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INCIDENCE OF BLOAT IN LACTATING DAIRY COWS FED CLOVER-DOMINANT HERBAGE AND MAIZE SILAGE

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SUMMARY

In 12 experiments in which white *(Trifolium repens),* red *(Trifolium pratense)* or Persian *(Trifolium resupinatum)* clovers, either with or without maize *(Zea mays)* silage, were fed to lactating dairy cows in northern Victoria, maize silage was shown to significantly ($P < 0.01$) reduce the incidence of bloat; 126 cases of bloat were recorded where the clovers were fed alone and only 3 cases were observed where maize silage was used to supplement the herbage. It was also found that, in some instances in which cows were offered white clover as the sole ration, virtually no bloat was observed whilst on other occasions, bloat was prevalent and very severe. There was a significant ($P < 0.01$) negative association between the incidence of bloat and the presence of large quantities of flowers in the white clover. It is suggested that this was due to high concentrations of condensed tannins in the flowers; this suggestion is discussed.
Keywords: dairy cows, clover, maize silage, bloat, condensed tannins.

INTRODUCTION

Research has clearly demonstrated that lactating dairy cows are significantly more productive when they are fed clovers than when they are fed grasses (Stockdale 1992). However, bloat is normally observed whenever most temperate clovers constitute a substantial proportion of the herbage on offer (McWilliam 1974). It is always of concern to dairy farmers and is continually put forward as a major reason preventing farmers from pursuing improvements in pasture quality by the introduction of more legumes. This report summarises the findings from a number of nutrition experiments in which some aspects of feeding influenced the incidence of bloat in lactating dairy cows.

MATERIALS AND METHODS

The incidence of bloat was monitored in 12 experiments conducted at the Kyabram Dairy Research Centre in Victoria during the period 1986-1993. In all of these experiments lactating cows were offered either white clover *(Trifolium repens),* red clover *(Trifolium pratense),* or Persian clover *(Trifolium resupinatum)* as a basal ration. The research included both indoor feeding and grazing experiments. In each experiment, pure swards of either white clover (cv. Haifa), red clover (cv. Redquin), or Persian clover (cv. Maral) were fed at levels of intake ranging from 7.3-24.0 kg dry matter (DM)/cow.day. On top of this, some cows were also fed quantities of either maize (*Zea mays)* silage or a maize silage based supplement ranging up to 10.7 kg DM/cow.day. Some details of the experiments are given in Table 1.

In the pen feeding experiments, cows were fed half their daily ration twice a day. Freshly forage-harvested herbage was offered first, followed by the supplement about 2-3 hours later; these cows were fed in individual stalls. In the grazing experiments, cows were offered fresh strips of pasture twice each day, after each milking. In contrast to the pen feeding experiments, the grazing cows were individually fed their supplement before they returned to the pasture. When at pasture, cows grazed in groups according to their allocated treatment.

In individual experiments (Table 1), cows were either not drenched, or drenched twice daily with the recommended dose of Teric12A23B (ICI, Australia). Throughout all experiments, the incidence of bloat in each treatment was recorded daily. In addition, in one experiment (Experiment 11 - Table 1), 12 cows were drenched twice daily with Teric12A23B while 12 cows were not drenched at all. Comparative milk yields were recorded twice daily throughout this experiment.

Chi-square tests (LeClerg *et al.* 1962) were done to make statistical comparisons when considering aspects that might impact on the incidence of bloat; chi-square probabilities were determined for both the influence of white clover flowers and the effect of feeding maize silage on the incidence of bloat. To assess the effect of drenching on milk production, standard errors about mean milk yields were calculated for the 2 groups of cows in Experiment 11.

RESULTS

Over the 12 experiments, a total of 129 incidences of bloat (ranging from O-42 in individual experiments - Table 1) were recorded. In those experiments in which white clover was fed, there was a very strong negative association between the presence of flowers in the sward and bloat incidence

Table 1. Details of each of the 12 spring (October to December - Spr) and autumn (February to May - Aut) experiments in which incidences of bloat were recorded

	Time of year	No. of cows	Duration (days)	Grazed (G) Penned (P)	Clover	Food eaten (kg DM/cow.day)		Clover protein content (% DM)	Drench	Bloat incidence (no.)
						Clover	Maize silage			
1	Spr	19	35	P	Persian	4.0-14.5	0-10.7	20.9	No	15
2	Spr	20	40	G	Persian	12.2-24.0	0-8.3	20.0	No	22
3	Spr	15	35	G	White	12.8-15.2	0-5.0	17.2	Yes	0
4	Aut	15	35	G	White	7.9-11.5	0-7.3	19.6	Yes	11
5	Spr	32	38	G	Persian-white	10.3-16.0	0-3.7	18.2	Yes	14
6	Spr	24	49	P	White	15.2-18.8	0-5.6	18.2	No	0
7	Aut	24	42	P	White	8.9-15.3	0-7.5	20.7	No	10
8	Aut	32	35	G	Red-white	9.7-12.9	0-3.8	20.6	Yes	5
9	Aut	16	32	G	White	7.7-12.7	0-4.3	22.7	Yes	42
10	Spr	24	36	G	White	12.2-14.4	0-4.9	24.6	Yes	10
11	Spr	24	34	G	White	10.6-13.2	0-5.0	18.0	Both	0
12	Aut	12	32	G	White	12.0-12.9	0-5.0	23.8	Yes	0

(Table 2). Even stronger was the negative association between feeding maize silage and bloat incidence (Table 2), and this occurred regardless of type of clover. In the 3 instances in which bloat was recorded when maize silage was fed, at least 40% of the silage had been replaced with cracked barley grain.

Table 2. Chi-square (χ^2) tests for two factors associated with the incidence of bloat in lactating dairy cows. $\chi^2 = 0$ for P = 1.00 when testing for the presence of a 1:1 ratio within these comparisons. $\chi^2_{d.f.=1}$ for P = 0.01 is 6.635

Factor	Comparison	Bloat incidence	χ^2
Presence of white clover flowers	<5% of DM	60	54.3
	>5% of DM	2	
Feeding of maize silage	No	126	117.3
	Yes	3	

In Experiment 11, the mean daily milk yield, over the last 4 weeks of the experiment, of those cows that were drenched was 20.4 (s.e. ±0.84) kg/cow while that of those cows that were not drenched was 20.9 (s.e. ± 0.75) kg/cow.

DISCUSSION

A surprising result was that bloat was not always observed when cows were offered pure white clover diets. One of the plant factors associated with bloat is a high concentration of soluble clover protein (particularly F1 leaf protein) which is released quickly into the rumen upon ingestion of herbage (McWilliam 1974). A stable foam is formed in the rumen which traps the gaseous products of fermentation and leads to a build up of intra-ruminal pressure (Ayre-Smith 1971). The soluble clover leaf proteins are considered largely responsible for the stabilisation of the foam. The Fl protein concentration in rumen liquor can be reduced by condensed tannins which bind and precipitate the protein (Jones and Mangan 1977); the protein may then be released beyond the rumen where the environment is acidic-

Jones *et al.* (1976) reported that condensed tannins are found in the flower petals of white clover. Across the experiments reported here, flowers constituted from 0-25% of the total white clover dry matter on offer. A spot check of the condensed tannin content of white clover flowers produced in summer revealed a concentration of 3.3% in whole flowers and 6.0% in flower petals. Therefore, although the cows were always offered pure white clover, it appears that an abundance of flowers provided sufficient

condensed tannin to significantly lower the incidence of bloat.

Stockdale and Dellow (1994) reported results from nutrition studies which provide additional support for the condensed tannin hypothesis presented here. They fed white clover with maize silage to dairy cows in early lactation (November/December) or late lactation (April/May); in early lactation, flowers constituted up to 25% of the herbage on offer while in late lactation, they were a negligible proportion of the sward. Contrary to expectations, the marginal responses in milk yield to feeding additional maize silage were greater in late, rather than in early, lactation. Maize silage is particularly low in protein and relies on the basal ration to provide sufficient rumen degradable protein for its effective utilisation in the rumen. By complexing with much of the soluble protein in the white clover, the condensed tannins present in the flowers probably induce a shortage of protein which results in an inefficient use of the dietary energy provided by maize silage in early lactation. This type of response has been demonstrated for *Lotus* spp. by Waghorn and Shelton (1992).

The use of a roughage, such as hay, has been suggested as an effective means of bloat prophylaxis (Holmes and Donohue 1992). Anecdotal evidence has attributed the same property to maize silage. The research reported here confirms that maize silage does indeed reduce the incidence of bloat. The probable reasons for the apparent efficacy of roughages in bloat prevention are first, one of dilution of soluble protein entering the rumen (lower protein intake *per* se, and Fl protein in particular) and second, the fact that the cows are unlikely to eat clover as rapidly after an initial meal of maize silage as they otherwise would where no supplement was fed.

Of the 129 cases of bloat observed, 47 occurred in experiments where drenching was not done while 82 cases were reported for experiments in which twice daily drenching for bloat control was routinely undertaken. Drenching resulted in a probable underestimate of the value of flowers on the severity and/or incidence of bloat in cows grazing white clover but it may also have overestimated the value of maize silage as a bloat prophylactic when bloat was prevalent.

In Gippsland, research into bloat prevention has shown that drenching can result in up to a litre of extra milk even when there is no sign of bloat in cows grazing clover (P.J. Moate, personal communication). In one experiment in this study, half the cows were drenched while the rest were not. The result in this instance was that there was no effect of drenching on milk production. This result corroborates earlier research at Kyabram in which a Pluronic and a Teric were assessed for their effects on milk production, independent of their effects as anti-bloat agents (Stockdale 1980).

CONCLUSIONS

This research has indicated that feeding options can reduce the likelihood of bloat. Specifically with regard to white clover, the choice of variety could also be an important consideration when farmers are renovating their pastures. However, there is some need to be cautious. While the use of high flowering white clover varieties may result in little or no bloat at certain times of the year, it may also result in a deficiency of rumen degradable protein when starch-based supplements are fed, thereby limiting responses to these supplements (Stockdale and Dellow 1994).

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