In-Situ Dry Matter Degradability of Eastern Gamagrass (T*ripsacum dactyloides* L.) Harvested at Ten Stages of Maturity

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Story in Brief

An in-situ trial with whole-plant 'Pete' eastern gamagrass (EGG), harvested on ten dates (from May 15 to July 17, 2000), was conducted to determine degradation of dry matter (DM) in five (856 + 80 lb) ruminally cannulated crossbred steers. The steers were offered a maintenance ration of bermudagrass hay (80%) and grain concentrate (20%). Chemical composition of whole plant EGG indicated that acid detergent fiber (ADF) increased with advancing harvest date up to the fourth harvest (June 5, 2000), but thereafter ADF increased only gradually. The eighth harvest had the highest ADF content (44.5%). Crude protein (CP) content of EGG declined from 14.6% (first harvest) to 5.7% (last harvest). Ruminal disappearance of DM was determined at 0, 3, 6, 9, 12, 24, 48, 72, 96, and 120 h for each harvest date. The lag time of DM degradation did not change ($P > 0.05$) as harvest date increased. Effective degradation of DM decreased ($P < 0.05$) from the first harvest to the last. With advancing harvest dates, the potential extent of DM degradation declined ($P < 0.05$). The potential extent of DM disappearance was highest ($P < 0.05$) at 85.9% on the first harvest date compared with 85.4, 83.8, 79.2, 79.4, 78.8, 78.8, 75.4, 76.3 and 75.7% for harvest dates 2, 3, 4, 5, 6,7, 8, 9 and 10, respectively. Degradability of DM was faster (4.6%/h) for the first harvest ($P < 0.05$) compared to subsequent harvest dates. The DM disappearance declined in relation to advancing harvesting date of EGG.

Introduction

Limited research work has been done on eastern gamagrass (EGG) compared to other warm season grasses. Interest in working with EGG gained momentum during the late 1980s and 1990s when the cultivar 'Pete' was developed and registered as a composite from 70 accessions originating from US native EGG populations in Kansas and Oklahoma (Fine et al., 1990). Chemical composition of EGG has been studied by Coblentz et al. (1998) who reported that CP concentration exceeds 12.5% at the boot and anthesis stages. At moderate N fertilization, CP concentration approached 20% of the whole plant at boot stage. Studies done on digestibility of EGG in Kansas by Coblentz et al. (1998) revealed that the potential extent of ruminal degradation of dry matter and neutral detergent fiber (NDF) at boot stage was comparable to that of high quality legumes; however, degradation occurred at slower rate. The fibrous components of EGG resemble the composition of C_4 grass species; therefore, the proportion of cell wall in the whole plant is high. The objective of this study was to measure in situ dry matter disappearance of the whole plant 'Pete' eastern gamagrass harvested at ten different dates.

Experimental Procedures

Five ruminally cannulated crossbred steers (mean BW = 855.6 ± 80 lb) were used as replicates to determine in situ degradation of EGG. These animals were cannulated by approved procedures of the University of Arkansas Institute of Animal Care and Use Committee. Steers were housed in individual pens, and fed a basal diet of 80% bermudagrass hay and 20% concentrate composition. Steers were fed 2.2% BW twice daily at 7:30 am and 4:00 pm. Water supply was ad libitum to all steers. Steers were adapted to the basal diet for 10 days before the trial period.

A pasture plot of eastern gamagrass established in the spring of 1999 was divided into four equal size blocks (82 x 82 ft) before the first forage samples were harvested on May 15, 2000. Whole plant forage sample harvesting was done by hand clipping a 39.4 in row at a height of 8 in above the ground. Two replicate whole plant samples were harvested from each block and were dried to a constant weight under forced air at 122°F. Whole plant harvesting dates were as follows: May 15, 22, and 29, June 5, 12, 19, and 26, July 3, 10, and 17, and were labeled as harvest date 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10, respectively.

Dried EGG whole plant samples were ground through a 2-mm screen for in-situ analysis. A small grab of representative sample from each whole plant replication was ground through I-mm screen for chemical analysis. The NDF and acid detergent fiber (ADF) analyses were conducted by batch procedures as outlined by ANKOM Technology Corp. (Fairport, NY). The CP was calculated from N determined by a modified Kjeldahl procedure (Kjeltec Auto 1030 Analyzer, Tecator, Inc. Herndon, VA).

A total of 500 dacron bags (3.9 x 7.9 in. 53-mm pore size; ANKOM Technology Corp; Fairport, NY) were filled with 5 g samples and carefully sealed by using an impulse heat sealer (Model CD-200; National Instrument Co; Inc; Baltimore, MD). Ten dacron bags for each period were placed into each 14.2 x 13.8 in mesh bag. All mesh bags were soaked at the same time in tepid (109°F) water for 20 min to wash out water-soluble components and minimize time lag associated with wetting. All mesh bags containing sample bags, excluding those labeled 0 h, were immediately inserted into the ventral rumen simultaneously and incubated for 3, 6, 9, 12, 24, 48, 72, 96, and 120 h. After insertion animals were fed the basal diet.

Zero hour soaked bags and incubated bags from the rumen were rinsed by a washing machine (Whirlpool Corp; model# Lx R 7144 EQ1, Benton Harber, MI) ten times in 12 gal 1 min agitation, 2 min spin per rinse according to procedure described by Coblentz et al. (1997). Rinsing was done to minimize microbial N contamination.

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In situ DM residues were divided into three fractions (Wilkerson et al., 1995) based on susceptibility to ruminal degradation and were defined as follows: A = the immediately soluble fraction; B = the fraction that was degraded at a measurable rate; and C = the fraction unavailable in the rumen. Fractions A, B, and C were derived directly or indirectly from non- linear regression (PROC NLIN of SAS Inst., Inc, Cary, NC) as the percentage of DM that remained after incubation times. Lag times, degradation rate constants, and fractions B and C were determined directly from the model. The maximum theoretical extent of degradation was determined similarly (total DM – C). The immediately soluble portion, fraction A, was calculated by difference (total DM – (B+C)).

For each individual harvesting date regression analysis (SAS, PROC REG) was used to analyze chemical concentrations (NDF, ADF, and CP) for linear, quadratic, and cubic responses over the ten harvesting dates.

Results and Discussion

Quality of Eastern Gamagrass. Chemical composition of whole plant eastern gamagrass for each harvest date is shown in Table 1. The NDF and ADF content increased as gamagrass harvest date advanced. Acid detergent fiber increased from 32.3 % in the first harvest to 44.5 % at the eighth harvest. The protein content of the whole plant EGG decreased with advancing harvest date from 14.6 to 5.7 % for the first and the last.

In this study NDF content of EGG was 66.2% during the first harvest (May 15) and the level rose ($P < 0.01$) to 79.4 during the eighth harvest date July 3) and then dropped again. The fiber concentration of whole plant and CP is described by the following equations:

$$\text{Whole plant NDF \%} = 66.0 + 0.4258(d) - 0.0038\,(d)^2$$
$$\text{Whole plant ADF \%} = 33.2 + 0.2859\,(d) - 0.0020\,(d)^2$$
$$\text{Whole plant CP \%} = 14.2 - 0.1290\,(d).$$

The concentration of NDF and ADF were comparable with findings reported by Coblentz et al. (1997) who reported that EGG at boot stage had 69.4% and 35.3% NDF and ADF respectively. The anthesis stage EGG had 73.1% NDF and 39.6 % ADF, while at physiological maturity NDF and ADF content were 78% and 44.8% respectively. In the present study NDF content of EGG was 66.2% at the first harvest, and rose to 79.4 at eighth harvest. In this trial CP% content decreased linearly ($P < 0.01$) form 14.6% during the first harvest to 5.7% during the last harvest (Table 2).

Degradation Kinetics of DM. In situ degradation kinetics of whole plant EGG are presented in Table 2. In this study, immediately soluble DM between first and third harvest was 24.2 to 22.7% ($P < 0.05$) and could be compared to that found at boot and anthesis stages by Coblentz et al. (1998).

The lag time of DM degradation did not change ($P > 0.05$) with advancing harvest date of EGG. Effective degradation of DM decreased ($P < 0.05$) from the first harvesting date to the last. Measurable degradable DM was 61.8 to 58.0% ($P < .05$). The potential extent of DM degradation declined ($P < 0.05$) but the undegradable fraction increased with advancing harvest dates. The potential extent of DM disappearance was highest on the first harvest with 85.9% and declined with increasing harvesting dates.

Implications

Degradation characteristics of dry matter indicated a decline with advancing harvest dates. The results of this study suggest that more trials should be carried out to determine and compare degradation characteristics of other nutrients concentrations of eastern gamagrass.

Literature Cited

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Table 1. Composition of whole plant forages of eastern gamagrass harvested at ten dates from May 15 to July 17 (as % DM)

Harvest date	NDF[1]	ADF[2]	CP[3]
1	66.2[b]	32.3[b]	14.4[a]
2	67.8	35.1	13.1
3	70.2	36.7	12.6
4	74.4	38.9	9.8
5	73.9	38.6	11.1
6	76.6	40.3	10.1
7	74.2	39.4	9.4
8	79.4	44.5	7.1
9	79.0	42.2	6.5
10	76.2	43.0	6.3
SEM	0.6	0.9	0.4

[1] NDF = neutral detergent fiber.
[2] ADF = acid detergent fiber.
[3] CP = crude protein.
[a] Linear effect ($P < 0.01$) with harvesting dates.
[b] Quadratic effect ($P < 0.01$) with harvesting dates.

Table 2. In situ DM degradation[1] of the whole plant eastern gamagrass at ten harvest dates (as % DM)

Harvest date	A	B	C	EXT	EFF	LAG, h	Rate, K_d
1	24.2[a]	61.8[ab]	14.0[e]	85.9[a]	58.8[a]	1.5	4.6[a]
2	22.7[ab]	62.7[a]	14.6[ed]	85.4[a]	55.6[b]	0.7	3.9[b]
3	22.7[ab]	61.2[ab]	16.3[d]	83.8[a]	55.4[b]	1.7	4.1[ab]
4	19.2[bc]	60.0[ab]	20.8[c]	79.2[b]	50.4[c]	1.8	3.9[b]
5	19.1[c]	60.3[ab]	20.6[c]	79.4[b]	46.9[d]	1.2	3.0[c]
6	15.7[cd]	62.3[a]	21.9[bc]	78.8[bc]	44.0[e]	1.2	2.9[cd]
7	17.7[cd]	62.3[a]	21.2[c]	78.8[b]	42.5[ef]	1.1	2.5[cde]
8	14.5[d]	60.9[ab]	24.6[a]	75.4[d]	41.0[f]	2.3	2.7[cde]
9	16.1[cd]	60.3[ab]	23.7[ab]	76.3[cd]	40.5[f]	1.6	2.5[de]
10	17.7[c]	58.0[b]	24.3[a]	75.7[d]	40.7[f]	1.6	2.3[e]
SEM	7.7	11.1	3.1	3	3.2	2	0.001

[a b c d e f] Means in a column without a common superscript differ ($P < 0.05$).
[1]A= immediately soluble fraction; B=fraction degradable at a measurable rate;
C= un-degradable fraction; EXT=Potential extent of degradation; EFF=Effective degradation.