

Cubed Alfalfa Hay or Cottonseed Meal-Barley as Supplements for Beef Cows Grazing Fall-Winter Range

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Abstract

A 2-year study evaluated the efficacy of supplements for beef cows grazing mixed grass prairie during the fall and winter. Cows were allotted to 3 treatments: (1) range forage only, (2) range forage plus 1.2-1.3 kg alfalfa cubes $\cdot \text{hd}^{-1} \cdot \text{d}^{-1}$, and (3) range forage plus .9 kg cottonseed meal-barley cake $\cdot \text{hd}^{-1} \cdot \text{d}^{-1}$. Supplements were fed daily to provide approximately 50% of crude protein requirements. Treatment effects did not depend ($P < 0.10$) on year for independent variables evaluated. Although weather conditions differed among years, observed changes in weight and condition score were similar ($P < 0.10$) for both years. Supplemented cows gained weight; but supplement type did not influence weight gains. In contrast, unsupplemented cows displayed significant weight loss. Supplemented cows either maintained or slightly increased in body condition during the fall-winter period. However, body condition of unsupplemented cows decreased ($P < .05$) compared with condition of supplemented cows. Supplementation with alfalfa cubes resulted in similar performance compared with supplementation with cottonseed meal-barley cake. Supplementing diets of wintering range cows with feeds high in protein improved performance compared with no supplementation.

Supplementing beef cattle grazing on native winter rangeland in the Northern Great Plains is common but costly. Reducing these costs requires supplementation practices that meet nutritional requirements while enhancing forage utilization. Energy supplementation of animals consuming poor quality forage often results in depressed cellulose and hemicellulose digestibility (Henning et al. 1980, Kartchner 1981), reduced protein digestibility (Cook and Harris 1968), and decreased intake of forage (Crabtree and Williams 1971a,b; Lamb and Eadie 1979). In contrast, supplementing poor quality forage with a nitrogen or protein source frequently yielded increased forage intake (Amos and Evans 1976, Kartchner 1981), improved crude protein digestibility (Coleman and Wyatt 1982) and elevated crude fiber digestibility (Lyons et al. 1970). Alfalfa is a protein-rich feedstuff that generally costs less than traditional "protein" supplements. Alfalfa has been successfully used to complement the diets of sheep fed low quality tall fescue

(Hunt et al. 1985). However, published evaluations of alfalfa fed at low levels to wintering range cattle are limited (Clanton et al. 1980). In addition published comparisons of performance results from cattle fed cubed alfalfa hay and traditional supplements are not available. Therefore, we tested the hypothesis that supplementing cows grazing fall-winter range with low levels of alfalfa cubes will result in similar performance (as defined by changes in body weight and condition) relative to supplementing with an equivalent quantity of nitrogen in the form of cottonseed meal-barley cake. Moreover, we tested whether supplementation with feeds high in protein improves performance compared with no supplementation.

Materials and Methods

Trials were conducted at the Fort Keogh Livestock and Range Research Laboratory, Miles City, Mont., during the fall and winter of 1982/83 and 1983/84. The study was conducted in 6 paddocks contained within a 342-ha mixed grass prairie pasture. Predominant forage species were blue grama (*Bouteloua gracilis*), western wheatgrass (*Pasocopyrum smithii*), needle-and-thread (*Stipa comata*), and buffalograss (*Buchloe dactyloides*). Browse species available included greasewood (*Sarcobatus vermiculatus*), shadscale (*Atriplex confertifolia*), Gardner's salt brush (*Atriplex gardneri*), winterfat (*Creatoides lanata*), big sagebrush (*Artemisia tridentata wyomingensis*), and silver sagebrush (*Artemisia cana*) (Kartchner 1981).

Mature, pregnant crossbred cows ($n=87$ for 1982/83 and $n=64$ for 1983/84) were randomly assigned to the 6 paddocks. Stocking rates were maintained at levels which insured forage availability was not limiting in either year. Stocking rates used were considered moderate to light based on previous work with the pasture used in this study (Holscher and Woolfolk 1953). Two paddocks were randomly assigned to each of 3 supplement treatments: (1) range forage only, (2) range forage plus alfalfa cubes, and (3) range forage plus 30% cottonseed meal-70% barley cake. Alfalfa was fed to supply 50% of the crude protein requirement (NRC 1976) of a dry, pregnant, mature cow in the middle third of gestation ($1.3 \text{ kg} \cdot \text{hd}^{-1} \cdot \text{d}^{-1}$ for 1982/83 and $1.2 \text{ kg} \cdot \text{hd}^{-1} \cdot \text{d}^{-1}$ for 1983/84). Cottonseed meal-barley cake was fed to supply similar levels of energy and protein as the alfalfa cubes ($.9 \text{ kg} \cdot \text{hd}^{-1} \cdot \text{d}^{-1}$ during both years). Supplements were offered on a daily basis. During trials, alfalfa hay cost \$65.00/ton; cubing costs varied between \$10.00 and \$20.00/ton. The cottonseed meal-barley cake we used was valued at \$230.00/ton. Other commonly used range cake (barley cake adjusted to 20% crude protein) by ranchers in eastern

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Montana cost \$165.00/ton during our study. We began trials on 3 November 1982 and 4 October 1983 and continued them until forage availability warranted providing additional energy as hay. Termination dates were 25 January 1983 and 10 January 1984.

Animals were weighed to the nearest 0.5 kg at 14-day intervals throughout the course of each trial. Before weighing, cows were allowed to graze but were held off water for approximately 18 hours. Body condition scores were recorded for each cow at the beginning and end of each trial based on a palpated determination of fleshing over the ribs and thoracic vertebrae as described by Bellows et al. (1971). Scores were independently estimated by 2 individuals. Possible range for numerical scores was from 1 (thinnest) to 10 (fattest). The average of the 2 individuals' scores was used as the estimate of condition.

Four esophageally fistulated steers were used to collect diet samples from each of 2 paddocks during each collection period. Diet samples were collected to evaluate forage quality during the study. Collections were made during December and January of 1982/83 and October, November, December and January of 1983/84. Samples were collected during the morning following an overnight fast. Masticates were subsampled, composited, and dried for a minimum of 48 hours at 50° C. Fistula forage samples and supplements were ground with a Wiley mill to pass a 1-mm screen and then analyzed for various chemical constituents (Table 1). Crude protein was determined by AOAC (1980) procedures.

Table 1. Chemical composition¹ and digestibility of range forage and supplements.

Item	Chemical component (%) ²					
	OM	CP	ADF	NDF	ADL	IVOMD
Year 1 - 1982/83						
Range forage						
December	91.9	3.2	51.5	77.8	5.8	50.4
January	91.7	3.0	51.4	77.8	4.9	57.1
Alfalfa cubes	89.2	15.9	34.7	43.6	6.3	63.8
Cottonseed meal-barley	95.0	22.1	9.6	20.9	2.4	82.6
Year 2 - 1983/84						
Range forage						
October	91.2	6.5	48.7	73.2	4.2	65.5
November	90.8	5.7	49.3	72.4	4.0	67.9
December	91.3	5.1	50.4	74.2	4.4	63.9
January	89.4	4.8	49.4	72.5	4.9	61.9
Alfalfa cubes	88.6	17.6	32.8	42.7	5.4	69.3
Cottonseed meal-barley	95.0	22.1	9.6	20.9	2.4	82.6

¹OM=organic matter.

CP=crude protein.

ADF=acid detergent fiber.

NDF=neutral detergent fiber.

ADL=acid detergent lignin.

IVOMD=in vitro organic matter digestibility

²Dry matter basis.

Acid detergent fiber, neutral detergent fiber, and acid detergent lignin were determined as described by Goering and Van Soest (1970). A modification (White et al. 1981) of the Tilley and Terry (1963) procedure was used for determining in vitro organic matter digestibility.

Weight and condition score data were evaluated by analysis of variance. Terms included in the model and their corresponding degrees of freedom were year (1), treatment (2), year × treatment (2), paddock within year × treatment (6), animal within paddock within year × treatment (139). Terrain differed among paddocks; consequently, 1 degree of freedom from the paddock within year × treatment interaction was used to account for this known source of variation among paddocks. The random variation among paddocks (5 degrees of freedom) was used as the testing term for year, treatment and year × treatment interaction. Orthogonal contrasts were used to partition treatment sums of squares. Contrasts were

(1) alfalfa cube versus cottonseed meal/barley and (2) supplementation versus no supplementation.

Results and Discussion

Treatment effects did not depend ($P>0.10$) on year for any of the responses evaluated. Although temperatures were warmer and less snow fell (Fig. 1) during year 1 (1982/83) compared with year 2

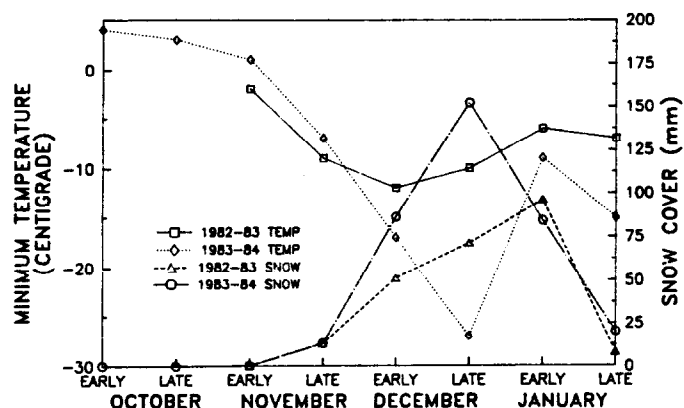


Fig. 1. Fourteen day averages of daily minimum temperature and snow cover.

(1983/84), we observed no difference ($P>0.10$) among years in total weight or condition score change. Supplemented cows gained weight (Table 2); supplement type did not influence ($P>0.25$) weight gains. Similarly, we observed no difference ($P>0.50$) among cows receiving either supplement for change in body condition score (Table 3). Supplemented cows maintained or slightly increased in body condition during the fall-winter period.

Unsupplemented cows lost more ($P<0.025$) weight during fall and winter than supplemented cows. Body condition scores of unsupplemented cows also decreased during fall-winter. We observed lower ($P<0.05$) condition scores in unsupplemented cows compared with supplemented ones. Condition score and reproductive characteristics have been observed to be more highly correlated than body weight and reproductive characteristics (Staigmiller et al. 1979). Dzuik and Bellows (1983) indicated that the dam should have a minimum score of 5 at calving to ensure adequate postpartum reproduction. We observed condition scores in unsupplemented cows below this level and surmise that this could potentially depress their reproductive performance during the postpartum period.

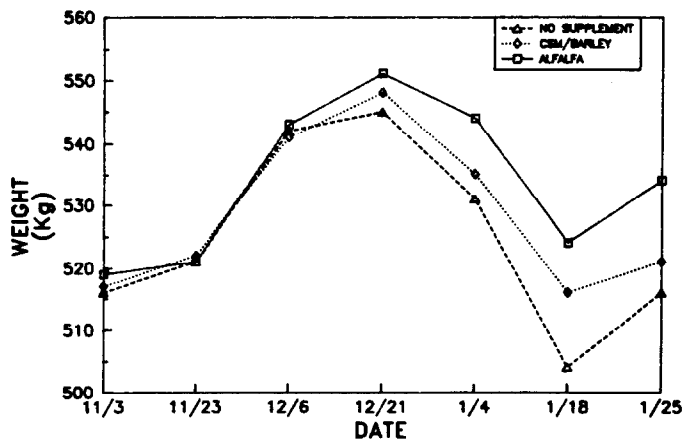


Fig. 2. Weight profile of beef cows during fall-winter 1982-83.

Weight profiles of supplemented cows paralleled those of unsupplemented one during year 1 (Fig. 2), but diverged during

Table 2. Least squares means¹ for initial weight, final weight and weight change² of pregnant beef cows at the initiation and termination of supplementation periods.

Item	Treatments				Orthogonal contrasts		
	Range forage only (RFO)	Alfalfa cubes (AC)	Cottonseed meal-barley (CSM/B)	SE ³	AC + CSM/B		
					AC vs CSM/B	2	vs RFO
Animals, (no.)	53	49	49				
Initial weight (kg)	516	517	518	3	<i>P</i> >.50		<i>P</i> >.50
Final weight (kg)	505	541	532	6	<i>P</i> >.40		<i>P</i> <.025
Weight change (kg)	-11	24	14	9	<i>P</i> >.25		<i>P</i> <.025

¹Pooled across years.

²End-beginning weight.

³SE = standard error.

Table 3. Least squares means¹ for initial, final and change in condition score² of pregnant beef cows at the initiation and termination of supplementation periods.

Item	Treatments				Orthogonal contrasts		
	Range forage only (RFO)	Alfalfa cubes (AC)	Cottonseed meal-barley (CSM/B)	SE ³	AC + CSM/B		
					AC vs CSM/B	2	vs RFO
Animals, (no.)	53	49	49				
Initial condition score	5.1	5.2	5.2	.1	<i>P</i> >.50		<i>P</i> >.30
Final condition score	4.6	5.4	5.2	.2	<i>P</i> >.50		<i>P</i> <.025
Condition score change	-.5	.2	0	.2	<i>P</i> >.50		<i>P</i> <.05

¹Pooled across years.

²End-beginning score; 1 = thinnest, 10 = fattest.

³SE = standard error.

year 2 (Fig. 3). All groups lost weight rapidly during mid-December. This pattern of weight gain and loss coincided with the beginning of severe weather during both years. Generally, periods of substantial snow cover accompanied colder temperatures (Fig. 1), thus limiting forage availability. Severe winter conditions would increase the maintenance energy requirement of cows (NRC 1981). In addition, time spent grazing decreases at extremely low environmental temperatures (Adams and Reynolds 1983). Therefore, the rapid weight losses we observed may reflect actual decreases in empty body weight as well as decreases in gut fill. The small increases in live weight at the end of both trials correspond

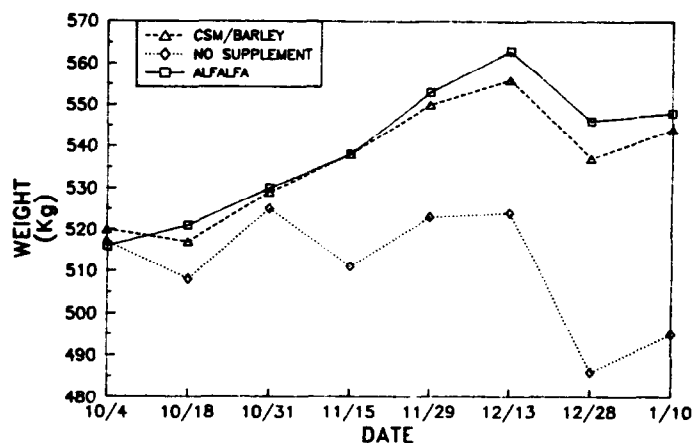


Fig. 3 Weight profile of beef cows during fall-winter 1983-84.

with decreased snow cover and increased temperature. Increased grazing activity, and thus gut fill may explain this rapid recovery of body weight.

Evaluation of supplement prices and quantity fed indicated that similar winter performance could be realized for approximately half the costs when using alfalfa cubes (11 cents • hd^{-1} • d^{-1}) compared with cottonseed meal-barley cake (23 cents • hd^{-1} • d^{-1}). If barley cake adjusted to 20% crude protein (\$165.00/ton) was fed at

the same level as the cottonseed meal-barley cake and produced similar performance response, there would continue to be a 5 cents • hd^{-1} • d^{-1} advantage for supplementation with alfalfa cubes. A price differential of 5 to 12 cents • hd^{-1} • d^{-1} would be a significant savings for ranchers who routinely choose to supplement their cows during the fall and winter. However, the competitive advantage from supplementing with alfalfa cubes is highly dependent on the prices of alfalfa hay and other supplemental feeds. Therefore, final choice of supplement type may be modified by feed prices within a given year. Determination of the usefulness of winter supplementation is complex due to modifying influences of cow body condition, physiological state, forage quality, weather, pre- and postpartum nutritional treatments, varying management schemes, and cattle prices. However, several long-term supplementation studies (Black et al. 1938, Bellido et al. 1981, Heitschmidt et al. 1982) indicate that benefits from supplementation may be substantial during significant stress periods (e.g., severe winters, drought, extreme weed infestation, and heavy stocking rates). Under more favorable conditions, the usefulness of supplementation programs has been questioned (Bellows and Thomas 1976, Bellido et al. 1981). Further work identifying levels of supplementation appropriate for various stressors and development of supplementation strategies which are related to stressor presence and severity would be useful in reducing costs associated with unnecessary supplementation.

In conclusion, changes in live weight and condition score observed in this study support the hypothesis that similar or improved performance can be realized using an alfalfa cube supplement compared with providing an equivalent quantity of nitrogen as cottonseed meal-barley cake. This finding concurs with results reported by Clanton et al. (1980) for grazing cows supplemented with alfalfa hay or soybean meal during the winter period. Supplementing the diets of wintering range cows with feeds high in protein improved performance compared with no supplementation.

Literature Cited

- Adams, D.C., and W.L. Reynolds. 1983. Winter grazing patterns of three- and six-year-old crossbred cows in the Northern Great Plains. *J. Anim. Sci.* 57(Suppl. 1):34. (Abstr.)

- Amos, H.E., and J. Evans. 1976. Supplementary protein for low quality bermudagrass diets and microbial protein synthesis. *J. Anim. Sci.* 43:861-868.
- AOAC. 1980. Official methods of analysis (13th Ed.) Association of Official Analytical Chemists. Washington, D.C.
- Bellido, M.M., J.D. Wallace, E.E. Parker, and M.D. Finkner. 1981. Influence of breed, calving season, supplementation and year on productivity of range cows. *J. Anim. Sci.* 52:455-462.
- Bellows, R.A., R.E. Short, D.C. Anderson, B.W. Knapp and O.F. Pahnish. 1971. Cause and effect relationships associated with calving difficulty and birth weight. *J. Anim. Sci.* 33:407-415.
- Bellows, R.A., and O.O. Thomas. 1976. Some effects of supplemental grain feeding on performance of cows and calves on range forage. *J. Range Manage.* 29:192-195.
- Black, W.H., J.R. Quesenberry, and A.L. Baker. 1938. Wintering beef cows on the range with and without a supplement of cottonseed cake. USDA Tech. Bull. No. 603.
- Clanton, D.C., M.E. England, and L.L. Berger. 1980. Winter nutritional programs. Nebraska Beef Cattle Report p. 9-11.
- Coleman, S.W., and R.D. Wyatt. 1982. Cottonseed meal or small grains forages as protein supplements fed at different intervals. *J. Anim. Sci.* 55:11-17.
- Cook, C.W., and L.E. Harris. 1968. Effect of supplementation on intake and digestibility of range forage. *Utah Agr. Exp. Sta. Bull.* 475.
- Crabtree, J.R., and G.L. Williams. 1971a. The voluntary intake and utilization of roughage-concentrate diets by sheep. 1. Concentrate supplements for hay and straw. *Anim. Prod.* 13:71-82.
- Crabtree, J.R., and G.L. Williams. 1971b. The voluntary intake and utilization of roughage concentrate diets by sheep. 2. Barley and soya bean meal supplementation of hay diets. *Anim. Prod.* 13:83-92.
- Dzuik, P.J., and R.A. Bellows. 1983. Management of reproduction of beef cattle, sheep and pigs. *J. Anim. Sci.* 57(Suppl. 2):355-379.
- Goering, H.K., and P.J. VanSoest. 1970. Forage Fiber Analyses. ARS-USDA Agr. Handbook No. 379.
- Heitschmidt, R.K., M.M. Kothman, and W.J. Rawlins. 1982. Cow-calf response to stocking rates, grazing systems, and winter supplementation at the Texas Experimental Ranch. *J. Range Manage.* 35:204-210.
- Henning, P.A., Y. VanDerLinden, M.E. Mattheyse, W.K. Nauhaus, H.M. Schwartz and F.M.C. Gilchrist. 1980. Factors affecting the intake and digestion of roughage by sheep fed maize straw supplemented with maize grain. *J. Agr. Sci. (Camb.)* 94:565-573.
- Holscher, and E.J. Woolfolk. 1953. Forage utilization by cattle on Northern Great Plains ranges. USDA Circular No. 918.
- Hunt, C.W., J.A. Paterson, and J.E. Williams. 1985. Intake and digestibility of alfalfa-tall fescue combination diets fed to lambs. *J. Anim. Sci.* 60:301-306.
- Kartchner, R.J. 1981. Effects of protein and energy supplementation of cows grazing native winter range forage on intake and digestibility. *J. Anim. Sci.* 51:432-438.
- Lamb, C.S., and J. Eadie. 1979. The effect of barley supplements on the voluntary intake and digestion of low quality roughages by sheep. *J. Agr. Sci. (Camb.)* 92:235-241.
- Lyons, T., P.J. Caffrey, and W.J. O'Connell. 1970. The effect of energy, protein and vitamin supplementation on the performance and voluntary intake of barley straw by cattle. *Anim. Prod.* 12:323-334.
- NRC. 1976. Nutrient Requirements of Domestic Animals. No. 4. Nutrient Requirements of Beef Cattle (6th Ed.). National Academy Press, Washington, D.C.
- NRC. 1981. Effect of environment on nutrient requirements of domestic animals. National Academy Press, Washington, D.C.
- Staigmiller, R.B., Short, R.A. Bellows, and J.B. Carr. 1979. Effect of nutrition on response to exogenous FSH in beef cattle. *J. Anim. Sci.* 48:1182-1190.
- Tilley, J.M.A., and R.A. Terry. 1963. A two-stage technique for the in vitro digestion of forage crops. *J. Brit. Grassl. Soc.* 18:104-111.
- White, L.M., G.P. Hartman, and J.W. Bergman. 1981. In vitro, digestibility, crude protein and phosphorus content of straw of winter wheat, spring wheat, barley and oat cultivars in eastern Montana. *Agron. J.* 73:117-121.

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