MIDGRASS PRAIRIE RANGE VERSUS PLAINS BLUESTEM 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 plains bluestem pasture. Forage intake trials were conducted in mid-May, late-June, mid-August, and mid-October. In situ organic matter and crude protein disappearance from masticate was greater for plains bluestem than midgrass prairie during all months. Organic matter intake on both forage resources was similar during May through August. However, organic matter intake during October was greater on midgrass prairie than on plains bluestem. Crude protein intake on midgrass prairie was highest in May. While crude protein intake on plains bluestem peaked in August. During June and August, crude protein intake was greater on plains bluestem than midgrass prairie. The conversion ratio of intake protein to post-ruminal protein was greater for midgrass prairie than plains bluestem during June and August. Small intestinal crude protein digestion was similar among all months except October when digestibility on plains bluestem was increased. Plains bluestem provided more digestible organic matter and crude protein than midgrass prairie during June and August, suggesting that it is a good complement to midgrass prairie during this period.

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

Introduction

Midgrass prairie and old world bluestem are two primary forage resources for beef cattle production in southwestern Oklahoma. Because these forages have different production curves and yields, incorporating them into an integrated forage system can improve animal performance and carrying capacity. Understanding the nutrient yield from these forages

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during the grazing season will improve recommendations for management of beef herds and forage systems.

Knowledge of nutrient intake and ruminal digestion for these forage resources will allow us to recommend optimal season of use by grazing livestock. Additionally, this information can be used to formulate supplements that correct dietary limitations to performance.

These data are preliminary results of a 2-year study evaluating intake and utilization plains bluestem (PLAINS) pasture and midgrass prairie range (PRAIRIE) by beef cattle. This part of the study was conducted to measure nutrient intake and digestion by cattle grazing these forages.

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 14 acres of PLAINS was established in 1989 on abandoned cropland. The only grazing management practice implemented was continuous stocking. The PLAINS was fertilized with 65 lb of nitrogen and 47 lb of phosphorous/acre.

Precipitation at Clinton, OK, located about 10 miles north of the station, was 27.2 inches (normal, 25.6 inches) from January through October in 1990. Gunter et al. (1991) provided a detailed description of the standing crop and species composition on both sites.

Procedures

Four steers fitted with esophageal cannulae and 6 heifers with ruminal and duodenal cannulae (British x British, avg wt = 604 lb) grazed each forage resource continuously from late April through October. The four 11-day trials began on May 9, June 23, August 10, and October, 13, 1990. Due to winter kill, the plains bluestem was ungrazed in May and data were collected only during the last three trials.

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

In preparation for in situ digestion, composite masticate was dried in a forced air oven at 30^{o} C and ground through a Wiley mill (2-mm screen); 5 g

aliquots were placed in 10 x 20 cm in situ bags (pore size = 53 ± 10 microns). Beginning on day 8, duplicate in situ bags were placed in the rumen of each heifer for 16, 24, and 36 h. Following removal, the bags were rinsed with cold tap water until effluent ran clear and stored frozen.

Chromic oxide was administered on days 1 through 10. Fecal grab samples were collected twice daily during the last 5 days while duodenal samples were collected from each pasture a total of 6 times between days 5 and 10. Duodenal and fecal samples were composited by heifer. Rumen samples were collected on days 5 and 6 at sunrise, midday, and late afternoon. All samples were strained, acidified, and stored frozen.

Diet, duodenal, and fecal samples were lyophilized, ground (2-mm screen), and analyzed for DM, ash, and total CP (nitrogen x 6.25). Diet samples were also analyzed for in vitro digestible OM (IVOMD). Duodenal and fecal samples were analyzed for chromium. Flow of OM at each site was determined by the ratio chromium dosed daily:chromium/g OM. Intake was calculated as fecal output/in vitro indigestibility. Duodenal and rumen samples were, also analyzed for ammonia-nitrogen (NH_3-N). In situ bags were dried in a forced air oven and the residues were analyzed for DM, ash, and CP.

Data were analyzed as a split-plot design. Extent of in situ digestion, diet composition, intake, and site and extent of digestion models contained pasture and trial as the main effects. The pasture effect was tested with heifer within pasture. Means for intake and nutrient flows were adjusted to the means body weight within period before analysis. The model for rumen NH_3-N also contained time of day and time of day x pasture A protected least significant different procedure was used to separate means.

Results and Discussion

Diet Quality

The CP content of PRAIRIE diets decreased ($P<.05$) from May to June (Table 1), but then increased ($P<.05$) from June to October. Plains bluestem diets contained more ($P<.05$) CP than PRAIRIE during all months with peak concentration ($P<.05$) occurring in August. The higher diet quality for PLAINS diets probably resulted from the establishment of new seedlings after undergoing winter kill and the high percentage of russian thistle in the pasture (Gunter et al., 1991).

In vitro OM disappearance from PRAIRIE diets decreased ($P<.05$) from May to June and remained constant ($P>.05$) throughout the rest of the grazing season (Table 1). PRAIRIE diets were less digestible ($P<.05$) than

Table 1. Body weight, chemical composition of diets of cattle grazing midgrass prairie (PRAIRIE) range or plains bluestem (PLAINS) pasture.

Item	Forage	Month				SE[a]
		May	June	August	October	
Body weight, lb		604	708	760	841	
		% of OM				
CP	PRAIRIE	13.1[c]	8.8[df]	10.0[def]	10.6[df]	.44
	PLAINS	---	14.4[cg]	17.5[dg]	14.4[dg]	.69
	SE[b]		1.13	1.69	.81	
IVOMD	PRAIRIE	58.6[c]	54.2[df]	54.2[df]	53.7[df]	.68
	PLAINS	---	59.0[g]	60.8[g]	60.0[g]	.46
	SE[b]		1.09	1.40	.1.51	

[a] Standard error, CP and IVOMD, PRAIRIE n=16 and PLAINS n=9; intake, PRAIRIE n=24 and PLAINS n=18.
[b] Standard error, CP and IVOMD, n=8; intake, n=12.
[c,d,e] Row means with uncommon superscripts differ (P<.05).
[f,g] Column means with uncommon superscripts differ (P<.05).

PLAINS diets. The IVOMD of PLAINS diets was constant (P>.05) across months.

Ruminal Fermentation

Ruminal NH_3-N in heifers grazing PRAIRIE were similar (P>.05) among all periods (Table 2). The proper NH_3-N level for optimal protein synthesis and fiber digestion is somewhere between 2 and 5 mg/dl. Ruminal NH_3-N in heifers grazing PLAINS peaked (P>.05) during August (Table 2) and were higher (P<.05) than PRAIRIE in August and October.

Extent of in situ OM disappearance from PRAIRIE diets was greatest (P<.05) during May (Table 2). OM disappearance was depressed in June (P<.05), but increased (P<.05) slightly during August and October. Extent of CP disappearance followed a similar pattern (Table 2). The extent of OM and CP disappearance from PLAINS diets followed similar patterns over the grazing season (Table 2). Disappearances were about 17% higher (P<.05) in

Table 2. Extent of ruminal OM and CP disappearance in situ and ruminal ammonia nitrogen (NH_4-N) in heifers grazing midgrass prairie (PRAIRIE) range or plains bluestem (PLAINS) pasture.

Item	Forage	Month				SE[a]
		May	June	August	October	
Disappearance of OM, %						
16 hours	PRAIRIE	64.2^{c}	35.3^{dg}	36.8^{dg}	40.5^{dg}	4.1
	PLAINS	---	54.9^{ch}	64.7^{dh}	53.2^{ch}	4.8
	SE[b]		4.3	4.3	4.3	
24 hours	PRAIRIE	70.3^{c}	40.4^{dg}	40.4^{dg}	49.6^{eg}	4.0
	PLAINS	---	62.8^{ch}	72.5^{dh}	62.0^{ch}	4.6
	SE		3.3	3.3	3.3	
36 hours	PRAIRIE	75.3^{c}	52.8^{dg}	56.9^{eg}	61.9^{eg}	2.7
	PLAINS	---	66.2^{ch}	77.4^{dh}	68.7^{eh}	3.2
	SE		2.5	2.5	2.5	
Disappearance of CP, %						
16 hours	PRAIRIE	64.4^{c}	20.3^{dg}	31.5^{eg}	43.6^{fg}	5.4
	PLAINS	---	52.5^{ch}	69.3^{dh}	55.4^{ch}	6.3
	SE		5.2	5.2	5.2	
24 hours	PRAIRIE	70.7^{c}	23.7^{dg}	40.3^{eg}	51.0^{fg}	4.4
	PLAINS	---	59.1^{ch}	78.3^{dh}	66.0^{eh}	5.1
	SE		3.5	3.5	3.5	
36 hours	PRAIRIE	78.0^{c}	44.1^{dg}	61.7^{eg}	68.1^{e}	3.9
	PLAINS	---	63.7^{ch}	83.1^{dh}	74.5^{e}	4.5
	SE		3.8	3.8	3.8	
Ruminal NH_4-N, mg/dl						
	PRAIRIE	2.8	2.6	3.6^{g}	3.3^{g}	1.8
	PLAINS	---	3.6^{c}	9.0^{dh}	5.9^{eh}	2.0
	SE		1.1	1.1	1.1	

[a] Standard error, PRAIRIE n = 24 and PLAINS n = 18.
[b] Standard error, n = 12.
[c,d,e,f] Row means with uncommon superscripts differ (P < .05).
[g,h] Column means with uncommon superscripts differ (P < .05).

August than in June or October. Disappearances were generally higher ($P<.10$) for PLAINS diets than PRAIRIE diets.

The NRC (1985) has suggested that the proper ratio of rumen degradable CP/rumen digestible OM is 16.3 g/100 g for optimal microbial protein synthesis. Based on in situ data, these ratios ranged from 13.1 to 6.4 for PRAIRIE diets and 19.5 to 13.7 for PLAINS diets. These estimates do not include nitrogen recycling, but heifers grazing PRAIRIE may have benefitted from increased ruminal fiber digestion if they had been provided with a rumen degradable protein source.

Forage Intake and Digestion

With the exception of October ($P<.05$), forage OM intake was similar ($P>.05$) between forage resources (Table 3). Intake averaged across both forage resources was 3.0, 2.5, and 2.4% BW for May, June, and August. During October intakes were 1.8 and 1.5% BW on PRAIRIE and PLAINS, respectively.

Assuming digestible OM intake is equivalent to TDN intake (NRC, 1985), heifers grazing PRAIRIE consumed enough TDN to gain 2.0, 1.3, .7, and .4 lb/day during May, June, August, and October. Heifers grazing PLAINS consumed enough TDN to gain 1.5, 1.5, and .1 lb/day during June, August, and October.

Crude protein intake by heifers grazing PRAIRIE was highest ($P<.05$) in May (Table 3) plus CP intake tended to be higher ($P=.09$) in August than June or October. Crude protein intake on PLAINS was higher ($P<.05$) than on PRAIRIE with peak intake occurring ($P<.05$) in August.

Non-ammonia CP flow at the duodenum was greater ($P<.05$) in heifers grazing PLAINS (Table 3). The conversion of intake protein to post-ruminal protein ranged from 1.2 to 1.7 on PRAIRIE and ranged from 1.0 to 1.2 on PLAINS. The NRC (1984) assumes an efficiency of 1.0 when calculating protein requirements. Duodenal flows in heifers grazing forage types were sufficient for gains in excess of 4 lb/day during all months (NRC, 1984).

Lower tract CP digestion was similar ($P>.05$) for all comparisons except in October when digestion was higher for PLAINS ($P<.05$; Table 3). This increase may have resulted from the change in level of intake noted at that time.

PLAINS bluestem provided the higher plane of nutrition during June and August. During October, PLAINS provided a high quality diet, but because forage intake was low, PRAIRIE would have provided a better plane of nutrition because of its higher level of intake.

Heifers grazing both forage resources consumed ample CP to support any level of performance a manager may desire. Daily TDN intake appeared to be the first-limiting nutrient for improved performance. Providing small

Table 3. Organic matter and CP intake and site and extent of CP digestion in heifers grazing midgrass prairie (PRAIRIE) range or plains bluestem (PLAINS) pasture.

Item	Forage	Month: May	June	August	October	SE[a]
Passage of OM, lb/day						
Intake	PRAIRIE	17.9[c]	17.3[c]	17.7[c]	15.2[df]	1.3
	PLAINS	---	18.4[c]	19.3[c]	12.2[dg]	1.5
	SE		1.2	1.2	1.2	
Passage of CP, lb/day						
Intake	PRAIRIE	2.4[c]	1.5[df]	1.8[df]	1.6[d]	.16
	PLAINS	---	2.6[cg]	3.4[cg]	1.8[d]	.19
	SE[b]		.15	.15	.15	
Duodenal Non-NH_4-CP						
	PRAIRIE	2.9[c]	2.5[df]	2.5[df]	2.2[df]	.11
	PLAINS	---	3.0[cg]	3.5[dg]	2.5[cg]	.13
	SE		.12	.12	.12	
Feces	PRAIRIE	1.1[c]	.9[df]	.9[df]	.8[e]	.07
	PLAINS	---	1.1[g]	1.2[g]	.7	.08
	SE		.06	.06	.06	
Digestion, % entering lower tract						
Lower tract	PRAIRIE	61.7	64.0	65.5	65.8[f]	2.91
	PLAINS	---	66.2[c]	67.0[c]	73.5[dg]	3.43
	SE		2.81	2.81	2.81	

[a] Standard error, PRAIRIE n=24 and PLAINS n=18.
[b] Standard error, n=12.
[c,d,e] Row means with uncommon superscripts differ (P<.05).
[f,g] Column means with uncommon superscripts differ (P<.05).

amounts (<.3% of body weight) of supplemental energy may increase performance without depressing forage intake (Mieres, 1992). Even though daily intake appears to be meeting the animal's requirement for weight gain, the in situ data from PRAIRIE diets suggests that ruminal bacteria were marginally deficient of CP during June, August, and October. Therefore, any supplement for cattle grazing PRAIRIE during these time periods must be adequately balanced for rumen degradable CP to avoid a low protein to energy balance in the rumen.

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