MONITORING ANTHELMINTIC RESISTANCE IN QUEENSLAND SHEEP FLOCKS

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Development of anthelmintic resistance in Australian sheep flocks over the past 20 years has caused concern for sustainable sheep and wool production.[1] Resistance was first reported in 1968,[2] and by the mid-1980s resistance of the important sheep nematode species (*Haemonchus*, *Ostertagia* and *Trichostrongylus*) to a range of anthelmintics had been described.[3] In a survey conducted during 1991/92, the prevalence of resistance to benzimidazole and levamisole anthelmintics was estimated to be 86 and 65%, respectively.[4] Resistance to macrocyclic lactone anthelmintics was not detected, however resistance to ivermectin was subsequently reported.[5] Factors associated with the emergence of resistance include excessive use of anthelmintics, underdosing and use of faulty equipment.[6] Regional control programs, based on monitoring flock faecal egg counts (FECs), have been developed and promoted to control anthelmintic resistance. To better advise producers on the most effective anthelmintics to use, it is essential to have information on the regional anthelmintic resistance status of flocks. We describe a 2-year monitoring program for anthelmintic resistance in southern Queensland flocks that was initiated to provide this information.

Materials & methods

Monitoring was conducted in an area that extends from the Great Dividing Range to west of the towns of St George and Roma in southern Queensland. The eastern part lies within the 650 to 750 mm annual rainfall zone; the western part within the 500 to 650 mm zone. Approximately 3.3 million sheep are grazed in this area. During 1998 and 1999, flock managers were informed that anthelmintic resistance testing was available and invited to apply. Flocks selected had either been drenched more than 6 weeks previously, or had recently conducted an FEC with a result of $\geq$ 400 eggs/gram. This selection criterion was used to reduce travel costs and to increase the chance that a test for anthelmintic resistance could be performed successfully.

Seventy young sheep were selected from each flock, randomly allocated to either a control or to one of 6 treatment groups and administered benzimidazole, levamisole, combination (benzimidazole plus levamisole), napthalophos, ivermectin or closantel (one-third dose to assess persistence) anthelmintics. In addition, a moxidectin group was included in 1999. Ten to 14 days after administration of anthelmintic, a FEC and larval differentiation were performed on samples from each group. Resistance in each test was defined as <95% reduction in the FEC, compared to the control group.

Results

Testing was successfully completed on 64 flocks (about 5% of sheep flocks in the monitoring area), a similar proportion being located in eastern and western zones. The mean age of sheep was 32 months, and mean weight was 48 kg. In 26 flocks, no *T.colubriformis* were cultured from controls. A high (>10%) prevalence of resistance to benzimidazole, levamisole, combination and napthalophos anthelmintic was detected (Table 1). *H.contortus* resistance to closantel was detected in 59% of flocks, and significantly ($P < 0.01$) more eastern (79%) compared to western (43%) flocks. No significant ($P > 0.05$) regional differences were detected for other anthelmintics tested. *H.contortus* resistance to combination and levamisole ($r_s = 0.52$), combination and napthalophos ($r_s = 0.28$), and levamisole and napthalophos ($r_s = 0.36$) anthelmintic, and *T.colubriformis* resistance to benzimidazole and napthalophos ($r_s = 0.37$), and napthalophos and combination ($r_s = 0.30$) anthelmintic was highly correlated within flocks tested. In most flocks resistance was detected to two or more anthelmintics (Table 2). The total cost (labour, travel, consumables) of monitoring was AU$47,672.

Table 1. Prevalence (%) of southern Queensland sheep flocks in which resistance of *H.contortus* and *T.colubriformis* to anthelmintic groups was detected during 1998-99.

	Haemonchus contortus			*Trichostrongylus colubriformis*		
Group	+ve	-ve	Prevalence (95% CI)	+ve	-ve	Prevalence (95% CI)
Benzimidazole	42	22	66 (53, 77)	22	16	58 (41, 73)
Levamisole	12	52	19 (10, 31)	18	20	47 (31, 64)
Combination	9	53	15 (7, 26)	14	23	38 (23, 55)
Napthalophos	7	54	12 (5, 23)	15	22	41 (25, 58)
Ivermectin	6	56	10 (4, 21)	0	37	nil (0, 8)
Moxidectin	0	15	nil (0, 18)	0	13	nil (0, 21)
Closantel	38	26	59 (46, 71)	…	…	…

Table 2. Frequency distribution of southern Queensland flocks in which resistance to anthelmintic groups was detected during 1998-99.

	Number of anthelmintic groups								
Species	0	1	2	3	4	5	6	7	Total
Haemonchus contortus	8	19	25	6	4	1	1	0	64
Trichostrongylus colubriformis	8	5	13	10	2	0	0	…	38

Discussion

Options are available to sheep producers for preserving the useful life of anthelmintics to which resistance has begun to develop.[6,7] Anthelmintic resistance monitoring programs are valuable for early detection of emerging resistance, so that control programs can be devised and the information communicated to sheep producers.[7,8] The cost of such a program appears to be relatively low. In 1988/89, the prevalence of resistance to benzimidazole in southern Queensland flocks was 31%, and *T.colubriformis* resistance to levamisole was 6% (M Lyndal-Murphy, unpublished data). No levamisole- or closantel-resistant populations of *H.contortus* were detected, and no resistance to ivermectin was detected. Despite problems in comparing monitoring programs, 1998/99 monitoring results suggest that the prevalence of anthelmintic resistance has increased during the past decade.

H.contortus is the primary internal parasite of concern in Queensland sheep flocks. Its control has been based on the strategic use of closantel, which has a sustained action against *H.contortus* reinfestation. The high prevalence of closantel resistance may be a consequence of reliance on this anthelmintic. Results suggest that in many flocks, particularly those located in the higher rainfall zone of southern Queensland, alternative control strategies need to be devised. Monitoring has provided information with which to develop new management options that recognise resistance to key anthelmintic groups is widespread. Although populations of *H.contortus* resistant to ivermectin have been described in Australia,[5] the prevalence of resistance is still low (< 10%) in southern Queensland flocks. In addition, no resistance to moxidectin was detected. Thus, *H.contortus* control strategies, based on the use of ivermectin and moxidectin anthelmintic groups, are required in the higher rainfall areas of Queensland in which sheep are grazed. Also of concern is resistance to multiple anthelmintics. Resistance of *H.contortus* and *T.colubriformis* to two or more anthelmintics was detected in 58 and 66% of flocks, respectively. In South Africa, there is speculation that the development of multiple anthelmintic-group resistant strains of *H.contortus* may make control of haemonchosis under intensive management systems almost impossible.[9] We share this concern with respect to southern Queensland flocks. Further monitoring will be necessary to detect whether substantial resistance to ivermectin and moxidectin anthelmintic groups is developing.

References

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