Winter performance of Hereford cows on fescue prairie and in drylot as influenced by fall grazing

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Willms, W. D., Rode, L. M. and Freeze, B. S. 1993. **Winter performance of Hereford cows on fescue prairie and in drylot as influenced by fall grazing.** Can. J. Anim. Sci. **73**: 881–889. An experiment was conducted to determine the feasibility of winter grazing pregnant Hereford cows on fescue prairie. The experiment was replicated over a 4-yr period (1988–1991, $n = 4$) and utilized a 2×2 factorial design representing fall grazing (September to November) on annual pasture (winter wheat and corn) or fescue prairie; and winter grazing (November to the end of February) on fescue prairie or feeding in a drylot. The cows weighed an average of 519 kg and had an average of 4.4 mm of backfat in late May when summer grazing on fescue prairie began and 7.2 mm of backfat at the beginning of fall grazing. Measurements of cow backfat and cow weights at each feeding change indicated that during the fall grazing period, average daily gain (ADG) was −0.43 kg and change of backfat was −1.0 mm on fescue prairie compared with +0.12 kg and +0.9 mm, respectively, on annual forage. Fall grazing of annual forages had no effect on the ADG of cows in winter but resulted in higher backfat after the winter feeding period (5.3 vs. 4.1 mm, $P = 0.009$). In later winter, cows kept on fescue prairie over the entire grazing period averaged 3.5 mm of backfat, while the cows grazed on annual forages in the fall and wintered in the drylot averaged 5.7 mm. Cows may be kept on fescue prairie in fall and winter. However, feed supplementation is needed to achieve optimal condition at calving. Fall grazing of annual forages may allow cows to maintain their body weight on fescue prairie, minimizing costly feed inputs prior to calving.

Key words: Cows, calves, annual forage, backfat, fall grazing

Willms, W. D., Rode, L. M. et Freeze, B. S. 1993. **Performances de vaches hereford hivernées sur prairie à fétuque ou en parc d'élevage en fonction de la nature du pâturage d'automne.** Can. J. Anim. Sci. **73**: 881–889. Une expérience a été réalisée pour établir la possibilité d'hiverner des vaches Hereford gravides sur une prairie naturelle à fétuque. L'expérience, qui était répétée sur une période de 4 ans (1988–1991, $n = 4$), utilisait un dispositif factoriel 2×2 représentant le pâturage d'automne (sept.-nov.) sur culture annuelle (blé d'hiver et maïs) ou sur prairie à fétuque, d'une part, et le pâturage d'hiver (nov.-fin février) sur prairie à fétuque ou alimentation en parc d'élevage, d'autre part. Les vaches pesaient en moyenne 519 kg, avec une couverture de gras de 4,4 mm, en fin de mai au départ de la saison de la paissance d'été sur prairie à fétuque. L'épaisseur du gras dorsal était de 7,2 mm au début du pâturage d'automne. Les mesures de l'épaisseur du gras dorsal et du poids des vaches à chaque changement de régime montrent que durant la phase de pâturage d'automne, le GMQ était négatif (−0,43 kg) et que les vaches perdaient 1,0 mm de gras dorsal sur prairie à fétuque, contre, respectivement, un GMQ de 0,12 kg et un gain de gras de couverture de 0,9 mm sur fourrages annuels. Le pâturage d'automne sur fourrages annuels n'avait pas d'effet sur le GMQ des vaches en hiver, mais les vaches avaient une couverture de graisse plus importante au terme de l'hiver (5,3 contre 4,1 mm, $P = 0{,}009$). En fin d'hiver, les vaches gardées sur prairie à fétuque pendant toute l'année avaient une couverture de gras dorsal de 3,5 mm en moyenne, tandis que chez celles qui avaient brouté les fourrages annuels en automne et étaient hivernées en parc, l'épaisseur du gras était de 5,7 mm. Il est donc possible de garder les vaches sur prairie à fétuque en automne et en hiver. Cependant ce régime doit être complémenté si on veut que les vaches soient en parfaite condition au moment du vélage. Le pâturage d'automne sur fourrage annuel peut permettre aux vaches de conserver leur poids sur prairie à fétuque, abaissant ainsi le coût toujours élevé d'une complémentation alimentaire avant le vêlage.

Mots clés: Vaches, veaux, fourrage annuel, gras de couverture, pâturage d'automne

The fescue prairie is found on the northern edge of the North American Great Plains and forms the interface between the xeric mixed prairie to the south and the mesic forests to the north. This region supports the deep-rooted grasses that produced the fertile black chernozemic soils that make this one of the most productive regions on the Plains. Most of the fescue prairie has been cultivated, but rugged terrain to the west has restricted agricultural activity to grazing.

In the west, the grasslands are dominated by rough fescue (*Festuca campestris* Rydb.), a deep-rooted tufted species with high production potential. Although the plant is readily damaged when grazed during the growing season and is replaced by less productive species, it tolerates grazing when dormant. Therefore, winter grazing allows conservation of the fescue prairie and is a sustainable way to reduce feed costs. However, senesced forage does not meet the maintenance energy requirements of pregnant cows (National Research Council (NRC) 1984), especially in the winter, when cows reduce their grazing time and feed intake (Adams et al. 1986). Johnston and Bezeau (1962) reported a decline in the crude protein (CP) concentration in rough fescue from 17% at the leaf stage to about 5% at the cured stage and a moderate increase of crude fiber from about 30% to 33%. For the same material, the in vitro dry matter digestibility (IVDMD) decreased from 48.5% to 32.1%, while the digestible CP content decreased from 6.6% to 1.5% (Bezeau and Johnston 1962). Previous grazing trials have shown that pregnant cows with calves pastured on fescue prairie lose weight after September (Willms et al. 1986), but no information on animal condition is available.

Annual forages have the potential for providing high-quality forage in fall. However, death of the leaves from cold temperatures in fall results in substantial DM losses and reduced forage palatability. Snow cover may further reduce availability. Tall annuals, such as corn (*Zea mays* L.), may overcome the problems associated with snow and weathering because they have a high stem/leaf ratio. Although the leaves decompose rapidly, the stems are resistant to decomposition and provide the major portion of DM for late-season grazing (Gutierrez-Ornelas and Klopfenstein 1991a). In a previous 3-yr trial, pregnant cows without calves gained 0.71 kg d^{-1} and 0.8 mm of backfat over a 4-wk period on corn with immature cobs and lost 0.26 kg d^{-1} and 0.4 mm of backfat on fescue prairie (unpubl. data).

Cows that are in better condition in the fall maintain that advantage throughout the winter grazing period (Adams et al. 1987). Consequently, improving cow condition prior to winter grazing on fescue prairie may be feasible to ensure adequate condition for calving in spring. While extending the grazing season avoids the cost of feeding preserved forages, the feasibility of this approach has not been investigated for this region. The objective of this study was to determine the effect of fall and winter grazing on the condition and weight gain of pregnant Hereford cows and on the weight gain of their calves in fall. A secondary objective was to determine the effect of calf sex on calf weight gain and the dam response to grazing treatments. Male calves have greater rates of growth and, hence, greater resource demands than female calves. It is important to understand the effect of this variable demand on the cow in order to interpret the treatment effect more accurately.

MATERIALS AND METHODS

The study was conducted 85 km northwest of Lethbridge near Stavely (50°12′ latitude, 113°57′ longitude) in the Porcupine Hills of southwestern Alberta. The vegetation is native prairie representative of the rough fescue association described by Moss and Campbell (1947). The dominant species is rough fescue (*F. campestris* Rydb.), with Parry oat grass (*Danthonia parryi* Scribn.) a co-dominant on drier sites. Aspen poplar (*Populus tremuloides* Michx.) occupies a small portion of the area in discrete groves. The topography is undulating with rounded hills and narrow drainage channels oriented in a north–south direction. The soils, classified as Orthic Black Chernozemic, are developed on till overlying sandstone. Average monthly temperatures from November to February are −1.5, −6.5, −10.2, and −5.0°C, and annual snowfall averages 175 cm. The area is subject to chinook winds that create sudden shifts in temperature, redistribute snow and may cause melting.

Grazing Treatments

Grazing treatments were replicated in time over a 4-yr period ($n = 4$) and used a 2×2 factorial design representing fall grazing on fescue prairie (F) or annual forages (A) and winter feeding on fescue prairie (f) or in a drylot (d). A group of 10 Hereford cows with calves was assigned to each of Ff, Fd, Af, and Ad treatments. A herd of 40 cows with calves was identified in each year of the study. Most of the animals were used each year, but replacements were substituted for eight that were culled: three in 1990 and five in 1991. Assignment of animals to the four groups was made randomly each year by sex of the calf to ensure that numbers of male and female calves among groups were as close to equal as possible. This was done by stratifying the animals according to sex and randomly allocating them to the groups. The number of male and female calves over the study period was 80 each, and within any group of a given year the greatest difference was 2 (i.e., 4–6). Over the period of the study, in treatments Ff, Fd, Af, and Ad, the average birth dates (SEM, days) were 18 April (2), 20 April (2), 27 April (4), and 18 April (2), respectively. The average birth weights (SEM) of the calves for the same treatments were 37.6 (0.8), 38.1 (0.7), 38.6 (0.8), and 37.3 (1.0) kg, respectively. The calves were weaned in November, after the fall grazing treatment, in accordance with standard practice in southern Alberta.

All animals grazed fescue prairie from about mid-May to 5 September each year, at which time group A_ was allowed to graze winter wheat for 1 mo followed by corn for 1 mo, while group F_ was kept on fescue prairie. Grazing on fescue prairie was on separate pastures in summer, fall and winter at recommended stocking rates of 2.4 animal-unit-mo (AUM) ha^{-1} on each (Wroe et al. 1988). After weaning, the cows in group _d were moved to a drylot and fed a diet of cubed alfalfa hay blended with barley silage to yield 15% CP and 2.46 Mcal DE kg^{-1} on a DM basis. The amount fed was sufficient to ensure a backfat measurement of 5 mm by calving. The cows of group _f were kept on fescue prairie until the end of February, when they were put into the drylot until calving. All cows in the drylot were fed according to an equation developed at the Lethbridge Research Station that uses cow weight and backfat to predict the energy required to bring cows to an optimal condition of 5 mm of backfat by calving (unpubl. data).

Water was available from a dugout during the summer grazing period. In the fall and winter, cattle on fescue prairie obtained water from another dugout or from snow. However, after freezing and in the absence of snow, heated water was provided in a trough. Cattle on annual pasture had water delivered to a trough from a nearby stream. Water to the drylot came from the Lethbridge supply and originated from the Oldman River. Artificial shelter was not provided during winter on the fescue prairie.

Winter wheat (Norstar) and corn (Pioneer 3957) were each seeded on 4 ha of land first broken in 1983. In each year of the study, fertilizer (27–14–0) was applied at a rate of 786 kg ha^{-1} to both fields; atrazine liquid (Ciba-Geigy) was applied at 2.2 L ha^{-1} on the corn field. The winter wheat and corn were seeded from mid-May to mid-June at rates (row width) of 90 kg ha^{-1} (15 cm) and 40 000 seeds ha^{-1} (76 cm), respectively.

Measurements

In each year of the study, cattle weights and cow backfat thicknesses were measured at the beginning of the trial in spring, at each feeding change in fall and spring, and at the end of the trial in early March. The final calf weights were measured at weaning in fall. The cattle were weighed after food and water had been withheld for a 12-h period. Backfat thickness was measured at the spinal process above the 11th rib on the left side of the animal about 15 cm from the midlines of the vertebrae using a portable Krautkramer USK 7 ultrasound machine (Krautkramer Branson, Hürth, FRG).

Portable exclosure cages were used to estimate available and residual forage in each field of summer pasture and winter wheat. Before- and after-grazing harvests were used to make similar estimates for corn and winter pastures. Residual forage was estimated after the grazing season; the cages were moved to a new location after each harvest. For each harvest, up to twenty 1-m^2 plots were clipped to near ground level, with the exception of corn, for which a 2-m length of row was sampled, representing an area of 1.5 m^2. The actual number of samples taken varied with the number of cages available, cages upset by the cattle, and samples lost in transit. The spring–summer pasture was not sampled in 1990 because of an error of omission. DM determinations were made by drying the forage at 70°C until constant weight was reached.

Forage Quality

Quality of forages available in 1989, 1990, and 1991 was determined by analyzing for CP and

IVDMD of the whole plant. On summer pasture, forage for analysis was obtained from grab samples taken to simulate cattle diets, and on fall and winter pastures, subsamples of forage harvested for DM determinations were used. Samples of simulated cattle diets were obtained by observing the type of forage being grazed and sampling similar forage at several locations in the field. The samples for chemical analysis were dried at 50°C and ground (1-mm screen). CP was analyzed by colorimetric determination of Kjeldahl nitrogen (× 6.25) using an autoanalyzer (Technicon Instruments Corp., New York, NY). IVDMD was determined by incubating the samples anaerobically in rumen fluid and buffer–nutrient solution for 48 h followed by acid-pepsin digestion for 24 h before filtering (Goering and van Soest 1970).

Statistical Analysis

The results at the end of the fall treatment were analyzed as a split plot with fall grazing as the main effect and sex of calf as the secondary effect. The final results included the winter treatment as the secondary effect and sex as a tertiary effect in an analysis of a split–split–plot design. The model for the former design was the following:

$$y = \text{yr} + f + (\text{yr} \times f) + s + (s \times f) + (\text{yr} \times s \times f)$$

where y = dependent variable; yr = year; f = fall treatments; and s = sex of calf. The error terms for the effects were (yr × f) and (yr × s × f). Nonsignificant ($P > 0.05$) error terms were pooled to test the main effects. Single degree-of-freedom contrasts were used to test the equality of paired means.

RESULTS AND DISCUSSION

Forage disappearance over the grazing period on fescue prairie was generally <50%, and residue after the grazing season was as low as 748 kg ha^{-1} but usually >1000 kg ha^{-1} (Table 1). Forage production on annual pasture was highly variable, and disappearance varied from 40 to 80%, with a minimum residue of 126 and 104 kg ha^{-1} and a maximum residue of 894 and 5611 kg ha^{-1} on winter wheat and corn, respectively.

Forage intake was not expected to be limited by forage quantity at any time during the grazing trials on fescue prairie. However, snow would have a variable effect depending on the amount deposited, redistribution by wind,

Table 1. Available and residual forage (kg ha^{-1} ± SEM (n)) in grazed pastures, 1988–1991

Period	Forage type		Forage (kg ha^{-1} (n)) 1988	1989	1990	1991	Overall mean
Spring–summer	Fescue prairie	Available	1885±178 (20)	1948±382 (10)	NA	3695±284 (14)	2509± 221 (3)
		Residual	1308±210 (20)	1092±151 (20)	NA	1835±230 (20)	1412± 593 (3)
Fall	Fescue prairie	Available	1545±310 (11)	1583±100 (20)	2468±222 (10)	2426±357 (10)	2006± 255 (4)
		Residual	748±183 (9)	808±169 (10)	1385±151 (10)	1017±166 (10)	989± 144 (4)
	Winter wheat	Available	1604±100 (8)	2102±247 (10)	2902±442 (10)	1453±260 (7)	2015± 326 (4)
		Residual	767± 74 (11)	747± 62 (10)	894±172 (10)	126± 73 (7)	633± 172 (4)
	Corn	Available	2614±259 (10)	2110±270 (10)	6354±421 (10)	3911±236 (10)	3748± 948 (4)
		Residual	386± 47 (10)	104± 11(10)	5611±399 (10)	1825±202 (10)	1982±1267 (4)
Winter	Fescue prairie	Available	1639±215 (10)	1280±110 (10)	1709±151 (10)	1795±192 (10)	1606± 113 (4)
		Residual	1502±450 (10)	1201±283 (10)	1274±221 (20)	1239±123 (10)	1304± 68 (4)

NA, not available.

and melting. Consequently, temporary restrictions may have occurred that would not have been measured by clipping standing herbage. Snow was not a factor during fall grazing, but the low residues of corn and winter wheat in 1989 and 1991, respectively, indicate that restricted intake was probable.

Over the 3-yr period, CP of forage from the fescue prairie in summer, fall and winter averaged 8.6, 5.4, and 4.1%, respectively (Table 2). Corresponding values for IVDMD were 76.1, 61.1, and 61.8%. The IVDMD values obtained were considerably greater than expected, but a check of the analyses and comparison with results obtained by another laboratory confirmed the results. Although rough fescue forage resists weathering losses better than most grasses, forage quality is reduced with senescence. Bezeau and Johnston (1962) reported a reduction of IVDMD from 36.3% to 24.0% from late summer to post-winter exposure, while CP values declined from 6.6% to 4.2% (Johnston and Bezeau 1962).

In fall, average CP (and IVDMD) of winter wheat and corn were 10.7% (78.9%) and 8.4% (82.9%), respectively. The values for the whole corn plant in this study were similar to those obtained by Lamm and Ward (1981) but considerably greater than those obtained by Gutierrez-Ornelas and Klopfenstein (1991a) for corn residue after harvesting for grain. Corn stems in winter tend to be more digestible and have higher CP than leaves, but they were only 40% digestible and had only 5% CP in the study of Gutierrez-Ornelas and Klopfenstein (1991a). The corn residue does not meet the nutrient requirements of beef cattle (NRC 1984), and protein supplementation is recommended (Gutierrez-Ornelas and Klopfenstein 1991b). In the present experiment, corn did not mature and rarely progressed beyond stage 6, defined as 12 d after silking (Hanway 1963).

The backfat of cows was 4.4 mm in spring and 7.2 mm (Table 3) in summer prior to fall grazing. At the end of summer, cows supporting male calves had significantly ($P = 0.012$) less backfat (6.4 mm) than those with female calves (8.0 mm), although there were no detectable differences in gains of backfat ($P = 0.219$) and body weight ($P = 0.723$) over the summer (Table 3). The average daily gain (ADG) of calves averaged 0.89 kg d^{-1}, with male calves heavier at birth ($P = 0.002$) and tending to gain more weight ($P = 0.069$) over the summer than females (Table 3).

Table 2. Percent crude protein (CP) and percent in vitro dry matter digestibility (IVDMD) of forages[z] over the grazing trial

		1989		1990		1991		Overall mean	
Period	Forage type (sampling time)	CP (%)	IVDMD (%)	CP (%)	IVDMD (%)	CP (%)	IVDMD (%)	CP (%)	IVDMD (%)
Summer	Fescue prairie (August)	9.6	76.5	8.1	75.1	8.2	76.6	8.6	76.1
Fall	Fescue prairie (October)	5.6	67.5	6.0	57.3	4.5	58.4	5.4	61.1
	Winter wheat (September)	8.6	76.1	12.4	81.4	11.2	79.3	10.7	78.9
	Corn (October)	10.6	79.9	8.0	81.8	6.7	87.0	8.4	82.9
Winter	Fescue prairie (December)	NA	NA	4.2	63.0	4.0	60.6	4.1	61.8

[z]Analyzed from a composite of 10 samples selected randomly over the field.
NA, not analyzed.

Table 3. Calf and cow attributes and their performance over the summer grazing period on fescue prairie relative to sex of calf, 1988–1991

	Calves				
	Male (n=80)	Female (n=80)	SEM	P	Overall mean (±SEM)
Calf data					
Birth date (JD)[z]	—	—	—	—	110.6 (1.3)
Birth weight (kg)	39.4	36.4	0.6	0.002	37.9 (0.4)
Initial weight (kg)[y]	65.2	61.5	1.3	0.077	63.5 (1.0)
Average daily gain (kg)	0.92	0.86	0.02	0.069	0.89 (0.01)
Cow data					
Age (yr)	—	—	—	—	6.1 (0.2)
Initial[y] weight (kg)	516	522	6.3	0.215	519 (5.5)
Average daily gain (kg)	0.43	0.44	0.03	0.723	0.43 (0.05)
Initial backfat (mm)[y]	4.1	4.8	0.3	0.129	4.4 (0.2)
Backfat gain (mm)	2.3	3.2	0.3	0.219	2.8 (0.3)
End of summer backfat (mm)	6.4	8.0	0.4	0.012	7.2 (0.3)

[z]JD, Julian day.
[y]Initial measurements made about 15 May.

Table 4. Effect of fall grazing and calf sex on cow weight and backfat gain in early and late fall and both periods combined (n = 80 for each group)

	Weight gain (kg d^{-1})			Backfat change (mm)			
Factor[z]	Early[y]	Late[x]	Combined	Early	Late	Combined	Final
Fall grazing							
Fescue prairie	0.28	−1.03	−0.43	−0.10	−0.90	−1.01	6.2
Annual	0.07	0.04	0.12	0.67	0.19	0.88	8.0
SEM	0.09	0.09	0.05	0.28	0.30	0.26	0.41
P	0.621	0.059	0.026	0.055	0.047	0.011	0.001
Sex							
Male	0.11	−0.45	−0.16	0.18	−0.04	0.16	6.44
Female	0.24	−0.54	−0.14	0.38	−0.66	−0.29	7.66
SEM	0.09	0.09	0.05	0.28	0.30	0.26	0.41
P	0.540	0.521	0.714	0593	0.226	0.467	0.009

[z]Interaction of main effects not significant ($P > 0.05$) for each variable.
[y]Annual forage is winter wheat.
[x]Annual forage is corn.

During the fall grazing period, cows on fescue prairie lost significantly ($P < 0.05$) more weight (−0.43 vs. +0.12 kg d^{-1}) and backfat (−1.01 vs. +0.88 mm) than did cows on annual forages (Table 4). As a result, prior to winter grazing, cows on fescue prairie had significantly less ($P = 0.001$) backfat than those on annual forages (6.2 vs. 8.0 mm), although both were above the pre-winter target of 5 mm set for cows calving in spring. In the second fall grazing period, cows lost more weight and backfat on fescue prairie and gained less on annual forages than in the first period (Table 4). However, this study was not designed to test types of annual forages, and any comparison of fall grazing periods is confounded by increasingly colder tempeatures and deteriorating forage quality. Nevertheless, feeding cattle annual forages improved animal condition at a time when losses would normally occur and postponed loss of backfat to the time when animals were put back on fescue prairie.

During the fall grazing period, calves gained significantly ($P = 0.001$) more weight on annual forages than on fescue prairie (0.72 vs. 0.48 kg d^{-1}) (Table 5). All the advantage occurred in the second period, when calves on fescue prairie gained 0.04 kg d^{-1} and those on corn gained 0.56 kg d^{-1} ($P = 0.002$). Male calves gained more ($P = 0.031$) weight in the first period than female calves (1.12 vs. 0.89 kg d^{-1}) and, on average, gained more ($P = 0.055$) over the entire fall grazing period (Table 5).

Sex of calf had no effect on weight or backfat gains of the cows over the fall grazing period (Table 4), but cows with female calves had higher pre-winter ($P = 0.009$) backfat than cows with male calves (7.7 vs. 6.4 mm). Cows that had nursed heifer calves maintained their advantage through the winter (Table 6). The interactions between sex of calf and fall grazing treatment were not significant ($P > 0.05$) for any variable.

As expected, cows wintered on fescue prairie lost more weight ($P < 0.001$) and backfat ($P = 0.004$) than those in the drylot (Table 6). However, the effect of fall grazing on backfat change over the winter period was not consistent ($P = 0.019$) between winter treatments. Animals in the drylot lost similar ($P = 0.730$) amounts of backfat for both fall grazing treatments, while animals on fescue prairie lost more ($P = 0.010$) backfat after fall grazing on annual forages than after fall grazing on fescue prairie (Table 6). The interactions in backfat change between the fall grazing and winter treatments were not reflected in the backfat measurements made prior to calving (Table 6). Nevertheless, fall grazing on annual forages resulted in cows that were in better condition ($P = 0.009$) in winter, while the benefit of winter feeding was marginal ($P = 0.080$). The drylot effects on backfat (both on the interactions of backfat change and on the final measurements) were predictable because of the controls imposed on the feed intake of cows in the drylot. That is, cows that grazed on annual forages in the fall had more backfat and, consequently,

Table 5. Effect of fall grazing treatment on the calf weight gain in early and late fall periods and both periods combined relative to their sex ($n = 80$ for each group)

Factor[z]	Weight gain (kg d^{-1}) Early[y]	Late[x]	Combined
Fall grazing			
Fescue prairie	1.04	0.04	0.48
Annual	0.97	0.56	0.72
SEM	0.052	0.065	0.029
P	0.449	0.002	0.001
Sex			
Male	1.12	0.30	0.65
Female	0.89	0.29	0.55
SEM	0.052	0.065	0.029
P	0.031	0.912	0.055

[z]Interaction of main effects not significant ($P > 0.05$) for each variable.
[y]Annual forage is winter wheat.
[x]Annual forage is corn.

Table 6. Effects of fall grazing, winter feeding treatment, and sex of calf previously supported by cow on average daily gain, change in backfat over the winter period, and final backfat (mm) averaged over 4 yr ($n = 80$ for groups of main effects and $n = 40$ for groups of interaction)

Factor	ADG (kg d^{-1})	Backfat change (mm)	Final backfat (mm)
Fall grazing (FG)			
Fescue prairie (F_)	0.13	−2.02	4.12
Annual (A_)	0.09	−2.75	5.26
SEM	0.035	0.26	0.31
P	0.567	0.028	0.009
Winter feeding (W)			
Fescue prairie (_f)	−0.27	−2.88	4.18
Drylot (_d)	0.50	−1.89	5.20
SEM	0.035	0.26	0.31
P	<0.001	0.004	0.080
Sex			
Male	0.13	−2.19	4.28
Female	0.10	−2.58	5.10
SEM	0.035	0.26	0.31
P	0.695	0.213	0.049
FG × W			
Ff	−0.23*a*	−2.06*b*	3.53*a*
Fd	0.50*b*	−1.98*b*	4.72*ab*
Af	−0.31*a*	−3.70*a*	4.82*ab*
Ad	0.50*b*	−1.80*b*	5.69*b*
SEM	0.050	0.37	0.54
P	0.519	0.019	0.762

a,b Within a column, means with a different letter are different ($P < 0.05$).

were fed a smaller ration than cows that had grazed on fescue prairie in fall and had less backfat. On the other hand, cows on fescue prairie in winter had access to the same forage regardless of their pre-winter body condition.

The effectiveness of a fall grazing treatment is determined not only by animal response but also by the duration and extent of the response into the winter period. Cows that were grazed on fescue prairie in the fall, with less backfat than those grazed on annual forages, did not show compensatory gain when put on a higher nutritional level. This is similar to the observations reported by White et al. (1987). However, cows that shifted from a relatively high nutritional level to a lower one tended to lose more weight and backfat, possibly because of the change in diet. White et al. (1987) reported that among steers moved to a common pasture, those that had been at a higher nutritional level had lower gains than those that had been on a lower nutritional level.

The cows kept on fescue prairie throughout the entire grazing trial had the lowest backfat prior to calving (3.5 mm). However, the treatment effects on animal condition did not affect the birth weight of calves or their subsequent gain. Dziuk and Bellows (1983) reported poorer reproductive performance and weaker calves as a result of suboptimal backfat at calving. Increasing the condition of cows with annual forage in fall is a viable alternative to keeping them in the drylot over winter. Based on current pasture fees in Alberta, cost of establishing annual pasture and drylot changes, the cost per cow of each treatment from October to March was about \$50 for Ff, \$110 for Fd, \$63 for Af, and \$125 for Ad. Thus, increasing animal condition with annual forages prior to winter grazing was less costly than feeding preserved forage in March to recover lost condition. Fall grazing of annual forages resulted in cows being in nearly optimal condition for calving (Table 6). Keeping cows on fescue prairie throughout the winter was least expensive; however, this practice left cows with lower than optimal levels of backfat in spring.

The sex of calf influenced the performance of cows over the grazing trial and resulted in 0.8 mm less backfat ($P = 0.049$) in cows that had supported male calves than in those that had supported female calves. However, the effect of calf sex was introduced at the beginning of the trial (Table 3) and with the exception of increasing differences through the fall grazing period (Table 4), was basically maintained over the trial (Table 6).

Feeding annual forages to increase the condition of pregnant cows prior to winter grazing is a viable option. However, annual cultivation is required, thereby exposing the soils to wind erosion. Where this is a problem, other strategies to boost animal condition, such as supplementing cows on winter pasture with a high-protein concentrate in the fall, might be necessary.

CONCLUSION

Pregnant Hereford cows did not maintain their condition on fescue prairie after summer, and if they were kept on the range through the winter they were below optimal condition for calving in spring. On the other hand, fall grazing cows on annual forages, prior to winter grazing, improved their condition and delayed the onset of weight loss. This resulted in a nearly optimal condition by calving in spring. Calves on annual forages gained about 0.25 kg d^{-1} more than calves on fescue prairie in the fall period. For cows that were not grazed on annual forage in fall, additional feed inputs were necessary to achieve optimal body condition prior to calving.

Cost of fall grazing on annual forages was approximately \$47 less per cow than maintaining the cattle in the drylot. While keeping cows on fescue prairie throughout the grazing period was least costly, the animals were in less than optimal condition for calving in spring. Therefore, grazing fescue prairie in winter is an economical and sustainable practice, but additional inputs are required for optimal performance.

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