Jamie L. Whitten Plant Materials Center

Coffeeville, MS

Vol. 14 No. 7 Technical Report August 1999

Clipping Effect on Yield and Quality of Eastern gamagrass, Switchgrass, and Bermudagrass

Scott Edwards, Joel Douglas and Herby Bloodworth

ABSTRACT

Frequent clipping can adversely effect yield, quality and stand survival of eastern gamagrass [*Tripsacum dactyloides* (L.) L.] and switchgrass (*Panicum virgatum* L.). This study compared the performance of 'Alamo' switchgrass, accession 9062680 eastern gamagrass, and 'Tifton 44' bermudagrass [*Cynodon dactylon* (L.) Pers.] on a 30 and 45 d clipping frequency. Species were planted in May 1994, in 10 by 20 ft plots replicated 5 times and allowed to establish for 2 yr before clipping treatments were introduced in May 1996 through September 1998. Measurements included dry matter yield (DM), crude protein, ADF and NDF. Eastern gamagrass, switchgrass, and bermudagrass clipped on 30 d intervals produced a 3 yr average DM yield of 9775, 6650, and 10 775 lbs/acre, respectively. Eastern gamagrass and switchgrass responded favorably to the 45 d clipping frequency by gaining 28% and 17% more DM yield, as compared to 30 d. Eastern gamagrass clipped on 45 d produced the highest average 3 yr season total DM with 12 447 lbs/acre. In 1998, season total DM yield for eastern gamagrass clipped on 30 d declined 71% to 3707 lbs/acre. Thirty day clipping severely reduced eastern gamagrass and switchgrass stands resulting in heavy weed competition in 1998. Percent crude protein was higher for both eastern gamagrass and switchgrass on a 45 d clipping frequency than bermudagrass. Percent ADF and NDF were also lower for these species on a 45 d frequency. While eastern gamagrass and switchgrass did not produce adequate DM yield on 30 d intervals, they can be clipped on 45 d intervals and maintain comparable yields with little difference in quality as compared with 30 d bermudagrass.

INTRODUCTION

In the southeastern United States, forage producers have relied on the introduced species bermudagrass [*Cynodon dactylon* (L.) Pers.] as a major component in their forage programs (Ball and Hoveland, 1991). Numerous cultivars have been released through plant breeding and selection to increase forage production and quality (USDA, 1994). Bermudagrass should be harvested every 4 to 5 weeks to maintain optimum quality. The stage of maturity at harvest influences the palatability, crude protein content, and especially the digestible energy level.

Scott Edwards is an Agronomist and Joel Douglas is Manager at the Jamie L. Whitten Plant Materials Center, 2533 Co. Rd. 65, Coffeeville, Mississippi 38922. Phone: (601) 675-2588; FAX:(601) 675-2369. Herby Bloodworth is an Agronomist, NRCS, Washington D.C.,

USDA NRCS
Natural Resources Conservation Service

Homer L. Wilkes, State Conservationist
Jackson, Mississippi

Forage quality deteriorates rapidly with advancing maturity even though yield will continue to increase (Ball and Hoveland, 1991).

Eastern gamagrass [*Tripsacum dactyloides* (L.) L.] and switchgrass (*Panicum virgatum* L.), both perennial warm-season grasses native to the southeastern United States, have potential as forage crops. Eastern gamagrass is adapted from Massachusetts to Michigan, Iowa and Nebraska, south to Florida and Texas. Switchgrass has an even larger distribution from Maine to North Dakota and Wyoming, south to Florida, Arizona and Mexico (Hitchcock, 1950).

The increased demand for native forage species for summer grazing (Burns et al., 1992), hay production (Hall et al., 1982) and silage (Brejda et al., 1994) have resulted in many advances in seed production, seed quality and stand establishment techniques. However, limited information is available on production potential of native grasses under management conditions used for introduced species (i.e., frequent clipping). The objective of this study was to evaluate clipping effects on yield and quality of eastern gamagrass, switchgrass, and bermudagrass.

MATERIALS AND METHODS

The study was conducted over a 3-y period from 1996 to 1998 at the USDA-NRCS-Jamie L. Whitten Plant Materials Center near Coffeeville, MS, on an Oaklimeter silt loam (Coarse-silty, mixed, thermic Fluvaquentic Dystrochrepts). Plots were established from transplants and sprigs and allowed to grow for 2 yr before clipping treatments were introduced in May 1996.

During establishment phase, 60 lbs N, 26 lbs P, and 36 lbs K were applied. All species were burned each spring prior to green-up. Thirty days after green-up all plots received 60 lbs N, 39 lbs P, and 48 lbs K. After initial harvest, 180 lb N and 120 lb K were applied in split applications. Study design was a split plot in a randomized complete block with 5 replications. Plots were split by 30 d and 45 d clipping frequency into 10 by 20-ft plots.

Bermudagrass and switchgrass were harvested from a 3-ft by 20-ft strip in each plot at a 4 inch cutting height using a sickle bar mower. Five eastern gamagrass plants were harvested from each plot to a 4 inch cutting height with a hand held sickle bar trimmer. Harvested material was weighed green in the field before a subsample was collected from each plot. Dry matter content was determined by drying sample in a forced air oven at 55°C for 16 hours. In 1996, 30 d plots were harvested 14 June, 15 July and 12 August; 45 d were harvested 28 June and 12 August. In 1997, 30 d plots were harvested 14 May, 19 June, 18 July and 18 August; 45 d plots 19 May, 30 June, and 11 August. In 1998, 30 d were harvested 22 May, 18 June, 24 July and 3 September; 45 d 22 May, 30 June, and 25 August. Precipitation was recorded on-site at the PMC for each year of the study (Table 1).

Table 1. Growing season precipitation totals for 1996 – 1998 and 20 y average, Coffeeville, Mississippi.

	Precipitation			
Month	1996	1997	1998	20-yr avg.
	----------inches----------			
March	5.20	7.83	6.57	5.75
April	5.94	3.15	5.59	5.47
May	3.90	7.17	4.53	5.75
June	11.77	12.32	1.97	4.84
July	4.80	4.09	4.09	4.33
August	3.50	3.15	3.62	3.27
September	7.52	5.59	0.28	4.17
Total	42.64	43.31	26.65	33.58

RESULTS AND DISCUSSION

There was a significant year x frequency x specie interaction therefore, each frequency was analyzed separately. Bermudagrass produced relatively consistent yields each year for both clipping frequencies with no differences in 1996 and 1998 (Table 2). These bermudagrass yields agree with Fisher and Caldwell (1958) but are higher than 4 yr average yield for 'Tifton 44' reported by Hearn (1999).

Table 2. Influence of clipping frequency on season total dry matter yield of 3 warm season grasses, 1996-1998, Coffeeville, Mississippi.

	Year			
Frequency	1996	1997	1998	Mean
		Bermudagrass		
		lbs / acre		
30 day	11561	10221	10542	10775
45 day	11092	7905	10860	9952
LSD (0.05)	NS*	1602	NS	693
		Eastern gamagrass		
30 day	12494	13123	3707	9775
45 day	10361	14652	12329	12447
LSD (0.05)	NS	NS	2235	2517
		Switchgrass		
30 day	5681	5675	8594	6650
45 day	3130	7914	12300	7781
LSD (0.05)	989	1915	1297	933

* Not significant

Eastern gamagrass responded early to a 30 d frequency but decreased 71% to 3707 lb/acre in 1998 (Table 3). In 1998, eastern gamagrass clipped on 30 d was slow to recover from winter dormancy and excessive weed competition became a problem as the stand declined under the frequent clipping regime. Brakie (1998) reported that a 30 d clipping frequency weakened plants of southern ecotypes of eastern gamagrass in eastern Texas. Kinsinger and Hopkins (1961) found that frequent defoliation in big bluestem (*Andropogon gerardii* Vitman) and western wheat grass [*Pascopyrum smithii* (Rydb.) A. Love] depleted root reserves. These food reserves are important for growth and regrowth following dormancy, defoliation, and other stressful conditions (Sosebee and Wiebe, 1971).

Brejda (1997), reported significant variation in eastern gamagrass forage yield between years because of wide variation in growing season precipitation amounts. In this study, it appears that clipping frequency had more of an effect on yield for eastern gamagrass than precipitation. During this study precipitation received during the growing season was more than 21% above the 20 yr average in 1996 and 23% above average in 1997. In 1998, growing season precipitation was 21% below the 20 yr average. During 1998, with limited precipitation, there was no significant difference in yield for 45 d as compared to 1996 and 1997. Eastern gamagrass yields reported in this study for 45 d clipping frequency are consistent with yields reported by Brejda (1997) but are lower than those reported by Brakie (1998).

Table 3. Season total dry matter yield comparison of 3 warm season grasses clipped on 30 and 45 d frequency, 1996 – 1998, Coffeeville, Mississippi.

Year	Bermudagrass	Eastern gama	Switchgrass	LSD (0.05)
----------30 d Clipping Frequency----------				
	----------lbs / acre----------			
1996	11561	12494	5682	1983
1997	10221	13123	5675	2560
1998	10541	3707	8597	1214
LSD (0.05)	1065	3088	1136	
----------45 d Clipping Frequency----------				
	----------lbs / acre----------			
1996	11092	10361	3130	1377
1997	7905	14652	7914	3654
1998	10860	12329	12300	NS
LSD (0.05)	1381	NS*	1573	

* Not significant

Bermudagrass and eastern gamagrass produced significantly higher yields than switchgrass in 1996 and 1997 when clipped on 30 d. In 1998, there was a significant increase in switchgrass yield. This is somewhat misleading because over half of the season total yield for 1998 30 d clipping frequency was produced in the third cutting (data not shown). Switchgrass clipped on 30 d began to show signs of decline similar to the eastern gamagrass with increased weed competition following winter dormancy which severely limited yield in the first and second cutting. Beaty and Powell (1975) reported that switchgrass yield and stand decreased under frequent defoliation resulting in an increase in weed growth.

Switchgrass yields increased significantly each year under 45 d clipping frequency (fig. 2). There was a 9170 lb/acre increase from 1996 to 1998. In 1998, there was no significant difference between species clipped on 45 d. Switchgrass yields reported in this study are 3 times larger than those reported by Beaty and Powell (1975).

There were significant differences in crude protein, ADF and NDF for species clipped on a 30 d frequency (Table 4). Percent crude protein content ranged from 6 to 11% in bermudagrass, 8 to 12% in eastern gamagrass and 7 to 13% in switchgrass. Crude protein contents for eastern gamagrass are in agreement with Brakie (1998). Protein content increased with each cutting in all three years peaking in the third or fourth cutting except in 1998. The highest crude protein content was in the 1998 second cutting during an extremely low precipitation period. Kamstra (1973) and Perry and Baltensperger (1979) reported that higher crude protein levels in switchgrass during drought years are associated with a higher leaf to stem ratio.

Percent ADF ranged from 33 to 40% in bermudagrass which was significantly lower than eastern gamagrass (36 to 41%) in all cuttings in 1996 and 1997. In 1998, there was no significant difference in %ADF. Eastern gamagrass and switchgrass had significantly lower %NDF per cutting as compared to bermudagrass for all years on a 30 d clipping frequency.

Table 4. Quality estimates by cutting and species for 30 d clipping frequency in 1996 – 1998, Coffeeville, Mississippi.

Species	% Protein				% ADF				% NDF			
	Cutting				Cutting				Cutting			
	1	2	3	4	1	2	3	4	1	2	3	4
	1996											
Bermudagrass	8	9	8	10	38	33	37	36	72	71	72	71
Eastern gama	10	10	10	12	41	38	39	37	67	69	67	67
Switchgrass	10	9	7	9	34	34	38	36	71	69	69	66
	1997											
Bermudagrass	6	12	10	11	33	34	35	33	72	70	70	70
Eastern gama	10	8	12	12	37	38	38	38	69	70	68	67
Switchgrass	10	8	12	12	34	33	35	35	67	70	66	65
	1998											
Bermudagrass	9	11	9	8	38	35	38	40	74	71	71	70
Eastern gama	9	12	10	N/A*	36	36	38	N/A	67	66	68	N/A
Switchgrass	8	13	10	N/A	37	34	38	N/A	68	65	67	N/A

LSD (0.05) for differences in species and cutting for Protein = 1.5
LSD (0.05) for differences in species and cutting for ADF = 2.0
LSD (0.05) for differences in species and cutting for NDF = 2.0

* N/A = Eastern gamagrass and Switchgrass were only clipped three times in 1998.

Table 5. Quality estimates by cutting and species for 45 d clipping frequency in 1996 – 1998, Coffeeville, Mississippi.

Species	% Protein			% ADF			% NDF		
	Cutting			Cutting			Cutting		
	1	2	3	1	2	3	1	2	3
	1996								
Bermudagrass	8	6	7	37	38	38	72	74	72
Eastern gama	10	6	9	37	41	40	71	70	70
Switchgrass	10	6	7	33	40	38	71	71	68
	1997								
Bermudagrass	5	6	N/A	35	38	N/A	74	74	N/A
Eastern gama	11	10	10	38	40	39	69	72	68
Switchgrass	10	8	8	34	36	39	67	71	70
	1998								
Bermudagrass	9	9	7	37	38	39	75	73	71
Eastern gama	10	10	10	37	38	38	68	68	70
Switchgrass	8	10	7	36	37	38	68	68	65

LSD (0.05) for differences in species and cutting for Protein = 1.5
LSD (0.05) for differences in species and cutting for ADF = 2.5
LSD (0.05) for differences in species and cutting for NDF = 4.0

* N/A = Bermudagrass was only clipped twice in 1997.

In 1997, bermudagrass was only clipped twice on a 45 d clipping frequency. Bermudagrass did not respond well to late 45 d harvest date in 1996. Bermudagrass clipped on 45 d produced lower % crude protein than both eastern gamagrass and switchgrass. (Table 5). Protein levels remained more consistent across cuttings for eastern gamagrass and switchgrass unlike the 30 d frequency ranging from 6 to 11% and 6 to 10% respectively.

There was no significant difference in %ADF across cutting or species in 1998 on a 45 d cutting frequency. Percent NDF also remained constant from first to last cutting each year with no significant difference within species.

CONCLUSIONS

A 45 d clipping frequency typically represents two to three harvests per growing season in the lower southern states, but is greatly influenced by moisture and length of growing season. Eastern gamagrass clipped on 45 d had a 3 yr average dry matter yield of 12 447 lb/acre with no significant variation between years. Bermudagrass clipped on 30 d had one more clipping per year but only had a 3 yr average dry matter yield of 10 775. Clipping native grasses on a 30 d frequency reduced stands allowing weeds to invade both eastern gamagrass and switchgrass. A 45 d clipping frequency appears to be more suited for native grasses, as indicated by the sustained yields for eastern gamagrass and the increase in yield of switchgrass.

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