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Genetic variation in incidence of daggy sheep — an indicator of genetic resistance to parasites?

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ABSTRACT

About 4000 ewes born over 3 years to single sire matings were repeatedly scored for incidence and severity of dags. Dag scores were analysed for evidence of genetic variation and relationship to structural and performance characteristics. Perendales were found to have lowest incidence of dags followed by Booroola × Perendales, Booroola × Romneys and then Romneys and Border Leicester × Romney ewes. There was no relationship between dag score and either wool or body weight characteristics, either within or between breeds. Among progeny of 6 Romney strains, daughters of Ruakura High Fertility rams had substantially lower incidence with little variation among the rest. It is suggested that long-term selection for fertility in this line has reduced incidence of dags through improved utilisation of forage, possibly as a result of resistance to internal parasites. The mean heritability for dag score was 0.31 with a range of 0.13 to 0.60, indicating that selection would be effective in reducing the incidence of dags and their associated costs to farmers.

Keywords Dags; sheep parasites; crutching; flystrike; sheep breeds; wool

INTRODUCTION

Daggy sheep are an economic burden to farmers due to reduced wool returns, increased stock losses from flystrike and labour costs for additional crutching and dag removal. A conservative estimate of these costs is 60 cents per stock unit plus labour in extra crutching and flystrike control.

The extent and severity of the problem clearly varies with season, age of stock and breed. Daggy sheep are often regarded by farmers as an indication of heavy parasite burdens and the time for drench. Periodic reports that breeders have successfully reduced the incidence of dagginess in their flocks through selection suggest that there may be a genetic component to dagginess and possibly to parasite resistance or tolerance as well.

EXPERIMENTAL DESIGN

Females from the Strain and Booroola trials at Rotomahana Research Station were periodically scored visually for severity of dags on a scale of 0 to 4. Each scoring was done prior to either crutching or shearing, hence all animals were scored with at least 3 months' wool growth.

A minimum of 3 observations were made on each of 3 year-classes born 1979/81. The youngest animals scored were ewe lambs at weaning and the oldest were 4-tooth ewes scored at lamb docking. Each year-class was run as a single group from weaning onwards apart from segregation of those ewes assigned to single-sire mating in separate rotated paddocks and

the subdivision of ewes into grazing groups from lambing until weaning.

The age of animals and timing of scoring is shown in Table 1 and the array of genotypes involved in the trial is given in Table 2. Strain trial ewes came from Romney ewes and rams of 8 'strains' (6 Romney sources plus Coopworth and Border Leicester sires) while Booroola trial ewes were born to Romney and Perendale ewes and were sired by either Booroola rams or rams of the respective ewe breeds. Each year-class was sired by a new set of rams within each genotype. In total, over 4000 ewes were involved and a total of about 14000 observations were recorded.

Data have been analysed by mixed model least squares analysis of variance procedures to examine breed and sire effects. Alternative heritability estimation procedures have been examined treating dag score as either a continuous, an all-or-none, or a threshold variate and employing the appropriate transformations. Results of the 3 approaches showed very little difference so the heritabilities reported are based on the analysis of dag score as a continuous variate.

RESULTS

Incidence varied widely over ages and seasons with the highest incidence generally observed among ewes at docking (Table 1).

The genotype means across years indicated very little difference among Strain ram sources apart from Strain 'B', the Ruakura High Fertility line, which

TABLE 1 Scoring schedule, incidence and heritability of dag scores.

Year born	Observation	Age (months)	Month scored	Incidence (%)	$h^2(\pm \text{S.E.})$
1979	1	21	June	13	0.60 \pm 0.17
	2	26	November	73	0.48 \pm 0.15
	3	37	October	69	0.31 \pm 0.12
1980	1	9	June	23	0.29 \pm 0.10
	2	13	October	41	0.39 \pm 0.12
	3	16	January	12	0.13 \pm 0.08
	4	25	October	72	0.13 \pm 0.08
1981	1	3	December	52	0.32 \pm 0.14
	2	9	June	68	0.35 \pm 0.11
	3	13	October	36	0.14 \pm 0.08

had an incidence markedly below the other strains (Table 2).

Among the genotypes in the Booroola trial, Perendales consistently exhibited the lowest incidence of dags, followed in increasing incidence by Booroola \times Perendales, Booroola \times Romneys and Romneys. The Strain control Romneys and the Booroola trial Romneys were sired by the same rams out of similar ewes and showed similar incidence of dags.

The data were examined in relation to several performance and structural measures. No relation was found between dag score and either body or fleece weight among lambs, hoggets or ewes, or between dag score and litter size of ewes. Similarly, no relationship was found between dag scores and either face cover, fleece staple length or wool fibre diameter when examined on a within genotype basis.

As for most categorical data of this sort, the means and variances of scores were highly correlated. The

mean of the 10 heritability estimates was 0.31 with a range of 0.13 to 0.60. The mean phenotypic correlation between scores within year-class was 0.30 while the associated mean genetic correlation was 0.75.

DISCUSSION

The absence of a relationship between dag score severity and either body weight, fleece weight or reproductive performance suggests that dagginess is not a mere consequence of differential forage throughput to meet differing nutritive requirements. Likewise, it suggests that under the conditions of this trial any underlying basis for variation in dagginess (e.g. parasitism) was not sufficiently severe to markedly affect performance.

The occurrence of diarrhoea and dags is not necessarily due to internal parasites, and likewise not all internal parasites cause diarrhoea (e.g. *Haemonchus*) even when present in numbers adequate to cause morbidity (Fitzsimmons, 1969). However, as long as 50 years ago Edgar (1933) reported that ill-thrift of lambs accompanied by severe diarrhoea was closely associated with heavy *Ostertagia* and *Nematodirus* burdens. More recently, West (1982) listed presence of dags and diarrhoea as the clinical evidence which veterinarians should take into account in assessing problems of ewe parasitism. Thus, it seems well established that dags and parasitism are related, at least under certain common management conditions.

Physical wool traits such as fibre diameter and staple length showed no relationship to severity of dag score either within or between genotypes. While the largest observed variation in fibre diameter occurred between genotypes, the fine-woolled Booroola crosses were intermediate in dagginess between Romneys and Perendales, 2 breeds with very similar fibre diameter. Similarly, wool staple length variation between genotypes showed no clear relation with dagginess, the low dag Perendales being intermediate between Booroola crosses and Romneys in staple length.

TABLE 2 Mean incidence of dags (%) by genotype and birth-year class.

Trial	Genotype	1979	1980	1981	Mean
Strain					
(sire source)					
	Romney Control	52	46	57	52
	Romney A	65	39	55	53
	Romney B	34	18	47	33
	Romney C	56	32	67	52
	Romney D	53	40	62	52
	Romney E	61	41	53	52
	Coopworth	54	51	63	56
	Border Leicester	50	44	62	52
Booroola					
	Romney Control	53	41	51	48
	Perendale	30	19	28	26
	Booroola \times Romney	52	27	42	40
	Booroola \times Perendale	43	22	35	33

The low incidence of dagginess in Perendales thus seems to be a breed trait not readily explained by either wool or performance characteristics. Subsequent observations from the trial have found the $\frac{1}{4}$ Booroola \times $\frac{3}{4}$ Perendale to be intermediate between the half-bred and the Perendale purebred, further evidence of the inheritance of this breed characteristic.

Probably the most interesting finding was the much lower incidence of dags in Ruakura High Fertility-sired ewes compared to the other strains (33% v 53%). Among the 8 strains, Ruakura High Fertility-sired females had the lowest incidence at 8 of the 10 observations and were within 2% of the lowest strain at the other 2 observations. The progeny were very similar in appearance and performance to progeny of other Romney ram strains apart from being more open-faced and producing slightly (5%) less wool of similar staple length and fibre diameter. The Ruakura High Fertility strain has been maintained as a closed flock and selected for multiple births for 35 years. The strain may have come to differ through 1 or more of 3 ways:

1. The Romney breed has changed since the original sampling and the Ruakura High Fertility strain is a remnant of the past;
2. the strain has come to differ through chance in sampling at the outset plus random drift combined with inbreeding;
3. the lower incidence of dags is a correlated response to selection for multiple births.

The first explanation is unlikely since there seems to be no evidence of indirect breed selection for dagginess among Romneys and the population size of the breed makes change by random drift very remote. The second explanation seems more reasonable apart from the fact that only the mean and not the variance is reduced. If drift due to sampling plus inbreeding were the basis, the variation among sire groups should be reduced.

The third explanation seems much more feasible if dags are taken to be indicative of digestive disturbances or inefficiencies. As reported by Meyer and Clarke (1982), variation in ovulation rate is the primary basis of variation in sheep litter size and the Ruakura High Fertility line has responded primarily through increased ovulation rate. Hence, any factor likely to favour higher ovulation rate would be selected for and factors such as parasite susceptibility and digestive inefficiencies would be selected against.

Studies are under way to examine the relationship between dagginess and worm burdens assessed through both faecal egg counts and autopsy procedures.

The wide range of heritability estimates derived from the various observations is indicative of substantial environment effects on the expression of the trait. Dag score results from a grazing trial at Woodlands Research Station (K. F. Thompson and J. N. Clarke, unpublished) indicated a substantial effect of grass v crop wintering which appeared confounded with different levels of parasite infestation. Despite these complications there were indications of substantial genetic differences both between Romney selection lines and between sire progeny groups within lines.

The phenotypic correlations (repeatability) between observations were not high. This is as might be expected with fluctuating parasite challenge, varying degrees of acquired resistance and seasonal fluctuations in both feed quantity and quality between observations. Nevertheless, the moderately high mean heritability suggests that selection can be expected to reduce the problem and the high genetic correlations found between observations indicate that the same genetic factors influence dagginess at all measurements. Hence, selection response achieved at any one age will also reduce incidence of dags at other points in the animal's lifetime.

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