Mineral Content in Creeping Bluestem as Affected by Time of Cutting

R.S. KALMBACHER AND F.G. MARTIN

Abstract

Florida's soils are low in nutrients, which is reflected in the low mineral content of range forages. This investigation was designed to determine the contents of P, K, Ca, Mg, Fe, Mn, Zn, and Cu and the Ca: P ratio in creeping bluestem *(Schizachyrium stoloniferum* Nash.), a widespread, high-yielding native forage. The grass was cut at 10 and 20-cm heights during 70-day intervals from June to October 1976, August to December 1976, and October 1976 to February 1977. Height of cut did not have significant effect on mineral contents, but strong seasonal patterns occurred. Based on whole plant samples, the contents of K, Mg, P, Zn, and Cu and the Ca: P ratio were inadequate when compared to National Research Council requirements for dry, pregnant cows, but Ca, Fe and Mn may be adequate in the forage.

All of the mineral soils of peninsular Florida are coarse textured with low pH, cation exchange capacity, and all plant nutrients. These edaphic conditions are reflected in the low mineral contents of the native forages. For example, 5 months after a burn, wiregrass (*Aristida stricta* Michx.) contained 0.03% P and 0.06% Ca, and declined to 0.01% P and 0.06% Ca after 12 months (Hilmon and Lewis 1962). Kirk et al. (1974) found that wiregrass, sampled at 3-month intervals during the year, ranged from 0.08 and 0.09% P; 0.37 to 0.53% Ca; and 0.10 to 0.22% Mg. Two other flatwoods grasses, chalky bluestem (*Andropogon capillipes* Nash.) and lopsided indiangrass (*Sorghastrum secundum* (Ell.)Nash.), reflected the low soil fertility with 0.06% P and 0.09% Ca in chalky bluestem and 0.08% P and 0.14% Ca in indiangrass (Lewis 1970).

Creeping bluestem (*Schizachyrium stoloniferum* Nash.) is an important component of Florida's native pastures (Yarlett 1970) and has been shown to be one of the highest producers of dry matter (Roush and Yarlett 1973). After mechanical brush control, deferred grazing, and proper grazing management, this species will spread and become dominant (Yarlett 1965).

Since it is imperative to know about the mineral composition of creeping bluestem, this study was designed to measure K, Ca, P, Mg, Fe, Mn, Zn, and Cu contents and the Ca: P ratio in forage sampled during 70-day intervals from June to October, August to December, and October to February.

Materials and Methods

Research was conducted at the University of Florida's Ona Agricultural Research Center. The experimental site was a pure stand of creeping bluestem growing on an Immokalee fine sand (Arenic Haplaquod). Soil was not limed or fertilized and had a pH of 4.0. From samples taken the upper 15 cm it was determined that inherent double-acid extractable P was 6; K, 75; Ca, 550; and Mg, 165 kg/ha.

Forage was cut 10 cm above the soil in January 1975, and a split plot experiment with whole plots arranged in four randomized complete blocks was layed out. Whole plot treatments were time of sampling: June to October; August to December; and October to February. A plot was cut initially at the beginning of each period (June, August, or October), then the same plot was recut two times on approximately 70-day intervals. The initial sampling contained forage produced during the 7-month period between the last cutting (October, December, or February) and the initial sampling. Sub-plots were height of cutting above the soil, and plants were cut at 10 and 20 cm with a rotary-type harvester. In the analysis of variance, harvest was used as a factor with three levels: one initial and two regrowths. Of particular importance was the sampling period × harvest interaction.

Forage was dried at 60° C and ground with stainless steel blades (40-mesh screen). All nutrient determinations involved dry ashing 0.5 gram samples at 450° C for 2 hours. Ash was put in solution with 2 ml of deionized water followed by 20 ml of concentrated HCl and evaporated to dehydrate the silica. After cooling, 20 ml of deionized water followed by 2.5 ml of 40% HCl were added and brought to a boil. The residue was filtered and brought up to a 50-ml volume.

Phosphorus content was determined by a Technicon Auto Analyzer II(R), and Ca, K, Mg, Mn, Fe, Cu, and Zn were determined by atomic adsorption methods. Dry matter was determined by the methods of A.O.A.C. (1970), and all values are expressed on a dry matter basis.

Results and Discussion

Mineral analyses were performed entirely on leaves, because without burning or soil disturbance creeping bluestem will remain almost entirely vegetative. The analyses of variance indicated that height of cut had no significant effects on the mineral composition of creeping bluestem. Significant differences in all mineral contents were due both to sampling period and time of clipping within sampling periods. Analyses of variance also showed that all minerals (except Zn) in the initial and two regrowth cuttings followed significantly different trends within each of the three sampling periods.

Potassium

There was no significant difference in K content in forage sampled at the end of any of the three initial growth periods, and K ranged from 0.33 to 0.38% (Table 1). Potassium content of regrowth after the November to June and January to August initial sampling increased, but K content of regrowth after the March to October initial sampling remained the same. Regrowth during July to August and September to October was higher in K than regrowth harvested in November to December or January to February. Average K content was 0.42%, and even when plants contained the most K in the summer and fall, this creeping bluestem forage would not meet the dietary requirements (0.6 to 0.8%) of beef cattle as established by the National Research Council (NRC)(1976).

Calcium

Initial growth in November to June was highest in Ca content,

Authors are associate agronomist, Ona Agricultural Research Center. Ona, Florida 33865 and associate statistician, University of Florida, Gainesville 32611.
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but after this initial growth, Ca declined with each regrowth sampling (Table 1). Herbage sampled at the January to August initial growth contained more Ca than forage sampled at the end of the March to October initial growth. Calcium content increased in forage grown from November to December. Dry, pregnant cows have a dietary requirement of 0.18% Ca (NRC 1976), which was the average for creeping bluestem. Apparently, the year-long supply of Ca would be adequate to marginal for dry, pregnant cows.

Phosphorus

Little fluctuation in P content occurred as a result of time of initial growth or time of regrowth (Table 1). Although P content usually increased significantly after the initial growth, the increases were small. Phosphorous has been cited as a major limiting element in wiregrass (Kirk et al. 1974), and P in creeping bluestem in this study also was well below the 0.18% P necessary for proper nutrition of dry, pregnant cows (NRC 1976).

Calcium-Phosphorus Ratio

Initial growth from November to June had a higher ratio (2.6) than that of the January to August (2.0) or March to October (1.8) initial growth (Table 1). After November to June and January to August initial growth, the Ca: P ratio in regrowth became significantly smaller. Unlike regrowth after the November to June initial growth, regrowth after the March to October initial growth had a larger Ca: P ratio than the initial. Forage growing from November to December or January to February (winter) had a larger ratio than July to August or September to October (summer) grown forage.

Cows can tolerate a wide range of C: P ratios above 1.0 (NRC 1976). The Ca: P ratios in creeping bluestem, which ranged from 1.4 to 2.6, were therefore satisfactory. However, while levels of Ca throughout the year ranged from marginal to adequate, P concentrations were deficient at all times. Consequently, adequate P supplementation would be necessary for range containing a high proportion of creeping bluestem.

Magnesium

Plant Mg was the same at each of the three initial harvests, but after the November to June initial Mg increased from 0.10%, then leveled out at 0.17 and 0.18% (Table 1). After initial growth from January to August, Mg in regrowth increased but was not as great as Mg in regrowth from the former initial cutting. Regrowth after the March to October initial increased very little in Mg, and January to February regrowth dropped to those levels found in the initial. The level set by the NRC (1976) for Mg is 0.13%, and it appears that this level could be met by creeping bluestem summer regrowth. Accumulated forage and winter regrowth appears to be deficient in Mg for pregnant cows.

Iron

There was no difference in Fe content at the end of the three initial growth periods when Fe ranged from 27.3 to 32.3 mg/kg (Table 2). After the November to June initial growth Fe in regrowth increased slightly, but after the January to August initial growth, the Fe in regrowth remained relatively constant. A large peak in Fe content occurred in the January-February regrowth. The Fe in creeping bluestem appeared to be well above the dietary requirement of 10 mg/kg established by the NRC (1976).

Table 1. Contents of K, Ca, P, Mg, (%) and the Ca:P ratio in creeping bluestem as affected by initial and regrowth time. Ona, Florida. 1977-78.

oven dry K content

Initial growth		1st Regrowth		2nd Regrowth		
Months	%K	Months	% K	Months	%K	
Nov-June	0.33[a]	July-Aug	0.54[a]	Sept-Oct	0.52[a]	b,a,a[2]
Jan-Aug	0.33[a]	Sept-Oct	0.52[a]	Nov-Dec	0.37[b]	c,a,b
Mar -Oct	0.38[a]	Nov-Dec	0.38[b]	Jan-Feb	0.39[b]	a,a,a

oven dry Ca content

Initial growth		1st Regrowth		2nd Regrowth		
Months	% Ca	Months	% Ca	Months	% Ca	
Nov-June	0.21[a1]	July-Aug	0.17[b]	Sept-Oct	0.15[c]	a,b,c[2]
Jan-Aug	0.16[b]	Sept-Oct	0.15[c]	Nov-Dec	0.22[a]	b,b,a
Mar-Oct	0.14[c]	Nov-Dec	0.21[a]	Jan-Feb	0.17[b]	c,a,b

oven dry P content

Initial growth		1st Regrowth		2nd Regrowth		
Months		Months		Months		
Nov-June	0.08a[a1]	July-Aug	0.10[a]	Sept-Oct	0.11[a]	c,b,a[2]
Jan-Aug	0.08[a]	Sept-Oct	0.11[a]	Nov-Dec	0.11[a]	b,a,a
Mar-Oct	0.08[a]	Nov-Dec	0.11[a]	Jan-Feb	0.80[b]	b,a,b

Ca:P ratio

Initial growth		1st Regrowth		2nd Regrowth		
Months	Ca:P	Months	Ca:P	Months	Ca:P	
Nov-June	2.6[a1]	July-Aug	1.7[b]	Sept-Oct	1.4[b]	a,b,c[2]
Jan-Aug	2.0[b]	Sept-Oct	1.4[c]	Nov-Dec	2.0[a]	a,b,a
Mar-Oct	1.8[c]	Nov-Dec	2.0[a]	Jan-Feb	2.0[a]	b,a,a

oven dry Mg content

Initial growth		1st Regrowth		2nd Regrowth		
Months	% Mg	Months	% Mg	Months	% Mg	
Nov-June	0.10[a1]	July-Aug	0.17[a]	Sept-Oct	0.18[a]	a,b,b[2]
Jan-Aug	0.11[a]	Sept-Oct	0.15[b]	Nov-Dec	0.13[b]	c,a,b
Mar-Oct	0.11[a]	Nov-Dec	0.13[c]	Jan-Feb	0.10[c]	b,a,b

[1]For vertical comparison. Means within columns followed by the same letter are not significantly different (Duncan's multiple range test, $P<0.05$).
[2]For 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 2. Contents of Fe, Mn, and Cu (mg/kg) in creeping bluestem as affected by initial and regrowth time. Ona, Florida 1977-78.

oven dry Fe content

Initial growth	1st Regrowth	2nd Regrowth	
Months	Months	Months	
Nov-June 27.5[a1]	July-Aug 41.3[a]	Sept-Oct 38.4[b]	b,a,a[2]
Jan-Aug 30.9[a]	Sept-Oct 37.0[ab]	Nov-Dec 31.1[b]	a,a,a
Mar-Oct 32.3[a]	Nov-Dec 30.4[b]	Jan-Feb 69.4[a]	b,b,a

oven dry Mn content

Initial growth	1st Regrowth	2nd Regrowth	
Months	Months	Months	
Nov-June 53.1[a1]	July-Aug 31.1[c]	Sept-Oct 59.7[b]	a,a,a[2]
Jan-Aug 23.2[b]	Sept-Oct 70.1[b]	Nov-Dec 139.6[a]	c,b,a
Mar-Oct 39.6[ab]	Nov-Dec 153.0[a]	Jan-Feb 154.4[a]	b,a,a

oven dry Cu content

Initial growth	1st Regrowth	2nd Regrowth	
Months	Months	Months	
Nov-June 2.1[a1]	July-Aug 2.6[ab]	Sept-Oct 1.2[b]	ab,a,b[2]
Jan-Aug 1.6[b]	Sept-Oct 1.7[b]	Nov-Dec 2.8[a]	b,b,a
Mar-Oct 1.1[c]	Nov-Dec 2.8[a]	Jan-Feb 2.4[a]	b,a,a

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

Manganese

The January to August initial growth was significantly lower in Mn than the November to June initial growth with the March to October growth intermediate (Table 2). The Mn content of regrowth after the November to June initial growth did not significantly change but Mn content of regrowth after the other initial periods increased. There was a large increase in Mn in herbage from the November to December and January to February regrowths. It is believed that during the cold months, the plant took up Mn, perhaps at the same rate as it did during the summer, but since plant growth was slow, Mn was not diluted by an accumulation of cell walls, etc. The content of Mn was well above the 1.0 to 10.0 mg/kg that was recommended by the NRC (1976).

Zinc

There was no significant sample period × harvest interaction for Zn, but the main effects for each factor were significant ($P<0.01$) The Zn content increased from an average 3.8 mg/kg during the August to December period to 8.5 mg/kg during the October to February period.

Copper

There were significant differences in Cu content during each of the initial growth times (Table 2). At the end of the November to June initial growth period, Cu was higher than in other initial growth periods, but subsequent regrowth was the same or lower. Copper in the January to August initial growth was lower than in November to June initial growth, but later regrowth increased in Cu content. March to October initial growth was lower in Cu than any other initial growth, but increased rapidly, then leveled out in later regrowth. Copper content at all times was substantially less than the 4.0 mg/kg established as a minimum by the NRC (1976).

Conclusions

Time of growth had a strong influence on the contents of P, K, Ca, Mg, Mn, Zn, and Cu in creeping bluestem forage. When compared to the nutrient requirements established for mature, dry cows (NRC 1976), whole plant samples of creeping bluestem were deficient in K, P, Zn, and Cu, and the Ca: P ratio may be rather large for adequate nutrition. Plant Ca, Mg, Fe, and Mn were estimated to be adequate or marginal for dry, pregnant cows. Plant K, Ca, and Mg were lower in the October to February period, and P was uniformly low through the entire year, especially in January and February. Although it is recognized that cattle are selective in their grazing, these data from whole plant samples suggest that creeping bluestem range will require mineral supplementation, especially during the winter when most Florida ranchers put cows on native pastures.

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