Blowfly strike of Merino sheep in relation to selection strategy, as well as to objective and subjective wool traits

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Summary
The frequency of flystrike on specific sites (breech, body and poll) was investigated in 16-month hoggets from a selection experiment with South African Merinos. Lines that were involved were selected for an increased fleece weight, against reproductive failure (referred to as Wet and Dry line) and for a reduced fibre diameter. A Control line where no directed selection was done was maintained together with the selection lines. Data were obtained for 2 progeny groups, born in 1998 and 1999. Line differences in fleece and body traits were in correspondence with the selection objectives strived for. The clean fleece weight of progeny in the Fleece Weight line was 28% higher (P<0.05) than that of the Control line. Fibre diameter in the Fine wool line was approximately 9% finer (P<0.05) than in the other lines. No significant differences were found between lines for either breech, body or poll strike (the latter was assessed only in ram hoggets born during 1999). When data for the three selection lines were pooled, a lower proportion of selection line hoggets was affected by combined breech and/or body strike than control group contemporaries (0.125 vs. 0.189; P<0.05). Clean fleece weight and staple strength were compromised (P<0.05) in animals affected by body strike. Subjective scores for wool quality, regularity of crimp, wool colour and underlines were lower (P<0.05) in animals that suffered from body strike than in contemporaries that were not affected. In the case of breech strike, these relationships were not as clear, and differences (P<0.05) were only found for regularity of crimp and staple formation.

Keywords
Selection, fleece weight, fineness, reproduction, body strike, breech strike

Introduction

Flystrike has had a major financial impact on sheep production over the years. The possibility of selection against flystrike has mainly centred round the reduction of body strike (Raadsma, 1991*b*). It was reasoned that it is relatively straightforward to control breech strike by chemicals and the mules operation, while external causes (like fighting) are implicated in the case of poll strike in rams (Raadsma, 1991*b*). Recently, a lot of emphasis has been placed on the role of chemicals harmful to the environment in sustainable agricultural systems. As a consequence, residues of such chemicals in wool have been scrutinized (Plant *et al., 1*999). The practice of mulesing has also been questioned on animal welfare grounds (Raadsma*, 1*991*b*). Strategies for the prevention of blowfly strike in general thus need to be reconsidered, apart from the efforts that have been leveled at body strike.

There is a wealth of information on the possibility of selecting sheep against body strike. In this regard, the susceptibility of sheep to fleecerot and dermatophilosis as possible indicator traits for flystrike has been investigated intensively (McGuirk and Atkins*, 1*984; Raadsma*, 1*989; Raadsma, 1991*b*; Raadsma *et al*.*, 1*988; Raadsma *et al*., 1989). Bloodline and strain differences in susceptibility to flystrike and fleecerot readily occurs in Australia, leaving producers the option of bloodline substitution (Raadsma *et al*.*, 1*989; Raadsma *et al*.*,* 1997), although it was stressed that the broader implications of such a strategy has to be considered beforehand. In South Africa, no such information is currently available, and it is thus impossible to make informed decisions. Results with regard to genetic correlations of blowfly strike with other traits of economic importance are also scarce in the literature. Against this background, this paper investigated the occurrence of flystrike in a South African selection experiment where 4 lines are involved. Objective performance and subjective wool conformation scores were also compared for animals that suffered from breech or body strike and those animals that were unaffected.

Material and Methods

Merino sheep from a selection experiment on the Tygerhoek experimental farm in the Southern Cape area of South Africa provided material for the study. The climate at the site is Mediterranean, with a total annual precipitation of 425 mm. The following lines were involved:

- Fleece Weight – Selected since 1970 for an increase in clean fleece weight with a check on fibre diameter (Cloete *et al., 19*98).
- Wet and Dry – Ewes in this line have been culled since 1993 on failure to lamb or to rear at least one lamb per lambing opportunity. During this period, rams were selected as was described by Cloete and Scholtz (1998).
- Fine wool – This line was descended from a similar line maintained at Cradock (Olivier *et al., 19*99), of which ewes were introduced to Tygerhoek during 1997. During the formation of this line, ewes were screened from their flocks of origin on the basis of a low fibre diameter and an above average live weight.
- Control – no directed selection has been applied to this line since 1970, although a measure of random genetic drift was measured in some traits (Cloete *et al., 19*98). It is maintained as a control for the other lines.

Ewes in these lines were mated during October-November to lamb during March-April of the following year. Data were available for 839 progeny born during 1998 and 1999. All progeny were mulesed as lambs, and maintained in single flocks (separated on sex) after weaning. Progeny were subjected to subjective appraisal of conformation traits at an age of approximately 16 months. A 50-point linear scoring system devised for this purpose (Olivier *et al., 19*87) was used. Clean yield, staple strength and fibre diameter were determined on a midrib sample obtained from individual animals at an age of approximately 15 months. Greasy fleece weight was measured at an age of 16 months, after a growth period of a year. Live weight and fold score were obtained just after shearing. The occurrence and site of blowfly strike (breech strike or body strike – Raadsma*, 19*87; Raadsma, 1991*b*) were recorded during the wool growth period of a year, and at shearing. Poll strike was recorded in rams, only for individuals born during 1999 (Raadsma*, 19*87; 1991*b*). No cases of pizzle strike were observed in rams. Routine management for the prevention of flystrike included the treatment of all animals with cyromazine during November-December. Spot treatment with a product containing chlorfenvinphos (30%) and esfenvalerate (2.5%) was also administered as required.

Blowfly strike at specific sites was recorded as either present or absent, i.e. the distribution was binomial. Nonparametric Chi² procedures were thus used to compare the proportion of affected animals between lines (Siegel*, 19*56). Body strike and breech strike were also combined as breech and/or body strike. Means for the relative production performance of the four lines represented were obtained from the 839 animals available as replacements during 1999 and 2000. In this analysis, the random effect of sires was fitted within lines. Blowfly strike at the two most important sites in both sexes (body and breech) was related to production traits and subjective conformation traits, using least squares procedures (Harvey, 1990) to account for uneven subclasses. This analysis used a total of 833 animals of which all production and conformation traits were recorded. Other fixed effects included in the analyses on production and conformation traits were birth year, sex, birth type and dam age, as well as interactions reaching significance ($P<0.05$) for at least one trait.

Results

Information on the relative production of animals belonging to the respective lines is presented to give an indication of the magnitude of these differences. It was found that selection line sheep were heavier ($P<0.05$) than control group contemporaries. When expressed relative to the Control line, these differences amounted to approximately 11% for the Fleece Weight and Wet and Dry lines and 23% for the Fine wool line (Table 1). Clean fleece weight of the Fleece Weight line was 28% higher ($P<0.05$) than in the Control line. Corresponding differences for the Fine wool as well as Wet and Dry lines were respectively 16 and 9%. The fibre diameter of animals in the Fine wool line was 9% lower than in the other lines. Individuals in the Wet and Dry line tended to be plainer ($P=0.07$) in skin fold development than contemporaries in the Fleece Weight line.

Table 1. Least squares means (±SE) for hogget production traits in the Merino selection lines at Tygerhoek.

Trait	Selection line			
	Control	Fleece Weight	Wet and Dry	Fine wool
Number	254	164	300	121
Live weight (kg)	45.9 ± 0.5^{1}	51.4 ± 0.7^{2}	50.7 ± 0.6^{2}	56.3 ± 0.9^{3}
Clean yield (%)	73.0 ± 0.3^{1}	73.9 ± 0.4^{2}	$73.6\pm0.4^{1,2}$	74.5 ± 0.5^{2}
Clean fleece weight (kg)	3.54 ± 0.05^{1}	4.53 ± 0.09^{4}	3.84 ± 0.08^{2}	4.09 ± 0.10^{3}
Staple strength (N/ktex)	31.7±0.8	31.7±1.2	32.4±1.0	33.7±1.4
Fibre diameter (μm)	20.4 ± 0.1^{2}	20.2 ± 0.1^{2}	20.4 ± 0.1^{2}	18.6 ± 0.2^{1}
Fold score (n)	8.1±0.2	8.4±0.2	7.7±0.2	7.9±0.3

^{1,2,3} – Means with different superscripts in rows differ ($P<0.05$)

In 839 animals assessed for breech and/or body strike, 718 did not suffer from flystrike, 84 suffered from breech strike only, 43 suffered from body strike only, and 6 suffered from breech strike and body strike. Expressed as proportions of the total, these amounted to 0.856, 0.093, 0.044 and 0.007 respectively. Twenty-five out of 173 (0.156) ram hoggets assessed during 2000 suffered from poll strike. The selection lines did not differ ($P<0.05$) for the proportions of hoggets suffering from flystrike at the respective sites (Table 1). There was a tendency ($P<0.15$) for animals in all the selection lines to be less likely to be struck when body and/or breech strike was combined. When data for all the selection lines were pooled and compared to the control line, 585 animals from the selection lines had a lower probability of being struck than 254 control line contemporaries (0.125 vs. 0.189; $Chi^2=5.40$, degrees of freedom=1; $P<0.05$).

Table 2. Proportions of hoggets in the Merino selection lines at Tygerhoek, where the occurrence of flystrike was recorded at different sites.

Site	Selection line				Chi^2*
	Control	Fleece Weight	Wet and Dry	Fine wool	
<u>Breech and Body:</u>					
Numbers	254	164	300	121	
Breech strike	0.130	0.085	0.080	0.107	4.32
Body strike	0.067	0.049	0.050	0.025	3.06
Breech and/or body strike	0.189	0.128	0.123	0.124	5.93
<u>Poll strike:</u>					
Numbers	64	32	73	29	
Strike	0.094	0.188	0.151	0.069	2.96

*Critical Chi^2 for 3 degrees of freedom: $P<0.05$ – 7.82
$P<0.10$ – 6.26
$P<0.25$ – 4.11

Production and wool conformation traits are tabulated for cases where tendencies towards significance (P<0.10) were found for at least one comparison between flystruck and unaffected sheep (Table 3). The live weight of animals not affected by body strike tended (P=0.07) to be heavier than that of contemporaries that suffered body strike. When expressed relative to animals not affected by body strike, clean fleece weight was compromised by 10% in individuals with body strike (Table 3). The staple strength of the latter group was accordingly impaired by 22%. Subjective wool scores of animals affected by body strike were generally lower (P<0.05) than that of animals without body strike. These animals had poorer quality (less well-defined crimps), more variation in crimp frequency, wool that was more yellow and poorer underlines. Breech strike was generally unrelated to the objective production traits, although wool from flystruck individuals were slightly broader (P<0.05). Scores for regularity of crimp and staple formation were lower in animals affected by breech strike than in contemporaries without breech strike.

Table 3. Least squares means (±SE) for hogget production and conformation traits in hoggets affected either by body or by breech strike.

Objective or conformation trait	Body strike		Breech strike	
	Not struck	Flystruck	Not struck	Flystruck
Number	790	43	749	84
Live weight (kg)	50.7±0.4	49.0±1.0	50.3±0.5	49.4±0.8
Clean fleece weight (kg)	3.97±0.04[1]	3.56±0.10[2]	3.83±0.05	3.71±0.08
Staple strength (N/ktex)	32.9±0.7[1]	25.7±1.8[2]	29.3±0.9	29.3±1.5
Fibre diameter (μm)	20.0±0.1[1]	19.6±0.2[2]	19.7±0.1[2]	20.0±0.2[1]
Quality (n)	29.9±0.5[1]	25.2±1.3[2]	28.4±0.6	26.8±1.0
Regularity of crimp (n)	30.3±0.5[1]	26.8±1.2[2]	29.7±0.6[1]	27.4±1.0[2]
Colour (n)	31.0±0.5[1]	28.1±1.2[2]	30.0±0.6	29.0±1.0
Staple formation (n)	25.3±0.2	24.4±0.6	25.5±0.3[1]	24.2±0.5[2]
Underlines (n)	30.2±0.3[1]	26.4±0.9[2]	28.3±0.5	28.2±0.7

[1,2]Means with different superscripts in rows differ (P<0.05)

Discussion

Performance of the respective lines were in accordance with the selection strategies employed (Cloete *et al.*, 1998; Olivier *et al.*, 1999). A negative relationship between skin folds and fertility has been documented in the literature (Atkins, 1980), and the suggestion of a plainer body type in the Wet and Dry line must be seen in this context.

No significant differences were found between lines for the frequency of flystrike recorded at specific body sites. It was only when all the selection lines were combined and compared with the Control line for breech and/or body strike that an advantage was found for the combined selection lines. The basis of such a comparison is debatable, since the lines were all selected differently. It is thus unlikely that common factors within lines contributed to this difference. Data with regard to fleece rot and dermatophilosis were not recorded. It is therefore unclear to what extent the relationship between these skin conditions and flystrike were involved. These conditions are seen as important in a strategy for the control of body strike in Australia (Raadsma, 1991*b*; Raadsma *et al.*, 1988; 1989; 1997). Direct selection for resistance to flystrike also becomes feasible under conditions where animals are subjected to an appropriate challenge (Raadsma, 1991*a*; Raadsma *et al.*, 1997). Heritability estimates ranging from 0.26 to 0.54 were computed for sheep under flywave conditions, suggesting that sufficient genetic variation for exploitation is available (Raadsma, 1991*a*). Under such conditions, it was calculated that the occurrence of body strike could be reduced from 20% to 7.2% over a 20-year period (Raadsma, 1991*a*). Lines that were divergently selected for combinations of fleece rot and body strike, were found to respond to selection (Mortimer *et al.*, 1998). There is thus little doubt that feasible selection strategies can be employed to combat body strike, although the economic implications of such programs are not always straightforward (Raadsma *et al.*, 1997).

Little is known with regard to selection possibilities for other forms of flystrike. In this study, breech strike was found to be more common that body strike, despite the fact that the animals were mulesed. This finding is not in agreement with that reported in Australia (Raadsma*, 19*87), where body strike was found to be the dominant problem in both sexes. The reason for this discrepancy is not clear at present, and further research needs to be carried out. Mulesing is generally regarded as being effective for the reduction of breech strike from 60-80% in ewes to <1% when combined with crutching (Raadsma*, 19*91*b*).

The phenotypic association of wool colour with body strike in particular conformed to those found in Australia with regard to fleece rot (James *et al., 19*87; Raadsma and Wilkinson*, 19*90). Given the association between fleece rot and body strike, this result is not surprising. James *et al*. (1987) also reported relationships of wool character and handle with fleece rot. The phenotypic association of wool quality (where character and handle are combined) could possibly be related to these findings.

Conclusions

It is important that bloodline substitution was seen as a possible means of reducing body strike in Australian Merinos (Raadsma *et al., 19*97). Significant (P<0.05) strain or bloodline differences in the occurrence of fleece rot and body strike were reported between Australian bloodlines after experimental induction (Raadsma *et al., 19*89; Mortimer *et al., 19*98). Similar differences may also be present between South African bloodlines. Results with regard to selection lines in the present study were not conclusive, since it is hard to imagine that the difference between the pooled selection lines and the control line in the occurrence of breech and/or body strike are based on the same biological principle. At best, it is probably valid to contend that the single trait selection that was practiced did not result in an unwanted increase in susceptibility to blowfly strike in the lines involved. In a previous study, correlated responses to divergent selection for combinations of fleece rot and body strike were generally unfavourable for fleece weight and fibre diameter (Mortimer *et al., 19*98).

Further work on South African Merino bloodlines appears to be warranted. Anecdotal evidence from broader industry suggests that South African strains may also differ in their susceptibility to flystrike. Unfortunately, no results substantiating these claims have ever been documented.

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