WATER PENETRATION INTO THE FLEECE OF MERINO SHEEP AFFECTED WITH FLEECE ROT

R.S. COPLAND*

SUMMARY

Fleece rot was induced in 15 young Merino ewes by treatment with repeated application of simulated rain. Forty days after induction, treated and five control ewes were subjected to 50 mm of simulated rain which contained a water soluble dye. Treated ewes absorbed significantly more water than controls (2.3 kg to 1.5 kg). Wool samples were collected at ten cm intervals along the dorsal mid-line to determine dye concentration and fleece rot development. Dye concentration was significantly higher in the treated than controls at all sites. Dye containing water entered the fleece principally along the dorsal midline, following the skin surface laterally around the body. The fleece rot band contained a high dye concentration. Wool grown after the initial wetting treatment contained less dye than previously leached wool. Wetting treatment changed fleece structure with many cross fibres.

INTRODUCTION

Water content of the ovine fleece is of primary importance to the survival and development of fleece dwelling organisms involved in mycotic dermatitis, fleece rot and cutaneous myiasis (Hayman 1953; Roberts 1967; Merrit 1979; Vogt and Woodburn 1980). Fleece rot has been induced by artificial wetting (McGuirk et al.. 1978) and the resultant lesion was found to be more hydrophilic than the surrounding wool (Lipson 1978).

Field observations have indicated that fleece rot and cutaneous myiasis are more prevalent after two periods of high rainfall separated by a dry period. Rapid growth of Pseudomonas aeruginosa could account for this phenomenon (Merritt and Watts 1978). Rain affects the skin of sheep (Nay and Watts 1977) and may change the ability of the fleece to repel water.

This paper reports on the effect of artificially induced fleece rot on the penetration of water into the fleece of Merino ewes.

MATERIALS AND METHODS

Twenty 18 month old Merino ewes with seven months wool growth were chosen at random from a flock in the Goondiwindi district. Fifteen of these were subjected to a daily total of 100 mm of simulated rain in four hours for eight consecutive days to induce fleece rot. The rain simulator consisted of four poly-pipe nozzles in an elevated position on four sides of a pen measuring3 m x 3 m. Rate of precipitation was maintained at 25 mm per hour by controlling the water pressure with a regulator set at 100 kpa. Except when in the simulator, all 20 sheep were kept as one group. After the induction period, the sheep were grazed in a paddock for 40 days, and protected from natural rain by shedding.

All sheep were then subjected to 50 mm of simulated rain in two hours, the water containing a soluble dye (0.2 mg/ml Solophenyl blue 2RL; Ciba-Geigy). The sheep were not fed or watered for 12 hours prior to being placed in the simulator to facilitate measurement of water absorption by liveweight change during wetting.

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* Pastoral Veterinary Centre, Department of Animal Production, University of Queensland, Goondiwindi, Qld 4390.

Seven wool samples, designated A (neck) to G (tail) were collected at 10 cm intervals along the dorsal midline of all sheep. Side samples were collected 10, 20 and 30 cm laterally (right) from dorsal sites C (tip of scapulae) and D. Observations were made on the location and concentration of dye retained in the fleece, and fleece rot development was assessed by measurement of the width (mm) of the fleece rot band. Wool samples were subdivided into four zones:

Zone 1 = skin surface to proximal border of fleece rot band
2 = fleece rot band
3 = distal border of fleece rot band to 1 cm proximal to the tip
4 = distal 1 cm of fleece

In sheep with no fleece rot zone, zone 1 was assumed to be half the length of zone 3. Dye concentration in these fleece zones was scored on a 0 to 3 scale by comparison with absorption of standard dye solutions onto white blotting paper.

Scale: 0 = no dye retained in sample
1 = up to 0.2 mg/ml dye in zone
2 = 0.2 to 0.6 mg/ml dye
3 = more than 0.6 dye retained in sample

A dye Score of 2 indicated that the sample had retained approximately 100% water, while a score of 3 indicated complete saturation.

Staple length was measured at each of the sampling sites, and wool faults such as cotting were assessed subjectively.

RESULTS

Fleece rot band width and dye concentration scores for control and treated sheep are presented in Table 1.

Fleece rot occurred only in the treated group, with a maximum fleece rot band width of 7.3 mm (SE 0.56) 10 cm posterior to the scapulae (site D), and a minimum of 0.2 mm (SE 0.2) at the tail (site G). The width of the fleece rot band decreased anteriorly, posteriorly and laterally from site D.

Control sheep absorbed significantly less water by weight than treated sheep (1.56 kg to 2.3 kg, ($P < 0.001$)). Dye retention was significantly less in control than treated sheep at all dorsal midline sites, for all four fleece zones ($P < .001$) zones 1, 2 and 3, ($P < 0.05$) zone 4. Dye retention was highest at site D for all four fleece zones in both control and treated sheep, the concentration decreasing anteriorly, posteriorly and laterally from this site. At all dorsal sites of treated sheep, dye concentration was significantly higher in zones 2 and 4 than in zones 1 and 3.

In treated sheep, dye retention at sites more than 10 cm lateral to the dorsal midline was highest in zone 4, decreasing linearly to zone 1. Dye retention at lateral sites in control sheep was significantly higher in zones 4 and 1 than in zones 2 and 3. Fleece rot band width correlations with dye concentration scores were 0.87, 0.99, 0.90 and 0.98 for zones 1 to 4, respectively ($P < 0.01$).

Staple length ranged from 66 mm (SE 2.1) for site B to 54.33 mm (SE 2.17) for site G. Samples collected from treated sheep displayed a high degree of cotting with a poorly defined crimp.

TABLE 1 Water penetration (dye score) and fleece rot band width (mm) for five control and 15 sheep with induced fleece rot (SE shown in brackets)

Site		Fleece zone 1 proximal	2	3	4 distal	Fleece rot band width
		Control sheep				
Dorsal midline sites*	A	0.50 (.16)	0	0.1 (.099)	1.30 (.30)	0
	B	0.60 (.19)	0.16 (.16)	0.2 (.120)	1.20 (.20)	
	C	1.00 (.00)	0	0.6 (.240)	2.6 (.24)	0
	D	1.20 (.20)	0.50 (.16)	0.3 (.120)	2.2 (.20)	0
	E	0.90 (.10)	0.10 (.09)	0.1 (.099)	1.8 (.20)	0
	F	0.80 (.12)	0.10 (.10)	0.1 (.099)	2.0 (.36)	0
	G	0.30 (.20)	0	0.1 (.099)	1.1 (.24)	0
Lateral sites**	C10	0.80 (.20)	0	0	2.0 (.32)	0
	C20	1.12 (.31)	0.25 (.25)	0.87 (.43)	1.75 (.25)	0
	C30	0.17 (.17)	0	0	0.33 (.33)	0
	D10	0.70 (.12)	0	0	2.2 (.37)	0
	D20	0.60 (.19)	0	0.2 (.20)	1.2 (.37)	0
	D30	0.50 (.28)	0	0.62 (.24)	1.63 (.34)	0
		Treated sheep				
Dorsal sites*	A	0.75 (.26)	1.58 (.38)	1.35 (.26)	2.21 (.21)	3.92 (1.00)
	B	0.90 (.22)	1.80 (.32)	1.17 (.23)	2.33 (.19)	5.33 (0.94)
	C	1.50 (.28)	2.33 (.29)	1.26 (.25)	2.66 (.16)	6.40 (0.97)
	D	2.07 (.13)	2.92 (.07)	1.50 (.17)	2.92 (.07)	7.21 (0.57)
	E	2.10 (.18)	2.60 (.21)	1.40 (.19)	2.93 (0.7)	6.73 (0.97)
	F	1.70 (.24)	2.00 (.31)	1.20 (.36)	2.46 (.19)	4.93 (1.14)
	G	0.43 (.14)	0	0.10 (.07)	1.20 (.11)	0.20 (0.20)
Lateral sites**	C10	0.70 (.18)	1.80 (.29)	1.23 (.30)	2.33 (.21)	2.13 (0.35)
	C20	0.32 (.11)	0.93 (.29)	1.42 (.20)	1.78 (.19)	2.50 (0.49)
	C30	0	0.40 (.22)	1.10 (.37)	1.40 (.27)	1.10 (0.38)
	D10	0.78 (.22)	1.57 (.36)	1.03 (.31)	2.21 (.18)	2.21 (0.51)
	D20	0.50 (.16)	0.57 (.31)	0.78 (.21)	1.50 (.17)	1.35 (0.58)
	D30	0.30 (.14)	0.80 (.26)	1.40 (.29)	1.53 (.21)	1.60 (0.32)

* Spaced at 10 cm interval along the dorsal midline from neck (A) to tail (G)
**Spaced 10, 20 and 30 cm lateral from dorsal sites C and D.

DISCUSSION

The results presented in this paper indicate that fleece rot development accompanies structural changes in the fleece which facilitate water penetration. Wool fibres detach from follicles during fleece rot development, the loose fibres leading to cotting and loss of staple definition (Ryder and Stephenson 1968; Nay and Watts 1977; Watts 1979). The fleece rot band contains large amounts of protein which binds wool fibres together (Merritt and Watts 1978).

The treatment administered to the sheep in this study would leach suint from the staple, reducing the hygroscopic activity of the fleece (Lipson 1978). However, treatment increased water penetration, indicating the wool wax was also removed, either by emulsification with suint, or by hydrolytic breakdown (Goodrich and Lipson 1978). In treated sheep, water was observed to penetrate into the leached distal portion of the staple, but was repelled by the wool grown after treatment. The high dye concentration in the fleece rot band indicates a hygroscopic activity of protein (Lipson 1978).

Examination of samples from lateral sites of control sheep indicates that the staple absorbs water from the fleece tip and skin surface. Water penetrates the fleece along the dorsal midline to the skin surface, moving laterally around the sheep. Water penetration along the dorsal midline is of primary importance in determining the total amount of water absorbed by the fleece.

The close relationship between the distribution of water soluble dye in the control and treated sheep with fleece rot development suggests that water penetration determines the location and severity of the fleece rot lesion. It appears that innately susceptible sheep may absorb water, develop fleece rot, leading to the absorption of more water.

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