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EFFECTS OF LEVEL OF CONCENTRATE AND FORAGE AVAILABILITY ON THE PERFORMANCE OF BEEF COWS GRAZING WINTER RANGE[1]

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Summary

A winter grazing study was conducted using 120 pregnant Simmental x Angus cows to determine the effect of level of concentrate supplement and amount of available forage on cow performance. Concentrate supplements were fed at a high, medium and low level which included corn, corn-soybean meal and soybean meal, respectively, and were formulated to provide .7 lb of crude protein per cow daily. Two winter pastures with distinctly different amounts of available forage were used in the trial. The amount of available forage had a greater effect on body weight and condition score change than did level of concentrate supplement fed. Cows receiving higher levels of supplement actually gained less weight. The interaction between level of supplement and amount of available forage showed that high levels of concentrate supplement may be more detrimental when amount of available forage is limiting.

(Key Words: Cow, Winter Grazing, Supplementation, Native Range.)

Introduction

Typically, protein is considered the most limiting nutrient in low quality forages such as native winter range. Research has shown that protein supplementation will decrease winter weight and condition score losses by improving intake and digestibility of mature, low protein forages. Recent research also suggests that supplements with high levels of starch may be detrimental to cow performance. It has been thought by some that the advantage of feeding higher levels of concentrate supplement may depend on the amount of forage available to be grazed. The objectives of this study are to determine how the level of concentrate supplement and forage availability affect cow performance.

Materials and Methods

In the first year of a three year study, 120 pregnant Simmental-Angus crossbred cows grazing native winter range during December and January at the SDSU Range and Livestock Research Station near Cottonwood were fed one of three concentrate supplements and grazed on a pasture of either high or low forage availability. Concentrate supplements were corn (high), soybean meal and corn (medium) and soybean meal (low) which each provided .7 lb of crude protein per day (Table 1). Supplements were fed in pelleted form and were balanced to exceed NRC requirements for calcium, phosphorus and potassium (Table 2).

The two pastures used in the study were composed predominantly of western wheatgrass (Table 3). The low available forage pasture (270 acres) was grazed for 4005 animal unit days prior to the trial to create a difference in quality and quantity of available forage. The high available forage pasture (351 acres) had not been grazed since the previous April. Available forage was estimated on 50 .25 m^2 plots per pasture using stratified random sampling, with all major range

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TABLE 1. SUPPLEMENTAL TREATMENTS[a]

	Low	Medium	High
Soybean meal	87.43	14.55	
Corn		73.57	87.90
Dicalcium phosphate	5.23	1.23	.25
Potassium chloride	6.81	3.07	2.17
Molasses	.52	5.97	7.77
Bentonite		1.84	1.91

[a] Percentage on a dry matter basis.

TABLE 2. COMPOSITION OF DAILY SUPPLEMENTAL INTAKE PER COW

	Low	Medium	High
Dry matter, lb	1.91	4.88	7.85
Crude protein, lb	.70	.70	.70
Metabolizable energy, Mcal[a]	2.31	6.70	10.92
Calcium, lb	.030	.022	.014
Phosphorus, lb	.029	.027	.027
Potassium, lb	.101	.124	.156

[a] Calculated from NRC feed tables.

sites sampled in each pasture. Estimates of plant height, number of reference units and cover were made for individual plant species in each plot. An additional 15 .25 m^2 plots were also estimated and then hand clipped, sorted by species, oven dried (60° C) and weighed in order to calibrate the weight estimates made on the other plots.

The 120 Simmental x Angus cows were allotted by age and weight into six treatment groups of 20 head each. Cows were gathered every morning, sorted into treatment groups and bunk fed their respective diets. At the beginning and end of the trial, cows were weighed in the morning on two consecutive days after removal from feed and water overnight. Condition scores (1 to 9, 1 = extremely emaciated) were assigned by two trained technicians at the beginning and end of the trial. The cows on trial were bred to either Angus or Simmental bulls and had mean calving dates of February 27 and March 26 for first calf heifers and mature cows, respectively.

In early January, forage samples were collected with four esophageally fistulated steers that grazed with the cows. All four steers were grazed together on each pasture for two consecutive days. Steers were allowed to graze with screened collection bags for 25 minutes after morning supplementation was completed. Extrusa samples were frozen, lyophilized and ground for later analysis. Ground samples were microhistologically analyzed for forage composition and analyzed for chemical composition. Hand clipped samples similar to cow diets were also taken at this time.

TABLE 3. AVAILABILITY OF PREDOMINENT GRASS SPECIES[a]

	Forage available					
	Low			High		
December 1						
Western wheatgrass	343.1	±	30.8	478.6	±	46.6
Japanese brome	53.5	±	12.9	53.2	±	9.6
Other grasses[b]	55.3	±	1.6	87.6	±	22.0
Total	451.9			619.4		
February 1						
Western wheatgrass	152.7	±	10.8	343.7	±	27.6
Japanese brome	16.9	±	4.6	53.5	±	10.0
Other grasses	61.3	±	4.9	85.1	±	9.2
Total	230.9			482.3		

[a] Expressed in lb per acre.

[b] Undifferentiated mixture of buffalograss, blue grama and sideoats grama.

This study was set up in a 3 x 2 factorial arrangement in which data were analyzed by the GLM procedure of SAS with treatment means separated by the PDIFF option. Dependent variables included initial, final and change in cow weight as well as initial, final and change in condition score. Independent variables included supplement treatment, pasture, supplement treatment x pasture, cow age and cow breed of sire.

Results and Discussion

The results of forage estimation taken at the beginning and end of the trial show definite differences in the amounts of forage available in the high and low available forage pastures (Table 3). Western wheatgrass was the predominant species of grass consumed with Japanese brome, buffalograss, blue grama and sideoats grama being consumed in minor amounts (Table 4). Cattle grazing the pasture with more forage available selected forage that was higher (P=.001) in crude protein and lower in acid detergent fiber (P=.002) and lignin (P=.07; Table 4). Clipped samples also indicate that higher quality forage was consumed by cattle grazing the pasture with more forage available (Table 4).

TABLE 4. COMPOSITION OF FORAGE SAMPLES COLLECTED IN EARLY JANUARY

	Forage available					
	Low			High		
Esophageal samples, % species compositon by weight[a]						
Western wheatgrass	96.63	±	.94	94.05	±	.86
Japanese brome	2.15	±	.63	1.19	±	.58
Other grasses	1.22[c]	±	.84	4.76[d]	±	.78
Esophageal samples, % organic matter basis[ab]						
Crude protein	3.73[c]	±	.17	5.45[d]	±	.16
Acid detergent fiber	57.56[c]	±	.71	53.54[d]	±	.65
Neutral detergent fiber	82.57	±	.85	80.76	±	.78
Acid detergent lignin	8.21[e]	±	.49	6.87[f]	±	.45
Clipped samples, % organic matter basis						
Crude protein	3.79			5.04		
Acid detergent fiber	49.86			47.83		
Neutral detergent fiber	80.38			77.35		
Acid detergent lignin	4.90			5.17		
Clipped samples, % dry matter basis						
Calcium	.26			.31		
Phosphorus	.07			.10		
Potassium	.19			.22		
Ash	5.42			5.69		

[a] Least squares means followed by standard errors.
[b] Uncorrected for salivary contamination.
[c,d] Means within rows with uncommon superscripts differ (P<.05).
[e,f] Means within rows with uncommon superscripts differ (P=.07).

The amount of available forage had a greater effect on cow performance than level of concentrate supplement (Table 5). Cows grazing the high available forage pasture gained 51.5 more pounds ($P<.001$) than cows grazing the low forage pasture. This difference in weight gain was due to cows on the high forage pasture being able to select a higher quality diet than cows on the low forage pasture (Table 4).

Cows receiving higher levels of supplement actually gained less weight ($P<.001$) and lost more condition score ($P<.01$; Table 5). In other words, cows lost more weight as the amount of corn per day in the concentrate supplement increased. Similar research conducted at the Gudmundsen Sandhills Laboratory near Whitman, Nebraska, found that cows grazing native winter range exhibited greater weight loss when additional energy was supplemented in the form of ear corn as compared to a protein supplement alone. The Nebraska results along with results from several other research projects indicate that increasing levels of starch in the diet cause negative effects on digestibility and intake of mature forage. Thus, increasing the amount of concentrate supplement may not result in increased weight gains for cows grazing mature, low protein forage once their protein requirement has been met. Instead, high levels of a supplement high in starch, such as corn, may have detrimental effects on cow performance.

The interaction between amount of forage and level of concentrate for weight change ($P=.10$) and condition score change ($P=.07$) shows that increasing the level of concentrate was more detrimental to cow performance on the low forage pasture (Table 6). Cows grazing the high available forage pasture had similar weight gains when supplemented with low or medium levels of concentrate supplement while cows receiving the high concentrate supplement gained less ($P=.02$) weight. Cows grazing the low available forage pasture gained less weight as level of concentrate increased.

Numerous research trials have demonstrated that providing a small amount of an all natural protein supplement to cows consuming mature, low protein forages will increase forage digestibility and forage consumption. The results from the first year of this study indicate that providing additional energy in the form of a high starch supplement, like corn, will not improve cow weight change but may in fact cause detrimental effects. In some cases, it has been thought that, when the amount of forage available to be grazed is limited, feeding a higher amount of a concentrate supplement is beneficial. But in this study, even when the amount of forage available to be grazed was lower, increasing the amount of supplement caused cows to gain less weight and lose more body condition. Due to year-to-year variations in pasture conditions, this trial will be repeated two more years.

TABLE 5. COW PERFORMANCE[a]

	Level of supplement			Available forage	
	Low	Medium	High	Low	High
No. cows	40	40	40	60	60
Initial weight, lb	1089 ± 15.4	1089 ± 15.8	1084 ± 15.7	1094 ± 13.5	1080 ± 14.5
Initial condition score, 1-9	5.5 ± .11	5.6 ± .11	5.6 ± .11	5.6 ± .10	5.6 ± .10
Weight change, lb	57.2[b] ± 5.0	46.0[c] ± 5.1	27.5[d] ± 5.1	17.8[b] ± 4.4	69.4[c] ± 4.7
Condition score change	.0[b] ± .09	.0[b] ± .09	-.3[c] ± .09	-.2[b] ± .08	.1[c] ± .08

[a] Least squares means followed by standard errors.
[b,c,d] Means within main effect with uncommon superscripts differ (P<.05).

TABLE 6. COW PERFORMANCE FOR THE INTERACTION OF SUPPLEMENT TREATMENT AND FORAGE AVAILABILITY

Forage available	Low			High		
Level of supplement	Low	Medium	High	Low	Medium	High
No. cows	20	20	20	20	20	20
Initial weight, lb	1095 ± 19.1	1098 ± 20.3	1089 ± 19.8	1082 ± 20.8	1080 ± 20.0	1078 ± 20.4
Initial condition score, 1-9	5.5 ± .14	5.7 ± .15	5.6 ± .14	5.6 ± .15	5.4 ± .14	5.7 ± .15
Weight change, lb	38.4[d] ± 6.18	15.8[c] ± 6.55	-1.1[b] ± 6.38	75.9[f] ± 6.72	76.2[f] ± 6.47	55.9[e] ± 6.58
Condition score change	.0[cd] ± .11	-.2[bc] ± .12	-.5[b] ± .11	.0[cd] ± .12	.2[d] ± .12	-.1[cd] ± 9.12

[a] Least squares means followed by standard errors.
[b,c,d,e,f] Means in a row with uncommon superscripts differ (P<.05).