# Specialist forages – A role in flystrike management?

D.M. Leathwick[1] and A.C.G Heath[2]
[1]AgResearch, Grasslands Research Centre, Private Bag 11008, Palmerston North, New Zealand.
[2]AgResearch, Wallaceville Animal Research Centre, P.O. Box 40063, Upper Hutt, New Zealand.
Email: Dave.Leathwick@agresearch.co.nz

## Summary
*Forage plants which naturally contain condensed tannins have been under investigation for many years for their potential to ameliorate the impacts of intestinal parasites. Trials showed that lambs grazed on these forages developed fewer dags than lambs grazed on other herbages such as lucerne or pasture and in one case there was an associated reduction in flystrike prevalence. We review subsequent trials which confirmed that lambs grazed on birdsfoot trefoil, a condensed tannin-containing forage, developed fewer dags and suffered less from flystrike than lambs grazed on ryegrass / white clover. This occurred as long as the lambs grazed the birdsfoot trefoil for 7 or more days each fortnight. A series of extension / technology transfer trials on commercial sheep farms confirmed these findings with lambs grazed on pasture being 5 times more likely to be flystruck than lambs grazed on birdsfoot trefoil. Although these forages are expensive to grow and lack persistence farmer interest in them remains high. A number of options for integrating such forages into an integrated programme of flystrike management are proposed.*

## Keywords
Flystrike, dags, forages, birdsfoot trefoil, sulla,

## Introduction

Flystrike is a significant disease of sheep in New Zealand, costing the industry more than NZD$30 million annually in prevention and control (Heath, 1994). Management of the disease has for many years focused on the use of insecticidal treatments, however, there are a number of reasons for investigating non-chemical approaches to deal with the problem;

1. Insecticide resistance is widespread although as yet it is not a serious threat to control;
2. Insecticide residues in wool have been a serious problem and continue to be of concern; and,
3. Interest in "organic" and low chemical production systems is increasing.

Condensed tannins (CT) are polyphenolic compounds present in a variety of plants including a number of legumes which can be grown as forages (Niezen *et al*., 1993). CT-containing forage plants have been under investigation for more than a decade for their potential to ameliorate the impacts of intestinal parasites on sheep production (Niezen *et al*., 1993). A number of studies demonstrated a significant reduction in dag formation when sheep grazed CT-containing forages (Robertson *et al*., 1995; Niezen *et al*., 1995) and in one of these trials there was an apparent associated reduction in flystrike (Niezen *et al*., 1995). Subsequently, more studies were conducted to establish the validity, and if possible the underlying mechanism(s), of this apparent effect of forage type on flystrike prevalence.

Here, we review the science relating to CT-containing plants and flystrike in New Zealand, describe a recent extension programme aimed at encouraging farmer uptake of the concept and finally speculate on possible applications of this approach as part of an integrated pest management (IPM) programme for flystrike in New Zealand.

### Experimental data

#### *Trial 1*
Niezen *et al*. (1995) compared the performance of lambs grazing on either lucerne (*Medicago sativa*) or sulla (*Hedysarum coronarium*). Their aim was to determine whether the CT in sulla could ameliorate the detrimental effects of gastro-intestinal nematode parasites. Two paddocks of each herbage were grazed for a period of 42 days by individual groups of lambs which were either routinely drenched to remove

parasites or remained undrenched and were given 20,000 larvae of *Trichostrongylus colubriformis* at the commencement of the trial. They found that the undrenched lambs grazed on sulla grew significantly faster than those on lucerne (129 cf –39 g/day respectively, $p<0.01$). In addition the lambs grazed on sulla had lower Faecal Egg Counts (FECs), fewer dags and less flystrike (Table 1).

**Table 1. Dag scores and number of undrenched lambs flystruck when grazed on lucerne or sulla.**

| | Dag score* | | | | | Lambs with |
|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | flystrike |
| Lucerne | 2** | 4 | 3 | 1 | 1 | 4 |
| Sulla | 11 | 3 | 1 | 0 | 0 | 0 |

* Score of 0 is completely clean, 4 is heavily soiled
** Number of animals with that score

***Trial 2***

A reduction in dag score in animals grazing forages containing CT had been shown (Robertson *et al*., 1995) but no connection had been made with flystrike despite the well-established link between this disease and dags. Trial 1 was the first to show a putative link between CT-containing forages, reduction in dags and flystrike prevalence and Leathwick and Atkinson (1995) set out to formally test this link.

Four adjacent 2.5 ha paddocks were sown to either the CT-containing birdsfoot trefoil (*Lotus corniculatus* cv Goldie) or to a conventional ryegrass/white clover mix. Unfortunately clover establishment was poor, resulting in the comparison being essentially birdsfoot trefoil vs ryegrass. Two replicates of a 2 x 2 design were established and in each replicate 62 lambs grazing birdsfoot trefoil were compared with 62 lambs grazing ryegrass, with half the lambs in each paddock being drenched fortnightly.

Two trials were run through the expected peak in the fly "season". The first (Trial 2a) ran 32 days (January 21 – February 21) and the second (Trial 2b) 42 days (March 8 – April 18). In Trial 2a lambs went onto the trial undrenched and uncrutched with a mean dag score of 0.9 (see Table 1 footnote). In contrast the lambs in Trial 2b had recently been crutched and shorn and had a mean dag score of 0.1. Three times each week all lambs were examined for flystrike and the position and severity of all strikes were recorded. After a sample of maggots had been collected for species identification strikes were spot-treated with insecticide. Other measurements included live-weight, FEC, mid-side patch wool growth, dag score and dry dag weights (DW) at the end of the trial.

***Trial 2a***

Lambs grazed on birdsfoot trefoil suffered less flystrike, had fewer dags and had higher live-weight gains than those grazed on ryegrass (Table 2). Lambs drenched fortnightly suffered less flystrike, had fewer dags and had higher live-weight gains than undrenched lambs. Flystruck lambs had lower live-weight gains than those unaffected (64 g/day (N=104) vs 105 g/day (N=146) respectively; $p < 0.01$).

**Table 2. The effect of pasture species and drenching on dag weights, live-weight gain and the prevalence of flystrike in Trial 2a.**

| | Birdsfoot trefoil | Ryegrass | Drenched | Undrenched |
|---|---|---|---|---|
| Flystrike (% lambs struck) | 32 | 51** | 26 | 57** |
| Dags (g DW) | 79 | 108** | 68 | 118** |

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**Table 3. The effect of pasture species and drenching on the prevalence of flystrike, dag weights, live-weight gain and faecal dry matter in Trial 2b.**

| | Birdsfoot trefoil | Ryegrass | Drenched | Undrenched |
|---|---|---|---|---|
| Flystrike (% lambs struck) | 1.5 | 7.4* | 4.1 | 4.8ns |
| Dags (g DW) | 9.7 | 14.3ns | 8.8 | 15.2ns |
| Live-weight gain (g/day) | -14 | -31ns | -13 | -32ns |
| Faecal % DM | 29.7 | 22.1** | | |

ns not significant
* $p < 0.05$
** $p < 0.01$

***Trials 2a and b combined***

When the proportion of lambs struck in each of the 16 treatment groups was regressed against the mean dag weight for each group a strong relationship between the prevalence of flystrike and the amount of dags in lambs was indicated ($y = -2.8 + 0.5x$; $p < 0.01$; $R^2 = 97\%$).

These results were taken as confirmation that grazing lambs on forages containing CT could significantly reduce the amount of dags and consequently the incidence of flystrike.

***Trial 3***

In the subsequent year, Leathwick and Atkinson (1996) used the Trial 2 site to investigate how much birdsfoot trefoil was needed in the diet of lambs to yield a significant benefit in terms of reducing the amount of dags and flystrike.

After the ryegrass paddocks had been over-sown with white clover two replicate trials were run in which treatments consisted of groups of lambs (N=26) that grazed birdsfoot trefoil for either 14, 10, 7, 4 or 0 continuous days each fortnight. When not grazing birdsfoot trefoil the lambs grazed the ryegrass / white clover swards. The trials were designed so that groups of lambs were swapped between pairs of paddocks at appropriate intervals such that a constant stocking rate was maintained at all times. The first trial, (spring), ran for 56 days (October 25 – December 20) while the second (summer) ran 48 days (January 17 – March 6). As with Trial 2, lambs were inspected 3 times weekly for flystrike which was spot treated with insecticide after maggots had been collected for species identification. Measurements were similar to Trial 2 but in Trial 3 the 2 trials were analysed as a single experiment with 2 times x 2 replicates x 5 treatments.

Flystrike prevalence differed between the two time periods (Table 4) which reflected the fact that the spring trial commenced before the presence of substantial numbers of flies. This was reflected by the number of flies caught in West Australian type monitor traps.

**Table 4. Percentage flystrike occurring in groups of lambs (N=52) grazed on birdsfoot trefoil or ryegrass / white clover for different numbers of days each fortnight.**

| | Days each fortnight grazing birdsfoot trefoil | | | | |
|---|---|---|---|---|---|
| Time – period | 14 | 10 | 7 | 4 | 0 |
| Oct. 25 – Dec. 20. | 2.0 ** | 2.1 | 3.8 | 5.8 | 14.0 |
| Jan. 17 – Mar 6. | 12.2 ** | 19.6 | 49.0 | 54.0 | 58.0 |

** treatment means differed significantly ($\chi^2$ test: $p < 0.01$)

These results were interpreted to indicate that the response from grazing birdsfoot trefoil varied with the "fly pressure" i.e., that when fly numbers were not high (in spring) benefit was apparent from grazing birdsfoot trefoil 4 days each fortnight. However, when flies were more abundant (summer) it was necessary to graze birdsfoot trefoil for 10 days each fortnight to effect a substantial reduction in flystrike prevalence

For the trial overall, lambs which grazed birdsfoot trefoil for 7 or more days each fortnight had significantly fewer dags at the end of the trial than did lambs which grazed birdsfoot trefoil for 4 or 0 days each fortnight (Table 5). Again there was a significant link between the amount of dags and flystrike, with struck lambs having significantly more dags than lambs that were not struck (185 vs 105g

respectively; $p < 0.01$). When the proportion of flystruck lambs was regressed against mean dag weight for each of the 20 treatment groups the goodness of fit was poor ($R^2 = 34\%$). However, when the same relationship was assessed for the two time periods separately, the goodness of fit for the spring trial remained low ($R^2 = 34\%$) while that for the summer period was much higher ($R^2 = 68\%$). Thus the relationship between dags and flystrike is poor when there are few flies present to cause strike.

**Table 5. Mean percentage of lambs flystruck, weight of dags, live-weight gain and faecal dry matter content of lambs grazed on birdsfoot trefoil or ryegrass / white clover for differing numbers of days each fortnight.**

| | Days each fortnight grazing birdsfoot trefoil | | | | |
|---|---|---|---|---|---|
| | 14 | 10 | 7 | 4 | 0 |
| % of lambs struck | 7** | 11 | 26 | 29 | 36 |
| Dags (g DW) | 86A[#] | 111A | 113A | 149B | 154B |
| Live-weight gain (g/day) | 160a[#] | 120ab | 104bc | 100bcd | 73d |
| Faecal DM (%) | 19.4 | 21.9 | 19.4 | 18.1 | 17.1 |

** treatment means differed significantly ($\chi^2$ test: $p < 0.01$)

[#] Means within a row which have letters in common are not significantly different, A = $p < 0.01$, a = $p < 0.05$.

Live-weight gains when lambs grazed birdsfoot trefoil were superior to those on ryegrass/white clover and as with Trial 1 reduction in the amount of dags was not associated with a difference in faecal dry matter (Table 5).

The authors concluded that in order to realise significant benefits from grazing birdsfoot trefoil farmers would need to graze their lambs on this forage for a minimum of 7 days each fortnight.

## Extension / Technology Transfer

Subsequent to the trials described above, a 3 year industry-funded programme was initiated to evaluate CT-containing forages (sulla and birdsfoot trefoil) with a view to facilitating their promotion and acceptance on commercial sheep farms (Niezen *et al*., *in prep*). The project was initially (year 1) aimed at refining methods for establishing forages on farms. Once forages were successfully established (years 2 & 3) they were to be used for on-farm performance comparisons with pasture and/or other specialist forages such as chicory. The first stage involved 7 farms whilst animal performance was compared only on the 4 farms where both sulla and birdsfoot trefoil were established.

Both forages established slowly and in the first 4 months produced less dry matter (DM) than permanent pasture. However, once established sulla produced 3,000-5,000 kg DM/ha more than permanent pasture, principally over the summer. Birdsfoot trefoil was more similar to pasture in production and seasonality than was sulla. Sulla persisted less than 2 years while birdsfoot trefoil lasted more than 3 years.

The higher energy contents of the two forages were not overall translated into better animal performance. This was taken to reflect a lack of knowledge on how to optimise grazing of these forages. Although average performance on the forages was no better than pasture, there were some outstanding examples on individual farms where performance on sulla, in particular, was excellent with growth rates up to 475 g/day being achieved on occasions.

Lambs grazed on birdsfoot trefoil had fewer dags than those grazed on pasture or chicory, and lambs were 5 times less likely to get flystrike when grazing on birdsfoot trefoil than on pasture.

Because they are expensive to establish and maintain (e.g. weed control) and do not persist compared with pasture, sulla and birdsfoot trefoil were generally concluded to be uneconomic. Despite this there was still considerable farmer interest in them. One farmer commented “Anything that has lambs growing rapidly, but has them free of dags, is every sheep farmer’s dream”.

A number of farmers saw some potential for birdsfoot trefoil used as a “hospital” paddock associated with reduced dagginess and used for tail-end lambs (“poor doers”) and for lambs approaching sale that could not by law be drenched or dipped.

## Options for integration

1. The most obvious use of CT-containing crops in flystrike management is to grow lambs continuously on these crops and reduce flystrike incidence through an overall reduction in the amount of dags on sheep on the farm. However, as highlighted above, there are problems, yet to be solved with these crops in terms of cost, persistence and seasonality of production. In the short-term then they are more likely to remain specialist forages with only a relatively small area of farms being given over to them.
2. Perhaps the most obvious short-term use of these forages, in flystrike management, will be the "hospital" paddock approach. With increasing withholding periods associated with pesticide use, having a 'safe' paddock to hold over lambs approaching sale is clearly an advantage.
3. In a similar manner, use of these forages could be integrated with farm shearing regimes to minimise flystrike in the pre-shearing interval when chemical applications are not allowed or are impractical. Further, grazing such forages for intervals pre- and post-crutching and/or shearing could result in substantial periods of low lamb susceptibility to flystrike without recourse to chemicals.
4. It is assumed that the usefulness of these forages will be even greater to those farms rearing animals under "bio-dynamic" or "organic" protocols where pesticide use is largely prohibited. In these situations one might see grazing of CT-containing forages integrated with intensive, early season use of flytraps and strategic crutching / shearing programmes.

## Discussion and Conclusions

Numerous studies, besides those mentioned here, have demonstrated the ability of plants containing CT to reduce dag formation in sheep (Robertson *et al*., 1995; Niezen *et al*. 1998). However, it remains unclear how dag formation is reduced by CT-containing plants as in many trials this occurs without any apparent change in faecal moisture content. A recent review indicates as yet unknown changes in intestinal function having an influence on faecal characteristics and adhesion to wool and faeces (Waghorn *et al* 1999). The action of CT-containing plants in reducing dag formation appears to be via a different mechanism to that associated with endophyte, where increased dag formation on endophyte contaminated pastures is invariably associated with scouring and low faecal dry matter (Fletcher *et al*., 1990; Fletcher and Sutherland, 1993). The presence of endophyte in the ryegrass is the likely cause for the observed difference in faecal DM in Trial 2b, although an equivalent effect was not seen in trial 3.

The link between dags and flystrike is well known to farmers and advisors alike and is consistent with a high proportion of strikes in young sheep being in the hindquarter and perineal regions (Heath and Bishop, 1995). It is perhaps not surprising then that a forage which can consistently result in fewer dags will also result in less flystrike. The experiments summarised here were the first to demonstrate this relationship and it is encouraging to see that the effect remains when these forages are transferred onto commercial farms. Moreover, the relationships evident in the trial data indicate that the CT-containing forage effect on flystrike is mediated substantially through their ability to reduce dag formation i.e., there is no "special" characteristic of these forages which deters flystrike in other ways.

Despite some problems remaining with the growing of such forages, farmer interest remains high. The challenge remains as how to best fit them into integrated systems for flystrike management such as those described by Cole and Heath (1999). Given the ingenious nature of farmers it would seem inevitable that before long someone will devise a means of using these crops in an appropriate and useful manner.

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