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Summary

Two winter grazing trials were conducted at the SDSU Cottonwood Research Station near Cottonwood, SD, to compare wheat middlings to soybean meal and corn-soybean meal supplements. In consecutive years, grazing trials from December to February were conducted using Simmental x Angus crossbred cows grazing two pastures with differing amounts of available forage and fed four supplemental treatments that were balanced to provide the following amounts of crude protein (lb) and metabolizable energy (Mcal) per cow daily: 1) soybean meal .75 and 2.40, 2) low wheat middlings .75 and 4.76, 3) corn-soybean meal 1.50 and 9.40, and 4) high wheat middlings 1.50 and 9.40. Cows grazing the high available forage pasture gained 53 lb more than those grazing the low available forage pasture. The supplement x pasture interaction indicates that level of available forage affects response to the supplemental treatment. When available forage was low, wheat middlings was a less effective source of supplemental protein than soybean meal. When available forage was high, soybean meal and the low wheat middlings supplements resulted in similar cow weight gains. Regardless of forage availability, the high wheat middlings supplement was a less effective source of supplemental energy compared to the corn-soybean meal supplement balanced to provide equal protein and energy. The supplement x year interaction resulted from soybean meal being more beneficial than low wheat middlings in year 1 while in year 2, soybean meal and low wheat middlings resulted in similar cow performance.

Key Words: Beef Cows, Winter Range, Available Forage, Wheat Middlings, Supplement

Introduction

Previous studies at the SDSU Cottonwood Research Station demonstrated the importance of adequate cow body condition at calving and prior to the breeding season for high reproductive performance. Supplementation of cows grazing mature, low protein forage can be used to maintain adequate body condition by minimizing cow weight loss in the winter.

Protein is typically the first limiting nutrient for cows grazing native winter range pastures. The use of all natural high protein supplements has been shown to improve cow weight change during the winter grazing period by improving forage intake and digestibility. Previous research at the Cottonwood Station confirms that protein should be the first consideration. Additional supplemental energy may be beneficial only after protein needs are met.

The use of grain which is high in starch can be detrimental to cow performance due to a reduction in intake and digestibility of the base forage. Previous research at the Cottonwood station indicates that grain supplements are more likely to be beneficial when there is abundant forage to graze or when additional protein is provided with the grain supplement. Lower starch by-product feeds, such as wheat middlings, soybean hulls, brewers grains, and sugar beet pulp have the potential to increase energy consumption without the detrimental effects of the starch in grains.

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This study was conducted to compare wheat middlings to soybean meal and corn-soybean meal supplements on the performance of beef cows grazing native winter range with two levels of forage availability.

Materials and Methods

Two winter grazing trials using 122 (year 1) and 127 (year 2) pregnant Simmental x Angus crossbred cows grazing native winter range were conducted at the SDSU Cottonwood Research Station. Cows were allotted by age and weight to four supplemental treatments (Table 1) and grazed on pastures with either high or low available forage from December to February. A soybean meal supplement was used as a base to provide .75 lb crude protein per cow daily. A low wheat middlings supplement was balanced to provide the same amount of protein daily. A high wheat middlings supplement was balanced to provide twice the amount of energy as the low wheat middlings supplement. A corn-soybean meal supplement was balanced to provide the same amount of protein and energy as the high wheat middlings supplement. Supplements were pelleted (3/16 in. diameter) and balanced to exceed NRC (1984) requirements for phosphorus and potassium (Table 2).

Table 1. Supplemental treatments[a]

	Supplement			
Item	Soybean meal	Low wheat middlings	Corn-soybean meal	High wheat middlings
Ingredients (years 1 and 2)				
Soybean meal	88.62	—	32.20	—
Corn	—	—	64.68	—
Wheat middlings	—	97.83	—	97.83
Beet molasses	2.24	2.17	2.21	2.17
Dicalcium phosphate	9.14	—	.91	—
Composition year 1				
Dry matter	87.77	87.92	86.44	86.40
Crude protein	44.34	18.30	23.74	18.23
Starch	7.90	18.17	45.48	18.17
Ether extract	.43	3.40	1.33	3.40
Neutral detergent fiber	7.82	37.81	10.50	38.19
Acid detergent fiber	5.29	11.75	4.35	11.60
Composition year 2				
Dry matter	89.41	85.78	86.29	85.78
Crude protein	47.62	16.72	21.86	16.72
Starch	7.53	37.03	63.37	37.03
Ether extract	.71	4.07	2.61	4.07
Neutral detergent fiber	8.27	36.89	8.58	36.89
Acid detergent fiber	5.67	11.90	4.67	11.90

[a]Percentage on a dry matter basis.

Table 2. Composition of daily supplemental intake per cow[a]

Item	Supplement			
	Soybean meal	Low wheat middlings	Corn-soybean meal	High wheat middlings
		Year 1		
Dry matter, lb	1.90	4.19	6.44	8.36
Metabolizable energy, Mcal/lb	2.36	5.43	9.19	10.84
Crude protein, lb	.84	.77	1.52	1.52
Starch, lb	.15	.76	2.93	1.52
Phosphorus, lb	.014	.046	.053	.092
Potassium, lb	.040	.056	.071	.099
		Year 2		
Dry matter, lb	1.92	4.08	6.44	8.29
Metabolizable energy, Mcal/lb	2.42	5.29	9.19	10.75
Crude protein, lb	.90	.68	1.41	1.39
Starch, lb	.14	1.51	4.08	3.07
Phosphorus, lb	.047	.039	.045	.080
Potassium, lb	.041	.051	.071	.103

[a]ME values are calculated from NRC (1984) feed tables. Other values are based on chemical analysis.

Two pastures used in the study were predominately western wheatgrass. The low available forage pasture (270 acres) was grazed for 5,575 (year 1) and 5,375 (year 2) animal unit days prior to the start of the trial to create differences in available forage. The high available forage pasture 351 acres (year 1) and 270 acres (year 2) had not been grazed since the previous April in both years.

From early December to early February, cows were gathered every morning, sorted into treatment groups, and bunk fed their respective supplements. At the beginning and end of the trials, cows were weighed in the morning on two consecutive days after overnight removal from feed and water. At the end of the supplemental feeding periods, cows were grazed on a common pasture without supplementation for four days to equalize fill. Initial and final cow weights were the average of the two consecutive weights. Condition scores (1 to 9, 1 = extremely emaciated) were assigned by two technicians at the beginning and end of the trials. On the second weigh day at the beginning and end of the trials subcutaneous fat was measured at the twelfth rib with an Aloka 500V ultrasound system using a 5 MHz, 5.8 cm probe. Cows were bred to either Angus or Simmental bulls. In year 1, 2-year-old heifers were to start calving February 15 and the cows on March 15. In year 2, 2-year-olds were to start calving on February 26 and the cows on March 18.

In early January of each year, forage samples were collected using four, mature esophageally fistulated steers fitted with screened collection bags. Steers grazed with the cows for 30 minutes following morning supplementation on two consecutive days per pasture. Samples were frozen, lyophilized, and ground for later analysis.

Data for the grazing trials were analyzed as a 2 x 4 factorial arrangement with two pastures and four treatments as main effects using the GLM procedure of SAS and treatment means were separated by the PDIFF option. Dependent variables included initial, final, and change in cow weight, condition score, and rib fat. Independent variables included supplement,

pasture, cow age, year, supplement x pasture, and supplement x year. Initial measurements were included as covariates for weight change, condition score change, and change in rib fat.

Results and Discussion

Forage samples from year 1 were lower in crude protein and higher in NDF than year 2 (Table 3). Forage samples in year 1 indicated that cattle grazing the high available forage pasture were able to select a diet higher ($P<.05$) in crude protein than the low available forage pasture. In year 2 the high and low pastures were more similar in forage quality.

Cows grazing the high available forage pasture gained 53 lb more ($P<.01$) weight and lost less ($P<.01$) body condition than cows grazing the low available forage pasture.

Table 3. Composition of forage samples[ab]

	Year 1		Year 2	
Item	Low	High	Low	High
Organic matter basis, %				
Crude protein	3.39[c] (.26)	4.45[d] (.28)	5.06[e] (.22)	5.32[e] (.22)
Neutral detergent fiber	85.54[d] (.95)	83.87[d] (.72)	80.12[c] (.79)	81.23[c] (.79)
Acid detergent fiber	57.28 (1.06)	55.23 (.80)	56.87 (.88)	55.99 (.88)
Acid detergent lignin	5.65[c] (.41)	6.11[c] (.31)	5.14[d] (.34)	4.65[d] (.34)
Dry matter basis, %				
Ash	13.36 (.94)	12.92 (.71)	14.55 (.78)	13.12 (.78)

[a]Least squares means followed by standard errors.
[b]Uncorrected for salivary contamination.
[c,d,e]Means within a year with uncommon superscripts differ ($P<.10$).

There was a supplement x pasture interaction ($P<.01$) for both weight and condition score change, indicating that response to a supplement was dependent on the amount of available forage (Table 4).

When forage availability was low, cows fed low wheat middlings lost 32 lb more ($P<.05$) weight than the soybean meal fed cows. Cows supplemented with high wheat middlings gained less ($P<.05$) weight and lost more ($P<.05$) body condition than the corn-soybean meal fed cows. The high wheat middlings supplemented cows lost 62 lb less ($P<.05$) weight and lost .4 units less ($P<.05$) body condition score than low wheat middlings fed cows. When forage availability is low, wheat middlings appear to be a less effective protein source compared to soybean meal and a less effective source of energy compared to corn-soybean meal.

When forage availability was high, cows fed .75 lb crude protein from wheat middlings and soybean meal had similar weight and condition score changes. Cows that the high wheat middlings supplement gained 37 lb less ($P<.05$) weight than corn-soybean meal fed cows. The high wheat middlings supplemented cows gained 36 lb more ($P<.05$) weight and lost less ($P<.05$) body condition than the cows fed low wheat middlings. When forage availability is high, wheat middlings is an effective protein source compared to soybean meal and is a less effective energy source compared to corn-soybean meal balanced to provide equal protein.

The supplement x year interaction ($P<.01$) for weight and condition score change resulted from soybean meal being more beneficial to cow performance than low wheat middlings in year 1 and in year 2, soybean meal and low wheat middlings resulted in similar cow performance (Table 5). The forage grazed in year 2 was higher quality (Table 3) than the forage grazed in year 1. This may have caused the supplement x year interaction.

Table 4. Effect of available forage and supplement on cow performance[a]

Level of forage	Low				High			
Supplement	Soybean meal	Low wheat middlings	Corn-soybean meal	High wheat middlings	Soybean meal	Low wheat middlings	Corn-soybean meal	High wheat middlings
No. cows	30	32	31	31	32	31	32	30
Initial wt, lb	1110	1107	1111	1096	1097	1109	1095	1098
Initial CS, 1-9	5.4[bc]	5.3[bc]	5.4[bc]	5.2[c]	5.2[bc]	5.4[c]	5.3[bc]	5.3[bc]
Initial rib fat, cm	.31	.29	.27	.25	.30	.29	.31	.26
Wt change, lb	-34[c]	-66[d]	50[f]	-4[d]	14[e]	11[de]	84[g]	47[f]
CS change	-.4[c]	-.6[b]	.0[ef]	-.2[d]	-.2[d]	-.1[de]	.2[f]	.0[ef]
Rib fat change, cm	-.08[bc]	-.10[b]	-.03[de]	-.04[cde]	-.07[bcd]	-.05[cde]	-.01	-.02[de]

[a]Least squares means.

[b,c,d,e,f,g]Means in a row with uncommon superscripts differ ($P<.05$).

Table 5. Effect of year and supplement on cow performance[a]

	Supplement				Forage availability	
	Soybean meal	Low wheat middlings	Corn-soybean meal	High wheat middlings	Low	High
			Year 1			
No. cows	30	31	31	30	60	60
Initial wt, lb	1136	1139	1130	1120	1138	1124
Initial CS, 1-9	5.5	5.4	5.4	5.4	5.4	5.4
Initial rib fat, cm	.40[c]	.35[bc]	.37[bc]	.30[b]	.36	.35
Wt change, lb	21[c]	-27[b]	53[d]	9[c]	-14[b]	42[c]
CS change	-.1[cd]	-.3[b]	.1[d]	-.1[c]	-.2[b]	.0[c]
Rib fat change, cm	-.05[b]	-.05[b]	.03[c]	.00[bc]	-.03	.00
			Year 2			
No. cows	32	32	32	31	64	63
Initial wt, lb	1071	1077	1076	1065	1069	1075
Initial CS, 1-9	5.1[b]	5.4[c]	5.2[bc]	5.1[b]	5.2	5.2
Initial rib fat, cm	.21	.23	.22	.20	.20	.23
Wt change, lb	-41[b]	-28[b]	81[d]	33[c]	-13[b]	36[c]
CS change	-.5[b]	-.4[b]	.1[c]	-.1[c]	-.4[b]	-.0[c]
Rib fat change, cm	-.10	-.10	-.07	-.06	-.09	-.07

[a]Least squares means.

[b,c,d]Means within main effect with uncommon superscripts differ ($P<.05$).

Previous studies have shown that a grain-based supplement may be detrimental to cow performance. Grain supplements are more likely to improve cow weight change when there is abundant forage or when the amount of protein in the supplement is high. In this study, the lower starch wheat middlings supplement did not improve weight change compared to the corn-soybean meal supplement that was balanced to provide the same daily level of protein and energy. Regardless of forage availability, the wheat middlings supplement did not improve cow performance over the higher starch corn-soybean meal supplement.

Forage availability is a factor in determining the response to a supplement. When forage availability is low, wheat middlings are a less effective source of supplemental protein compared to soybean meal. With low forage availability, wheat middlings do not appear to be as beneficial as a corn-soybean meal supplement when added energy is needed. If abundant forage is available, wheat middlings will provide similar gain responses as a protein supplement compared to soybean meal. With a high amount of available forage, wheat middlings and corn-soybean meal supplements had positive and beneficial weight gains when used as a source of additional energy. When maximum weight gains are needed (usually when cows are thin in the fall), a corn-soybean meal supplement will provide the greatest weight gains.

In some areas wheat middlings are a very low cost source of supplemental protein and energy for cows grazing winter range. When only minimizing winter weight loss is the goal, wheat middlings can be a cost-effective supplement. When higher gains are needed because cows are thin, soybean meal or corn-soybean meal combinations may be more effective in improving cow weight and body condition.