PHENOTYPIC ASSOCIATIONS BETWEEN FLEECE ROT AND SOME FLEECE CHARACTERS IN A MEDIUM WOOL MERINO FLOCK

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SUMMARY

The value of fleece characters as potential indirect selection criteria for increased resistance to fleece rot depends on their correlation with fleece rot and fleece production. The fleece characters - greasy and clean fleece weight, yield, average fibre diameter, wax, suint, wax/suint ratio and fleece wettability - were measured in a medium wool Merino flock which had been selected for maximum fleece production with minimum fleece rot. The data were analysed to determine the mean values, degree of variation, difference between affected and non-affected animals, variation due to sire effects, and phenotypic and genetic correlation between the characters and fleece rot. Wax/suint ratio was found to be the best potential alternative selection criteria, showing significant variation between affected and non-affected animals, between sires and was negatively correlated with fleece rot but positively correlated with fleece weight. A discriminant analysis showed that in addition to wax/suint ratio, wax, suint and greasy fleece weight could be used to describe a function to distinguish between affected and non-affected animals. The inclusion of wax/suint ratio into the selection index would depend on the cost of measurement balanced against the production losses attributable to fleece rot. The estimated heritability of fleece rot was 0.22 (±0.22).

INTRODUCTION

Recent studies of fleece rot have focussed on the identification of fleece and skin characters which may be used as indirect selection criteria in selection programs designed to reduce susceptibility to fleece rot and body strike. Some characters, follicle density and depth, average fibre diameter and coefficient of variation in fibre diameter (Evans and McGuirk 1983), appear to be consistently related to fleece rot while others, wax and suint content, suint pH, insoluble nitrogen, fleece wettability and wool colour, may be important in some flocks and not in others (Lipson 1978; Pascoe 1982; Watts et al. 1980,1981). Most studies have involved a comparison of affected and non-affected animals rather than an estimation of within-flock phenotypic and genetic correlations between fleece rot and the characters involved.

To evaluate characters as alternative selection criteria, information is required on the incidence of fleece rot, the association of the character with fleece rot and production characters, and the heritability of the character. A preliminary estimate of within-flock phenotypic and genetic correlations between some production and fleece characters and fleece rot was made using pedigree animals from Nerstane stud. The characters measured included routine individual production measurements, greasy fleece weight, clean fleece weight, yield, average fibre diameter, wax, suint and fleece wettability.

MATERIALS AND METHODS

Breeding program at Nerstane

The Nerstane stud was established in 1968 following the purchase of medium wool rams from "Koomarra" Crookwell and large frame medium wool rams and ewes from Warren. The Nerstane breeding program combines objective measurement of rams and some of the top ewes, and culling on traditional conformational and wool faults. No ram or ewe that has shown evidence of fleece rot by two years of age

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is included in the ram breeding program, described in a report by McLaren (1980).

Production information and wool samples were obtained for 187 2T rams which represented the progeny of eight sires, six from Nerstane and two from "Koonwarra". The production data included greasy fleece weight, yield, fibre diameter, clean fleece weight, fleece rot incidence, culling per cent and fleece value. The fleece samples were tested for wax and suint content using the Soxhlet extraction technique (Daly and Carter 1954). Fleece wettability was determined using the technique outlined by Lipson (1976) but water uptake was expressed as percentage increase in weight of sample rather than mg of water uptake. Wax/suint ratios were calculated for each sample,

**Statistical methods**

Individual results for 187 animals were used to calculate mean phenotypic values and degree of variation for each character. A within-sire nested analysis of phenotypic values was used to identify variation due to sire effects. A comparison of production and fleece character was made between animals with and without fleece rot followed by an estimation of phenotypic correlation between the characters and fleece rot incidence. Half sib heritability estimates for each fleece character and fleece rot and estimates of the genetic correlation between each character and fleece rot were obtained after adjusting for ram source using the program LSML76 (Harvey 1977). A discriminant analysis (Nie et al. 1975) was used to evaluate the production and fleece characters that establish a discriminant function to differentiate between affected and non-affected animals.

**RESULTS**

A summary of fleece characters examined in the study is shown in Table 1. There was a variation between sires (adjusting for source) for the characters greasy and clean fleece weight, average fibre diameter, yield, wax/suint ratio and fleece rot incidence. There were significant differences between affected and non-affected sheep in clean and greasy fleece weight and wax/suint ratio. Affected

Table 1 Summary of fleece characters examined in the study of 187 observations and their association with fleece rot

<table>
<thead>
<tr>
<th>Character</th>
<th>Population mean standard dev.</th>
<th>Means for</th>
<th>Correlations with fleece rot</th>
<th>Heritability estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Affected</td>
<td>Non-affected</td>
<td>Phenotypic</td>
<td>Genetic</td>
</tr>
<tr>
<td>Greasy fleece</td>
<td></td>
<td></td>
<td>0.10</td>
<td>-0.58</td>
</tr>
<tr>
<td>wt (kg)</td>
<td>4.18±0.59</td>
<td>4.39</td>
<td>4.14*</td>
<td></td>
</tr>
<tr>
<td>Clean fleece</td>
<td></td>
<td></td>
<td>0.10</td>
<td>-0.68</td>
</tr>
<tr>
<td>wt (kg)</td>
<td>3.12±0.45</td>
<td>3.28</td>
<td>3.15*</td>
<td></td>
</tr>
<tr>
<td>Yield (per cent)</td>
<td>74.71±2.61</td>
<td>74.55</td>
<td>74.74</td>
<td>-0.02</td>
</tr>
<tr>
<td>Average fibre diameter (μ)</td>
<td>18.79±0.75</td>
<td>18.94</td>
<td>18.78</td>
<td>0.10</td>
</tr>
<tr>
<td>Wettability</td>
<td></td>
<td></td>
<td>0.10</td>
<td>1.24</td>
</tr>
<tr>
<td>(per cent)</td>
<td>41.08±14.04</td>
<td>42.22</td>
<td>40.79</td>
<td>0.96</td>
</tr>
<tr>
<td>Wax (per cent)</td>
<td>24.50±5.48</td>
<td>23.41</td>
<td>14.69</td>
<td>-0.09</td>
</tr>
<tr>
<td>Suint (per cent)</td>
<td>17.75±4.31</td>
<td>17.68</td>
<td>17.76</td>
<td>0.10</td>
</tr>
<tr>
<td>Wax/suint ratio</td>
<td>1.45±0.47</td>
<td>1.34</td>
<td>1.47</td>
<td>-0.11</td>
</tr>
<tr>
<td>Fleece rot %</td>
<td>14.90</td>
<td>1.34</td>
<td>1.47</td>
<td>-0.11</td>
</tr>
</tbody>
</table>

*Level of significance is different between sires adjusted for source of sire. * (P < 0.05), ** (P < 0.01), + Genetic estimates based on eight sires
animals had a greater fleece weight, lower wax/suint ratio, lower wax content and slightly greater fibre diameter, suint content and wettability. Phenotypic correlations between production and fleece characters and fleece rot were not high. The maximum correlation was with wax/suint ratio (-0.11). A positive correlation (0.10 was found between fleece rot and clean fleece weight, greasy fleece weight, average fibre diameter and suint content, as well as fleece wettability (0.06). A negative correlation was found between fleece rot, wax content and yield. The estimated genetic correlation with fleece rot and production and skin characters were considerably greater. Fleece rot had a strong positive correlation with average fibre diameter, suint content and yield, and a negative correlation with fleece weight, and wax/suint ratio. The heritability of fleece rot was estimated to be 0.22 ± 0.22. The character of greatest heritability appeared to be wax/suint ratio (0.60 ± 0.38) followed by greasy fleece weight (0.44 ± 0.32).

The multivariate discriminant analysis showed that the characters most important in distinguishing between affected and non-affected animals included the wax/suint ratio, suint and wax content and greasy fleece weight. The use of this function gave a 36.4% miscalculation rate comparing the recorded incidence of fleece rot and the predicted incidence from the discriminant function. The other characters - fibre diameter, wettability yield and clean fleece weight - did not aid the differentiation of affected and non-affected animals.

DISCUSSION

The study indicates that of the characters examined wax/suint ratio was the best potential alternative selection criterion. It was negatively correlated with fleece rot, (Atkins and McGuirk 1979), had moderately high heritability and varied significantly between affected and non-affected animals. No single fleece character was highly correlated with fleece rot but a combination of characters - wax/suint ratio, wax and suint content, and greasy fleece weight - may be used to predict the fleece rot incidence. Fleece wettability was not very useful as an alternative selection criterion in the Nerstane flock although it may be important in some flocks (Pascoe 1982; Lipson 1978). Wettability had a low heritability (0.14 ± 0.19), lower than that reported by Pascoe (1982), a very small positive correlation with fleece rot and it did not vary significantly between affect and non-affected animals.

The possibility of genetic change in fleece rot resistance by selecting directly for resistance, will depend on the incidence of the disease. The heritability of fleece rot has been shown to vary from 0.09 ± 0.08 to 0.23 ± 0.12 depending on incidence (Atkins et al, 1980). The heritability of fleece rot in the Nerstane flock was found to be 0.22 ± 0.22. The positive phenotypic correlation between fleece weight and fleece rot found in this study and reported by Atkins and McGuirk (personal communication) suggests that selection for increased fleece weight may increase susceptibility to fleece rot, although the genetic correlations indicate the reverse situation. If fibre diameter is held constant and the fleece weight increased by selection there should be no increase in fleece rot susceptibility. It may even decrease.

CONCLUSION

Many fleece and skin characters have been considered as alternative selection criteria in breeding programs aimed at reducing the incidence of fleece rot. Some characters such as wool colour (McGuirk and Atkins 1980), fibre diameter variation, follicle density and depth (Evans and McGuirk 1983) have a significant phenotypic correlation with fleece rot depending on the source of data. Although no single character appears to have a consistently high correlation with fleece rot in all flocks, a combination of some characters may be useful in the selection of fleece.
rot resistant animals in particular flocks in a given environment. Of the characters considered in this study a combination of the characters wax/suint ratio, wax, suint content and greasy fleece weight could be used to predict fleece rot incidence for medium wool Merinos in the New England region.

Although fleece rot resistance can be a major aspect of a breeding program the ultimate objective is usually to maximise individual production together with minimising fleece rot and other production eroders. Alternative selection criteria should be positively correlated with fleece weight and negatively correlated with fleece rot; wax/suint ratio fits these conditions. The genetic correlation between fleece rot and production characters indicate that the Merstane breeding program of selecting for increased fleece weight at a constant fibre diameter may be indirectly reducing the fleece rot incidence because of the negative genetic correlation between fleece weight and fleece rot. Selection against individuals showing fleece rot can lead to a gradual reduction in fleece rot incidence without any significant decrease in wool production. The inclusion of any alternative selection criteria into a breeding program will depend on the cost of the additional measurement, its potential effects on fleece rot incidence and wool production, and the magnitude of losses attributable to fleece rot. In a flock where the current breeding program and management practices help to minimise the incidence of fleece rot the cost of additional measures for alternative selection criteria may not be justified.

REFERENCES


