SHORT COMMUNICATION

Effect of stage of growth of alfalfa on the incidence of bloat in cattle[1]

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[2]*Agriculture and Agri-Food Canada, Range Research Unit, 3015 Ord Road, Kamloops, British Columbia, Canada V2B 8A9;* [3]*Pacific Agri-Food Research Centre, Agriculture and Agri-Food Canada, Highway 97, Summerland, British Columbia, Canada VOH 1ZO.* *Received 27 June 2000, accepted 23 August 2000.*

Thompson, D. J., Brooke, B. M., Garland, G. J., Hall, J. W. and Majak, W. 2000. **Effect of stage of growth of alfalfa on the incidence of bloat in cattle.** Can. J. Anim. Sci. **80**: 725–727. Alfalfa of different maturities was produced simultaneously by varying the timing of the first cut. Groups of fistulated steers were confined and simultaneously fed alfalfa herbage at three stages of growth once a day. More bloat occurred during the vegetative stage of growth, it declined during bud development, and it was absent during bloom. This pattern occurred with both the number of cases of bloat and with the severity of bloat, which was much greater during the vegetative stage. Feed quality components also varied significantly between stages as did the leaf:stem ratio.

Key words: Cattle, bloat, legumes, *Medicago sativa* L.

Thompson, D. J., Brooke, B. M., Garland, G. J., Hall, J. W. et Majak, W. 2000. **Effet du stade de croissance de la luzerne sur la fréquence d'apparition du météorisme chez les bovins**. Can. J. Anim. Sci. **80**: 725–727. Nous avons obtenu simultanément, de l'herbage de luzerne de différents stades de croissance en manipulant les dates de la première récolte. Des groupes de bouvillons fistulisés élevés en claustration recevaient en même temps une fois par jour de l'herbe de luzerne coupée à trois stades de précocité. Les cas de météorisme les plus fréquents correspondaient à la consommation de luzerne au stade végétatif, ils diminuaient quand la récolte était au stade du bouton et disparaissaient complètement avec le stade de floraison. Ce comportement s'appliquait aussi bien au nombre de cas de météorisme qu'à leur degré de gravité, lequel était beaucoup plus élevé au stade végétatif de la culture. Les composantes nutritionnelles du fourrage, ainsi que le rapport feuille : tige, manifestaient également des variations significatives selon le stade de croissance.

Mots clés: Bovins, météorisme, légumineuse, *Medicago sativa* L.

Alfalfa (*Medicago sativa* L.) is recognized as one of the most nutritious forages available and is widely used as a conserved forage in diets of cattle and sheep. However, the utilization of alfalfa by grazing livestock has been limited due to its potential for causing frothy bloat on pastures. As reviewed by Majak et al. (1995), numerous studies have shown a positive association between the incidence of bloat and the protein content of alfalfa. The concept that the probability of bloat decreases with advancing plant maturity is generally accepted and, moreover, the growth stage of the legume is recognized as one of the most important factors influencing the severity of pasture bloat. To our knowledge, however, these concepts have not been validated experimentally in animal feeding trials. The objective of the present study was to simultaneously feed alfalfa at the vegetative, bud and bloom stages of growth to cattle to determine differences, if any, in the bloat potential of alfalfa. This experimental design provided a comparison of the stages of growth under conditions of identical weather and daylength.

Feedlot trials were carried out at Kamloops, BC, during the summers of 1997 and 1999. Each trial had a three-period crossover design using three groups of animals, four per group. Each period of a crossover trial continued until the sum of the cases of bloat from the three groups reached 24 (Majak et al. 1995). Between periods, cattle were fed alfalfa hay for 1 d. Animals were cared for under the guidelines laid down by the Canadian Council on Animal Care. Eight animals were common to the two experiments, but the other four were replaced in 1999 due to old age.

The ruminally fistulated 7- to 10-yr-old Jersey steers weighing 700 to 800 kg in 1999, were confined in pens and were fed fresh alfalfa herbage adjusted to 10 kg DM head^{-1} d^{-1} at 0800 h (Majak et al. 2001). Ruminal cannulae of all steers were opened at least once daily beginning at approximately 0.75–2.0 h after feeding began to assess of the severity of bloat as described by Majak et al. (1995). A single animal bloating on 1 d was counted as one animal-day of bloat, but the animal may have distended more than once on that day. Thus, in addition to the individual cases of bloat, the number of multiple distensions per animal per day were also recorded. The data of each year were analysed sepa-

[1]*Portions of these findings were presented at the 1998 Annual Meeting of the Canadian Society of Agronomy held 7–8 July in Vancouver, British Columbia, and at the 2000 North American Alfalfa Improvement Conference held 16–19 July in Madison, Wisconsin.*

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Table 1. Occurrence of bloat[z] in cattle fed fresh alfalfa at three stages of growth in 2 yr

	Animal-days of bloat			Incidence of distension per day			
				Vegetative		Bud	
Year	Vegetative	Bud	Bloom	Once	Twice or more	Once	Twice or more
1997	62[y]	10	0	25[x]	37[x]	9	1
1999	67[y]	10	0	36	31	8	2

[z]Scoring 3 or higher (Majak et al. 1995).
[y]$P < 0.01$ for vegetative versus bud and vegetative versus bloom.
[x]$P < 0.05$ for vegetative versus bud.

rately. To account for the daily fluctuations in the bloat potential of alfalfa, comparisons of the effects of stage of growth on the occurrence of bloat were made using Cochran's Q-test (Cochran 1950) adapted for crossover designs. Differences in the incidence of multiple distensions were tested using a chi-squared test. Comparisons of feed quality were made using analysis of variance followed by a least significant difference test for means separation. A significance level of 0.05 was used throughout and the observed tail probabilities (P) are reported where appropriate.

Beginning in May, 6 wk before the commencement of the trial, strips of alfalfa (10 × 240 m) were cut at 5-d intervals across a field of WL225 alfalfa to provide stands of alfalfa with a range of growth stages. During the trial, strips of 2 × 80 m, 2 × 120 m and 2 × 240 m alfalfa, at the bloom, bud and vegetative stages, respectively, were harvested daily for feeding. Growth stage was determined visually and confirmed by the numerical scale of Kalu et al. (1987). Ten representative grab samples cut at 5 cm were separated, while fresh, into leaf (including flowers and buds) and stem portions, then dried and weighed to determine leaf:stem ratio.

Cattle were fed freshly chopped alfalfa herbage daily to provide representative and homogeneous plant material at each stage of growth. Grazing was avoided because, under these conditions, cattle may have selected specific stages or portions within a stand of alfalfa. In a separate experiment, it was also shown that the incidence of bloat was 33% higher ($P < 0.05$) if cattle were fed herbage than if they were allowed to graze alfalfa continuously over 24 h (W. Majak, unpublished data). This result agrees with the concept of using uninterrupted feeding regimens for bloat control (Majak et al. 2001). Therefore, one would expect feedlot tests to be more sensitive to treatment effects.

The highest number of animal-days of bloat clearly occurred during the vegetative stage of growth (Table 1). The number of animal-days with more than one distension per day was greater during vegetative stages than during bud stages (38 vs. 1 in 1997; 31 vs. 2 in 1999). As well, the incidence of multiple distension in 1997 was significantly higher during vegetative stages than during bud stages (Table 1). The absence of bloat during bloom (Table 1) presents yet another management strategy for the prevention of frothy bloat in cattle. Grazing alfalfa during more advanced stages of growth will significantly reduce the risk of bloat, but not necessarily eliminate it. When chopped alfalfa was fed to cattle there was little opportunity for selection, but, during grazing, cattle may periodically select leafier parts such as shoot tips.

Table 2. Feed quality[z] of alfalfa at three stages of growth in 2 yr

		Stage of growth			
Year	Component	Vegetative	Bud	Bloom	SE
1997	DM	17.0*a*	19.1*b*	22.4*c*	0.28
	ADF	27.9*a*	30.9*b*	34.9*c*	0.75
	CP	25.2*a*	20.8*b*	18.5*c*	0.53
	Leaf:stem[y]	1.21*a*	0.77*b*	0.46*b*	0.14
1999	DM	16.6*a*	17.9*b*	22.1*c*	0.35
	ADF	22.1*a*	27.7*b*	38.3*c*	0.67
	CP	25.9*a*	22.6*b*	18.3*c*	0.48
	Leaf:stem	1.46*a*	0.96*b*	0.43*c*	0.11

[z]Components expressed as a percentage.
[y]Leaf:stem ratio measured on a DM basis.
a–c Means in the same row followed by the same letter are not significantly different by the least significant difference test.

The reduction in bloat observed with increasingly mature alfalfa can be related to the higher dry matter and fibre content and lower crude protein content (Table 2). Although the changes in alfalfa quality that occur with maturity have been documented previously (Albrecht 1983), the correspondence with the occurrence of bloat have not. Protein constituents of alfalfa herbage have been implicated in the cause of bloat (Majak et. al. 1986) and these constituents are likely more concentrated at the vegetative stage. Grazing alfalfa at the bloom stage would reduce the incidence of bloat while still providing more than an adequate protein supply (18%) for cattle (Taylor 1994).

In this study, the leaf:stem ratio decreased from 1.2 to 0.5 in 1997 and from 1.5 to 0.4 in 1999 (Table 2) as the crop matured from the vegetative to bloom stage. This is comparable with the findings of Albrecht (1983). The absence of bloat during bloom can be attributed to the much lower leaf:stem ratio at that stage (Table 2). Majak (1986) suggested that chloroplast membrane fragments contribute to bloat. As most chloroplasts are within the leaves, the lower leaf:stem ratio at bloom would reduce the concentration of these fragments. A leaf:stem ratio of < 0.5 (< 1:2) could be used as an indicator of a low potential for bloat in alfalfa. The leaf:stem ratio may be an especially important indicator of bloat potential in the fall, when abortion of flowers makes rating growth stage difficult. It should be cautioned that leaf:stem ratios can also vary substantially between cuts of

alfalfa. The present ratios were obtained from a second cut of alfalfa. The leaf:stem ratio may also be affected by photoperiod and soil moisture availability.

In summary, it has been confirmed that the bloat potential of alfalfa varies significantly with the phenological stage of the plant and that the greatest risk to cattle occurs during the vegetative stage of growth, the risk declines during the bud stage and it may be absent during bloom.

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