	.
Genesis_D0	.	.	.	.	0	0	.	.	.	.
Genesis_D7	0	1350	426.7	86.0	15	11	65.6	88.7	.	.
Genesis_D14	0	950	314.3	51.8	14	10	77.6	92.9	.	.
Genesis_D21	0	1550	286.7	40.3	15	10	77.5	93.5	.	.
Prolev_D0	.	.	.	.	0	0	.	.	.	.
Prolev_D7	0	1450	518.0	115.0	15	12	58.2	84.8	.	.
Prolev_D14	0	850	339.3	159.4	14	13	75.8	78.1	.	.
Prolev_D21	0	1000	317.9	22.0	14	7	75.0	96.4	.	.
Panacur_D0	.	.	.	.	0	0	.	.	.	.
Panacur_D7	0	1500	536.7	252.0	15	14	56.7	66.8	.	.
Panacur_D14	0	1700	610.0	307.7	15	14	56.4	57.8	.	.
Panacur_D21	0	2600	560.0	110.0	15	12	56.0	82.2	.	.
Control_D0	0	3000	1410.7	598.0	15	14	.	.	.	.
Control_D7	50	2600	1239.3	758.9	14	14	.	.	.	.
Control_D14	0	2800	1400.0	729.6	12	11	.	.	.	.
Control_D21	0	2600	1271.4	617.5	14	13	.	.	.	.

Table 15: Farm 4 Genera Efficacy based on AMs and Control Group Mean Counts

Group/Day	Haem.	Tela.	Trich.	Coop.	Oeso./Chab.
Tison Attack_D7	.	74.4	33.9	100.0	100.0
Tison Attack_D14	100.0	85.8	31.6	100.0	100.0
Tison Attack_D21	100.0	60.1	49.9	100.0	100.0
Switch_D7	.	76.7	40.0	100.0	100.0
Switch_D14	100.0	91.4	16.2	100.0	100.0
Switch_D21	100.0	74.1	34.3	100.0	100.0
Genesis_D7	.	82.8	56.1	91.4	100.0
Genesis_D14	100.0	77.6	65.4	100.0	100.0
Genesis_D21	100.0	32.4	72.8	100.0	100.0
Prolev_D7	.	16.4	49.4	100.0	100.0
Prolev_D14	100.0	19.2	68.2	100.0	100.0
Prolev_D21	100.0	25.0	69.9	100.0	100.0
Panacur_D7	.	35.0	52.1	100.0	72.9
Panacur_D14	100.0	-74.3	52.1	97.8	71.0
Panacur_D21	11.9	11.9	62.7	78.0	3.1
Control_D0	0.0	28.2	1326.0	28.2	28.2
Control_D7	0.0	49.6	941.9	49.6	198.3
Control_D14	14.0	84.0	854.0	280.0	168.0
Control_D21	25.4	25.4	991.7	101.7	127.1

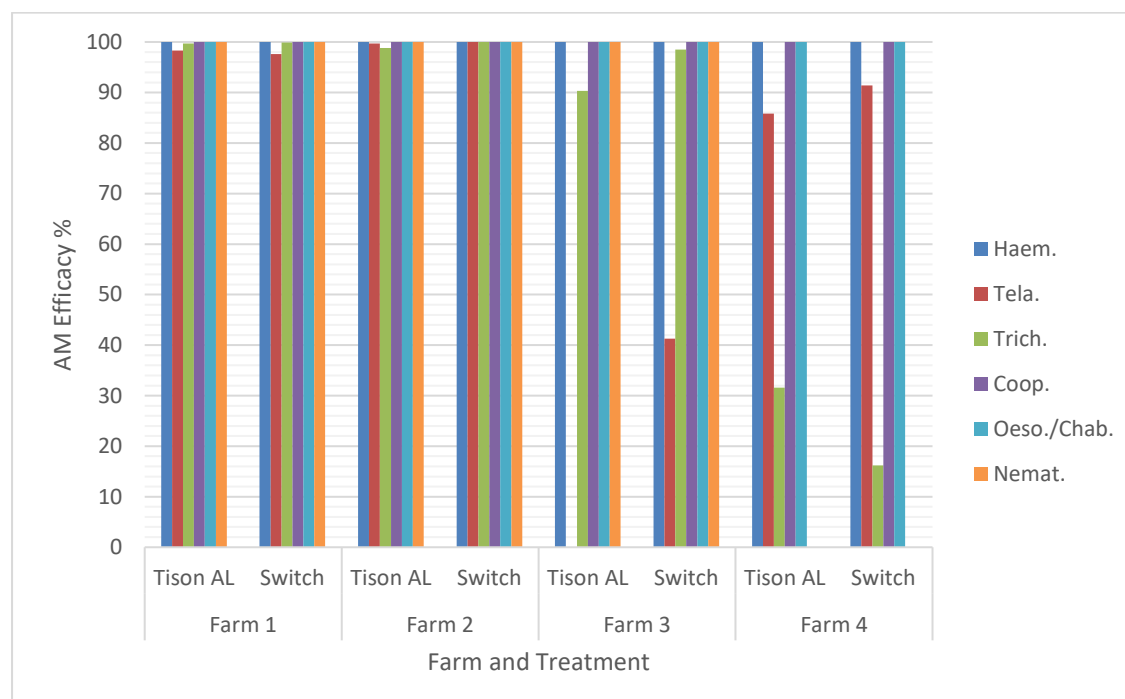
Overall Summary of Results

Notwithstanding strains of dual abamectin and levamisole resistant gastrointestinal nematodes, Tison Attack demonstrated efficacies > 95% on undifferentiated strongyle and *Nematodirus* egg counts 7 days after treatment, and was highly effective against *Haemonchus*, *Cooperia* and *Oesophagostomum/Chabertia* on all farms.

On two properties (Farms 1 and 2), the efficacy of Tison Attack against *Teladorsagia* and *Trichostrongylus* was > 98% on both Days 7 and 14 post-treatment. This included strains resistant to either the levamisole or ML action families. Moreover, the efficacy Tison Attack matched that of the same combination (Switch) given orally. Given marked dual resistance, all products had poor efficacy against *Teladorsagia* and *Trichostrongylus* on Farm 4. On Farm 3, Tison Attack reduced *Trichostrongylus* counts slightly less than Switch, however, there was no evidence that this 5 – 9% difference was significant.

Tison Attack was safe, with no systemic adverse events. As has been observed in safety studies conducted with Tison Attack, mild transitory inflammation and subsequent crusting on the skin surface that adhered to the growing wool was observed at the application site on some sheep. As already mentioned these observations were consistent with what is described on the Tison label and what has been seen in the field.

Figure 1: Tison Attack (AL) and Switch Arithmetic Mean Efficacy by Genera



N.B. The negative efficacy for *Teladorsagia* spp. for Tison Attack on Farm 3 is shown as 0 in this bar chart. Tison AL is short hand for Tison Attack.

3. Field Testing of a topical anthelmintic for merino sheep

FECR field studies in naturally infected merino lambs were conducted across six farms in North and Central Otago and South Canterbury in the spring of 2022. The efficacy of Tison Attack (Group 1), Tison (Group 2, ACVM No. 011955, Inovata Ltd) and Venator (Group 3, ACVM No. 11650, Donaghys Ltd) was compared with negative controls (Group 4).

Table 16: Treatment Groups

Group	Treatment	Active Ingredients and Concentration	Route of Administration
1	Tison Attack	Abamectin (6 mg/kg) and levamisole (10.4 mg/kg)	Topical
2	Tison	Eprinomectin (6 mg/kg) and levamisole (10.4 mg/kg)	Topical
3	Venator	Abamectin (0.2 mg/kg) and levamisole (8 mg/kg)	Oral
4	Untreated Control	-	-

Figure 3: An example of Merino Lambs Treated Off-Shears



Method

The study was carried out in approximately 10 month old merino hoggets. The sheep were naturally infested with parasites and stayed on the home property for the entire study period. All sheep had been shorn within 24 hours of treatment except for Farm B where the animals were shorn 2 days before treatment.

There were 10 animals per treatment group. Animals were selected as they presented in the race. Once a positive faecal sample was taken, the animal was tagged with a numbered coloured tag with the colour identifying the animal's treatment group. If a faecal sampling was unable to be taken from an animal it was passed over and not included in the study.

Once 40 samples were collected animals were weighed and treated by treatment group. Dose was calculated for individual animals and a 20 mL syringe (with drench nozzle attached for the oral product) was used for application. The Tison Attack and Tison groups were treated according to the proposed Tison Attack label for use in sheep off shears. I.e. *Apply with a drench gun nozzle as a single 200-300mm midline stripe down the backbone in the middle of the back.*

Figure 3: Tison Attack application of shears



The animals and their application sites were inspected approximately 2 hours after treatment.

Faecal egg samples were taken 13 or 14 days after treatment and the application site was inspected for any reaction to treatment. Eggs were counted using the standard McMaster counting technique with undifferentiated strongyle *Nematodirus* spp. eggs counted. Group-level pooled coprocultures were performed on all samples.

Bayesian hierarchical models from the “eggCounts” R package were used to calculate the FECR for strongyles. FECR was modelled using Zero inflated paired design models (ZIPP) and Individual efficacy paired design models (IEP).

Species specific arithmetic and geometric mean efficacy was calculated at each time point using $FECR_2$ shown here:

$$FECR_2\% = 100 \left(1 - \frac{\bar{x}_{t_1} \bar{x}_{c_0}}{\bar{x}_{t_0} \bar{x}_{c_1}} \right)$$

Where:

$\bar{x}_{c_0}$ = control group mean FEC pre-treatment

$\bar{x}_{c_1}$ = control group mean FEC post-treatment

$\bar{x}_{t_0}$ = treatment group mean FEC pre-treatment

$\bar{x}_{t_1}$ = treatment group mean FEC post-treatment

Results

Safety evaluation

There were no negative effects reported for any of the products approximately two hours after treatment. There were no negative effects on the skin or wool growth at the application sites reported 13 or 14 days after treatment.

Efficacy

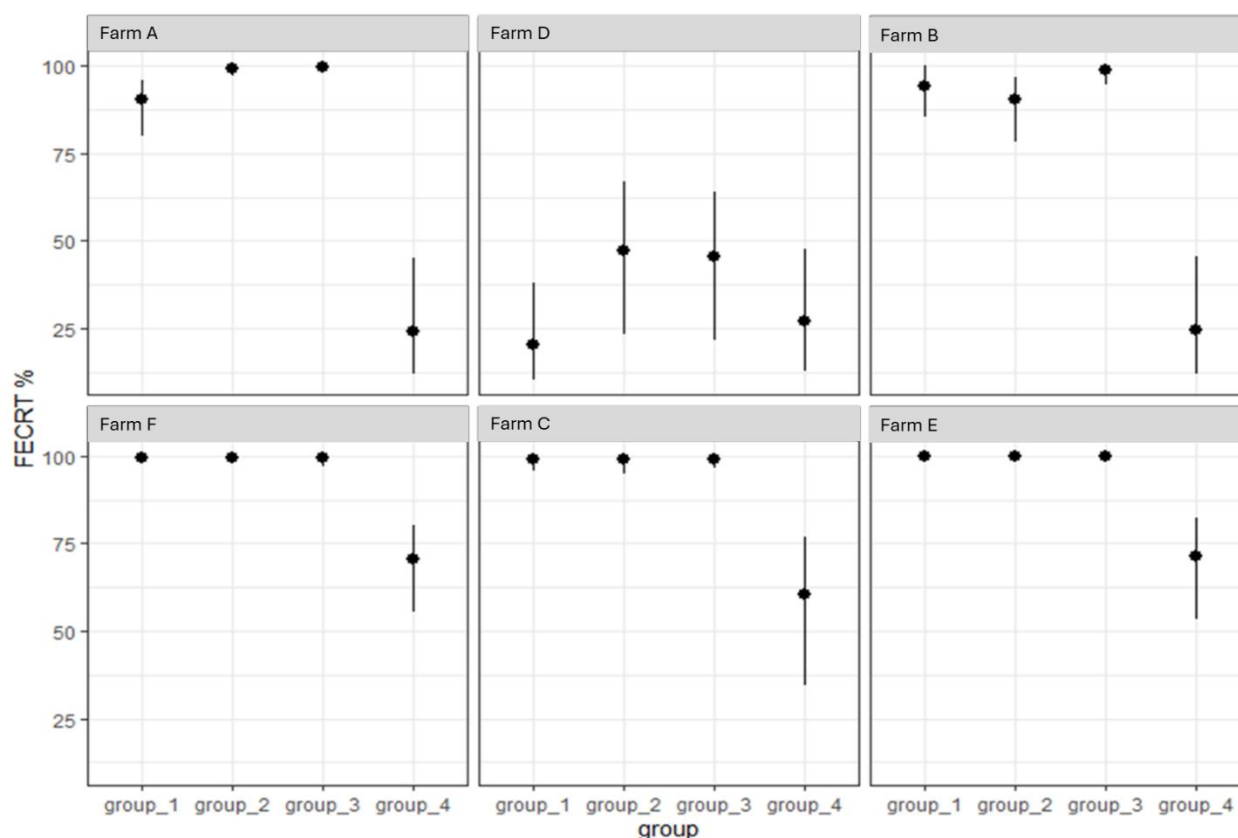
Gross median efficacy FECR was excellent across all properties for all treatment groups.

Table 17: FECR median and 90% Confidence Intervals by group (all farms)

group	median_pre	median_post	perc_5	perc_50	perc_95
group_1	808.8	109.6	97.52	99.65	99.99
group_2	1,083.3	59.6	99.29	99.96	100.00
group_3	1,292.5	62.3	99.91	100.00	100.00
group_4	883.3	417.6	37.02	47.14	55.71

For undifferentiated FECs good efficacy (>90%) was seen for all treatments on all farms except for Farm D where the efficacy was 20%, 47% and 45% for Treatment Groups 1 to 3 respectively. The low efficacy in Treatment Group 3, the positive control demonstrated that resistance was present on this property to macrocyclic lactones (abamectin and eprinomectin) and levamisole.

Figure 4: Undifferentiated FECR median and 90% Confidence Interval by group and farm



Five species of parasite were found in the pre-treatment FECs with the egg numbers found for some species being less than 50 epg on some farms. No *Haemonchus* spp. were found in the FECs and *Cooperia* spp. were only found on Farm A.

On Farm D all treatments showed poor efficacy (<40%) and in the case of Tison Attack negative efficacy against the only genera present, *Trichostrongylus* spp. The equally poor efficacy of the positive control product (also containing abamectin and levamisole) demonstrated that resistance to these two actives was present on the property. The sheep on this property had been treated with a long acting moxidectin injection (Exodus LAI, ACVM No. 010399, Boehringer Ingelheim) 50 days before Study Day 0. This product has persistent activity (112 days for *Teladorsagia circumcincta* and 42 days for *Trichostrongylus colubriformis*), removing all sensitive worms species leaving only the resistant species, hence the pure *Trichostrongylus* spp. population found at larval culture.

The arithmetic mean efficacy was good (>90%) for all treatments on all farms and species except for at Farm B and D.

On Farm B, Tison Attack had arithmetic mean efficacy against *Trichostrongylus* spp. of 76.4% and Tison had arithmetic mean efficacy of 89.9% and 89.6% against *Teladorsagia* spp. and *Trichostrongylus* spp. respectively.

Resistance to the macrocyclic lactone and levamisole actives is common across New Zealand, especially in *Trichostrongylus* and *Teladorsagia* spp. The positive egg counts found at Farm B could

indicate the emergence of this resistance on this property with the improved activity of positive control product being due to being given orally.

Table 19: Farm A, FECs and FECR by Genera

		Pre FEC	Post FEC	Efficacy by AM (%)	Efficacy by GM (%)
Tison Attack	<i>Teladorsagia</i> spp.	32	31	92.0	98.3
	<i>Trichostrongylus</i> spp.	223	4	95.5	99.0
	<i>Cooperia</i> spp.	7	0	100	100
	<i>Oesoph/Chabertia</i> spp.	97	0	100	100
	<i>Nematodirus</i> spp.	0	0	-	-
Tison	<i>Teladorsagia</i> spp.	18	0	100	100
	<i>Trichostrongylus</i> spp.	500	0	100	100
	<i>Cooperia</i> spp.	6	0	100	100
	<i>Oesoph/Chabertia</i> spp.	85	0	100	100
	<i>Nematodirus</i> spp.	0	0	-	-
Venator	<i>Teladorsagia</i> spp.	70	0	100	100
	<i>Trichostrongylus</i> spp.	980	0	100	100
	<i>Cooperia</i> spp.	56	0	100	100
	<i>Oesoph/Chabertia</i> spp.	294	0	100	100
	<i>Nematodirus</i> spp.	25	0	100	100
Negative Control	<i>Teladorsagia</i> spp.	34	400		
	<i>Trichostrongylus</i> spp.	375	159		
	<i>Cooperia</i> spp.	11	0		
	<i>Oesoph/Chabertia</i> spp.	140	29		
	<i>Nematodirus</i> spp.	55	0		

Table 20: Farm B, FECs and FECR by Genera

		Pre FEC	Post FEC	Efficacy by AM (%)	Efficacy by GM (%)
Tison Attack	<i>Teladorsagia</i> spp.	77	8	94.2	99.4
	<i>Trichostrongylus</i> spp.	256	22	76.4	97.5
	<i>Cooperia</i> spp.	0	0	-	-
	<i>Oesoph/Chabertia</i> spp.	33	0	100	100
	<i>Nematodirus</i> spp.	0	0	-	-
Tison	<i>Teladorsagia</i> spp.	76	14	89.9	99.2
	<i>Trichostrongylus</i> spp.	293	11	89.6	99.2
	<i>Cooperia</i> spp.	0	0	-	-
	<i>Oesoph/Chabertia</i> spp.	27	0	100	100
	<i>Nematodirus</i> spp.	0	0	-	-
Venator	<i>Teladorsagia</i> spp.	152	0	100	100
	<i>Trichostrongylus</i> spp.	252	0	100	100
	<i>Cooperia</i> spp.	0	0	-	-
	<i>Oesoph/Chabertia</i> spp.	30	0	100	100
	<i>Nematodirus</i> spp.	0	0	-	-
Negative Control	<i>Teladorsagia</i> spp.	130	237		
	<i>Trichostrongylus</i> spp.	225	82		
	<i>Cooperia</i> spp.	0	0		
	<i>Oesoph/Chabertia</i> spp.	40	70		
	<i>Nematodirus</i> spp.	0	1		

Table 21: Farm C, FECs and FECR by Genera

		Pre FEC	Post FEC	Efficacy by AM (%)	Efficacy by GM (%)
Tison Attack	<i>Teladorsagia</i> spp.	76	0	100	100
	<i>Trichostrongylus</i> spp.	130	0	100	100
	<i>Cooperia</i> spp.	0	0	-	-
	<i>Oesoph/Chabertia</i> spp.	214	0	100	100
	<i>Nematodirus</i> spp.	0	0	-	-
Tison	<i>Teladorsagia</i> spp.	86	0	100	100
	<i>Trichostrongylus</i> spp.	133	0	100	100
	<i>Cooperia</i> spp.	0	0	-	-
	<i>Oesoph/Chabertia</i> spp.	140	0	100	100
	<i>Nematodirus</i> spp.	0	0	-	-
Venator	<i>Teladorsagia</i> spp.	125	0	100	100
	<i>Trichostrongylus</i> spp.	228	0	100	100
	<i>Cooperia</i> spp.	0	0	-	-
	<i>Oesoph/Chabertia</i> spp.	217	0	100	100
	<i>Nematodirus</i> spp.	0	0	-	-
Negative Control	<i>Teladorsagia</i> spp.	92	37		
	<i>Trichostrongylus</i> spp.	132	83		
	<i>Cooperia</i> spp.	0	0		
	<i>Oesoph/Chabertia</i> spp.	216	47		
	<i>Nematodirus</i> spp.	0	1		

Table 22: Farm D, FECs and FECR by Genera

		Pre FEC	Post FEC	Efficacy by AM (%)	Efficacy by GM (%)
Tison Attack	<i>Teladorsagia</i> spp.	0	0	-	-
	<i>Trichostrongylus</i> spp.	520	565	-34.2*	-45.4
	<i>Cooperia</i> spp.	0	0	-	-
	<i>Oesoph/Chabertia</i> spp.	0	0	-	-
	<i>Nematodirus</i> spp.	0	0	-	-
Tison	<i>Teladorsagia</i> spp.	0	0	-	-
	<i>Trichostrongylus</i> spp.	580	310	34.0	38.4
	<i>Cooperia</i> spp.	0	0	-	-
	<i>Oesoph/Chabertia</i> spp.	0	0	-	-
	<i>Nematodirus</i> spp.	0	0	-	-
Venator	<i>Teladorsagia</i> spp.	0	0	-	-
	<i>Trichostrongylus</i> spp.	705	350	38.7	37.0
	<i>Cooperia</i> spp.	0	0	-	-
	<i>Oesoph/Chabertia</i> spp.	0	0	-	-
	<i>Nematodirus</i> spp.	0	0	-	-
Negative Control	<i>Teladorsagia</i> spp.	0	0		
	<i>Trichostrongylus</i> spp.	630	510		
	<i>Cooperia</i> spp.	0	0		
	<i>Oesoph/Chabertia</i> spp.	0	0		
	<i>Nematodirus</i> spp.	0	0		

*This negative efficacy is shown as 0 in Figure 3 below.

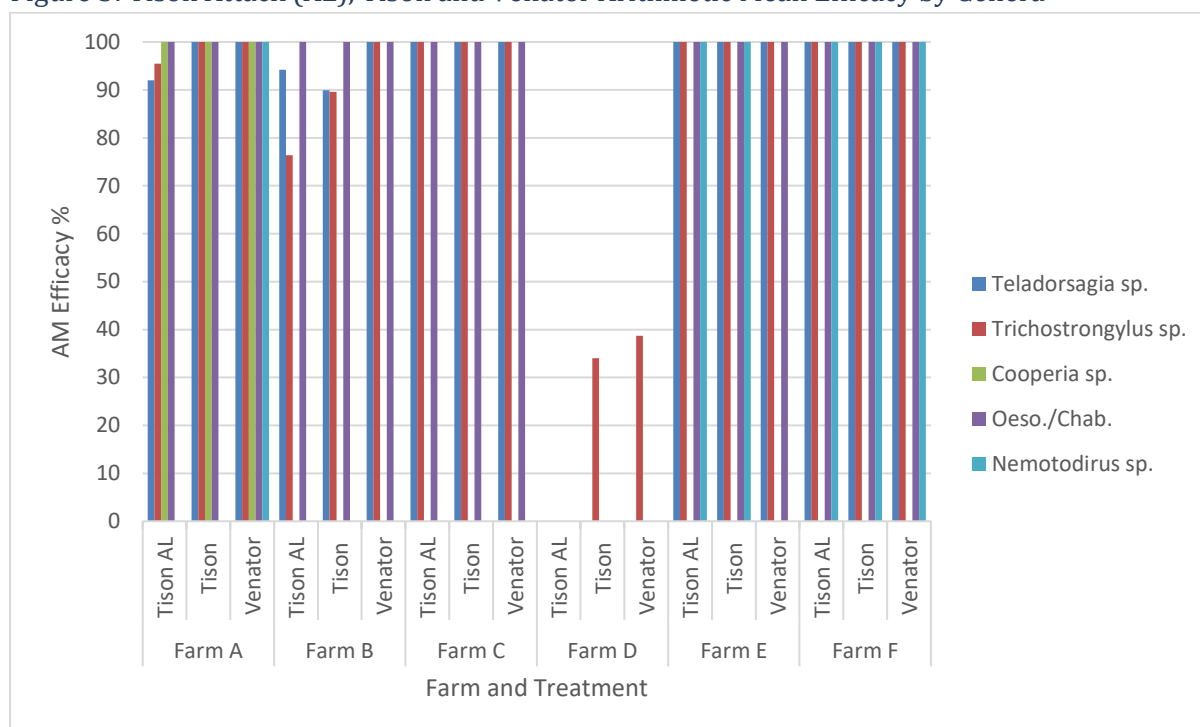
Table 23: Farm E, FECs and FECR by Genera

		Pre FEC	Post FEC	Efficacy by AM (%)	Efficacy by GM (%)
Tison Attack	<i>Teladorsagia</i> spp.	24	0	100	100
	<i>Trichostrongylus</i> spp.	1988	0	100	100
	<i>Cooperia</i> spp.	0	0	-	-
	<i>Oesoph/Chabertia</i> spp.	383	0	100	100
	<i>Nematodirus</i> spp.	65	0	100	100
Tison	<i>Teladorsagia</i> spp.	123	0	100	100
	<i>Trichostrongylus</i> spp.	2207	0	100	100
	<i>Cooperia</i> spp.	0	0	-	-
	<i>Oesoph/Chabertia</i> spp.	736	0	100	100
	<i>Nematodirus</i> spp.	30	0	100	100
Venator	<i>Teladorsagia</i> spp.	54	0	100	100
	<i>Trichostrongylus</i> spp.	2403	0	100	100
	<i>Cooperia</i> spp.	0	0	-	-
	<i>Oesoph/Chabertia</i> spp.	243	0	100	100
	<i>Nematodirus</i> spp.	0	0	-	-
Negative Control	<i>Teladorsagia</i> spp.	63	368		
	<i>Trichostrongylus</i> spp.	1743	164		
	<i>Cooperia</i> spp.	0	0		
	<i>Oesoph/Chabertia</i> spp.	294	34		
	<i>Nematodirus</i> spp.	45	0		

Table 24: Farm F, FECs and FECR by Genera

		Pre FEC	Post FEC	Efficacy by AM (%)	Efficacy by GM (%)
Tison Attack	<i>Teladorsagia</i> spp.	276	0	100	100
	<i>Trichostrongylus</i> spp.	414	0	100	100
	<i>Cooperia</i> spp.	0	0	-	-
	<i>Oesoph/Chabertia</i> spp.	565	0	100	100
	<i>Nematodirus</i> spp.	113	0	100	100
Tison	<i>Teladorsagia</i> spp.	612	0	100	100
	<i>Trichostrongylus</i> spp.	528	0	100	100
	<i>Cooperia</i> spp.	0	0	-	-
	<i>Oesoph/Chabertia</i> spp.	292	0	100	100
	<i>Nematodirus</i> spp.	88	0	100	100
Venator	<i>Teladorsagia</i> spp.	563	0	100	100
	<i>Trichostrongylus</i> spp.	844	0	100	100
	<i>Cooperia</i> spp.	0	0	-	-
	<i>Oesoph/Chabertia</i> spp.	938	0	100	100
	<i>Nematodirus</i> spp.	150	0	100	100
Negative Control	<i>Teladorsagia</i> spp.	185	221		
	<i>Trichostrongylus</i> spp.	485	99		
	<i>Cooperia</i> spp.	0	0		
	<i>Oesoph/Chabertia</i> spp.	485	20		
	<i>Nematodirus</i> spp.	90	0		

Figure 5: Tison Attack (AL), Tison and Venator Arithmetic Mean Efficacy by Genera



NB The negative efficacy for Tison Attack on Farm D is shown as 0, Tison AL is short for Tison Attack.

Conclusion

Tison Attack was safe, efficacious and had similar efficacy to an oral combination of the same actives on all but one out of six farms in merino sheep off shears. Tison gave similar results showing that it was efficacious in merino sheep off shears.

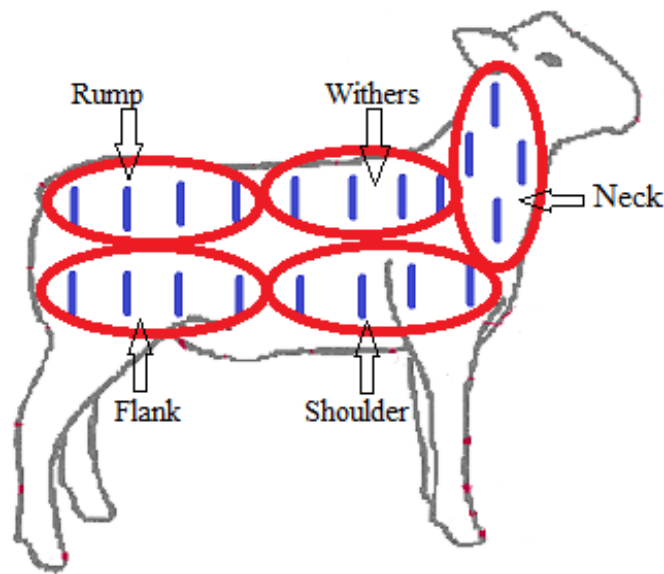
4. A field study evaluating the efficacy of Tison Attack against *Bovicola ovis* in long wool crossbred sheep, Morton Mains.

This field study evaluated the efficacy of Tison Attack against the sheep body louse (*Bovicola ovis*) on a commercial sheep farm in Morton Mains, Southland. The sheep were mixed age pregnant ewes (n=314) showing signs of lice infestation. The sheep had 7 months wool at the time of the study and were not shorn at treatment.

Method

Lice counts were carried out with lice counted from 40 x 10 cm partings across specified areas of the body of the sheep on Days -1, 13 and 30. Lice counts included both adults and nymphs.

Figure 6: Indicative position of wool partings for one side of the sheep for the lice counting procedure.



Lice counts were completed as sheep presented for counting and 25 tracer animals with lice counts ≥ 40 were identified. The tracer animals had a mean louse score of 120 and a range in louse score of 60-329 on Day -1. Tracer animals were tagged with an individual animal ID and run with the rest of the flock for the study. Tracer animals ranged in wool staple length from 8.5 to 12.0 cm.

A selection of the heaviest sheep from the mob were drafted off and weighed with weights from 72 to 90 kg. The mob was treated for the heaviest in the majority of the mob at 90 kg and were given 36 mL of Tison Attack according to the dose rate of 1 mL/2.5 kg. One sheep, No. 113, was noted as looking significantly heavier than the rest of the mob. It was weighed to be 93.5 kg but was treated for 94.5 kg in error. This is not considered to affect the results or interpretation of the study. Two rams also running with the mob were weighed to be 110 kg and were treated for this weight. It was judged that treating all the animals for the true heaviest animal in the mob (110 kg) would have resulted in the significant over-dosing of the vast majority of sheep so the dosing schedule described was applied.

Treatment used a specially designed double headed nozzle that applied product in two spots 7.5 cm apart at the base of the fleece. This was fitted to a calibrated drench gun.

Figure 7: Double Headed Nozzle for Application of Tison Attack 7.5 cm Apart in Long Wool Sheep



Efficacy was calculated according to the following formula:

$$\text{Lice Count Reduction (LCR)} = (X_{t0} - X_{t1}) / X_{t0}$$

Where: X_{t0} = Mean Lice Count pre-treatment

X_{t1} = Mean Lice Count post-treatment

Table 25: Arithmetic Mean Lice Counts Over Time and Arithmetic Mean LCR

	Mean Lice Count	Minimum	Maximum	Arithmetic Mean LCR
Day 0	120.1	60	329	-
Day 13	10.4	1	27	91.3%
Day 30	3.0	0	12	97.5%

Lice counts on Day -1 in the tracer animals ranged from 60 to 329 with a mean of 120.1. These mean counts had dropped to 10.4 and 3.0 on Days 13 and 30 respectively equating to an efficacies of 91.3% and 97.5%.

Conclusion

Tison Attack was effective at controlling a lice infestation in long wool crossbred sheep 30 days after treatment.

References

Daly S, Spot-on drenches in sheep for control of gastrointestinal parasites and lice, Proceedings of the Sheep and Beef Cattle Veterinarians and the Deer Veterinarians Branches of the NZVA, June 2023

Appendix 1. Worm species abbreviations

<i>H. con</i>	<i>Haemonchus contortus</i>	<i>N. spp.</i>	<i>Nematodirus</i> spp.
<i>Tel. spp.</i>	<i>Teladorsagia</i> spp.	<i>Tel. cir</i>	<i>Teladorsagia circumcincta</i>
<i>T. axe</i>	<i>Trichostrongylus axei</i>	<i>N. spa</i>	<i>Nematodirus spathiger</i>
<i>Trich. spp.</i>	<i>Trichostrongylus</i> spp.	<i>N. fil</i>	<i>Nematodirus filicollis</i>
<i>C. cur</i>	<i>Cooperia curticei</i>	<i>T. col</i>	<i>Trichostrongylus colubriformis</i>
<i>Oes. spp.</i>	<i>Oesophagostomum</i> spp.	<i>T. vit</i>	<i>Trichostrongylus vitrinus</i>
<i>C. spp.</i>	<i>Chabertia</i> spp.	<i>Tel. tri</i>	<i>Teladorsagia trifurcata</i>
<i>T. ovi</i>	<i>Trichuris ovis</i>	<i>Coop. spp.</i>	<i>Cooperia</i> spp.
<i>C. ovi</i>	<i>Chabertia ovina</i>	<i>C. onc</i>	<i>Cooperia oncophora</i>
<i>Haem.</i>	<i>Haemonchus</i> spp.	<i>Tela.</i>	<i>Teladorsagia</i> spp.
<i>Trich.</i>	<i>Trichostrongylus</i> spp.	<i>Coop.</i>	<i>Cooperia</i> spp.
<i>Oeso.</i>	<i>Oesophagostomum venulosum</i>	<i>Chab.</i>	<i>Chabertia ovina</i>

Appendix 2. Positive Control Product Details from Study 2. Faecal Egg Count Field Studies, Taumarunui

Name	ACVM No.	Registrant
Switch Hi-Mineral	A009970	Boehringer-Ingelheim Animal Health NZ Ltd
Genesis Hi-Mineral	A007189	Boehringer-Ingelheim Animal Health NZ Ltd
ProLev + Minerals	A10924	Donaghys Ltd
Panacur 100	A007154	Schering-Plough Animal Health Ltd