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Susceptibility of Romney and Perendale sheep to flystrike by the Australian Green Fly, *Lucilia cuprina* (Wied.), and fly attractant trials

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ABSTRACT

The incidence of flystrike in New Zealand flocks is about 3% in most years. This low level of prevalence makes it difficult to discriminate between potential flock replacements based on naturally occurring flystrike. Selection decisions could be improved if either the rate of flystrike could be raised artificially or an easily measured trait that has a higher level of occurrence could be found. The second approach is used in Australia where fleece-rot has both a higher incidence rate than flystrike and is highly genetically correlated to susceptibility to flystrike. However, the incidence of fleece-rot in New Zealand dual-purpose sheep is not sufficiently high to allow its use as an indirect indicator. In a effort to find a means of artificially increasing the incidence of flystrike, groups of hoggets were brought indoors and exposed to the Australian green fly *Lucilia cuprina*. In total, 5 trials (10 animals/treatment) were run to compare: the susceptibility of Romney vs Perendale sheep, using wetting, dung or homogenised liver as attractants. Wetting was applied along the back from a watering can while the other attractants were applied to a patch on the shoulder, mid-back and rump. About 2000 gravid flies were released into a fly-proof room along with the penned sheep. The main results of these trials were: a) It was very difficult to get an established maggot population on clean wet sheep; few eggs were laid and no cases of established strike occurred; b) Dung acted as a moderately successful attractant; maggots were hatched on the sheep but none developed to the skin penetrating stage; c) Liver acted as a very successful attractant and maggots developed on all treated sheep. No between-breed differences occurred with wetting, dung or liver attractants. Further studies are required to refine the use of attractants. In particular, an attractant that is less powerful than homogenised liver but more potent than wetting or dung is required before moving onto large-scale field trials.

Keywords: Flystrike; fly attractants; selective breeding.

INTRODUCTION

Each year, flystrike costs New Zealand millions of dollars in lost production and export earnings (Dymock, 1991). Losses include both the direct cost of sheep mortality, as well as the associated indirect costs including labour and chemical costs, and reduced meat and wool yields. *Lucilia cuprina* is the most prevalent strike fly in Australia, and is an increasing cause of flystrike in New Zealand (Heath, 1996). The fly can breed all year round in warm, moist conditions, producing up to 10 generations per year.

Heath (1990) suggested that there are four ways that flystrike can be prevented:

1. Prevent gravid females from reaching sheep.
2. Prevent gravid females that reach sheep from laying.
3. Prevent eggs laid from developing.
4. Reduce local fly numbers.

The first two of these methods rely mainly on physical methods of control, while the fourth, that of reducing local fly numbers, relies on mainly mechanical means. It is the third method of fly control, that of stopping egg and larval development, that has received the most attention. This method usually relies on the application of an insecticide to the animal, either as a prophylactic treatment, or as a dressing on existing strike. However, resistance to these prophylactic chemicals has been increasing in recent years (Nicholas, 1987).

Attention has therefore turned towards alternative means of control. One alternative approach is selective breeding for genetic resistance to strike (Raadsma, 1991; Raadsma *et al.*, 1992). A natural, genetically-based mechanism may provide effective sustained, responsive protection against flystrike.

The first aim of the study was to trial fly attractants that would raise natural levels of strike susceptibility for use in subsequent field trials. Natural levels of strike are about 3 % per year (Brandsma and Blair, 1997), a level too low to allow identification of, and selection amongst, potentially resistant stock within realistic timeframes. A suitable attractant would therefore provide consistently elevated levels of strike in field trials, and would allow investigation of the mechanisms involved at each of Heath's (1990) four levels of resistance.

Romney and Perendale sheep are believed by farmers to differ in their susceptibility to flystrike, and both breeds are of economic importance in New Zealand. The second aim of this study was to compare natural levels of resistance to strike by *L. cuprina* in Romney and Perendale sheep.

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METHODS

The trials were conducted between February and May 1993. All experiments were conducted in a flyproof, temperature controlled room, maintained at 27°C ± 3°C on a 14h:10h light:dark regime. The sheep were kept in pairs in elevated animal pens. They were supplied with water and lucerne chaff *ad lib.*, and were given a salt mixture every second day.

Sheep

The sheep used in the trials all came off Massey University farms. Hoggets of between seven and nine months of age (average weight 28.5 kg ± 5.4 kg), with no previous exposure to flystrike or chemical treatment were used. The sheep were all shorn in December 1992, two months before the trials commenced. During all trials, any sheep that exhibited advanced strike (3rd instar maggots observed), were removed from the trial, the affected area clipped, and the site dressed with Zenith™ brand dip.

Attractant trials

For each trial, 20 Romney hoggets were brought into the temperature-controlled room, and randomly assigned to either control or challenge groups. Control treatment consisted of the application of 1 litre of water to the fleece for each night of the trial to encourage fleece rot. Challenge treatment consisted of the same fleece watering plus the application of either 25 ml ground faeces (Trial 1) or 25 ml homogenised beef liver (Trial 2) to patches between the shoulderblades, along the midback and on the rump of each treatment animal.

On the fourth day (Day 1 of the experiment), 10 day old *L. cuprina* that had received a protein meal were released into the experimental room at a density of 10 flies m^{-3}. On Day 1, 5 and 9 of each trial, skin temperature was recorded using a Becton-Dickson digital thermometer at the midside for each animal, and a midside wool clip was removed for moisture content analysis. Moisture content was determined from the difference in the fresh and air dried (35°C for 72-120 hr) weights of the wool clips. All sheep were checked daily for evidence of oviposition and larval development. The control and challenge treatment patches were clipped for analysis (see below) at the conclusion of each experiment.

Breed comparison trials

For each trial, 10 Romney and 10 Perendale hoggets were brought into the experimental room, and randomly assigned into inter-breed pairs. Treatments were the same for both breeds, and consisted of: fleece wetting only (Trial 3), wetting plus 25 ml dung patches at the shoulder, midback and rump (Trial 4), and fleece wetting plus 25 ml patches of homogenised beef liver (Trial 5). The same sampling protocols as in Trials' 1 and 2 were followed.

Analysis of wool clips

From each clip a representative sub-sample of between 5 and 10 g was taken and the numbers of eggs and maggots (in 1 mm size increments) were counted using a dissecting microscope. Maggots were divided into 1st, 2nd and 3rd instar on the basis of length (Zumpt 1965) and counts were converted to individuals g^{-1} of wool.

Statistical analysis

Data were analysed in the SAS statistical package using either chi-squared (X^2) goodness of fit or t tests to compare treatment group means.

RESULTS

Attractant trials

There were no significant differences in wool moisture content or skin temperatures between the treatments in either attractant trial. Flystrike levels were significantly higher on dung treatment animals (seven sheep with eggs laid) than controls (one sheep with eggs laid) ($X^2 = 7.91$, $P < 0.01$), but no maggot development was recorded.

Treatment with liver greatly increased the incidence of strike, with an average strike of 63.8 eggs and maggots g^{-1} wool on liver treatment animals, compared to 0.2 eggs and maggots g^{-1} wool on control animals ($P < 0.01$) (Table 1). Within the liver treatment animals, there was a significant preference for the midback site over the shoulder, but no significant differences in strike intensity between the rump and shoulder or midback sites (Table 1). Strike progressed furthermost in the midback site; this area being the only one to possess 3rd instar maggots.

TABLE 1: Flystrike levels in shoulder, midback and rump patches on control and liver challenge Romney sheep in Trial 2. Figures are expressed in eggs and maggots g^{-1} wool. Within columns, different superscripts denote significance at $P < 0.05$, while the same superscript denotes no significant difference.

Treatment	Site	Eggs	Maggots	Total
Fleece wetting	Shoulder	0	0	0
	Midback	0	0.11	0.11
	Rump	0.02	0.07	0.09
	Total	0.02	0.18	0.20
Liver attractant	Shoulder	1.82^{a}	4.88^{a}	6.69^{a}
	Midback	5.73^{b}	34.60^{b}	40.32^{b}
	Rump	$2.60^{a,b}$	$14.24^{a,b}$	$16.83^{a,b}$
	Total	10.15	53.72	63.84

Breed comparison trials

In the untreated-sheep breed comparison, fleece moisture was significantly higher in Romney (9.66%) than in Perendale sheep (3.32%) on Day 1 ($P < 0.01$), but no significant difference existed at Day 5. Average fleece lengths were 51 mm for Romneys and 43 mm for Perendales. There was more pronounced midline parting observed in Romneys than in Perendales, and this was observed while the fleeces were wet. There were no significant differences in skin temperatures. Fly strike levels were low on all animals, with eggs laid on 6 Romneys and 1 Perendale, a difference that was not significant. There was no development of maggots on any animal.

In the dung attractant comparison, fleece moisture was significantly higher in Romneys than in Perendales both on Day 1 (Romney = 11.73% moisture by weight, Perendale = 5.03% moisture by weight, $P < 0.05$) and on Day 5 (Average moisture contents = 11.43% and 4.18% for Romney and Perendale respectively, $P < 0.05$). The average fleece length was 84 mm for both breeds. Early strike was recorded on 2 Romneys and 1 Perendale, but there was no larval development.

Liver attractant facilitated considerable oviposition and larval development in both breeds. Regardless of breed, oviposition was highest and the maggot development most advanced in the midback site (Table 2). There were no significant differences in levels of strike between breeds, either in total numbers of eggs and maggots present, or between corresponding patches. Average fleece lengths were 105 mm for Romneys and 92 mm for Perendales. There were no significant differences in wool moisture content.

TABLE 2: Levels of flystrike in liver treatment patches during breed comparison trial. Figures are expressed in eggs and maggots g^{-1} wool. ns = no significant differences in flystrike level.

Site	Romney	Perendale	Significance
Shoulder	2.79	4.74	ns
Midback	19.73	17.25	ns
Rump	12.66	8.99	ns
Total	35.18	30.98	ns

DISCUSSION

Full myatic strike relies on at least three steps (Heath, 1990). Gravid females must first locate sheep, and then assess whether or not conditions are suitable for oviposition. Given an oviposition event, conditions must be favourable to allow maggot development through to the third instar.

Faecal contamination of the breech region has previously been shown to be correlated with high flystrike levels (Morley *et al.*, 1976, Watts *et al.*, 1979, Leathwick and Atkinson 1995, 1996). However, the results from this study suggest that dung alone cannot provide conditions suitable for full myatic strike, but may be used by *L. cuprina* as an olfactory indicator of suitable oviposition conditions.

In comparison, liver fulfils all the requirements of a good attractant. It has a strong odour, and high enough free protein levels to support maggot development through to the third instar.

Further attractant trialing should concentrate on two fronts. The protein requirements of larval *L. cuprina* should be quantified, along with the protein contents of possible attractant compounds. Potential attractants could therefore be first screened in the laboratory, before moving on to field trials. A range of attractants should also be developed. “Self-contained” attractants, such as liver, provide all the requirements for full strike, and do not cause immediate harm to the sheep. Such an attractant could be used for things such as insecticide trials and studies of blowfly ecology. “Modification” attractants would catalyse suitable conditions on the sheep through the promotion of lymph and plasma leakage, and may be more suitable for genetic breeding programmes.

The breed comparisons conducted provided no statistically significant evidence of a breed difference in *L. cuprina* strike susceptibility between Romney and Perendale sheep. However, in the trials conducted, the Romney fleece was more open, retained moisture longer, and was more prone to midline parting. Several studies have shown that *L. cuprina* prefer to oviposit in open fleeces with cavities close to the skin (Barton-Browne, 1958, Rogoff and Barton-Browne, 1956), where there are high humidity and low light levels, thus preventing egg and larval desiccation (Barton-Browne 1962). Romney sheep appear to fit these criteria better than Perendales, at least at the hogget stage.

The results of these trials apply only to the fleece and skin levels of potential resistance and provide no information as to any sub-cutaneous or genetic differences in susceptibility to flystrike. Further work is needed to study these potential levels of resistance. Experiments are required to investigate any mechanisms present that could be manipulated or exploited to increase intrinsic flystrike resistance in sheep populations.

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