CERVINE ANTHELMINTICS – THE BUBBLE HAS BURST

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Abstract
ML anthelmintics especially in Pour On formulation have become the norm for treating parasites of farmed deer in New Zealand. FECRT have been shown to be unsatisfactory in deer to determine the presence of drench resistance by gastrointestinal nematodes. This investigation used slaughter trials to establish the status of drench resistance on two farms. Both had significant resistance by Ostertagia to Moxidectin. Moxidectin injection gave better results than Moxidectin Pour On. Alternative anthelmintics were evaluated including a Long Acting Moxidection injection, Startect (Derquantel & Abamectin) and the combination of Moxidectin Injection with Oxfendazole/Levamisole oral. The combination drench was the only one to exceed 95% efficacy threshold.

Keywords
Deer, drench resistance, gastrointestinal parasites, Ostertagia, moxidectin pour on, moxidectin injection.

Introduction
Parasitism is acknowledged to be the most important and significant disease of farmed deer in New Zealand (Mackintosh and Wilson 2003). Despite this it is a subject which attracts very little research. In a review of Anthelmintics of Deer in New Zealand (Charleston 2003) stated “the published information on efficacy of the anthelmintics currently being used ranges from barely adequate to non-existant” and unfortunately nothing has changed.
Moxidectin Pour On was shown to have 100% efficacy against mature and immature lungworm, adult Ostertagia-type nematodes, Trichostrogylus sp. and 99.8% efficacy against early L4 Ostertagia-type nematodes (Mackintosh et al 1993). Similar efficacies were reported by Waldrup et al 1998. This data plus the persistant activity claims for moxidectin has meant Moxidectin Pour On has become the most widely used and in many cases exclusively used anthelmintic on New Zealand deer farms (Castillo-Alcala et al 2005).
By 2005 a question mark was raised over the presence of gastrointestinal parasite ML resistance in deer (Hoskin et al 2005)
Lungworm was considered the parasite of most significance in deer with deaths particularly in young deer attributed to lungworm infections. Lungworm have not been reported to have developed resistance to any anthelmintics in any species (Pomroy 2006)

Background
The aim of the trial (replicated on two farms Trial I & II) was to determine the efficacy of pour-on moxidectin (MOXp) and injectable moxidectin (MOXi) against naturally-acquired infection of gastrointestinal (GI) nematodes of finishing deer under field conditions and determine the level if any of resistance to moxidectin. The trial was extended on the second farm (Trial III) to include additional anthelmintic options

Material and methods

Two commercial deer farms, one in central Southland (Trial I) and one in the Te Anau basin (Trial II) were approached in Autumn of 2010 and each agreed to run a trial using finishing stock on their farms in the Spring of 2010, Both farms were breeder/finisher operations using Wapiti terminal sires over red-type base hinds

Animals

Trial I & II. On each farm eighteen 9-10 month old hybrid deer were selected based on being around 100kg liveweight. (To keep costs to a minimum we wanted to use stock that the farmer would be compensated for in the normal way where applicable) Deer on the central Southland farm were last drenched late Autumn with MOX injection (0.2mg/kg Cydectin Pfizer). They had been on a grass rotation over winter subsequent to Trial I starting on 20 September. Deer on the Te Anau farm were last drenched with MOX injection (0.2mg/kg Cydectin Pfizer) in late Autumn and grazed on swedes and baleage over winter with Trial II starting on 4 November.

Trial III on the Te Anau farm required a further eighteen animals of around 100kg liveweight..

Treatments

In Trials I & II the three treatment groups (n=6) were control (CON, no anthelmintic), pour-on moxidectin (MOXp, 0.5mg/kg, Cydectin, Pfizer) and injectable moxidectin (MOXi, 0.2mg/kg, Cydectin, Pfizer, not licensed for use in deer)

In Trial III the three additional treatment groups (n=6) were injectable LA moxidectin(MOXiLA, 1.0mg/kg, Cydectin, Pfizer, not licensed for use in deer), oral derquantel & abamectin (STAR, 2.0mg/kg Derquantel & 0.2mg/kg Abamectin, Startect, Pfizer, not licensed for use in deer) and the combination injectable moxidectin and oral oxfendazole/levamisole (MOXi, 0.2mg/kg, Cydectin, Pfizer, not licensed for use in deer OXLEVo, 4.53mg/kg oxfendazole & 8mg/kg levamisole HCL , Scanda, Schering Plough, not licensed for use in deer).Dose rates were based on individual weights taken immediately prior to administration. Where products used were not licensed for deer the manufacturers recommended dose for cattle or sheep were applied. Application was by calibrated syringe and separate syringes used for each anthelmintic.

Measurements

At Day 0 faecal samples were taken from the Control groups and faecal egg output was estimated by a modified McMaster technique

At Day 0 the Control groups went to DSPs and abomasa were collected for abomasal washing and abomasal digest where 1% of content was counted.

At Day 2 (with adult worm counts known from the Control groups) the MOXp and MOXi groups were treated

At Day 14 the MOXp groups were slaughtered at DSPs and the MOXi groups necropsied on farm. Abomasa were collected from both groups for a 1% count of abomasal washings and abomasal digest.

At Day 14 lungs were collected from the Trial II MOXp group for total lungworm counts with dissection technique followed by 12hr floatation.

Speciation was undertaken on the Central Southland farm Trial I. From the Control group 100 male Ostertagia-type nematodes were identified and 50 from each of the MOXp and MOXi groups

Results

Faecal egg counts

Nematode egg output was recorded in all 5 of the control animals sampled in Trial 1 and 3 of 6 control animals in Trial II. As was expected there is no correlation between FEC and adult nematodes in the abomasa.

Gastrointestinal (Abomasal) parasites

In Trial I levels of Ostertagia in CON group were quite high with an average of 18,133 (range 3800 to 56,700). MOXp had a 71.2% efficacy and MOXi an 83.5 % efficacy against adult Ostertagia. Efficacy against immature forms was 18.9% for MOXp and 80.7% for MOXi.

Efficacy against adult T. axei was 94.4% with MOXp and 100% with MOXi

Table 1: Trial 1 – Winton. Individual animal and group data.

Deer	Sex	LWT	FEC	Oster adults	T.axei adults	Oster larva
Control						
1	S	116.5	80	56700	1100	22400
2	S	105	N S	10300	2400	17300
3	H	105	60	5600	900	32700
4	S	95	300	23900	500	10800
5	S	104	280	3800	1100	24900
6	H	99	20	8500	1200	19500
Average		**104.1kg**	**144epg**	**18133**	**1200**	**21200**
MOXp						
1	H	100		4900		18400
2	H	98		3300		13400
3	S	98		10400	400	20400
4	S	105		3800		18400
5	S	103		5500		20200
6	S	96		3400		12400
Average		**100.0kg**		**5217**	**67**	**17200**
MOXi						
1	S	106		1400	0	5400
2	S	106		4500	0	2700
3	S	96		2200	0	4800
4	S	103		4600	0	5400
5	H	101.5		3600	0	1400
6	H	91		1600	0	4800
Average		**100.6kg**		**2983**	**0**	**4083**

Table 2: Summary Trial I – Winton

	Oster adults	T.axei adults	Oster larva
Control	**18133**	**1200**	**21200**
Moxi PourOn	**5217**	**67**	**17200**
% efficacy	**71.2%**	**94.4%**	**18.9%**
Moxi Inj	**2983**	**0**	**4083**
% efficacy	**83.5%**	**100%**	**80.7%**

Table 3: Trial II – Te Anau. Individual animal and group data.

Deer	Sex	LWT	FEC	Oster adults	T.axei adults	Oster larva
Control						
1	H	106	150	3800	100	1200
2	S	105	50	2200	0	1600
3	S	107	50	3800	200	1000
4	S	102	0	3200	0	1800
5	S	113	0	4900	0	3900
6	S	116	0	2300	0	600
Average		**108.2kg**	**42**	**3367**	**50**	**1683**
MOXp						
1	H	107		900	0	3600
2	S	107		4900	0	1200
3	S	110		2500	0	1900
4	S	111		4400	100	700
5	S	110		1100	0	500
6	S	110		2500	0	2800
Average		**109.2kg**		**2717**	**16.7**	**1783**
MOXi						
1	S	102		300	0	400
2	S	105		400	0	0
3	S	108		500	0	600
4	S	105		600	0	400
5	H	101		200	0	0
6	S	106		600	0	400
Average		**104.5kg**		**433**	**0**	**300**

In Trial II levels of Ostertagia in CON group were less but still significant numbers of both adult and larval numbers were present and in all animals. MOXp had a 19.3% efficacy and MOXi an 87.1 % efficacy on adult Ostertagia. Efficacy against immature forms was 0% for MOXp and 82.2% for MOXi.
Total numbers of adult T. axei in the CON group were insufficient to provide efficacy data.

Table 4: Summary Trial II – Te Anau

	Oster adults	T.axei adults	Oster larva
Control	**3367**	**50**	**1683**
Moxi Pour On	**2717**	**17**	**1783**
% efficacy	**19.3%**		**0%**
Moxi Inj	**433**	**0**	**300**
% efficacy	**87.1%**		**82.2%**

Table 5. Trial III– Te Anau. Individual animal and group data.

Deer	Sex	LWT	FEC	Oster adults	T.axei adults	Oster larva
Control						
1	H	106	150	3800	100	1200
2	S	105	50	2200	0	1600
3	S	107	50	3800	200	1000
4	S	102	0	3200	0	1800
5	S	113	0	4900	0	3900
6	S	116	0	2300	0	600
Average		**108.2kg**	**42**	**3367**	**50**	**1683**
MOXiLA						
1	S	103		3200	0	100
2	S	103		200	0	
3	S	98		0	0	
4	S	97		0	0	
5	S	102		500	0	100
6	S	105		0	0	200
Average		**101.3kg**		**650**	**0**	**67**
MOXiOX LEVo						
1	H	99		100	0	100
2	S	103		200	0	100
3	S	103		100	0	0
4	H	101		0	0	0
5	S	104		0	0	0
6	S	99		100	0	0
Average		**101.5kg**		**83.3**	**0**	**33.3**
STAR						
1	S	97		700	0	0
2	S	101		700	0	0
3	S	105		600	0	100
4	H	95		800	0	0
5	H	99		100	0	0
6	S	104		800	0	0
Average		**100.2kg**		**616.7**	**0**	**17**

Table 6: Summary Trial III – Te Anau

	Oster adults	T.axei adults	Oster larva
Control	**3367**	**50**	**1683**
Moxi LA Inj	**650**	**0**	**67**
% Efficacy	**80.7%**		**96.0%**
Moxi Inj/Scanda	**83**		**33**
% Efficacy	**97.5%**		**98.0%**
Startect	**617**		**17**
% Efficacy	**81.7%**		**98.9%**

MOXiLA produced a good result against Ostertagia larva with 96.0% efficacy but was only 80.7% for adults.
Similarly STAR had 98.9% efficacy against Ostertagia larva but only 81.7% for Ostertagia adults.
MOXi/OXLEVo combination achieved the best result with 98% efficacy for larva and 97.5% efficacy for adults.

Table 7: Trial 1 – Winton – Speciation

Parasite	Control		MOXp		MOXi	
	N	%	N	%	N	%
Ostertagia circumcincta	0	0	0	0	0	0
Ostertagia trifurcata	0	0	0	0	0	0
Ostertagia leptospicularis (O.l)	47	47	27	54	14	28
Spiculopteragia assymetrica (S.a)	1	1	0	0	0	0
Spiculopteragia spiculoptera (S.s)	52	52	23	46	36	72
Total	100		50		50	

Ostertagia leptospicularis (O.l) species has a minor morph – Ostertagia kolchida which has been included in the numbers for O.l

Table 8: Trial I – Winton – Drench Efficiency by Ostertagia Species

	O.l	S.a	S.s
Control	8522	181	9429
Moxi Pour On	2817	0	2400
% efficacy	67%	100%	74%
Moxi Inj	805	0	2147
% efficacy	91%	100%	77%

On the Winton farm the predominant Ostertagia species were Ostertagia leptospicularis and Spiculopteragia spiculoptera and both had poor efficacies with MOXp and MOXi. Both Moxidectin formulations were 100% effective on Spiculopteragia assymetrica although numbers were low and this species represented only 1% of the Ostertagia burden

Lungworm

No lungworm were present in the lungs from any of the animals treated with MOXp group.

Discussion

The huge paucity of information relating to parasitism in farmed deer in New Zealand is reflected in previous proceedings of this publication. In the last seven years over 250 articles have been published with only 9 relating to parasites (by comparison there are 47 relating to Johnes). Parasitism has been estimated in the past to be the most significant disease facing the industry in New Zealand with an estimated annual cost of over $13 million (compared to the $0.5 annual Johnes cost). It is therefore not surprising that parasite control of farmed deer has reached a critical point.

No lungworm count was performed on the control animals. It is realistic to assume there were some present and therefore assume MOXp was effective against lungworm although not proven. Interestingly it was this same group of animals that MOXp had only 20% efficacy on Ostertasgia-type nematodes and 0% efficacy against immature Ostertagia-type nematodes in the abomasal lining.

The results on both farms with Cydectin Injection were unsatisfactory but were consistently better than Cydectin Pour On. Under normal field conditions there remains a question over compromised effect due to contamination and/or dirt present among the hair of farmed deer.

The three alternative anthelmintic treatments trialled: - Cydectin LA, Startect and Cydectin injection/scandal oral combination all had satisfactory efficacies on immature forms of Ostetrtagia.
Cydectin LA a new sheep injectable drench is five times the strength of normal Cydectin Injection and has a label claim for 90 days persistant activity in sheep. At the sheep dose rate it failed to achieve a satisfactory efficacy on adult Ostertagia. Worthy of note was that at time of slaughter, 12days post treatment examination of injection site failed to find any visible sign of prior injection.
Startech the new generation sheep drench gave similar result – good with immature but unsatisfactory with adults. The positive out of this trial was that from a toxicological perspective deer tolerated the sheep dose. It may be that a higher dose rate of this product is required in deer.
The inclusion of Cydectin Injection/Scanda oral had been based on anecdotal comments from deer farmers claiming good success using it. This study vindicates that farmer observation being the only anthelmintic trialed to have exceeded the required 95% efficacy threshold.
The two Spiculopteragia species of Ostertagia type nematodes are species specific to deer. While Ostertagia leptospicularis was introduced to New Zealand by deer it has been reported in both sheep and cattle here. Evidence suggests it has the potential to be a serious pathogen in cattle grazing with deer (Swanson et al 2007). All three species were identified on the Winton farm and Moxidectin resistance by Ostertagia leptospicularis and Spiculopteragia spiculoptera was present. A previous report of Ostertagia species resistance (Hoskin et al 2005) showed all three species were resistant to Ivermectin oral but that only Ostertagia leptospicularis was resistant to Moxidectin as a Pour On

Conclusion

The author’s observations are that gastrointestinal parasites especially Ostertagia affects all breeds of farmed deer in New Zealand: - Elk, Wapiti, Eastern and Red deer. The inclusion of Red deer is also supported studies in United Kingdom (Connan 1991, Connan 1996 and Connan 1997)
Moxidectin resistance was demonstrated on these two farms and to an alarming extent. Statistically it was shown on the Te Anau farm that treating with Moxidectin Pour On was as effective as no treatment at all. The extent to which Moxidectin resistance exists

through the deer industry in New Zealand is unknown but it would be naïve to think it is not widespread.

It is imperative we take the lead shown by the sheep industry and attempt to delay the onset of resistance by the use of combination drenches. This study has shown that the triple combination of Moxidectin injection and Scanda oral was effective. Further studies need to be done to determine if a Moxidectin/Oxbendazole combination and oral application is as effective.

Aside from the use of combination drench, the place of quarantine drenching and applying the principle of refugia must become the norm on New Zealand deer farms.

This study shows particularly poor results with Pour On, which support recent findings in cattle in New Zealand (Leathwick pers communication). As a means of anthelmintic treatment of farmed deer in New Zealand the use of Pour On should be actively discouraged.

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