Yield and Quality Components of Six Grass Species

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ABSTRACT

Management of warm season perennial grasses in south Texas can be improved if seasonal fluctuations in nutritional quality and productivity are documented. The objectives of this study were to determine the phenological changes in nutritional quality and productivity of Bell rhodesgrass (*Chloris gayana* (Kunth)), buffelgrass (*Cenchrus cilaris* L.), Kleberg bluestem (*Dichanthium annulatum* (Stapf)), kleingrass (*Panicum coloratum* L.CV. 75), and Callie and common bermudagrass (*Cynodon dactylon* L.). Samples were analyzed for crude protein (CP), *in vitro* dry matter digestibility (IVDMD), neutral detergenet fiber (NDF), acid detergent fiber (ADF), permanganate lignin (PL) and dry matter yield (DM). Average DM ranged from 1.03 (common bermudagrass) to 3.62 (buffelgrass) tons per acre. All of the grass species tested were below 7% CP during February and August. The IVDMD and CP% of all species were higher while ADF, NDF and PL were lower in the spring. Results of this study indicate that buffelgrass is a desirable grass for this region.

INTRODUCTION

Soil fertility and management practices affect the quantity and quality of warm-season grasses. In general, the nitrogen (N) levels, dry matter (DM), crude protein (CP), and **in vitro** dry matter digestibility (IVDMD) increase with nitrogen fertilizer applications; and nitrogen levels, CP, and IVDMD decrease and DM content increased with the maturation of the forage (Taliaferro **et al.**, 1980; Jolliff **et al.**, 1979; Varner and Blankenship; 1980).

McCawley and Dahl (1980) compared livestock gains of heifers grazing Bell rhodesgrass (**Chloris gayana**), Coastcross -1 bermudagrass (**Cynodon dactylon**), and kleingrass - 75 (**Panicum coloratum**). The heifers consumed an average of 26.5 lbs/head/day regardless of plant species. There were no differences in seasonal gain of yearlings grazing Coastcross -1 bermudagrass or kleingrass - 75. Heifers grazing Bell rhodesgrass had the lowest digestibility, crude protein, phosphorous and digestible energy. Duble **et al.**, (1971) also found that animal performance declined as available forage and dry matter digestibility decreased. The cell wall content ($r = -0.80$) and IVDMD ($r = -0.78$) are both reliable criterion for evaluating animal performance on forage (Duble **et al.**, 1971).

The objective of this study was to assess monthly variations in yield and quality of six perennial warm-season grass species.

MATERIALS AND METHODS

This study was conducted on the Texas A & I University farm, located 1 mile north of Kingsville, Texas. The soil in the test area was sandy clay loam. Commercial soil tests indicated a low amount of N; medium to high P; very high K, Ca, and Mg; and pH of 7.5 to 8.1

The six grass varieties included in the study were Bell rhodesgrass, buffelgrass (**Cenchrus ciliaris**), Callie and common bermudagrass, kleingrass - 75, and Kleberg bluestem (**Dichanthium annulatum**).

Five year old stands of the six grasses in six 40 acre pastures were used as the study sites. In each pasture, a 40 ft × 40 ft enclosure was divided into 2 equal blocks, and on half of each block 16-10-5 fertilizer was broadcast at the rate of 100 lbs/A. The enclosures were uniformly mowed to a height of 2 inches in February.

The forages were clipped by hand, using a 1.6 × 1.6 ft quadrat, randomly placed within each block. The harvested samples were dried at 158° F, ground in a Wiley mill to pass through a 40-mesh screen, and stored in airtight polyethylene sample bags. The samples were analyzed for dry matter (DM), crude protein (CP) (Harris, 1970), **in vitro** dry matter digestibility (IVDMD) (Tilley and Terry 1963 from Harris, 1970); neutral detergent fiber (NDF), acid detergent fiber (ADF), and permanganate lignin (PL) (Goering and Van Soest, 1970). All assays were run in duplicate. Data was analyzed by analysis of variance using a factorial experimental design and differences among grass species means were identified using Tukey's w-procedure (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Monthly yields ranged from a low of 0.09 T/A of kleingrass - 75 (March) to a high of 5.67 T/A of buffelgrass (October). Buffelgrass produced the highest average monthly yield of dry matter (3.65 T/A) while common bermudagrass produced the lowest average monthly yield (1.25 T/A) (Table 1). Bell rhodesgrass and kleingrass - 75 produced approximately the same ($P < .05$) average monthly yields 2.46 and 2.41 T/A, respectively; while Kleberg bluestem produced 3.17 T/A. Callie bermudagrass produced an average monthly yield of 1.25 T/A.

By July, Bell rhodesgrass and common bermudagrass reached peak production. The other four species reached peak production in October. There was no decline in production of buffelgrass during the summer months (Table 1).

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Table 1. Dry matter yield (T/A) crude protein (% DM) and in vitro dry matter digestibility (% DM) of six grasses grown near Kingsville, Texas.

Month	Component	Kleberg bluestem	Bell rhodesgrass	Callie bermuda	Common bermuda	Buffel grass	Kleingrass 75
Mar	DM (T/A)	0.49	0.49	0.26	0.40	0.26	0.09
	CP (%)	16.5	12.2	25.6	19.2	21.0	17.0
	IVDMD (%)	62	56	75	71	72	73
Apr	DM (T/A)	0.94	1.25	1.07	1.07	1.29	1.03
	CP (%)	10.4	9.7	15.3	12.4	17.7	13.4
	IVDMD (%)	58	65	73	67	74	68
May	DM (T/A)	2.23	2.14	0.85	1.03	2.28	1.61
	CP (%)	7.2	8.3	12.6	13.4	11.5	11.7
	IVDMD (%)	56	57	66	63	66	66
Jun	DM (T/A)	2.72	2.59	1.38	1.52	3.62	2.19
	CP (%)	7.2	8.3	12.6	13.4	11.5	11.7
	IVDMD (%)	56	57	66	63	66	66
Jul	DM (T/A)	3.80	3.57	1.70	2.19	4.60	3.17
	CP (%)	3.3	3.6	7.2	6.9	6.7	6.4
	IVDMD (%)	40	43	53	52	53	53
Aug	DM (T/A)	3.13	2.72	1.47	1.11	4.83	3.26
	CP (%)	3.8	3.6	6.0	5.6	4.2	8.2
	IVDMD (%)	58	45	49	44	55	46
Sep	DM (T/A)	3.44	2.46	1.88	1.12	4.73	2.46
	CP (%)	4.5	3.9	7.4	8.9	6.0	3.8
	IVDMD (%)	43	40	47	41	50	44
Oct	DM (T/A)	5.28	3.04	1.43	0.76	5.68	3.62
	CP (%)	4.7	5.7	9.9	9.4	6.7	8.2
	IVDMD (%)	41	39	54	41	49	43
Nov	DM (T/A)	5.14	3.13	1.43	0.90	5.14	3.57
	CP (%)	4.7	5.7	9.9	9.4	6.7	8.2
	IVDMD (%)	33	35	50	42	43	42
Dec	DM (T/A)	4.69	3.35	1.38	1.07	4.51	3.08
	CP (%)	4.7	5.1	8.4	8.3	8.0	7.7
	IVDMD (%)	32	32	51	39	43	39
Jan	DM (T/A)	3.17	2.41	1.29	0.67	3.57	2.32
	CP (%)	3.5	4.0	7.8	6.8	7.6	7.0
	IVDMD (%)	30	30	43	35	36	35
Feb	DM (T/A)	3.08	2.28	1.16	0.62	3.21	2.14
	CP (%)	3.2	3.1	6.3	6.3	6.5	6.2
	IVDMD (%)	26	27	41	32	31	30
Means	DM(T/A)	3.17b	2.46c	1.25d	1.03e	3.62a	2.41c
	CP (%)	6.0d	5.8d	10.6a	9.7b	9.2c	8.9c
	IVDMD (%)	42d	43d	55a	49c	53b	50c

Means followed by the same letter are not significantly different (P = 0.05).

Monthly levels of CP ranged from a low of 3.10% in Bell rhodesgrass in February to a high of 25.6% in Callie bermuda in March. The average CP contents of the grasses ranged from 10.6% for Callie bermudagrass to 5.8% for Bell rhodesgrass (Table 1). Forages at levels less than 7% are considered deficient in CP because animal intake and rumen microorganism activity is reduced. Callie and common bermudagrass were sufficient in CP throughout the year, except for August and February. Kleingrass was low in July (6.4), September (3.8) and February (6.2) and bufflegrass was low in CP in August (4.2), September (6.0) and February (6.5). Kleingrass was the only grass that had a CP% above the critical level of 7% in the month of August (8.2). Bell rhodesgrass and Kleberg bluestem were sufficient in CP only during the spring.

Callie bermudagrass and common bermudagrass had average CP contents of 10.6 and 9.7% respectively (Table 1); Callie bermudagrass was below 7% CP in August as was common bermudagrass in July, January and February (Table 1). Buffelgrass and kleingrass - 75 averaged 9.2% and 8.9% CP, respectively (Table 1); however, buffelgrass was low in CP in July (6.7), August (4.2), September (6.0), October (6.7), November (6.7) and February (6.5) while common bermudagrass was low in CP in July (6.9), August (5.6), January (6.8) and February (6.3) (Table 1). Bell rhodesgrass and Kleberg bluestem were adequate in CP only during March, April, May and June; both species averaging 5.8% and 6.0% CP respectively for the year (Table 1).

Variation in IVDMD was significantly different among species (Table 1). Callie bermudagrass had the highest average

($P<.05$) IVDMD (55%) with a range of 75% in March to 41% in February. Buffelgrass IVDMD was significantly ($P<.05$) different from all other grasses. Buffelgrass IVDMD ranged from 74% to 31% with an average of 53%. There was no difference ($P>.05$) in IVDMD of common bermudagrass (49%) and kleingrass - 75 (50%). Kleberg bluestem (42%) and Bell rhodesgrass (43%) had similar ($P>.05$) IVDMD for the year. Kleberg bluestem and Bell rhodesgrass had the two lowest (26% and 27% respectively) IVDMD of the test in February (Table 1). We found that Callie bermudagrass and kleingrass - 75 were the two more digestible grasses in the test.

Grasses increased in ADF and NDF with advanced maturity (Table 2), Kleberg bluestem had the highest ADF (45.1%) followed by Bell rhodesgrass (40.9%), buffelgrass (38.8%), Callie bermudagrass (38.1%), kleingrass - 75 (37.8%), and common bermudagrass (37.6%). All species were significantly different ($P<.05$) from each other in ADF except kleingrass - 75 and common bermudagrass. In general, grasses that are low in ADF are more digestible and subsequently higher in quality.

Permangenate lignin increased in all species with maturity. By June, Kleberg bluestem reached 7.1% PL (Table 2). This is because it matures very early in comparison with the other grass species. Of the six species used in this study, buffelgrass (5.3%), callie bermudagrass (5.2%) and kleingrass - 75 (5.5%) were the lowest in PL (Table 2). Increasing lignin content in grasses is associated with decreased IVDMD (Blaser, 1964; Duble **et al.** 1971; Cogswell and Kamstra, 1976; Ellis and Lippke, 1976).

Table 2. Neutral detergent fiber (NDF), acid detergent fiber (ADF) and permangenate lignin (PL) of six grasses grown at Texas A & I University near Kingsville, Texas.

Month	Component	Kleberg bluestem	Bell rhodesgrass	Callie bermuda	Common bermuda	Buffel grass	Kleingrass 75
				%			
Mar	NDF	61.1	60.7	53.9	61.0	55.6	54.1
	ADF	33.6	30.9	24.7	27.9	27.3	28.5
	PL	4.1	4.2	3.4	3.4	3.7	3.3
Apr	NDF	66.7	61.0	64.9	65.8	55.0	62.8
	ADF	39.0	36.1	29.7	32.1	30.7	32.4
	PL	5.4	4.0	3.6	4.2	4.2	3.9
May	NDF	66.8	68.0	66.6	65.7	61.5	66.0
	ADF	42.7	36.6	33.1	34.8	32.0	35.5
	PL	4.0	5.5	5.2	5.0	5.1	4.5
Jun	NDF	71.2	70.7	68.9	70.2	66.6	70.3
	ADF	45.4	34.5	38.2	35.2	35.0	37.6
	PL	7.1	4.7	4.7	5.0	4.6	5.6
Jul	NDF	68.6	70.7	76.7	73.5	73.8	68.6
	ADF	46.2	39.8	40.4	40.5	39.8	36.2
	PL	6.7	5.9	6.0	6.4	6.1	6.6
Aug	NDF	69.6	74.0	71.9	70.2	71.1	72.7
	ADF	47.0	41.4	41.0	39.7	39.1	38.1
	PL	6.1	6.1	5.3	7.5	6.7	6.1
Sep	NDF	69.7	74.2	73.1	71.1	72.2	77.0
	ADF	47.8	43.4	42.4	41.1	42.2	40.6
	PL	6.3	5.6	5.4	6.6	6.2	5.9
Oct	NDF	71.7	74.2	72.4	72.9	73.3	75.2
	ADF	48.5	45.6	41.2	40.8	43.1	40.6
	PL	6.3	6.0	5.8	6.5	5.5	6.2
Nov	NDF	72.2	75.7	75.1	74.2	74.6	74.9
	ADF	47.5	44.9	41.0	40.8	43.6	40.4
	PL	7.2	6.4	5.3	7.0	5.3	6.2
Dec	NDF	72.2	74.8	72.6	73.8	70.6	72.0
	ADF	47.3	45.5	42.1	40.5	43.5	41.3
	PL	7.6	6.5	5.6	7.2	5.6	6.3
Jan	NDF	72.2	71.7	71.8	71.5	73.7	73.1
	ADF	47.3	45.6	42.3	41.1	44.2	41.5
	PL	7.0	7.1	5.9	6.4	6.3	6.1
Feb	NDF	71.9	74.1	72.7	72.6	73.0	72.6
	ADF	46.8	45.8	42.2	40.9	44.2	41.8
	PL	7.6	7.5	6.0	7.0	6.1	6.1
Means	NDF	69.5b	70.8a	70.0b	70.1b	68.4c	70.0b
	ADF	45.1a	40.9b	38.1d	37.6e	38.8c	37.8e
	PL	6.3a	5.8b	5.2d	6.0b	5.3cd	5.5c

Means followed by the same letter are not significantly different ($P = 0.05$).

CONCLUSION

These results indicated that the intensity of management anticipated for a seeded site should be considered in selecting a grass species. The selection of a grass species for seeding sites for livestock production is an important decision. The data discussed in this paper indicates that buffelgrass is the most desirable species tested, followed by kleingrass - 75. Both species should be grazed in the spring when protein levels are adequate (above 7%). Both species produce well during the summer months and did not begin to decline in production until December. The low quality of the late winter forage samples indicates a nutritionally critical period if levels of livestock production are to be maintained, especially if early spring calving is planned.

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An Economic And Nutritional Evaluation of Pricklypear As An Emergency Forage Supplement

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ABSTRACT

This investigative research centered on the comparison of supplemental feeding of pricklypear as opposed to conventional hay feeding during drought conditions. Nutritive values of four commonly used supplemental hays were compared to those of pricklypear. Costs of supplementing pricklypear in relation to fuel consumption, protein supplementation, and maintenance of machinery were obtained from ranchers throughout South Texas who have fed pear to their range cattle in the past. Pricklypear supplementation was found to be a rather inexpensive means of feeding and maintaining range cattle during drought conditions - up to 60% less than typical hay feeding programs. This was regardless of weather conditions and month of the year. Pricklypear was found to have extremely low nutritive values as compared to the hay varieties studied.

INTRODUCTION

Pricklypear has been used as livestock feed for more than a century. It usually is considered an undesirable plant on Texas rangelands, but does have some economic value as supplemental forage for cattle during winter and drought periods. Pricklypear has the unique ability of storing water in its flattened fleshy stems. This water reserve enables the plant to withstand long drought periods (Hoffman, 1914). During droughts and range overuse, pricklypear density increases as grass cover lessens. The most common and widespread pricklypears known to Texas ranchers are Engelmann (**Opuntia engelmanni**), Nopal (**Opuntia Lindheimeri**), and Plains (**Opuntia polyacantha**).

Extensive areas of rangeland in South Texas are occupied by dense stands of pricklypear and its net value is controversial (Vallentine, 1971). The pricklypear region par excellence is in Texas, from the Edwards Plateau southward (Griffiths, 1920).

Even relatively inflexible systems of range deferment have resulted in better grass production and higher animal carrying capacity in Texas. In South Texas, orderly programs of range deferment break down during droughts when most pastures should not be grazed at all (Lehmann, 1969). The best native grasses seldom hold more than 2.5 tons of forage per acre at the onset of drought. Purposefully planted and cultivated pricklypear commonly provides 37.50 tons of emergency forage per acre. Cows consume approximately 65.0 lbs. of pricklypear daily (Lehman, 1969). With this known, 93.0 tons of pricklypear on 2.50 acres of land is sufficient for one cow for more than three years. A range stocked with one cow per 15.0 acres should have a year's supply of emergency forage; also, there would be enough pear for quick regrowth if only two percent of the total acreage is in pricklypear (Lehmann 1969). As a forage reserve, pricklypear is more drought resistant than grass and more dependable. Furthermore, pricklypear now is relatively economical to feed. A few South Texas cattle ranchers have been growing substantial numbers of acres (500-625) of pear and harvesting the crop. Af-

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