Quality Characteristics and In Situ Dry Matter Disappearance Kinetics of Bahiagrass and Three Varieties of Bermudagrass Harvested During the Summer and Early Fall in West-Central Arkansas[1]

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Story in Brief

Limited data are available that describe the DM disappearance kinetics of bahiagrass (*Paspalum notatum*) during summer and early fall. Five ruminally-cannulated steers were used to determine ruminal in situ disappearance kinetics of DM for 'Sand Mountain' bahiagrass compared with 3 varieties of bermudagrass (*Cynodon dactylon*; 'Common', 'Midland', and 'Tifton 44') harvested on 3 dates (June 9, August 6, and October 5, 2004) in west-central Arkansas. For fractions A, B, and C, the potential extent of disappearance, rate of disappearance (K_d), and effective degradability, a forage type x harvest date interaction ($P < 0.05$) was observed. Fraction B was greater ($P < 0.05$) for bahiagrass on June 9 (60.6%), August 6 (54.7%), and October 5 (56.4%) compared to Common (49.4, 43.3, and 42.5%), Midland (50.6, 49.8, and 42.6%), and Tifton 44 (53.3, 46.3, and 41.0%). Potential extent of disappearance was greater ($P < 0.05$) for bahiagrass on June 9 (81.0%) and October 5 (69.4%) compared to all 3 varieties of bermudagrass, and the K_d was slower ($P < 0.05$) for Tifton 44 (0.034/hr) and bahiagrass (0.040/hr) compared to Common (0.048/hr) and Midland (0.049/hr) on August 6. Effective degradability was greater ($P < 0.05$) for bahiagrass (58.3%) on June 9 compared to all 3 varieties of bermudagrass. On August 6, effective degradability was greater ($P < 0.05$) for Midland (48.0%) compared to bahiagrass (45.8%); however, effective degradability of bahiagrass was greater ($P < 0.05$) than that observed for Common (41.6%) and Tifton 44 (37.0%). 'Sand Mountain' bahiagrass offers a greater effective degradability of DM than bermudagrass during early summer and a greater potential extent of disappearance of DM than bermudagrass during summer and early fall.

Introduction

In the southeastern U.S., cow-calf production systems are the primary beef production enterprises due to the availability of forages throughout the year. Bahiagrass and bermudagrass are two primary warm-season forages utilized in the southeastern U.S. for hay production and grazing. Bahiagrass is grown on more than 4.9 million acres of land (Beaty and Powell, 1978; Gates et al., 1999), is adapted to a wide range of soil conditions, and is persistent under low fertility, drought, intermittent flooding, and heavy continuous grazing (Gates et al., 1999; Williams and Hammond, 1999). However, the disappearance kinetics of DM for bahiagrass is unclear. Therefore, the objective of the current study was to compare the nutritive values and ruminal in situ disappearance kinetics of DM for bahiagrass compared with 3 varieties of bermudagrass harvested on 3 dates in west-central Arkansas.

Experimental Procedures

This experiment was conducted near Booneville (35° 5' N; 94° 0' W) in west-central Arkansas. All forage within 2 quadrants (20 in x 20 in) of replicate 2.5-acre pastures of 'Sand Mountain' bahiagrass, 'Common', 'Midland', and 'Tifton 44' bermudagrass was clipped on June 9, August 6, and October 5, 2004. Forage samples were dried to a constant weight at 122°F and ground to pass through a 0.039- or 0.079-in screen in a Wiley mill. Samples ground to pass through a 0.039-in screen were analyzed for crude protein (CP; Leco® Nitrogen Determinator, St. Joseph, Mich.), acid detergent fiber (ADF), neutral detergent fiber (NDF) as described by Goering and Van Soest (1970), and in vitro DM digestibility (IVDMD) using the Ankom Daisy II In Vitro Digester® (Ankom Technology Corp., Fairport, N.Y.). Subsamples ground to pass a 0.079-in screen were stored at room temperature before subsequent in situ analysis.

Five ruminally-cannulated crossbred steers (1,397 ± 38 lb) were utilized to evaluate the in situ disappearance kinetics. Steers were maintained individually in 11.1- x 16.1-ft pens and were offered a basal diet of bermudagrass hay (14.3% CP, 71.4% NDF, and 27.0% ADF; DM basis) and a corn-based supplement (95.3% cracked corn, 3.0% molasses, and 1.7% trace mineral salt; as-fed basis). On an as-fed basis, the basal diet contained 85% bermudagrass hay and 15% supplement, and was offered at 0700 h and 1700 h in equal portions at a cumulative daily rate of 2% of BW. Steers had ad-libitum access to fresh water and were adapted to the basal diet for 10 d prior to the initiation of the trial.

Samples (0.2 oz) of each forage were weighed into Dacron (3.9 in x 7.9 in; 50 ± 10-µm pore size; Ankom Technology™, Macedon, N.Y.) bags. Dacron bags for each time period were placed in 14.2 x 19.7 in mesh laundry bags and incubated in tepid (102.2°F) water for 20 min. Mesh bags were placed in the ventral rumen prior to the 0700 h feeding and incubated for 3, 6, 9, 12, 24, 36, 48, 72, and 96 h. Following removal from the rumen, bags were rinsed in a top load washing machine. The 0-h bags were rinsed immediately following incubation in tepid water for 20 min. Samples were dried at 122°F to a constant weight following rinsing.

Disappearance kinetics were calculated by nonlinear regression of the percentage of DM remaining on incubation time using the PROC NLIN procedure of SAS (SAS Inst., Inc., Cary, N.C.).

[1] Names are necessary to report factually on available data; however, the USDA does not guarantee or warrant the standard of the product, and the use of the name by the USDA implies no approval of the product to the exclusion of others that may be suitable.

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Fraction A was defined as the immediately soluble fraction. Fraction B represented that portion of DM that disappeared at a measurable rate, and fraction C was defined as the portion that was undegraded in the rumen. Fraction B and C, lag time, and rate of disappearance (K_d) were determined directly from the nonlinear model. Fraction A was calculated as 100 – (B + C); similarly, the potential extent of disappearance was calculated as 100 – C. The effective ruminal degradability of DM was calculated as $A + B \times [K_d/(K_d + K_p)]$, where K_p = particulate passage rate (0.035 ± 0.007/hr) for steers consuming a similar bermudagrass-based basal diet (Scarbrough et al., 2001). Indices of nutritive value were analyzed using the SAS system for mixed models with repeated measurements. In situ disappearance kinetics were analyzed as a randomized complete block design with a 4 x 3 factorial arrangement of treatments using the MIXED procedure of SAS with steers representing the blocking term. Least squares means were separated using the PDIFF option of MIXED when protected by a significant ($P < 0.05$) treatment effect.

Results and Discussion

Nutritive values for each forage type and harvest date are presented in Table 1. For fractions A, B, C, potential extent of disappearance, K_d, and effective degradability, a forage type x harvest date interaction ($P < 0.05$) was observed. Fraction B was greater ($P < 0.05$) for bahiagrass than for all 3 varieties of bermudagrass across all harvest dates (Table 2). Fraction B for bahiagrass on June 9 (60.6%), August 6 (54.7%), and October 5 (56.4%) was higher than reported values for bermudagrass harvested over a range of maturities (Mandebvu et al., 1999) and stockpiled bermudagrass (Scarbrough et al., 2001). Fraction B for bahiagrass harvested on June 9 was 7.0, 7.0, and 12.5 percentage units higher than that for eastern gamagrass at the boot, anthesis, and mature stages of growth, respectively (Coblentz et al., 1998). The potential extent of disappearance was greater ($P < 0.05$) for bahiagrass than for all 3 varieties of bermudagrass on June 9 and October 5 (Table 2). Extent of disappearance did not differ ($P > 0.05$) between bahiagrass (71.3%) and Midland (68.9%) on August 6; however, the potential extent of disappearance for bahiagrass was 11.5 and 10.4 percentage units greater ($P < 0.05$) than Common and Tifton 44, respectively. The potential extent observed for bahiagrass on June 9 is comparable to that of eastern gamagrass at the boot stage but higher than gamagrass at the anthesis and mature stages of growth (Coblentz et al., 1998) and bermudagrass at various maturities (Mandebvu et al., 1999; Scarbrough et al., 2001).

No differences ($P > 0.10$) among forages were observed for K_d for June 9, and K_d averaged 0.055/hr. The K_d was slower ($P < 0.05$) for Tifton 44 (0.034/hr) and bahiagrass (0.040/hr) compared to Common (0.048/hr) and Midland (0.049/hr) on August 6. On October 5, K_d was slower ($P < 0.05$) for bahiagrass (0.028/hr) compared to Common (0.043/hr), Midland (0.040/hr), and Tifton 44 (0.044/hr). The K_d for bahiagrass on June 9 and August 6 was higher than for bermudagrass harvested over a range of maturities (Mandebvu et al., 1999). Although ADF was greater ($P < 0.05$) for bahiagrass compared to the 3 varieties of bermudagrass (Table 1), effective degradability was greater for bahiagrass (58.3%) on June 9 compared to all 3 varieties of bermudagrass. Effective degradability was increased ($P < 0.05$) for Midland (48.0%) than for bahiagrass (45.8%) on August 6; however, effective degradability of bahiagrass was greater ($P < 0.05$) than that observed for Common (41.6%) and Tifton 44 (37.0%). The effective degradability of bahiagrass for all 3 harvest dates is higher than for stockpiled bermudagrass (Scarbrough et al., 2001).

Implications

'Sand Mountain' bahiagrass provides beef cattle producers in west-central Arkansas an alternative mid-summer and early fall grazing forage. Although bahiagrass offers adequate DM degradability, further research is warranted to determine animal performance of beef cows grazing bahiagrass in west-central Arkansas.

Literature Cited

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Table 1. Least squares means for concentrations of crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), and *in vitro* dry matter digestibility (IVDMD) for 'Sand Mountain' bahiagrass, 'Common', 'Midland', and 'Tifton 44' bermudagrass harvested on three dates near Booneville, AR.

	Forage type				Harvest date		
Item	Bahiagrass	Common	Midland	Tifton 44	Jun 9	Aug 6	Oct 5
	% of DM				% of DM		
CP	8.1[b]	16.4[a]	14.3[a]	13.3[ab]	17.4[a]	12.8[b]	8.9[c]
NDF	75.0[a]	69.7[b]	68.6[b]	73.7[a]	68.2[c]	72.3[b]	74.2[a]
ADF	42.6[a]	32.5[b]	34.3[b]	36.5[b]	33.4[b]	37.1[a]	38.9[a]
IVDMD	64.4	61.7	63.5	60.7	71.5[a]	61.5[b]	54.7[b]

[a,b,c]Means, within a row and main effect of forage type or harvest date, without common superscripts differ ($P < 0.05$).

Table 2. In situ dry matter (DM) disappearance kinetics for 'Sand Mountain' bahiagrass, 'Common', 'Midland', and 'Tifton 44' bermudagrass harvested on three dates near Booneville, AR.

Harvest date/ Forage	A[1]	B	C	Extent[2]	Lag time, h[3]	K_d/hr	Effective Degradability[4]
	% of DM						% of DM
June 9							
Bahiagrass	20.6[b]	60.6[a]	19.0[b]	81.0[a]	4.16	0.059[a]	58.3[a]
Common	24.9[a]	49.4[c]	25.7[a]	74.3[b]	3.38	0.056[a]	54.9[b]
Midland	23.7[a]	50.6[b,c]	25.7[a]	74.3[b]	2.35	0.052[a]	53.6[b,c]
Tifton 44	20.6[b]	53.3[b]	26.3[a]	73.7[b]	2.82	0.051[a]	52.3[c]
August 6							
Bahiagrass	16.6[b]	54.7[a]	28.7[b]	71.3[a]	4.21	0.040[b,c]	45.8[b]
Common	16.5[b]	43.3[c]	40.2[a]	59.8[b]	1.21	0.048[a]	41.6[c]
Midland	19.1[a]	49.8[b]	31.1[b]	68.9[a]	1.87	0.049[a]	48.0[a]
Tifton 44	14.6[c]	46.3[c]	39.1[a]	60.9[b]	1.59	0.034[c]	37.0[d]
October 5							
Bahiagrass	13.0[c]	56.4[a]	30.6[c]	69.4[a]	5.55	0.028[b]	37.7[b]
Common	18.6[a]	42.5[b]	38.9[b]	61.1[b]	1.39	0.043[a]	41.9[a]
Midland	18.4[a]	42.6[b]	39.1[b]	60.9[b]	2.84	0.040[a]	40.9[a]
Tifton 44	16.3[b]	41.0[b]	42.7[a]	57.3[c]	2.58	0.044[a]	39.0[b]
PSE[5]	0.7	1.1	1.0	1.0	0.84	0.003	0.7

[a,b,c]Means, in a column and within a given harvest date, without common superscripts differ ($P < 0.05$).
[1]Abbreviations: A = Immediately soluble fraction; B = fraction disappearing at a measurable rate; C = undegraded fraction; and K_d = rate of disappearance.
[2]Potential extent of disappearance in the rumen and calculated as 100 - C.
[3]Main effect of forage type was the only significant ($P < 0.001$) treatment effect.
[4]Calculated as $A + B \times [K_d/(K_d + \text{particulate passage rate})]$, where mean passage rate for five steers was 0.035 ± 0.007/hr.
[5]Pooled standard error of forage type x harvest date interaction means (n = 5 steers).