

RESEARCH COMMUNICATION

**OVERBERG RESEARCH PROJECTS. IV. THE DEVELOPMENT OF RESISTANCE TO NEMATODIRUS IN LAMBS AND SPONTANEOUS CURE OF TELADORSAGIA IN WEANERS**

R. K. REINECKE, Overberg Research Projects, Department of Parasitology, Faculty of Veterinary Science, University of Pretoria, P.O. Box 680, Hermanus 7200

ABSTRACT

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Soon after 12-week old suckling lambs reached a peak infestation of *Nematodirus* resistance developed, worm burdens falling by 43,1-97,5 % in 18 week and 11-month old sheep respectively. Both *Teladorsagia* (syn. *Ostertagia*) and *Trichostrongylus* reached a peak geometric mean (G) of 18 099 and 3 278 worms on 02 December 1987 in weaners 5-6 months old. Within 6 weeks-6 months of sheep grazing on safe pastures, spontaneous cure of *Teladorsagia* occurred, worm burdens falling by 77,3-98,7 % but not of *Trichostrongylus* which was only reduced by 34-40 %.

The epidemiology of nematode parasites was compared in 2 flocks of 250 Merino ewes each and their progeny on the farm Boontjieskraal (10 km west of Caledon) in the Overberg area of the winter rainfall region (Reinecke & Louw 1989; Louw 1989).

This paper is confined to the epidemiology of the major genera *Teladorsagia* (Syn. *Ostertagia*), *Nematodirus* and *Trichostrongylus* recovered from 6 male lambs (born in June and July 1987) and thereafter 6 weaned wethers slaughtered every 6 weeks (31-48 days). The trial started in June 1987 and stopped in May 1988.

Pregnant ewes and lambs grazed on infested dry-land lucerne pastures from April-25 November 1987. Weaners grazed on wheat stubble from 26 November 1987-24 February 1988 and from 25 March-05 May 1988, were transferred to dry-land lucerne from 25 February-24 March and again from 6-16 May 1988. Reinecke & Louw (1989) have shown that grazing in summer, either on wheat stubble or lucerne is safe if mean monthly mean temperatures are >20 °C and rainfall is <30 mm per month (Fig. 1).

**Resistance to *Nematodirus***

*Nematodirus*: *N. spathiger* (Table 1, Fig. 2)  
*N. abnormalis* (5 sheep only, Table 2):

Suckling lambs 5-11 days old (Group C06) were negative and 6 weeks later *Nematodirus* was recovered, reaching a geometric mean (G) of 7 208 in September (in lambs 12 weeks of age) falling slowly but steadily thereafter, only G mean of 180 being present by May 1988, when lambs were 10-11 months old. This confirms the observations of other workers that lambs rapidly develop resistance to this genus (Seghetti & Senger, 1958; Donald Dineen, Turner & Wagland, 1964, cited by Fitzsimmons, 1969).

**Spontaneous cure of *Teladorsagia***

*Teladorsagia*: *T. circumcincta* and *T. trifurcata* (Table 1, Fig. 2)

After a slow start in July and September this genus reached a peak in December 1987. In July 64 % of all *Teladorsagia* recovered were either 3rd stage or 4th stage larvae (L<sub>3</sub> or L<sub>4</sub>) and this remained fairly constant

while the flock grazed on infested dry-land lucerne pasture. These larvae were hypobiotic (Louw, 1989).

As soon as weaners started grazing on wheat stubble from 26 November 1987, a different reaction known as

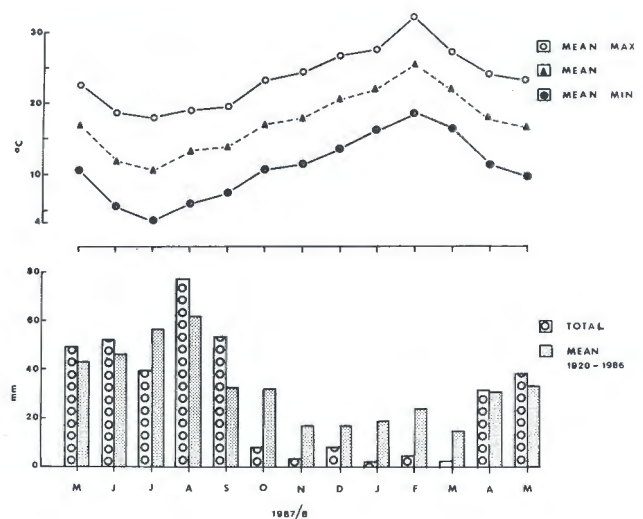


FIG. 1 Monthly temperature and rainfall recorded from May 1987-May 1988 at Boontjieskraal (Reinecke & Louw, 1989).

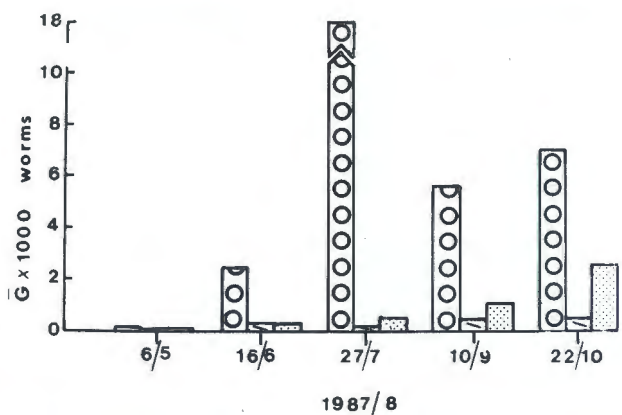


FIG. 2 Variations in the G mean worm burdens of *Teladorsagia* (□), *Nematodirus* (▨) and *Trichostrongylus* (▩) in suckling lambs and weaners from January 1987-May 1988 at Boontjieskraal (Reinecke & Louw, 1989).

TABLE 1 Nematodes consistently recovered from lambs and weaners in the control flock at Boontjieskraal

Group	Date killed	Lamb No.	Teladorsagia			Nematodirus			Trichostrongylus				All nematodes			
			L <sub>3</sub>	L <sub>4</sub>	<i>T. circumcincta</i>	<i>T. trifurcata</i>	L <sub>3</sub>	L <sub>4</sub>	<i>N. spathiger</i>	L <sub>3</sub>	L <sub>4</sub>	<i>T. rugatus</i>	Others (See Table 2)	L <sub>3</sub> +L <sub>4</sub>	Adults	Total
C07	27 Jul. 87	37 43 64 66 127 220	527 16 55 395 104 0	105 14 83 229 70 0	200 71 220 217 149 0	15 3 2 31 49 0	117 10 173 85 125 0	3 333 145 945 925 925 0	0 80 67 0 675 0	0 0 0 0 0 0	0 0 0 0 35 0	0 0 0 0 0 0	4 099 185 1 256 1 634 1 224 0	332 164 289 248 908 5	4 431 349 1 545 1 882 2 132 5	
C08	10 Sep. 87	27 45 118 198 242 502	1 548 1 309 915 147 383 1 087	2 183 2 121 3 667 1 333 1 507 1 633	1 615 1 345 2 924 1 167 1 85 1 347	175 199 729 206 35 0	80 150 200 167 167 200	1 240 1 350 2 333 747 1 867 2 300	6 160 14 425 9 033 100 4 380 12 050	0 0 0 0 0 0	40 50 0 0 0 0	190 433 0 40 467 497	0 106 2 0 554 3	5 091 4 980 7 115 2 394 3 924 5 220	8 140 16 082 13 121 1 513 5 621 13 897	13 231 21 062 20 236 3 907 9 545 19 117
C09	21 Oct. 87	5 11 86 106 125 238	4 875 7 550 9 007 3 746 2 354 2 534	1 850 3 507 6 020 4 333 2 020 2 650	8 347 10 580 1 513 3 603 1 803 100	928 1 307 0 400 0 0	0 0 0 7 10 0	660 390 500 380 70 2 340	10 940 8 770 287 540 11 670 2 906	0 0 0 0 0 0	20 0 7 13 0 20	3 830 1 200 2 547 1 140 840 0	5 22 9 16 7 403	7 405 11 447 15 534 8 479 4 464 7 631	24 050 21 879 4 356 5 699 14 320 3 409	31 455 33 326 19 890 14 178 18 784 11 040
C10	2 Dec. 87	2 46 69 82 163 170	2 501 5 500 6 650 5 169 5 601 1 635	3 451 7 333 8 500 4 515 6 373 4 335	4 975 5 433 15 916 8 209 6 736 4 589	0 0 1 384 1 226 430 1 077	0 0 0 0 0 0	50 1 650 725 625 50 425	50 4 275 2 975 1 375 50 3 575	0 0 0 0 0 0	0 0 0 0 0 0	2 475 3 800 5 275 3 450 2 300 2 520	35 12 2 267 1 816 20 641	6 002 14 483 15 875 27 817 13 396 9 536 6 395	7 535 13 520 43 692 16 076 23 421 12 402	13 537 28 003 43 692 29 472 23 421 18 797
C11	13 Jan. 88	49 55 188 191 196 197	1 0 427 669 3 367	366 450 4 515 6 373 3 315 2 075	2 139 1 851 4 042 3 506 1 568 1 433	0 0 450 0 275 0	0 0 0 0 0 0	130 195 255 567 33 140	205 1 075 1 085 5 700 586 918	0 0 0 0 0 0	5 0 0 0 0 0	900 1 475 2 740 5 199 1 273 2 400	4 15 19 26 100 114	502 645 5 197 7 609 351 2 582	3 248 4 416 8 336 14 431 3 802 4 867	3 750 5 061 13 533 22 040 4 153 7 449
C12	24 Feb. 88	25 75 96 124 150 190	0 17 8 2 0 0	265 1 896 8 1 837 196 43	801 2 091 1 806 1 761 30 2 884	24 179 193 177 0 0	0 0 0 0 0 0	10 200 13 47 199 187	330 9 900 680 747 200 199	0 0 0 0 0 0	0 0 0 0 0 0	1 030 3 200 1 187 2 053 1 907 853	24 42 8 26 16 10	275 2 113 21 1 886 226 230	2 209 15 412 3 874 4 764 3 232 3 946	2 484 17 525 3 895 6 650 3 232 4 176
C13	11 Apr. 88	505 92 131 132 139 166	0 0 0 0 0 0	164 85 120 272 112 279	1 487 1 551 661 2 345 788 1 707	0 130 0 171 0 90	0 0 0 0 0 0	10 20 27 20 20 47	130 1 013 1 333 20 260 760	0 0 0 0 0 0	0 0 0 0 0 0	1 320 1 840 1 433 2 254 2 360 1 060	29 27 19 29 21 19	174 105 147 242 132 326	2 966 4 561 3 446 4 912 3 429 3 636	3 140 4 666 3 593 5 204 3 561 3 962
C14	18 May 88	39 71 87 104 144 146	0 0 0 6 10 0	509 457 1 500 347 433	62 2 1 81 707 21	0 0 0 0 0 0	20 0 0 0 0 23	4 973 20 40 513 20 100	60 0 0 780 20 40	0 0 0 0 0 0	300 127 87 60 40 60	1 160 3 994 3 287 1 580 787 3 626	14 71 33 24 23 30	5 802 604 128 1 079 417 616	1 296 4 671 3 321 2 465 1 537 3 717	7 098 4 671 3 449 3 544 1 954 4 333

TABLE 2 Nematodes occasionally recovered from control lambs and weaners at Boontjieskraal

Group	Date killed	Sheep No.	<i>Nematodirus abnormalis</i>	<i>Oesophagostomum venulosum</i>	<i>Trichostrongylus colubriformis</i>	<i>Trichostrongylus falculatus</i>	<i>Trichostrongylus ptietersei</i>	<i>Trichuris skrjabinii</i>	Total	
C08	10 Sep. 87	45	0	6	0	0	100	0	106	
		118	0	0	0	0	0	2	2	
		242	487	0	0	0	0	67	0	554
		502	0	3	0	0	0	0	0	3
C09	21 Oct. 87	5	0	2	0	0	0	3	5	
		11	0	1	0	0	0	21	22	
		86	0	0	0	0	0	9	9	
		106	0	2	0	0	0	14	16	
		125	0	4	0	0	0	3	7	
		238	0	4	393	0	0	6	403	
C10	02 Dec. 87	2	0	0	0	0	0	35	35	
		46	0	0	0	0	0	12	12	
		69	2 250	0	0	0	0	17	2 267	
		82	1 800	0	0	0	0	16	1 816	
		163	0	0	0	0	0	20	20	
		170	0	0	0	630	0	11	641	
C11	13 Jan. 88	49	0	0	0	0	0	4	4	
		55	0	0	0	0	0	15	15	
		188	0	2	0	0	0	17	19	
		191	0	0	0	0	0	26	26	
		196	80	4	0	0	0	16	100	
		197	102	2	0	0	0	10	114	
C12	24 Feb. 88	25	0	0	0	0	0	24	24	
		75	0	0	0	0	0	42	42	
		96	0	3	0	0	0	5	8	
		124	0	1	0	0	0	25	26	
		150	0	2	0	0	0	14	16	
		190	0	0	0	0	0	10	10	
C13	11 Apr. 88	505	0	0	0	0	0	29	29	
		92	0	0	0	0	0	27	27	
		131	0	0	0	0	0	19	19	
		132	0	0	0	0	0	29	29	
		139	0	0	0	0	0	21	21	
		166	0	0	0	0	0	19	19	
C14	18 May 88	39	0	0	0	0	0	14	14	
		71	0	0	0	0	0	71	71	
		87	0	5	0	0	0	28	33	
		104	0	0	0	0	0	24	24	
		144	0	0	0	0	0	23	23	
		146	0	1	0	0	0	29	30	

TABLE 3 Spontaneous cure of *Teladorsagia*. A comparison of the geometric means of larvae (L<sub>3</sub>+L<sub>4</sub>) and adult *Teladorsagia* between Groups (C10-C14) slaughtered from 02 December 1987-18 May 1988

Group	Date killed	G L <sub>3</sub> +L <sub>4</sub>	G Adult
C10	02 December 1987	10 351	7 498
C11	13 January 1988	1 288	2 291
C10 and C11	Difference	-87,6 %	-69,5 %
C11	13 January 1988	1 288	2 291
C12	24 February 1988	195	1 622
C11 and C12	Difference	-84,9 %	29,2 %
C12	24 February 1988	195	1 622
C13	11 April 1988	155	1 349
C12 and C13	Difference	-20,5 %	-16,8 %
C13	11 April 1988	155	1 349
C14	18 May 1988	182	26
C13 and C14	Difference	+17,4 %	-98,4 %

“spontaneous cure” occurred (Stewart, cited by Gordon, 1967). There was a dramatic fall in the worm burdens from a G mean of 18 099 to 4 108 in the period between 02 December 1987 and 13 January 1988, which continued to fall and by the end of this trial on 18 May 1988 only a G mean of 230 worms were recovered.

The reduction in the geometric means of the larvae ( $L_3+L_4$ ) and adult *Teladorsagia* and the percentage differences between successive groups (C10, C11, C12, C13 and C14) of weaners slaughtered while spontaneous cure was taking place are summarized in Table 3. The Mann-Whitney U test (Siegel, 1956) was used to compare 1 group with the following group, with the following results:

	$L_3+L_4$	Adults
Group C10 compared with Group C11	P<0,004	P<0,001
Group C11 compared with Group C12	P<0,032	P<0,294
Group C12 compared with Group C13	P<0,409	P<0,120
Group C13 compared with Group C14	P<0,032 <sup>(1)</sup>	P<0,002

<sup>(1)</sup> Larvae in Group C14 were significantly more than those in Group C13 (see below).

Reinecke & Louw (1989) have shown that larvae aestivate in the soil and only migrate on to the lucerne pasture if the mean monthly mean temperatures are <20 °C and the total monthly rainfall is >30 mm, which occurred in April 1988 (Fig. 1). Weaners in Group 14 grazed on infested dry-land lucerne pasture for 10 days (06–16 May 1988) prior to slaughter and became reinfested, accounting for the larval increase in Group 14. In all other groups spontaneous cure was most evident in the 1st 6 weeks on wheat stubble and both larvae and adults were spontaneously expelled by the hosts.

This differs from experiments done by Armour, Jarrett & Jennings (1966) who dosed 16 6-month-old worm-free sheep with a single dose of 100 000 infective larvae of *T. circumcincta* and slaughtered them in pairs from 4–60 days after infestation. They showed that most of the worms were adult stages which were expelled at 16 days and a further decrease occurred 35–60 days after infestation. In the present trial both adults and larvae were expelled within 6 weeks of freedom from reinfestation and this process continued for at least another 4 months.

Sommerville (1954) showed that  $L_4$  of *T. circumcincta* could be inhibited for as long as 12 weeks before the 4th moult took place and referred to this inhibition as the histotrophic phase. This is a normal part of the life-cycle which Reinecke (1977) also noted when he dosed worm-free lambs with infective larvae of *T. circumcincta*, some of which remained as  $L_4$  for at least 9 weeks after they should have undergone the 4th moult ( $M_4$ ) and developed to the 5th and adult stages.

The following confirms the observations on *Ostertagia ostertagi* by Michel (1963) and Michel, Lancaster & Hong (1976 a, b):

Many adult *Teladorsagia* probably live for less than 6 weeks, possibly only 25–30 days as is the case with *O. ostertagi*. Those that were recovered after 6 weeks on

safe pastures probably developed from the larval stages which had been acquired while sheep had been grazing on infested dry-land lucerne the previous spring.

It is possible to postulate that the surviving worms have been derived from a genetic strain which does not die for at least 6 months and will assure that the genus survives under the grazing conditions at Boontjieskraal, to contaminate the pastures when weather conditions are favourable for the free-living stages to develop into viable infective larvae to infest the grazing hosts.

*Trichostrongylus*: *T. rugatus* (Table 1, Fig. 2).

*T. colubriformis* (1 lamb), *T. falculatus* (1 lamb) and *T. pieterse* (2 lambs) (Table 2).

This genus lives longer than either *Nematodirus* or *Teladorsagia* in lambs and weaners and the host does not develop resistance, nor is there any spontaneous cure within the 1st 11 months of its life under the grazing conditions in the present trial. Within 6 weeks–6 months of weaners grazing on safe pastures worm burdens were reduced by 34–40 %, which is probably a normal fluctuation.

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