Yield and Quality of Creeping Bluestem as Affected by Time of Cutting

R.S. KALMBACHER, F.G. MARTIN, AND J.M.S. ANDRADE

Abstract

Creeping bluestem (*Schizachyrium stoloniferum* Nash.) is a rhizomatous native grass that is the dominant species on many Florida rangelands. To evaluate its grazing potential, dry matter yield, in vitro organic matter digestibility (IVOMD), crude protein, neutral detergent fiber (NDF), acid detergent fiber (ADF), and acid detergent lignin (ADL), were measured in plants cut at 10 and 20 cm stubble heights during 70-day intervals from June to October (summer), August to December (summer-fall), and October to February (winter). Winter yields were significantly greater (2,090 kg/ha) than summer yields (1,600 kg/ha) with summer-fall yields intermediate (1,860 kg/ha). After 3 years there was a significant decline in dry matter in plants cut at 10 cm, but yield was sustained in plants cut at 20 cm. Herbage regrowth in July to August was high in IVOMD (37.8%). Crude protein and IVOMD percentages were also greater in November to December regrowth (7.5 and 36%, respectively) and January to February regrowth (6.8 and 37%, respectively). However, since forage yield was lowest at the time, yield of protein and digestible organic matter were lowest. Percent NDF, ADF, and ADL were not greatly affected by initial growth or regrowth periods and averaged 80.0, 42.3 and 5.8%, respectively. Creeping bluestem may be one of Florida's greater yielding native grasses, but will require protein and energy supplements to provide good livestock performance.

Creeping bluestem (*Schizachyrium stoloniferum* Nash.) is a warm-season, rhizomatous perennial grass (Yarlett 1970), and its dominance on Florida (Yarlett 1963), Georgia, and Alabama (Halls et al. 1964) flatwoods range makes the species among the most widespread and desirable of Southern native grasses. It responds favorably to range improvement and increases pasture yield above that of wiregrass (*Aristida stricta* Michx.) dominated range. Yarlett (1965) estimated that green weight yields of creeping bluestem increased from 1,800 kg/ha at 3 months after mechanical brush control to 6,700 kg/ha at 11 months after treatment.

Creeping bluestem was found to out-yield four other native grasses in an investigation by Roush and Yarlett (1973). Time, frequency, and height of cut were found to affect yield and vigor. Lowest yield (12 metric tons/ha of green forage) resulted from cutting at 10 cm above the soil whenever the plant reached 20 cm in height. Greatest yield (21.5 metric tons/ha) resulted from harvesting 50% of the plant in April, June, and September. These yields reported by Roush and Yarlett were high because all grasses received fertilization.

The major contribution that creeping bluestem can make in a grazing program results from its forage production potential. Cattle can have a 5 to 6-month grazing period as compared with 1 to 2-month period with other native forage resources.

Crude protein and in vitro dry matter digestibility (IVDMD) of a composite of several bluestems, including creeping bluestem,

were reported by Lewis (1975). In April forage averaged 10.2% protein and 54.0% IVDMD, but declined to 3.2% protein and 34.0% IVDMD by October.

In order to evaluate the potential of creeping bluestem, additional information is needed about its seasonal yield and quality. This investigation was designed to determine the dry matter yield, in vitro organic matter digestibility (IVOMD), crude protein, neutral detergent fiber (NDF), acid detergent fiber (ADF), and acid detergent lignin (ADL) in plants cut at 10 and 20 cm above the soil during 70-day intervals from June to October, August to December, and October to February.

Materials and Methods

Experimental work was conducted at the University of Florida's Ona Agricultural Research Center which is 27° 55' N and 81° 55' W. The soil was unlimed, unfertilized Immokalee fine sand, which is an Arenic Haplaquod. From samples taken in the upper 15 cm, soil pH was 4.0, and inherent soil P was 6.0; K, 75.0; Ca, 550.0; and Mg, 165.0 kg/ha.

A thick stand of creeping bluestem, which had not been burned during the 3-years prior to its selection in 1975, was cut to 10 cm and all forage removed in early January, 1976. The experiment was designed as a split-plot with whole plots arranged in four randomized, complete blocks. There were three whole plots which were time of clipping or sampling: June to October; August to December; and October to February. Each whole plot was cut three times per year: at the beginning of each period (June, August, October) and twice thereafter on approximately 70-day intervals. The initial growth refers to forage accumulated between the third or last cutting (ie. October) and the first cutting (ie. June), and regrowth refers to the forage produced in the two, 70-day intervals after the initial harvest. Sub-plots were height of cutting above the soil, and plots, which were 1.5 × 5.0 m, were cut at 10 and 20 cm with a rotary-type harvester.

Yield and dry matter were calculated from fresh sub-samples of approximately 0.25 kg, dried at 60° C. Methods described by Gallaher et al. (1977) and Isaac and Johnson (1976) were used for nitrogen analysis and that of Moore et al. (1972) for IVOMD. Yield of digestible organic matter (DOM) was calculated by multiplying dry matter yield by both IVOMD and organic matter percent. NDF, ADF, and ADL were determined according to the procedure described by Van Soest (1963) and Van Soest and Wine (1967).

Results and Discussion

Dry matter yield

Forage yield from June to October of 1978-79 was significantly lower ($P<0.05$) than the yield of the previous 2 years (Table 1). There was no significant drop in yield in the third year when creeping bluestem was clipped in August to December or October to February. When time of clipping was examined within 1976-77 and 1977-78, it was found that production resulting from cutting

Authors are associate agronomist, Ona Agricultural Research Center, Ona, Florida 33865; associate statistician University of Florida, Gainesville 32611; and pasture researcher, EPAMIG, Dept. Fitotecnia, Minas Gerais, Brazil.

This report is Florida Agr. Exp. Sta. Pap. No. 2156.

Manuscript received January 2, 1980.

Table 1. Annual dry matter yield (kg/ha) of creeping bluestem as affected by year and time of clipping. Ona, Florida, 1976-79.

Year	Clipping period			
	June to Oct.	Aug. to Dec.	Oct. to Feb.	
1976-77	1670 ^{a1}	1900 ^a	1930 ^a	b,ab,a ²
1977-78	1790 ^a	1950 ^a	2150 ^a	b,ab,a
1978-79	1350 ^b	1740 ^a	2180 ^a	c,b,a
Average	1600	1860	2090	

¹For vertical (year) comparison. Means within columns followed by the same letter are not significantly different. (Duncan's multiple range test, $P<0.05$).
²For horizontal (time of clipping) comparison. The letters correspond to the three means within a year. Means having the same letter are not significantly different. (Duncan's multiple range test, $P<0.05$).

plants from June to October was significantly lower than that of October to February, while production resulting from cutting in August to December was not different from either. In 1978-79 mean yields from each of the three time periods were different. Creeping bluestem makes most of its growth in the spring and summer (Yarlett and Roush 1970), and periodic clipping from June to October interrupted this growth. Forage yields were greater in the August to December and October to February periods because of the heavier yields accumulated by the initial harvest, which represented 60 and 77% of the total yield values for these respective periods shown in Table 1. The initial growth of the June to October cutting period represented 37% of the total average 1,600 kg/ha. Cutting creeping bluestem at 10 cm above the soil significantly reduced dry matter yields after 1977-78 (Table 2), but there was no significant drop in yield when plants were cut at 20 cm. In 1976-77 and 1977-78 cutting plants at 10 cm resulted in higher yields, and this would be expected as more herbage was harvested when cut closer to the soil. In 1978-79 there was no difference in yield between height of cut treatments. The plant stands were thinning out at the 10-cm height of cut, and tiller density (not in tables) was significantly less in the plots cut in June to October at the 10-cm level (117 tillers/m²) as compared with the tiller density average from all other plots (171 tillers/m²). The reduction in yield after 3 years of cutting at 10 cm in June, August, and October was

Table 2. Annual dry matter yield (kg/ha) of creeping bluestem as affected by year and height of cut. Ona, Florida, 1976-79.

Year	Height of cut (cm)		
	10	20	
1976-77	2330 ^a	1340 ^b	a,b ²
1977-78	2100 ^a	1800 ^a	a,b
1978-79	1700 ^b	1800 ^a	a,a

¹For vertical (year) comparison. Means within columns followed by the same letter are not significantly different (Duncan's multiple range test, $P<0.05$).
²For horizontal (height of cut) comparison. The letters correspond to the two means within a year. Means with the same letter are not significantly different. (Duncan's multiple range test, $P<0.05$).

probably due more to lower yield per tiller, rather than a significant loss of tillers.

Forage Quality

Crude protein was not significantly different ($P<0.05$) in forage accumulated prior to the beginning of each of the three sampling periods (initial growth) (Table 3). Regrowth from July to August or September to October was significantly lower in crude protein content, than that harvested November to December or January to February. There were small changes in protein percentages found in the forage sampled within the June to October (5.0 to 5.7%) or the October to February (4.5 to 6.8%) clipping periods, although protein differences between these two periods were great. The August to December clipping period, which overlapped in former two periods, had the most dramatic changes in crude protein, which ranged from 4.8 to 7.7%. Since protein yield was influenced most by dry matter yield, protein yields were greatest for the forage accumulated from March to October (70 kg/ha) (Table 4). Although ranchers using creeping bluestem during the winter would have more protein per hectare at the beginning of the season, little protein production could be expected from regrowth in November through February. Percent IVOMD in forage was significantly lower in the March to October initial growth (27.4%) as compared with forage accumulated in January to August (31.5%), and the latter was lower than the initial November to June forage (34.3%) (Table 5). These

Table 3. Crude protein (CP) on a dry matter basis in creeping bluestem as affected by time of initial growth and regrowth period. Ona, Florida, 1976-77 1977-78.

Clipping period	Months when forage was produced					
	Initial growth		Regrowth			
	Months	% CP	Months	% CP	Months	% CP
June-Oct.	Nov.-June	5.0 ^{a1}	July-Aug.	5.8 ^b	Sept.-Oct.	5.7 ^c b,a,a ²
Aug.-Dec.	Jan.-Aug.	4.8 ^a	Sept.-Oct.	5.8 ^b	Nov.-Dec.	7.7 ^c c,b,a
Oct.-Feb.	Mar.-Oct.	4.5 ^a	Nov.-Dec.	7.4 ^a	Jan.-Feb.	6.8 ^a c,a,b

¹For vertical comparison. Means within columns followed by the same letter are not significantly different (Duncan's multiple range test, $P<0.05$).
²For horizontal comparison. Letters correspond to the three means on the same line. Means having the same letter are not significantly different (Duncan's multiple range test, $P<0.05$).

Table 4. Yield (kg/ha) of crude protein (CP) from creeping bluestem as affected by time of initial growth and regrowth period. Ona, Florida, 1976-77 and 1977-78.

Clipping period	Months when forage was produced					
	Initial growth		Regrowth			
	Months	CP	Months	CP	Months	CP
June-Oct.	Nov.-June	30 ^{c1}	July-Aug.	30 ^a	Sept.-Oct	30 ^a a,a,a ²
Aug.-Dec.	Jan.-Aug.	50 ^b	Sept.-Oct.	30 ^a	Nov.-Dec.	20 ^b a,b,c
Oct.-Feb.	Mar.-Oct.	70 ^a	Nov.-Dec.	20 ^b	Jan.-Feb.	10 ^c a,b,c

¹For vertical comparison. Means within columns followed by the same letter are not significantly different (Duncan's multiple range test, $P<0.05$).
²For horizontal comparison. Letters correspond to the three means on the same line. Means having the same letter are not significantly different (Duncan's multiple range test, $P<0.05$).

Table 5. In vitro organic matter digestibility (IVOMD) in creeping bluestem as affected by time of initial growth and regrowth period. Ona, Florida. 1976-77 and 1977-78.

Clipping period	Months when forage was produced						
	Initial growth		Regrowth				
	Months	% IVOMD	Months	% IVOMD	Months	% IVOMD	
June-Oct.	Nov.-June	34.3 ^{a1}	July-Aug.	37.7 ^a	Sept.-Oct.	33.6 ^b	b,a,b ²
Aug.-Dec.	Jan.-Aug.	31.5 ^b	Sept.-Oct.	33.8 ^b	Nov.-Dec.	35.7 ^a	c,b,a
Oct.-Feb.	Mar.-Oct.	27.4 ^c	Nov.-Dec.	36.9 ^a	Jan.-Feb.	37.2 ^a	b,a,a

¹For vertical comparison. Means within columns followed by the same letter are not significantly different (Duncan's multiple range test, $P<0.05$).

²For horizontal comparison. Letters correspond to the three means on the same line. Means having the same letter are not significantly different (Duncan's multiple range test, $P<0.05$).

Table 6. Yield (kg/ha) of digestible organic matter (DOM) in creeping bluestem as affected by time of initial growth and regrowth period. Ona, Florida, 1976-77 and 1977-78.

Clipping period	Months when forage was produced						
	Initial growth		Regrowth				
	Month	DOM	Months	DOM	Months	DOM	
June-Oct.	Nov.-June	210 ^{c1}	July-Aug.	200 ^a	Sept.-Oct.	170 ^a	a,a,b ²
Aug.-Dec.	Jan.-Aug.	350 ^b	Sept.-Oct.	170 ^a	Nov-Dec	80 ^b	a,b,c
Oct.-Feb.	Mar.-Oct.	430 ^a	Nov.-Dec.	100 ^b	Jan-Feb	30 ^c	a,b,c

¹For vertical comparison. Means within columns followed by the same letter are not significantly different (Duncan's multiple range test, $P<0.05$).

²For horizontal comparison. Letters correspond to the three means on the same line. Means having the same letter are not significantly different ($P<0.05$).

differences in IVOMD were due to age of forage sampled. November to June initial forage was younger, spring growth as contrasted with senescent forage produced in the spring and summer and sampled in August or October. The IVOMD values were greater in regrowth than in their respective initial growths, and this was especially obvious in regrowth after the March to October initial, which increased from 27.4% initially to 36.9 and 37.2% in regrowth. Even the regrowth highest in IVOMD (July to August regrowth was 37.7%) was apparently about 10% lower than the IVOMD values reported by Lewis et al. (1975) for bluestems grown during this period in southern Georgia.

Yield of digestible organic matter like protein yield was more of a function of dry matter yield than IVOMD% and was greatest at the end of March to October initial growth period (Table 6). Regrowth from July to August resulted in greater DOM yields than November to December or January to February regrowth.

Percent NDF ranged from 79.1 to 82.0% and was not significantly different when comparisons were made among the initial growth cuttings (Table 7). NDF in regrowth from the June to October or August to December clipping period was not significantly different from the NDF of their respective initial periods. However, regrowth after the March to October initial period did drop significantly in NDF during each of the successive harvests. IVOMD% was fairly closely associated with NDF% with $r=0.70$. Leland et al (1976) reported cell wall constituents of unburned *Andropogon gerardi* (Vitman) and *S. scoparium* (Michx. Nash.) to

be about 76% to 79%, respectively, which is similar to those values in Table 7.

Percent ADF and ADL were affected by time of use (Table 8). Both ADF and ADL percentages were significantly higher in the October to February period than in the June to October period. The low IVOMD% reflects the high percentage of seemingly

Table 8. Percent acid detergent fiber (ADF) and percent acid detergent lignin (ADL) in creeping bluestem as affected by time of use. Ona, Florida 1977-78.

	Clipping period		
	June to October	August to December	October to February
ADF	42.8 ^{a1}	43.2 ^a	43.0 ^a
ADL	5.3 ^b	5.5 ^b	5.9 ^a

¹Means on the same line followed by the same letter are not significantly different. (Duncan's LSD, $K = 100$).

undigestible cellulose found in the ADF fraction. Leland et al (1976) reported lower cellulose values for *A. gerardi* and *S. scoparium*, which were 33% and 34%, respectively. Lignin was 6% to 7%, respectively, in these species. The ADL% reported for creeping bluestem was not usually high so if lignin had a negative affect on

Table 7. Percent neutral detergent fiber (NDF) in creeping bluestem as affected by time of initial growth and regrowth period. Ona, Florida, 1977-78.

Clipping period	Months when forage was produced						
	Initial growth		Regrowth				
	Months	NDF	Months	NDF	Months	NDF	
June-Oct.	Nov.-June	80.9 ^{a1}	July-Aug.	80.9 ^a	Sept.-Oct.	81.5 ^a	a,a,a ²
Aug.-Dec.	Jan.-Aug.	81.6 ^a	Sept.-Oct.	81.5 ^a	Nov.-Dec.	81.3 ^a	a,a,a
Oct.-Feb.	Mar.-Oct.	82.0 ^a	Nov.-Dec.	80.7 ^a	Sept.-Oct.	81.5 ^a	a,a,a ²
Aug.-Dec.	Jan.-Aug.	81.6 ^a	Sept.-Oct.	81.5 ^a	Nov.-Dec.	81.3 ^a	a,a,a
Oct.-Feb.	Mar.-Oct.	82.0 ^a	Nov.-Dec.	80.7 ^a	Jan.-Feb.	79.1 ^a	a,b,c

¹For vertical comparison. Means within columns followed by the same letter are not significantly different (Duncan's multiple range test, $P<0.05$).

²For horizontal comparison. Letters correspond to the three means on the same line. Means having the same letter are not significantly different. (Duncan's multiple range test $P<0.05$).

Table 9. Percent acid detergent fiber (ADF) and percent acid detergent lignin (ADL) in creeping bluestem forage as affected by initial harvest and regrowth. Ona, Florida. 1977-78.

Harvest	Cell Fraction	
	ADF	ADL
Initial	44.1 ^a	6.2 ^a
1st regrowth	42.9 ^b	5.2 ^b
2nd regrowth	42.0 ^c	5.3 ^b

^aMeans within columns followed by the same letter are not significantly different (Duncan's LSD, K = 100).

digestibility, it was probably due to where the lignin was located in the cell rather than the quantity.

Both ADF and ADL percentages were higher in the initial harvest than in the two following 70-day regrowth periods (Table 9). This response was a reflection of older forage accumulated for the initial harvest. Regrowth ADF and ADL were lower than the initial harvest and were indicative of a better forage.

Although Yarlett and Roush (1970) had reported five vegetative tillers to one productive tiller on ungrazed, unburned creeping bluestem, the herbage in this study remained completely vegetative. The low protein and digestibility values were apparently due to low soil fertility and anatomical characteristics at the cellular level in leaf and sheath tissue.

These data indicate that intake, protein and digestible energy would be limiting factors for mature dry cows grazing creeping bluestem. Protein and digestibility of creeping bluestem does not appear to be greatly different from that reported for wiregrass (Kirk et al. 1974; Lewis et al. 1975). However, yield of creeping bluestem is greater than yield from wiregrass and this alone is justification for management to foster its dominance on Florida range. Continued research should deal with management that will improve grass quality.

Conclusions

Annual yields of creeping bluestem were highest when used from October to February as compared to use from June to October. Cutting creeping bluestem during June to October was detrimental to sustained yield, whereas cutting in August to December or October to February did not reduce yields after 3 years. Cutting at 10 cm resulted in a significant reduction in dry matter yield after 3

years as compared with cutting at 20 cm above the soil surface, which resulted in sustained yields.

Crude protein and IVOMD percentages were significantly greater in regrowth as compared to initial growth. Yield of protein and digestible organic matter was greatest in forage which had been accumulated from March to October. Although there were statistical differences in NDF, ADF or ADL percentages from creeping bluestem during the year, they were slight, and it is not anticipated that they would result in differences in livestock performance.

Literature Cited

- Gallaher, R.N., C.O. Weldon, and F.C. Boswell. 1977. A semi-automated procedure for total nitrogen in plant soil samples. *Soil Sci. Soc. Amer. Proc.* 40:887-889.
- Halls, L.D., R.H. Hughes, R.S. Rummell, and B.L. Southwell. 1964. Forage and cattle management in longleaf-slash pine forests. U.S.D.A. *Farmers Bull.* 2199.
- Issac, R.A., and W.C. Johnson. 1976. Determination of total nitrogen in plant tissue using block digester. *J. Ass. of Anal. Chem.* 69:98-101.
- Kirk, W.G., G.K. Davis, F.G. Martin, E.M. Hodges, and J.F. Easley. 1974. Effect of burning and mowing on the composition of pineland threeawn. *J. Range Manage.* 27:420-423.
- Leland, J.A., L.H. Harbers, R.R. Scalles, C.E. Owensby, and E.F. Smith. 1976. Range burning and fertilizing related to nutritive value of bluestem grass. *J. Range Manage.* 29:306-308.
- Lewis, C.E., R.S. Lowrey, W.G. Manson, and F.E. Knox. 1975. Seasonal trends in nutrients and cattle digestibility of forage on pine-wiregrass range. *J. Anim. Sci.* 41:208-212.
- Moore, J.E., G.O. Mott, D.G. Dunham, R.W. Omer. 1961. Forage capacity in vitro OM digestion procedure. *J. Anim. Sci.* 31 (1) 231. Abstract No. 261.
- Roush, R.D., and L.L. Yarlett. 1973. Creeping bluestem compared with four other native range grasses. *J. Range Manage.* 26:19-21.
- Van Soest, P.J. 1963. Use of detergents in the analysis of fibrous feeds. II. A rapid method for the determination of fiber and lignin. *J. Ass. Offic. Anal. Chem.* 56:829-835.
- Van Soest, P.J., and R.H. Wine. 1967. Use of detergents in the analysis of fibrous feeds. IV. Methods for determination of plant cell walls. *J. Ass. Offic. Anal. Chem.* 50:50-55.
- Yarlett, L.L. 1963. Some important and associated native grasses on central and south Florida ranges. *J. Range Manage.* 16:25-27.
- Yarlett, L.L. 1965. Control of saw palmetto and recovery of native grasses. *J. Range Manage.* 18:344-345.
- Yarlett, L.L., and R.D. Roush. 1970. Creeping bluestem (*Andropogon stolonifer* (Nash.) Hitchc.) *J. Range Manage.* 23:117-122.