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THE EFFECT OF CUTTING MANAGEMENT AND FUNGICIDE APPLICATION ON COUMESTROL LEVELS IN THREE LUCERNE CULTIVARS

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SUMMARY

A field trial with three cultivars was used to assess the effect of resistance to leaf diseases, cutting management and fungicide sprays on the amount of foliar disease infection and the coumestan content in lucerne (*Medicago sativa*). A highly significant correlation ($r = 0.84^{**}$) between foliar infection and coumestan levels was established. Cutting and fungicide treatments reduced coumestan levels especially in Washoe and Wairau. Saranac had lower coumestan levels under cutting and fungicide treatments. Fungicides are not economic compared to effective grazing management of resistant cultivars, in providing lucerne with low coumestan levels which could be used for flushing ewes.

INTRODUCTION

Since Coop and Clarke (1960) established that flushing and mating ewes on lucerne may depress lambing percentages, farmers have been reluctant to graze lucerne during the autumn flushing period. Especially after a dry summer, when other feeds are in short supply, lucerne could make a useful contribution, if this problem could be overcome.

The depression of lambing percentages from lucerne is largely due to a decrease in the ovulation rate and a resultant decrease in multiple births (Scales *et al* 1977, Smith *et al* 1980). These effects result from the presence in lucerne of a group of oestrogenic compounds known as coumestans. Coumestrol, the principal oestrogenic compound in lucerne, accumulates in the herbage in response to infection by fungi (Sherwood *et al* 1970, Morgan and Parbery 1980) and attack by aphids (Kain and Biggs 1981). Hart and Close (1976) showed that fungicidal sprays reduced the level of foliar fungal infection.

It is obvious that lucerne would have considerable potential as a flushing feed if coumestan levels could be controlled. Cultivar resistance to foliar diseases, combined with appropriate management may be enough to control these levels. A field trial was established at Lincoln to assess the effect of resistance to leaf diseases, cutting management, and fungicidal sprays on the amount of foliar disease infection and the coumestan content of lucerne herbage.

MATERIALS AND METHODS

The trial was sown at Lincoln in October 1979, using a split plot design with three replicates. Fungicide treatments were the main plots, cutting treatments subplots and cultivars sub-subplots. Cultivar plots were 3.0m² in area. Each set of cultivar plots was separated by an uncut Washoe buffer to act as a barrier to spray drift and to provide a source of inoculum for foliar diseases. The cultivars used were Wairau and Washoe which are susceptible to foliar diseases, and Saranac which is moderately resistant (Dunbier *et al* 1976).

All plots were cut on 12 February 1980 before application of any treatments. On 6 March the "cut" treatment plots were cut and weighed. All plots were cut and weighed on 18 April, on completion of the trial. Starting from 28 February a spray mixture containing benomyl (2 g/litre), mancozeb (2 g/litre) and universal spraying oil (10

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ml/litre) was applied to the “sprayed” plots approximately every 10 days. Chlorpyrifos (3.0 ml/litre) was applied to control aphids when necessary. Metalaxyl (2 g/litre) was applied on 26 March to control any increase of downy mildew (*Peronospora trifoliorum*), in a period of moist weather.

Samples of five stems per plot were taken at random once per week. Foliar diseases were identified, and the proportion of leaf area infected was assessed using the keys for lucerne disease assessment developed by James (1971). Because of the limitation of the number of samples which could be analysed, a bulk sample from the three replicates of each treatment was subsampled and analysed for coumestans. Coumestan levels were determined using the quantitative technique of Sherwood *et al* (1970). Three chromatograms were run from each sample and coumestrol was estimated fluorometrically. The trial was analysed as a split-split plot randomised block with appropriate LSD calculated for comparisons of means.

RESULTS AND DISCUSSION

Rainfall figures for the trial period are presented in Fig. 1. There were many cloudy and rainy days, which resulted in cool daytime and mild night-time temperatures. Ground conditions were wet and soil temperatures lower than usual for the time of year. This resulted in slow regrowth in the “cut” plots.

Mean stem lengths of all cultivars are shown in Fig. 2. There was approximately a 10 cm regrowth on the “cut” plots by the final cut, compared with over 30 cm in the “uncut” plots. There was, however, no significant dry matter difference between the “cut” and “uncut” plots over the trial period (see Table 1). In the “uncut” treatment, fungicide treated plots yield 18% more herbage ($P \leq .05$) than the untreated plots. This effect came from the cultivars Wairau and Washoe, while Saranac showed no response to fungicide treatment.

TABLE 1: Dry matter yields with different cutting and fungicide treatment. Mean of all cultivars in kg/ha.

Cutting treatment	Fungicide Treatment		significance
	“untreated”	“sprayed”	
“cut”	2116	1981	n.s.
“uncut”	1713	2077	$P \leq 0.05$
significance	n.s.	n.s.

Fig. 1: Daily rainfall (mm) at Lincoln during the experimental period.

Fig. 2: Stem length (mean of all cultivars) during the experimental period.

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The moist conditions during the trial period resulted in a rapid build-up of foliar fungal diseases as shown in Fig. 3. The main diseases present were common leaf spot (*Pseudopeziza medicaginis*) and stemphylium leaf spot (*Stemphylium botryosum*). Yellow leaf blotch (*Leptotrichila medicaginis*) and downy mildew were noted after the continuous heavy rainfall at the end of March.

Fig. 3: Differences between levels of foliar fungal infection in three lucerne cultivars and the effect of cutting.

The proportions of leaf area infected in the “cut” and “uncut” treatments are shown in Fig. 3. In all three cultivars there was a lower level of foliar infection in the “cut” plots. These differences were large and significant for Wairau and Washoe from 45 days after cutting. For Saranac, although the differences were significant they were smaller. Saranac had the lowest level of foliar diseases over all sampling dates and was significantly ($P \leq .05$) below Washoe from 30 days after cutting, in both the “cut” and “uncut” plots. Saranac had significantly lower levels of foliar diseases than Wairau after about 42 days from cutting in the “uncut” treatment.

The response to fungicidal sprays was greatest in Washoe and Wairau. In both the “cut” and “uncut” treatments Washoe and Wairau had significantly lower levels of infection in the sprayed plots after 38 days from cutting. Saranac, however, only showed a significant ($P \leq .05$) response in the “uncut” treatments after 51 days from cutting.

Hanson *et al* (1965) demonstrated a relationship between foliar fungal infection and coumestan levels in lucerne. In our data there is a highly significant correlation ($r = 0.84^{**}$, 70 d.f.) between the proportion of leaf area infected by foliar pathogens (mean of three replicates) and the square root of the coumestan level in the lucerne (mean of three coumestan analyses). Mean coumestan levels for each of the three cultivars for the duration of the trial are shown in Fig. 4. Young regrowth in both cutting treatments had low coumestan levels and the levels increased with time, in line with the increase in foliar diseases. The use of the “cut” treatment kept coumestan levels at a low and probably safe level for the first 8 weeks of the trial. Fungicidal application maintained low coumestan levels and kept the lucerne safe for a similar period without cutting. The superiority of Saranac was again apparent in its lower coumestan levels in the unsprayed plots.

Fig. 4: Effect of cutting and fungicide applications on coumestan levels.

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CONCLUSIONS

By effective autumn management, lucerne can provide a safe source of feed for the flushing and mating of ewes. Young regrowth contains low levels of foliar diseases and coumestans. Flushing and mating on this young lucerne will not depress ovulation rates and lower resulting lambing percentages. Fungicides which control fungal leaf spotting organisms could be used to provide lucerne of low coumestan levels but are not economic compared with effective grazing or cutting management of cultivars with resistance to foliar fungal diseases.

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REFERENCES

- Coop, I.E. and Clarke, V.R., 1960. The reproductive performance of ewes mated on lucerne. *N.Z. J. Agric. Res.* 3: 922-933.
- Dunbier, M.W., Close, R.C. and Ellis, T.J., 1976. Disease and pest-resistant lucerne cultivars for New Zealand. *Proc. 29th N.Z. Weed and Pest Control Conf.* 46-49.
- Hanson, C.H., Loper G.M., Kohler, G.O., Bickoff, E.M., Taylor, K.W., Kehr, W.R., Stanford, E.H., Dudley, J.W., Pederson, M.W., Sorenson, E.L., Carnahan, H.L., and Wilsie, C.P. 1965. Variation of coumestrol content of alfalfa as related to location, variety, cutting, year, stage of growth and disease. *U.S. Dep. Agric. Tech. Bull. No. 1333*.
- Hart, R.I.K. and Close, R.C., 1976. Control of leaf diseases of lucerne with benomyl. *Proc. 29th N.Z. Weed and Pest Control Conf.* 42-45.
- Kain, W.M. and Biggs, D.R., 1981. Effect of pear aphid and blue-green aphid (*Acyrtosiphon* spp) on coumestrol levels in herbage of lucerne. *N.Z. J. Agric. Res.* 23: 563-568.
- James, C.W., 1971. An illustrated series of assessment keys for plant diseases, their preparation and usage. *Can Plant Dis. Surv.* 51: 39-65.
- Morgan, W.C. and Parbery, D.G., 1980. Depressed fodder quality and increased oestrogenic activity of lucerne infected with *Pseudopeziza medicaginis*. *Aust. J. Agric. Res.* 31: 1103-1110.
- Scales, G.H., Moss, R.A. and Kelly, R.W., 1977. Reproductive performance of ewes mated on lucerne. *Proc. N.Z. Soc. Animal Prod.* 37: 152-7.
- Sherwood, R.T., Olah, A.F., Oleson, W.H. and Jones E.E., 1970. Effect of disease and injury on accumulation of a flavonoid oestrogen, coumestrol, in alfalfa. *Phytopathology* 60: 684-688.
- Smith, J.F., Jagusch, K.T., Burnswick, L.F.C., and McGowan L.T., 1980. The effect of lucerne feeding on ovulation rates in ewes. *Proc. N.Z. Soc. Animal Prod.* 40: 44-49.