Protein supplementation to enhance the performance of pregnant cows on rough fescue grasslands in winter

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Protein supplementation to enhance the performance of pregnant cows on rough fescue grasslands in winter

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Willms, W. D., Rode, L. M. and Freeze, B. S. 1998. **Protein supplementation to enhance the performance of pregnant cows on rough fescue grasslands in winter.** Can. J. Anim. Sci. **78**: 89–94. Rough fescue grasslands are readily damaged with heavy grazing pressure in the summer but tolerate grazing in winter. In addition, these grasslands have physical and nutritive properties that make them favourable for winter grazing by cattle, which reduces the cost of winter feeding while preserving the integrity of the grasslands. This study was conducted on the rough fescue grassland to determine the impact of protein supplementation on pregnant Hereford cows and the effect of supplementation on forage intake. A secondary objective was to determine the winter quality of forage from this grassland as measured by crude protein (CP), phosphorus (P), and acid detergent fibre (ADF) of selected species. The study site was in the rough fescue grasslands at the Agriculture and Agri-Food Canada Range Research Substation west of Stavely, AB. A canola based supplement (32% CP) with added minerals was fed to pregnant Hereford cows at four levels [0, 0.4, 0.8, and 1.2 kg d^{-1} per animal] from 1 November to 31 January over 3 yr. Two animals were used in each of 12 paddocks (1.67 ha each) arranged in a randomized complete block design with three blocks. Cow weight and backfat were recorded before and after each feeding period. Forage biomass and feed intake were estimated by harvesting plots before and after grazing, and with the use of a non-destructive method based on measurements of individual plants that allowed estimates for each forage species. Cow weights were affected (P = 0.002) by supplementation. Cows receiving 0.4 kg d^{-1} supplement lost the most weight while cows receiving 0.8 or 1.2 kg d^{-1} lost the least. Backfat was not responsive to supplementation ($P > 0.05$). Rough fescue grasslands must be in good condition to be able to support winter grazing because rough fescue provides most of the forage utilized by cattle in winter.

Key words: Winter grazing, *Festuca campestris*, rough fescue, weight loss, backfat, digestibility, beef cattle

Willms, W. D., Rode, L. M. et Freeze, B. S. 1998. **Effets d'un complément protéique sur les performances de vaches gravides gardées en hiver sur des prairies naturelles à fétuque rude**. Can. J. Anim. Sci. **78**: 89–94. Les parcours à fétuque rude se dégradent facilement sous un chargement animal dense en été mais ils supportent assez bien d'être pâturés en hiver. Par ailleurs, ces prairies possèdent des propriétés physiques et nutritionnelles qui en font de bons pâturages d'hiver par les bovins. Cette pratique réduit le coût d'affouragement d'hiver tout en préservant l'intégrité du peuplement herbager. Nos recherches, réalisées sur un parcours à fétuque rude, avaient pour objet de déterminer l'influence d'une complémentation protéique sur les performances de vaches Hereford gravides ainsi que sur leur taux d'ingestion d'herbe. Nous voulions aussi établir la qualité hivernale de l'herbe de ces prairies d'après les teneurs en protéines brutes (PB), en phosphore (P) et en lignocellulose (FDA) de certaines des espèces composantes. L'expérience était réalisée dans les prairies à fétuque rude de la sous-station de recherches sur les parcours (Ministère de l'agriculture et de l'agroalimentaire du Canada) située à l'ouest de Stavely en Alberta. Un complément à base de colza canola (32 % PB) enrichi de minéraux était servi trois ans de suite aux vaches à quatre niveaux, soit 0, 0,4, 0,8 et 1,2 kg j^{-1} par animal du 1er novembre au 31 janvier. Deux animaux étaient utilisés dans chacun des enclos de 1,67 ha, selon un dispositif expérimental en blocs aléatoires complets à 3 répétitions. Le poids des vaches et l'épaisseur du gras de couverture étaient mesurés avant et après chaque période d'affouragement. La biomasse de fourrage disponible et la biomasse consommée étaient estimées aux moyens de parcelles récoltées avant et après la période de pâturage, selon une méthode non-destructive de mesure des plantes individuelles permettant d'évaluer la contribution au rendement des différentes espèces herbagères. La complémentation protéique influait (P = 0,002) sur le poids des vaches, celles recevant 0,4 kg j^{-1} perdant le plus et celles recevant 0,8 ou 1,2 kg le moins de poids. La complémentation n'avait pas d'effet significatif (P > 0,05) sur l'épaisseur du gras de couverture. Les parcours à fétuque rude doivent être en bon état pour tolérer le pâturage d'hiver parce que c'est la fétuque rude qui fournit la grosse partie du fourrage consommé par les bovins en hiver.

Mots clés: Pâturage d'hiver, *Festuca campestris*, fétuque rude, perte de poids, gras de couverture, digestibilité, bovin de boucherie

Climax communities of the rough fescue grasslands are dominated by rough fescue [*Festuca campestris* Rydb. in southern Alberta and *F. hallii* (Vassey) Piper in the Parklands]. Rough fescue is a large tufted plant that is more accessible to herbivores under a snow cover than most other grasses in this community.

Rough fescue grasslands tolerate, and may benefit from winter grazing but withstand only light grazing pressure (less than 50% utilization) in summer (Willms et al. 1985). Historical summer grazing by bison would, undoubtedly,

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Abbreviations: ADF, acid detergent fibre; **CP**, crude protein; **DIP**, degradable intake protein; **NDF**, neutral detergent fibre have produced a community dominated by species resistant to grazing. The fact that this has not occurred supports the notion that the grasslands developed under a system of winter grazing. Therefore, winter grazing by livestock could be practiced both to protect the resource and to reduce the cost of winter feeding. Winter grazing of rough fescue grasslands is economically feasible although pregnant cows do not maintain optimal condition for calving in spring (Willms et al. 1993). Consequently, supplementation is needed to maintain body condition.

DelCurto et al. (1990) reported improved body condition and weight of pregnant Hereford ± Angus cows in response to protein supplementation over winter on tallgrass prairie. These results were in agreement with Clanton and Zimmerman (1970) who observed that cows maintained more of their initial weight and body condition when supplemented with protein.

Winter feed costs are the single largest expense incurred by beef cow-calf producers. These costs can be reduced from about \$1.00 animal^{-1} d^{-1} in the feedlot to about \$0.30 when kept on rough fescue grasslands that are in good condition (Willms et al. 1993). In senesced rough fescue forage, the concentration of digestible CP, estimated by in vitro techniques, is less than 1.5% (Bezeau and Johnston 1962). Crude protein supplementation may increase the dry matter digestibility of very-low-quality forages (Cook and Harris 1968; Rittenhouse et al. 1970) and increase forage intake (DelCurto et al. 1990). Therefore, it could be advantageous to provide a protein supplement in order to conserve cow body condition.

Improved body condition and reduced weight loss have been observed in response to protein supplementation of beef cows (Clanton and Zimmerman 1970; DelCurto et al. 1990; Beaty et al. 1994). However, the amount of supplement offered to cows in these studies was up to 0.5% of body weight and provided up to 120% of the cows CP requirements (Beaty et al. 1994). While biologically effective, this level of supplementation is often deemed impractical and uneconomical by cattlemen. There is very little information available on the effects of providing beef cows with lesser amount of protein supplements on winter range.

The significant economic and ecological value of the rough fescue grasslands predicates a better understanding of management opportunities and grazing effects. Therefore, a study was conducted to determine the impact of protein supplementation on pregnant Hereford cows and the effect of supplementation on forage intake. A secondary objective was to determine the winter quality of forage from this grassland as measured by CP, phosphorus (P), and ADF) of selected species.

MATERIALS AND METHODS

The study was conducted on rough fescue grasslands at the Agriculture and Agri-Food Canada Range Research Substation west of Stavely, Alberta (50°12′N, 113°54′W). Twelve paddocks (1.67 ha each) were constructed on grassland that had been infrequently grazed during the previous 50 yr and had received only light grazing pressure in any year. Rough fescue was the dominant species and the grassland was in excellent condition.

Table 1. Chemical composition (DM basis) of supplement offered to pregnant beef cows on rough fescue grassland in winter

Item	Concentration
Dry matter (%)	86.9
Crude protein (%)	31.7
Acid detergent fibre (%)	10.5
Metabolizable energy (MJ kg^{-1})	0.57
Ca (%)	0.66
P (%)	0.87
K (%)	0.80
Mg (%)	0.28
Na (%)	0.14
Zn (ppm)	58
Mn (ppm)	53
Cu (ppm)	8
Fe (ppm)	184

Grazing Animals

A canola-based supplement (32% CP) with added minerals (Table 1), was fed to pregnant Hereford cows at four levels (0, 0.4, 0.8, and 1.2 kg d^{-1} per animal) from 1 November to 31 January over 3 yr (hereafter, the winters are defined by the first, second, or third for 1992/1993, 1993/1994, and 1994/1995, respectively, or by the year in which the December portion occurred). Two animals were used in each of 12 paddocks (1.67 ha each) arranged in a randomized complete block design. The stocking rate, based on an animal-unit represented by a cow weighing 454 kg, averaged 3.22 animal-unit-months ha^{-1} and varied from 3.16 to 3.38 among years depending on cow weight. The cows were from the same herd each year but with as many replacements as necessary among years and re-randomized among treatments. The cows had ad libitum access to mineral supplements over the summer and fall periods prior to the trial, and to cobalt-iodized salt throughout the winter trial.

The cows depended on snow for their water supply although water was delivered to a trough when snow was unavailable. A wind barrier (5 m wide × 2 m high) was constructed from boards in each paddock to provide protection to the animals and capture snow.

Cattle Performance

The cows were weighed and backfat was measured ultrasonically at the beginning and end of the trial. Weights were taken in the morning after withholding water overnight; snow would be unavailable because of the limited area of the holding pens. Guidelines for animal care (Canadian Council on Animal Care) were followed at all times.

Forage Utilization

Forage standing crop was determined with both a clipping and a non-destructive technique. Eight randomly distributed plots (0.5 m^2) were clipped before grazing in each paddock to determine standing crop as an estimate of available forage; different plots were clipped each year. Standing crop and dry matter disappearance were also determined using repeated measurements of individual plants before and after grazing of the major species. Two, 4 × 4 m grids were located in each paddock. From each grid, two 1-m^2 plots were randomly selected and the plants within each were mapped, numbered by species, and measured for basal area and height. The species surveyed were rough fescue (*Festuca campestris* Rydb.), Idaho fescue (*Festuca idahoensis* Elmer), Parry oat grass (*Danthonia parryi* Scribn.) and smooth aster (*Aster laevis* L.) which formed the major components of the standing crop. The basal area and height of each grass plant and the height of each smooth aster plant were measured before grazing in fall and again after grazing when the snow melted in winter or spring. In the final sample, the proportion of plant area that was grazed and the height of grazed stubble were also estimated.

Standing crop of grass was estimated according to Willms et al. (1980). This technique required calculating two regression equations describing the relationships of (1) plant weight to plant volume and (2) the distribution of biomass to plant height. A sample of 5 plants species^{-1} paddock^{-1} was obtained for a total of 60 plants that encompassed a wide range of plant sizes. Their basal areas and heights were measured and their cylindrical volumes calculated. Oven-dry (50°C) weights were determined, regression analyses (simple and quadratic polynomials) calculated, and the best equation expressing the relationship between plant weight and volume was selected based on the significance of an improved R^2 and visually from a scatter plot. The relationship between plant weight and height was estimated from two plants harvested from each grass species in each paddock. The plants were cut into five segments of equal length (20% of total plant height), oven dried, and weighed. The proportion of total plant weight was calculated for each segment and regression equations (simple, quadratic, and cubic polynomials) of proportion weight on proportion height were calculated. New equations were calculated in each year of the study. These equations were used to determine standing crop of grass, by species, before and after grazing. The contribution of smooth aster was determined from total plant numbers and an average plant weight. Dry matter disappearance was estimated for each species as the difference in weight before and after grazing.

Percent disappearance of dry matter over the period was applied to the clipped estimates of standing crop and expressed as utilization. The clipped estimates represented a more reliable measure of available forage because of the larger sample size. However, the repeated measurements are a more sensitive estimate of disappearance and selection. Applying the indirect estimate to the clipping estimate assumes that species composition and dry matter disappearance among species are similar for both samples. This assumption seems reasonable since both samples were randomly selected and grazing pressure was relatively uniformly distributed over the paddock. The difference between utilization and available forage was residual forage.

Data Analyses

Cattle performance data were analyzed for the effects of supplementation (Su), year (Y), and their interaction (Su × Y). The error term for Su was the interaction of Su × replicate (R) while the error term for Y and Su × Y was the interaction of Su × Y × R. Paired means were compared using single degree of freedom contrasts (Steel and Torrie 1980). Available standing crop and utilization data were analyzed for Su, species (Sp), and Y; Sp was the second level factor and Y the third. Appropriate interactions with replication constituted the error term for testing the main effects and their interactions. Where main effects responded differently ($P < 0.05$) among years, the effect was analyzed by year and reported as such.

Table 2. Precipitation and average temperatures in December and January over 3 yr in southwest Alberta[z]

	Precipitation		Temperature	
	Dec.	Jan.	Dec.	Jan.
	(mm)		(°C)	
1992/1993	48.0	8.1	–5.4	–10.6
1993/1994	11.5	17.4	–0.7	–6.0
1994/1995	11.0	5.4	–4.0	–5.7

[z]Average from Pincher Creek and Claresholm (from Alberta Agriculture, Food, and Rural Development, 1994, 1995).

Forage Quality

Herbage samples of rough fescue, Idaho fescue, Parry oat grass, and smooth aster were collected in December and January at two sites. At each site, five plants per species were randomly selected and harvested near ground level. The leaves of the grasses are all basal, therefore, the concentration of nutrients in the plant would be relatively uniform. The material was dried at 50°C and, in each year, was composited by species and ground through a laboratory mill equipped with a 1-mm screen and analyzed for CP, P, and ADF. These estimates were used to calculate the intake of CP from forage in each treatment.

The samples were analyzed for ADF according to the Association of Official Agricultural Chemists (1984) method 7.076 using filter paper instead of sintered glass crucibles, CP by colorimetric determination of Kjeldahl nitrogen (× 6.25) using an autoanalyser (Technicon Instruments Corp., New York, NY), and for phosphorus (P) according to Ward and Johnston (1962). The ADF and NDF were determined as outlined by Goering and Van Soest (1970) using sodium sulphite and decalin. Acid detergent-insoluble nitrogen was determined from macro Kjeldahl analysis of filter papers and acid detergent insoluble residues.

RESULTS

The winter of 1992 was, on average, about 5°C colder than in 1993 and 1994 (Table 2). Snow also tended to persist and accumulate in the first winter but melt or dissipate with chinook winds in the other years.

Drinking water was not offered to the cows in the first winter and only for a few days in subsequent winters. Accumulated snow at the shelters and in the proximity of the larger rough fescue plants usually provided an adequate source of water for cows.

Table 3. Effect of supplementation on the performance of cows over a 2-mo period in winter (1992–1994) (*n* = 18)

Supplementation (Su) (kg d^{-1})	Weight loss (kg)	Backfat (mm)
0.0	–35.1*b*	–1.05*a*
0.4	–46.1*a*	–0.94*a*
0.8	–25.1*c*	–0.56*a*
1.2	–19.5*c*	–0.44*a*
SEM	7.4	0.43
Prob	0.002	0.802
Year (Y)		
1992	–51.3*a*	–1.25*a*
1993	–27.8*b*	0.42*b*
1994	–15.2*c*	–1.42*a*
SEM	6.4	0.37
Prob	<0.001	0.005
Su × Y		
Prob	0.206	0.558

a–c Means within the same letter, within a column subset, do not differ significantly ($P > 0.05$).

Cattle Performance

Cow weights were affected ($P = 0.002$) by supplementation with canola meal and the effects were similar ($P = 0.206$) in each year of the study (Table 3). Cows receiving 0.4 kg d^{-1} supplements lost more ($P < 0.05$) weight (–46.1 kg) than the control (–35.1 kg) while cows receiving 0.8 or 1.2 kg d^{-1} lost the least. Weight loss was greatest in the first winter and least in the third (Table 3). Backfat was not responsive ($P > 0.05$) to supplementation with canola meal but average losses tended to decrease with increased supplementation (Table 3).

The change ($P > 0.05$) in weight loss observed with supplementation was not detected in the final weights of cows because of large animal variability and small animal numbers (Table 4). Average birth date for calves was 1 April and calf weights were not affected ($P > 0.05$) by the supplementation treatments.

Table 5. Standing crop, utilization and residual herbage on study area in relation to supplementation treatments

	Available standing crop	Utilzation	Residual
Supplementation (kg d^{-1})		(kg ha^{-1})	
0	3020*a*	872*ab*	2148*ab*
0.4	2745*a*	1031*b*	1714*a*
0.8	2895*a*	685*ab*	2210*ab*
1.2	3044*a*	580*a*	2464*b*
SEM	237	146	202
Year			
1992	2444*a*	571*a*	1873*a*
1993	3409*b*	998*b*	2412*b*
1994	3044*ab*	807*ab*	2118*ab*
SEM	206	126	175
Effects		Probabilities	
Supp (S)	0.800	0.162	0.096
Year (Y)	0.011	0.078	0.115
S × Y	0.998	0.885	0.889

a–b Means within a column subset having the same letter do not differ significantly ($P > 0.05$).

Standing Crop

Standing crop was similar ($P > 0.05$) among supplementation treatments but greater ($P < 0.05$) in 1993 than in 1992 (Table 5). Forage utilization decreased ($P < 0.05$) from the 0.4 kg d^{-1} supplementation level to the 1.2 kg d^{-1} level. Over the 3-yr study period, utilization was 29, 38, 24, and 19% for the 0.0, 0.4, 0.8, and 1.2 kg d^{-1} supplementation levels, respectively (calculated from information in Table 5). Average dry matter disappearance was 792 kg ha^{-1} consisting of 90.4, 8.7, 0.6, and 0.2% rough fescue, Parry oatgrass, Idaho fescue, and smooth aster, respectively.

Table 4. Weight and condition (backfat) characteristics of cows used in the winter grazing study over three years (*n* = 6)

	Supplementation (kg d^{-1})	Weight (kg) Initial	Weight (kg) Final	Backfat (mm) Initial	Backfat (mm) Final	Calf at birth Weight	Calf at birth No. dead[z]
1992	0.0	593	534	6.2	4.2	35.6	1
	0.4	633	560	5.2	4.7	38.8	1
	0.8	630	592	5.2	4.2	37.2	1
	1.2	570	535	6.8	5.3	34.8	2
	SEM	30.3	25.2	1.7	1.0	1.9	
	Prob	0.092	0.060	0.718	0.856	0.464	
1993	0.0	603	566	5.5	5.8	38.5	1
	0.4	614	579	5.7	5.0	40.0	1
	0.8	650	620	5.0	5.8	39.0	0
	1.2	645	628	5.3	6.8	40.2	0
	SEM	24.6	21.5	0.8	0.6	2.1	
	Prob	0.356	0.140	0.818	0.214	0.935	
1994	0.0	587	578	7.5	6.0	39.2	0
	0.4	619	589	8.0	6.3	39.6	0
	0.8	605	597	5.7	4.2	42.0	1
	1.2	586	574	6.0	5.0	44.5	0
	SEM	17.9	16.5	1.0	0.8	2.8	
	Prob	0.752	0.859	0.666	0.761	0.461	
Mean		611	579	6.0	5.3	39.1	

[z]Includes aborted fetuses.

Table 6. Forage concentrations of crude protein, phosphorus, and acid detergent fibre in important species on the fescue grasslands in December and January over three years (1992–1994) (n = 3)

	Rough fescue	Idaho fescue	Parry oat grass	Smooth aster	SEM	Probability
	(%)					
Crude protein	4.7	4.7	4.5	5.2	0.5	0.78
Phosphorus	0.065	0.064	0.055	0.061	0.008	0.83
ADF[z]	45.9	48.1	46.5	45.2	1.3	0.62

[z]Acid detergent fibre.

Table 7. Predicted forage intake and nutrition of cattle on winter range based on information from Table 5 and estimated diet composition

Supplement	Supplemental protein	Forage intake	Forage protein[z]	Total protein intake
	(kg d^{-1})			
0.0	0.0	11.7	0.55	0.55
0.4	0.13	13.9	0.65	0.78
0.8	0.26	9.2	0.43	0.68
1.2	0.38	7.8	0.37	0.75

[z]Based on a composite diet and a CP analyses of each species.

Diet Quality

None of the forages met the requirements of CP or P concentrations (National Research Council [NRC] 1996) for mature cows over winter (Table 6). The average CP content of forage utilized over the 3-yr study period was estimated to be 4.7% based on the contribution of the sampled species to the diet. The total amount of CP ingested was least for animals receiving no supplement and similar for those receiving any amount of supplements (Table 7).

DISCUSSION

Cattle Performance

Protein supplementation in 0.8 kg d^{-1} of canola meal or greater resulted in a reduction ($P < 0.05$) in cow weight loss. For all supplementation groups, initial cow body weights tended to be greater than for the control group. Assuming that the additional maintenance energy requirement imposed by heavier body weights would have resulted in additional body weight loss, and body weight loss would have provided 0.95 MJ NEm kg^{-1} (Buskirk et al. 1992), it could be expected that cows would have lost an additional 13.5, 18 and 2 kg body weight, respectively, when offered 0.4, 0.8 or 1.2 kg d^{-1} supplement. Therefore, weight loss, adjusted to 600 kg body weight, would be expected to be 33.0, 31.0, 9.0, and 19.5 kg for cows offered 0, 0.4, 0.8 and 1.2 kg d^{-1} of supplements, respectively. While changes in backfat were small, they followed a similar pattern to that observed for weight loss. DelCurto et al. (1990) and Beaty et al. (1994) observed a quadratic reduction in body weight loss but a linear change in body condition score with increasing level of protein supplementation. However, the amount of supplement was considerably more (0.4 to 0.5% of body weight) than in our study (up to 0.2%). Supplementing at 0.4 kg d^{-1} had no beneficial effect on animal performance. This is in spite of the supplement providing approximately 20% of the cows' requirement for DIP (NRC 1996) and sufficient energy to spare 13 kg body tissue loss (Buskirk et al. 1992) over the experimental period.

At higher levels of supplementation, weight loss was decreased but whether this was due to additional energy or protein is uncertain. Beaty et al. (1994) and Clanton and Zimmerman (1970) found high protein supplements more effective than low protein–high fermentable carbohydrate supplements, in maintaining body condition and weight. As the DIP requirement for these animals was greater than the metabolizable protein requirement (NRC 1996), it is unlikely that there would be any advantage to supplementing with a protein source that was higher in undegradable intake protein. Beaty et al. (1994) speculated that high protein supplements may spare maternal tissue metabolism via the provision of glucogenic precursors.

Animal performance was poorest in 1992 when snow conditions and cold temperatures were the most severe (Table 2) and possibly restricted forage utilization (Table 5). Although grazing activity may not be affected by temperature fluctuations between 8 and –26°C (Dunn et al. 1988), forage intake is reduced with snow cover and low temperatures (Adams et al. 1986). However, contrary to Dunn et al. (1988), Prescott et al. (1994) reported reduced grazing time with increased thermal stress.

At the higher levels of supplementation (0.8 and 1.2 kg d^{-1}), cows lost less backfat and less weight than low or nonsupplemented groups. With more supplementation, the cows tended to substitute forage DM with supplement DM. Thus, overall protein intake was unaffected by supplementation. This made it impossible to truly evaluate the effect of protein intake on animal performance.

Reduced forage consumption may be a benefit of supplementation if it enables increased stocking rates while maintaining animal condition or relieving grazing pressure on fragile grasslands. The latter benefit is less of a factor on winter-grazed range when grasses are more tolerant to defoliation; however, other ecosystem benefits accrue from standing litter, such as cover for small animals and snow capture. Supplementation reduced forage utilization (Table 5) in approximately a linear response as suggested by Vanzant and Cochran (1994).

The effect of forcing cattle to use snow for their water source should not have had an impact on their performance (Degen and Young 1990a). Cattle will tolerate the thermal stress of ingesting snow (Degen and Young 1984) and the only effect on animal weight may be during the initial period of adjustment (Degen and Young 1990b). In the present study, snow was generally always available although it may have been restricted to areas where it had drifted.

Diet Quality

Nonsupplemented animals were deficient in CP and P (NRC 1996) while all levels of supplementation would likely meet their requirements. The predicted CP intake for a composite diet from each treatment indicates that cattle receiving supplements received a similar level of CP intake. Deficient P intake by unsupplemented animals is unlikely to be responsible for observed differences in animal performance since the animals would likely have drawn on body reserves and the effect of suboptimal P intake would only be observed in calf growth rate and cow fertility in the subsequent lactation. Based on animal performance, supplementation improved the animals' nutritional status and may have allowed them the luxury of feeding more selectively.

Estimates of CP intake were affected by the variability of estimating forage intake and of predicting the composition of forage species in the diet. Selective feeding may result in a diet that is better in quality than the standing crop (Coleman and Barth 1973) thereby introducing an error in estimating CP intake. Even though the diet was adjusted for the major species present, and differences in forage quality among species were small, green regrowth may have been present from the previous fall and had not been sampled.

CONCLUSIONS

Supplementing with CP did not improve animal condition significantly ($P > 0.05$) but reduced weight losses for animals receiving more than 0.4 kg d^{-1} of canola meal. Crude protein supplementation reduced the demand for forage and allowed the luxury of selective feeding. While reducing weight losses among animals, supplementing with CP will enhance the feasibility of winter grazing by either supporting more animals on range or tolerating a greater snow cover.

The rough fescue grasslands are capable of supporting winter grazing with a minimal amount of supplementation. However, the study was based on a grassland in excellent condition represented by a large proportion of rough fescue. This must be a condition for successful winter grazing since rough fescue is a large plant that is accessible through snow and maintains reasonably good forage quality. As a result, it provides most of the available forage for winter grazing.

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