MIDGRASS PRAIRIE RANGE VERSUS SIDEOATS GRAMA/SWEETCLOVER PASTURE FOR STOCKER CATTLE

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Story in Brief

Beef cattle fitted with esophageal or ruminal and duodenal cannulae grazed midgrass prairie range or a sideoats grama/sweetclover pasture during mid-May. Dietary crude protein concentration was greater for cattle grazing the sideoats grama/sweetclover pasture. Fiber content and digestibility of the diets were similar. Extent of in situ organic matter and crude protein disappearance were greater for range diets than pasture diets. Intake, duodenal flow, and fecal output of organic matter were similar between forage resources. Intake and duodenal flow of crude protein was greater in cattle grazing the sideoats grama/sweetclover pasture despite similar apparent ruminal protein digestion. Total protein apparently absorbed from the small intestine was about 14% higher for cattle grazing the sideoats grama/sweetclover pasture. Cattle protein status on grass/legume pasture was superior to native grass. However, cattle protein status was excellent on either forage type and total digestible nutrient intake appeared to be first-limiting for weight gain.

(Key Words: Beef Cattle, Range, Grazing, Protein, Digestion, *Melilotus* spp.)

Introduction

Throughout the West, landowners are revegetating deteriorated croplands with introduced and native grasses. However, introduced pastures have limited species diversity which can result in reduced diet quality. This problem may be partly overcome by including legumes in to seed mixtures.

The introduction of palatable clovers into grass swards improves diet quality. Yet, some landowners are reluctant to use clover because of its unreliability and the difficulty of managing mixed swards. Common yellow

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sweetclover (*Melilotus* spp.) is a legume that grows well in western Oklahoma. However, its production in unpredictable. Furthermore, little is known about the value of sweetclover to grazing livestock.

This discussion raises two questions: First, do differences in forage intake and digestion exist for cattle grazing native range and cattle grazing range or pastures containing sweetclover? Second, what type and amount of supplements, if any, would cattle require to improve performance?

With these questions in mind, a trial was conducted comparing midgrass prairie range (PRAIRIE) and a planted mixture of sideoats grama and sweetclover (PASTURE).

Materials and Methods

Research Site

This study was conducted on the Marvin Klemme Range Research Station in Washita County, OK. The 120 acres of PRAIRIE had never been cultivated. Soils on this site are in the Cordell Series and are mapped as Red Shale Range sites. The 80 acres of PASTURE were established on abandoned cropland more than 15 years ago. The only grazing management practice implemented was continuous stocking.

Precipitation at Clinton, OK, located about 10 miles north of the station, was 16.5 inches (normal, 10.8 inches) from January through May in 1990. The average temperature during the experiment was 81° F with an average low of 68° F and an average high of 93° F.

Procedures

Standing crop in the pastures was estimated by clipping forage to the ground inside .1 m^2 quadrats ($n = 40$) along paced transects. Live:dead ratios were estimated using simultaneous equations relating total sample DM to the DM of the live and dead fractions. The dry-weight-rank method was used to estimate species composition of the pastures (Gillen and Smith, 1986).

Four steers fitted with esophageal cannulae and 6 heifers with ruminal and duodenal cannulae (British x British, avg wt = 604 lb) grazed each forage type for 2 weeks before the 11-day trial began on May 9, 1990.

Diet samples were collected from each pasture on two consecutive days starting on day 1 of the trial. After collection, the samples were mixed and a 20% aliquot was stored frozen. The remaining masticate was composited across steers and used for the in situ digestion substrate.

Chromic oxide was used to determine fecal output and duodenal flow. Chromic oxide was administered twice daily on days 1 through 10. Fecal grab samples were taken twice daily at dosing times during the last 5 days. Duodenal samples were obtained a total of 6 times from each pasture between days 5 and 10. All sample were composited within heifer. Rumen samples were taken on days 5 and 6 at sunrise, midday, and late after noon. All samples were strained, acidified, and stored frozen.

The composite masticate was dried in a forced air oven at 30^{o} C, ground through a Wiley mill (2-mm screen), and 5 g aliquots were placed in 10 x 20 cm polyester bags (pore size=53 ± 10 microns). On day 8, duplicate in situ bags were placed in the rumens of each heifer for 48, 36, 24, 16, and 8 hours. Upon removal, the bags were rinsed with cold tap water until effluent ran clear and then stored frozen.

Diet, duodenal, and fecal samples were lyophilized and were analyzed for DM, ash, and total CP (nitrogen x 6.25). Diet samples were also analyzed for neutral and acid detergent fiber and in vitro digestible OM. Duodenal and fecal samples were analyzed for chromium. Duodenal flow and fecal output estimates were based on chromium dilution at each site. Intake was calculated as fecal output/in vitro indigestibility. Duodenal and rumen samples were analyzed for ammonia-nitrogen (NH_3-N). In situ bags were dried in a forced air oven and residues were analyzed for DM, ash, and CP.

Statistical Analysis

Data were analyzed as a completely randomized design. Extent of in situ digestion and diet composition models contained pasture as the main effect. The model for rumen NH_3-N also contained time of day and time of day x pasture; the pasture effect was tested using heifer within pasture. Models for nutrient intake and site and extent of digestion used body weight as a covariate. A protected least significant different procedure was used to separate means.

Results and Discussion

Standing Crop

Total standing crop in both pastures was similar (Table 1) although species composition of the pastures differed. The primary differences were the high proportion of sideoats grama and the presence of sweetclover in the PASTURE.

Table 1. Standing crop and species composition of a midgrass prairie (PRAIRIE) range and a sideoats grama/sweetclover (PASTURE) pasture.

Item	PRAIRIE	PASTURE
Standing crop lb DM/acre	1505	1640
Live:dead ratio	2.5	2.0
Species	%	
Sideoats grama	21	48
Blue/hairy grama	17	4
Buffalograss	14	1
Little bluestem	T[a]	2
Other grasses	13	17
Annual grasses	6	5
Forbs	27	14
Sweetclover	0	6
Locoweed	1	2
Half shrubs	2	3

[a] T denotes trace amounts, less than 1% of total DM/acre.

Diet Quality

Steers grazing PASTURE consumed a diet that contained 16% more ($P = .02$) CP than steers grazing the PRAIRIE (Table 2). Diets collected from PASTURE tended ($P = .11$) to contain less NDF (Table 2). Because of this tendency, the ratio of NDF/ADF tended ($P = .07$) to be lower for diets collected from PASTURE (Table 2). Legumes have a lower NDF/ADF ratio than grasses (Bowman et al., 1988). This difference suggests that the steers grazing PASTURE were consuming more legumes. In vitro OM disappearance was similar ($P = .72$) between diets (Table 2). Diets containing forbs typically have a lower extent of digestion than diets of predominantly grass (Bowman et al., 1988).

Moore et al. (1991) suggested that as the ratio of TDN:CP exceeds 8, dietary CP limits intake. TDN:CP ratios for cattle diets from both resources were below 8 (PRAIRIE=4.5; PASTURE=3.9). Therefore, it is doubtful that protein supplements would increase forage intake.

Table 2. Chemical composition and total digestible nutrient:crude protein ratios of cattle diets collected from a midgrass prairie (PRAIRIE) range and a sideoats grama/sweetclover (PASTURE) pasture.

Item	PRAIRIE	PASTURE	SE[a]	P-value
CP, %	13.1[d]	15.0[e]	.31	.02
NDF, %	68.2	64.9	1.21	.11
ADF, %	36.0	36.2	.69	.79
NDF/ADF	1.9	1.8	.03	.07
IVOMD[b], %	58.6	59.0	.68	.72
TDN:CP[c]	4.5[d]	3.9[e]	.10	.02

[a] Standard error, n=8.
[b] In vitro OM disappearance.
[c] TDN is assumed equivalent to IVOMD (NRC, 1985).
[d,e] Means with uncommon superscripts differ (P<.05).

Ruminal fermentation

The rumen NH_3-N concentration (mg/dl) was greater (P=.02) in heifers grazing the PASTURE (3.8 vs. 2.8; SE=0.27); this difference was consistent across times of the day. Bowman et al. (1988) reported that as the amount of legumes in the diet of sheep was increased, rumen NH_3-N increased linearly. This difference in rumen NH_3-N concentration probably results from lower NH_3-N use by microbes because of legumes' lower extent of OM digestion in the rumen.

In situ OM disappearance was lower (P<.03) for PASTURE diets (Table 3). This lower digestion is usually attributed to more lignin and less digestible fiber in legumes. Bowman et al. (1988) reported a linear decrease in the extent of DMD as alfalfa was increased in the diets of sheep consuming caucasian bluestem hay.

In situ CP disappearance was higher (P<.05) for the PRAIRIE diets (Table 3). However, the total amount of CP released was similar because

Table 3. Extent of OM and CP disappearance in situ from masticate collected from a midgrass prairie (PRAIRIE) range and a sideoats grama/sweetclover (PASTURE) pasture.

Item	PRAIRIE	PASTURE	SE[a]	P-value
Extent of OM disappearance				
8 hours	41.1^b	35.6^c	1.5	.03
16 hours	64.2^b	52.5^c	2.2	.001
24 hours	70.3^b	61.2^c	2.1	.01
36 hours	75.3^b	68.8^c	1.2	.003
48 hours	80.2^b	72.1^c	.9	.0001
Extent of CP disappearance				
8 hours	44.6^b	39.2^c	1.5	.03
16 hours	64.4^b	52.8^c	2.6	.01
24 hours	70.7^b	63.6^c	2.2	.05
36 hours	78.0^b	71.5^c	1.1	.002
48 hours	80.0^b	72.5^c	1.5	.005

[a] Standard error, n = 12.

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

PASTURE diets contained more CP. Therefore, any differences in microbial protein production probably would result from differences in amount of energy available in the rumen (NRC, 1985).

Based on in situ data, the mean ratio of grams of rumen degradable CP (RDCP)/100 g rumen digestible OM (RDOM) at 24 and 36 hours were 13.1 and 16.5 g for PRAIRIE and PASTURE, respectively. The PASTURE provided more ($P = .02$) RDCP/100 g RDOM than the PRAIRIE diets. This higher ratio was the result of the lower ($P < .03$) RDOM content of the diet. If urea recycling is considered, an estimated total of 15.6 and 18.8 g CP/100 g of RDOM for microbial protein synthesis for PRAIRIE and PASTURE diets, respectively (NRC, 1985). Based on NRC (1985) equations, rumen microbes require a ratio of 16.3 g RDCP/100 g RDOM for optimal protein synthesis. Cattle grazing both forages appear to benefit from a near optimal protein to energy balance in the rumen. Supplements for these cattle would need to contain a minimum RDCP:RDOM ratio of 16.3 g/100 g to avoid inducing a ruminal CP deficiency.

Forage intake

Total OM intake was similar (P=.72; Table 4), the cattle consumed 3.2% BW/d. This level of intake far exceeds that predicted by the NRC (1984; 2.1%). Because of this high level of intake, these cattle may perform superior to NRC (1984) expectation if judgements are based solely on the chemical composition of diets. Total CP intake was .4 lb greater (P=.01) for cattle grazing PASTURE (Table 4). Crude protein intakes for both forage types were in excess of the requirement for 4 lb gain/day (NRC, 1985). Obviously this rate of gain is unrealistic, but this estimate establishes that TDN intake (10.6 lb/day) was first-limiting for weight gain.

Table 4. Site and extent of OM and CP digestion in heifers grazing midgrass prairie (PRAIRIE) range or sideoats grama/sweetclover (PASTURE) pasture.

Item	PRAIRIE	PASTURE	SE^a	P-value
Passage of OM, lb/day				
Intake	18.0	18.2	.5	.72
Duodenal	10.8	11.4	.3	.13
Fecal	7.4	7.5	.2	.89
Digestion of OM, % of intake				
Ruminal, Apparent	39.3	37.3	1.1	.25
Lower tract	19.4	21.6	1.1	.18
Passage of CP, lb/day				
Intake	2.4^b	2.7^c	.1	.01
Duodenal	3.0^b	3.4^c	.1	.04
Non-ammonia-CP	2.9^b	3.3^c	.1	.04
Fecal	1.1	1.2	.03	.59
Digestion of CP, % entering lower tract				
Lower tract	61.8^b	66.0^c	1.0	.02

[a] Standard error, n=12.

[b,c] Means with uncommon superscripts differ (P<.05).

Site and extent of digestion

Duodenal flow of OM tended (P=.13) to be greater for cattle grazing PASTURE (Table 4). This tendency toward greater duodenal OM flow in cattle grazing PASTURE agrees with the differences noted for in situ digestion (Table 3). Even though duodenal OM flow tended to differ, apparent ruminal digestibility was similar (P=.25; Table 4) between diets. Lower tract digestibility was also similar (P=.18; Table 4).

Total tract digestibility yielded 10.6 and 10.8 lb TDN/day for heifers grazing PRAIRIE and PASTURE, respectively. The TDN requirement for heifers of this type gaining 2 lb/day is 10.9 lb/day (NRC, 1984).

Duodenal CP flow was 126% of CP intake for both forages. Protein requirements calculated by the NRC (1984) assumes an efficiency of 1.0 in dietary protein to post-ruminal protein conversion. Digestion of non-ammonia-CP in the small intestine was greatest (P=.02) for the PASTURE diet. Total CP apparently absorbed from the small intestine was 1.8 and 2.2 lb/day for PRAIRIE and PASTURE, respectively.

Fecal CP output was similar (P=.59) between forage resources. An important consideration when calculating the CP requirement of the heifers was the high fecal output (9.5 lb DM/day). The estimated metabolic fecal CP excretion was .6 lb/day (NRC, 1984). This value exceeds the NRC (1984) estimates by 69% (based on a intake of 2.1% BW and 30 g metabolic fecal CP/kg DM intake). This higher metabolic fecal CP loss would increase these heifer's dietary CP requirement.

Apparently, TDN intake was first-limiting for weight gain of cattle grazing both forage resources and the cattle might have benefitted from supplemental energy if it was necessary to increase weight gain. In practice, it is generally impossible to meet an animal's TDN requirement by just offering an amount of TDN equal to the difference between the requirement and intake (Moore et al., 1991). However, when grain supplementation is held below .3% of BW, forage intake may be unchanged or even increased (Pordomingo et al., 1991).

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