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ANTHELMINTIC RESISTANCE : A QUESTIONNAIRE STUDY OF FARMER PRACTICES

Macchi C.[1], Pomroy W.[2], Pfeiffer D.[1], Morris R.[1], West D.[1], Samson R.[3]

Une enquête postale avec tirage aléatoire a été réalisée auprès de 300 éleveurs ovins de la région de Manawatu en Nouvelle Zélande, dans le but de déterminer les pratiques habituelles de drogage et les facteurs associés au développement de résistance aux anthelminthiques. Le taux de réponse de 65,7% a montré un fort intérêt de la part des éleveurs. Les éleveurs droguent leur troupeau plus fréquemment que ce qui est généralement conseillé eu égard au développement de résistance aux anthelminthiques. Il est apparu un manque de compréhension de l'usage combiné de certaines pratiques de pâturage destiné à contrôler les nématodes gastro-intestinaux tout en limitant l'usage des anthelminthiques. 53% des éleveurs ont déclaré qu'ils mettent leurs agneaux sur un pâturage non infesté après sevrage, au moins occasionnellement, mais seulement 24% d'entre eux attendent plus de 2 mois avant de remettre les agneaux sur une pâture contaminée. Bien que dans la plupart des cas (94%) les éleveurs traitent leurs moutons en fonction du poids du mouton ou du lot le plus lourd, 43% d'entre eux estiment le poids en fonction de leur expérience et 12% ne vérifient jamais le bon fonctionnement du pistolet de drogage. La moitié seulement des éleveurs enquêtés ayant acheté des moutons au cours de l'année précédente les ont drogués à l'arrivée dans l'élevage, de manière préventive. Bien que tous les éleveurs paraissent au courant des problèmes de résistance aux anthelminthiques, seuls 31% d'entre eux ont réalisé au moins un test de résistance sur leur élevage. Parmi les élevages l'ayant testée, la prévalence de la résistance est de 69,6%, et concerne les produits de la famille des benzimidazoles, sauf dans un cas pour lequel le produit inefficace est le lévamisole. La plupart des éleveurs (76% des 166) ont déclaré être satisfaits de leur programme antiparasitaire ; cependant 14 éleveurs ont attiré l'attention sur le manque d'information claire en ce qui concerne les moyens de prévention de l'apparition de résistance aux anthelminthiques.

INTRODUCTION

Factors which have been associated with the development of anthelmintic resistance include frequency of treatment[8][5], timing of use of anthelmintics in relation to season and life stage of the sheep[8][5][2], dosage[3] and rotation of drench families[8]. This questionnaire investigated current parasite control measures in New Zealand, and how this compares with current recommendations for both the control of nematode parasites and the prevention of anthelmintic resistance.

MATERIALS AND METHODS

In August 1995, a questionnaire was sent to 300 randomly selected sheep farmers. It included questions about details of farm and livestock numbers, management of lambs, drenching policy and procedures, and the farmer's own opinion on issues related to anthelmintic resistance.

Following a broad descriptive analysis, farms were compared according to whether or not a drench test had been performed, the outcome of the test, and the number of anthelmintic treatments administered to the lambs. Subsequently, a forward stepwise logistic regression analysis was performed, with the variable *TEST* (completion of a drench test on the farm) as the outcome variable. Variables showing at least a moderate association ($p<0.20$) with the outcome were included in the model as independent variables. Criteria for model selection included a p-value of 0.10 for entry of new variables and of 0.15 for removal of variables; goodness of fit was evaluated by means of a Pearson's χ^2 test. The stepwise selection method was based on the significance of the score statistic, and removal testing on the probability of a likelihood ratio statistic based on the maximum partial likelihood estimates.

RESULTS

After eliminating non-usable responses 178 (59.3%) questionnaires were available for analysis.

During the first two months after weaning, lambs were either set stocked (41% of 172) or shifted at intervals greater than 10 days (46%). Only the 22 remaining farmers (13%) shifted the animals every 2-10 days. While 47% of respondents indicated that they never made use of *clean* pastures (i. e., not grazed by lambing ewes since 1 June 1994) to graze their lambs at weaning, the remainder used them at least occasionally. In the latter case, lambs were subsequently moved back to a contaminated pasture after less than one month in 34% of cases (n=85) and between one and two months in 42% of cases. Only nine of the replying farmers (10%) left the lambs on the clean pasture for more than two, and 12 (14%) for more than three months. Most (79% of 157) farmers attempted to create safe pastures for lambs, at least occasionally, by grazing cattle or deer, making hay, or by different means, in the intervals between sheep and lamb grazing.

Lambs which remained on the property for the first year of their lives received, on average, 6.16 anthelmintic treatments during this year, although there appeared to be a great deal of between-farm variability (Figure 1).

1 Department of Veterinary Clinical Sciences, Massey University, Palmerston North, New Zealand
2 Department of Veterinary Pathology and Public Health, Massey University, Palmerston North, New Zealand
3 MAF Quality Management, Batchelar Centre, Palmerston North, New Zealand

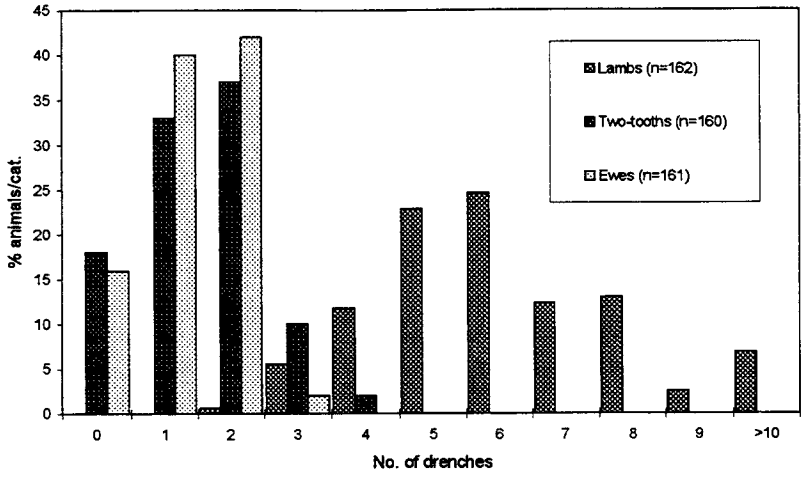

Figure 1. Drenching frequency for three categories of sheep
(number of drenches administered between 1 July 1994 and 30 June 1995)
n= number of respondents

Of the 94 farmers (n=178) who changed drench between 1 July 1994 and 30 June 1995, 66% were following a pre-determined action family rotation. During the first year of their lives, lambs were treated with anthelmintics from more than one action family in 29% of cases. Among farmers who believed they were rotating drenches yearly (n=57), 37% had used anthelmintics of different action families on the same generation of lambs within the same year. When asked about their drenching policy, 37% of farmers (n=174) indicated that they followed a 5-6 drench programme by drenching every 3-4 weeks from weaning, regardless of the weather or other factors, although for some of these (15% of 65) other factors were also involved in determining drenching times. Faecal egg counting was used as a criterion to help determine the timing of drenching by 12% (n=174) of the farmers. Of these, 33% (a total of 7 farmers) only drenched their lambs when the faecal egg counts were considered high.

After drenching the lambs, 34% of 165 farmers returned them to a fresh pasture, not recently grazed by other lambs, on more than half of the occasions and 11% did so on an irregular basis, while the majority (54%) returned the lambs to the same paddock. Lambs which had been weaned on to a *clean* pasture were more likely to be also returned to a different pasture every time they were drenched (OR=2.06). However, the χ^2 test was not statistically significant (χ^2 = 2.73, 1 df, p=0.0987). The frequency of treatment of two-tooth and adult ewes is depicted in Figure 1. The pattern of drenching purchased sheep differed according to the category of sheep that were purchased. The anthelmintic used was different from the one they were using on the rest of their animals in 60% of cases. Farmers who had purchased lambs were 14.37 times as likely to drench the purchased animals as farmers who had bought adult ewes (χ^2=15.14, p<0.001). The dose rate was calculated either according to the weight of either the heaviest individual (52% of 173) or the heaviest group of animals (40%) in the mob. However, 43% of farmers (n=171) evaluated live weight of sheep stated they based on their personal experience; 49% said they weighed some animals before drenching the mob, and 8% always weighed all sheep prior to treatment. Presence of drench resistance had been assessed on 53 farms (31% of respondents). For the 32 farms diagnosed as having drench resistance, this involved benzimidazoles in 29 cases, levamisole in 1, and a combination of the two in another case. Drenching frequency in lambs was significantly positively associated with the size of the farm (p=0.004, χ^2=15.391, 4 df). A significantly greater proportion (86%) of the 21 farmers who used faecal nematode egg counts in the decision on when to drench the lambs had also performed a drench test on their farm, compared with those who had not used egg counting (n=156), of whom only 19% had performed a drench test (OR=0.004, χ^2 =41.74, p<0.001). The difference was more striking if farms had previously been diagnosed as having a resistance problem: 52% of such farms (n=27) drenched their lambs based on the results of their egg counts, while only 20% of farms where a drench test had yielded a negative result for anthelmintic resistance (n=20) used egg counts as a basis for their drenching programme (OR=4.31, χ^2 =4.93, p=0.0263). After performing a forward stepwise logistic regression, using *TEST* (whether or not a drench test had been carried out on the farm) as the dependent variable, the final model which offered the best fit included two main effects: use of egg counts as a diagnostic aid (*egg counts)*, and sheep:total SU ratio *(sheep:tot SU*, categorised into <0.6, >0.6 and <0.75, and >0.75) (Table I). The results suggest that farms on which faecal egg counting was carried out regularly appeared to be 24.63 times as likely to test for anthelmintic resistance as those where drenching of lambs was carried out irrespectively of their worm loads. Farmers with a sheep:total SU ratio comprised between 0.6 and 0.75 were shown to be more than twice as likely to perform a drench test as farmers with either higher or lower sheep:total SU ratios.

Table I. Final logistic regression model for the dependent variable *TEST*

Variable	OR	Lower 90% CI	Upper 90% CI	Wald	df	p-value
Egg counts	24.627	8.160	74.330	22.759	1	<0.001
Sheep:Tot SU				4.698	2	0.095
1	1.119	0.381	3.286	0.029	1	0.864
2	2.557	1.111	5.884	3.432	1	0.064

DISCUSSION

New Zealand sheep farmers appear to be increasingly aware of the problem of drench resistance. Still, most farmers based their anthelmintic strategy on their past experience and subjective evaluation of the performance of animals. The analysis of this questionnaire reveals the urgent need to provide new specific guidelines to farmers, aimed at minimising the risk of selecting for drench resistance, while still maintaining an effective worm control. However, this is a very controversial issue and there appears to be no perfect way of dealing with this double-folded problem. There is increasing evidence that any measure undertaken in order to control parasitism will ultimately result in a higher selection pressure for anthelmintic resistance[7][8][1]. However, most strategies rely upon an integrated approach to control[6] and include the use of grazing management to minimise the larval challenge of sheep, the use of a correct dose of anthelmintic and a strategic timing of treatments[7][4]. Most farmers do not appear to follow consistently these basic principles. The frequency of anthelmintic treatments was higher than would be hoped to delay the onset of drench resistance[5][8]. The questionnaire revealed that only 66% of respondents specifically followed an annual drench family rotation, which is recognised as one of the components of any antiparasitic policy aimed at delaying the onset of resistance[4]. Another factor, which has been blamed as one of the main causes of drench resistance, is underdosing[3]. The results of this questionnaire suggest that, while farmers try to avoid it by basing the dosage on the weight of the heaviest animals that are being drenched, they do not systematically use scales to weigh their animals before drenching them. Previous studies have shown that farmers are often mistaken in both weight estimations and calculations of dose volume[3].

Experts agree in recommending quarantine drenching of all purchased sheep prior to introducing them on to a property in order to avoid bringing in resistant nematode genotypes. Treatment should be done with an anthelmintic to which drug resistance is least likely to have developed[8]. A considerable proportion of farmers does not routinely quarantine drench purchased adult sheep.

The results of logistic regression show that the use of faecal egg counting as a diagnostic tool and the ratio between sheep and total stock units have the greatest impact in predicting whether or not a farmer is likely to perform a drench test.

The primary objective of this questionnaire was to describe the present situation on a representative sample of sheep farms and to reach a better understanding of both perceived and real problems associated with drench resistance in this region of New Zealand.

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