Warm-Season Grass Responses to Potassium and Phosphorus Fertilization

By Maria L. Silveira

Pasture fertilization plays a vital role in successful forage-based livestock production systems, but producers often under fertilize, and fail to replace nutrients removed at harvest.

Long-term persistence of grass pastures and hayfields Is often related to adequate soil P and K.

Large K removal in crops harvested from sandy-textured, low K-buffering soils can lead to severe K deficiency.

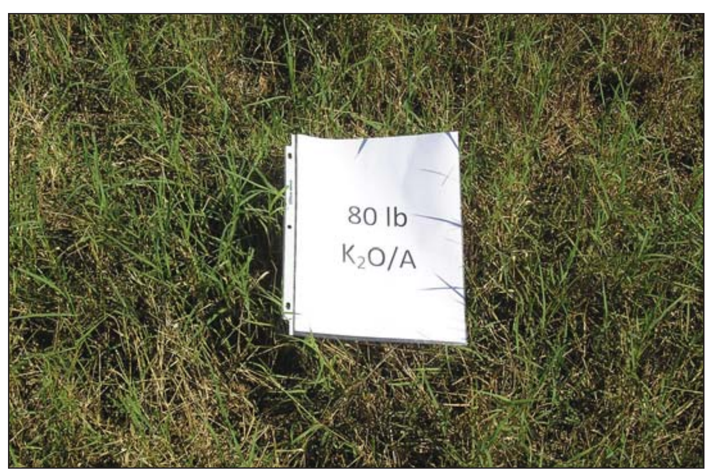
In the southeastern U.S., forage-based livestock systems rely on warm-season perennial grasses such as bermudagrass (*Cynondon dactylon*), bahiagrass (*Paspalum notatum*), and limpograss (*Hemarthria altissima*). More specifically in Florida, bahiagrass is the predominant cultivated grass occupying approximately 2 million acres in the state. While bahiagrass is widely used in low input systems with limited (or no) fertilizer inputs, other grasses such as hybrid bermudagrass and limpograss are important forage crops for both dairy and beef cattle producers because of their greater yield potential and better nutritive value. However, because of the greater yields, these grass species require relatively higher fertilization compared to other less productive grasses like bahiagrass.

If a soil tests low or medium for P, fertilizer recommendations for bermudagrass (Jiggs variety) and limpograss grown for hay in Florida consist of 80 lb N/A, 20 lb P_2O_5/A and 40 lb K_2O/A after each cutting For grazing, the recommended application rates are 160 lb N/A, up to 40 lb P_2O_5/A and 80 lb K_2O/A depending on soil test results. The need for routine use of micronutrients has not yet been demonstrated.

Despite the University of Florida recommendations for K and P fertilization, many forage producers do not supply adequate K and P to replace the nutrients removed as harvested forage. Consequently, soil K concentrations (and to a lesser extent soil P) decline, which often results in poor stand persistence and greater incidence of diseases and insect damage.

The objective of this 3-yr field trial was to evaluate Jiggs bermudagrass and limpograss responses to K and P fertilization. The study was conducted on established bermudagrass and limpograss fields at the University of Florida, Range Cattle Research and Education Center, Ona, FL on a Ona fine sand. Treatments consisted of minimum fertilization regimens that could maintain optimum forage yield, nutritive value, and stand persistence. Potassium and P were applied in April of 2012, 2013 and 2014 at annual rates of 0, 40 and 80 lb K_2O/A and 0, 20 and 40 lb P_2O_5/A, respectively. Nitrogen was applied at an annual rate of 80 lb N/A. Nitrogen was applied as ammonium nitrate and P and K as triple superphosphate and potassium chloride, respectively. Plot size was 20 x 10 ft. for bermudagrass and 13 x 10 ft. for limpograss. Initial soil pH was 5.3 and Mehlich-1 extractable P, K and Mg concentrations were 23, 12 and 293 lb/A, respectively. These concetrations are medium for P, very low for K, and very high for Mg. For-

Abbrevations and notes: N = nitrogen; P = phosphorus; K = potassium; Mg = magnesium. IPNI Project USA-FL31.



Jiggs bermudagrass grown in plots (3rd year of experiment) receiving 0, 40 and 80 lb K_2O/A at Ona, Fl.

Limpograss grown in plots (3rd year of experiment) receiving 0, 40 and 80 lb K_2O/A, at Ona, Fl.

age was harvested at 6-week intervals for four harvest events per year to determine dry matter yield and nutritive value. Dry matter yield was determined by harvesting two 3- x 10-ft forage strips from each plot to a 3 in. stubble height using a forage harvester. The remaining herbage was harvested to the same stubble height using a sickle bar mower and removed from the plots.

Temperature patterns observed during the 3-yr study were typical for the region, with exception of 2013, which experienced significant freezing temperatures in March. Rainfall during the study period was 20% below average in 2012 and 2013. The drought conditions experienced in the beginning of the 2013 growing season contributed to decreased forage production during that year.

Bermudagrass Responses

Bermudagrass dry matter yield increased linearly as annual K fertilization rates increased (**Table 1**). No yield response to P fertilization was observed. Cumulative annual dry matter yield for the treatments receiving K increased by 26 to 377% relative to the control treatments (no K added). The largest differences between control and K-receiving treatments were observed in 2014. During this year, K fertilization increased bermudagrass dry matter yield by as much as 377% (5,357 lb/A for the treatment receiving 80 lb K_2O/A compared to 1,124 lb/A for the controls). Bermudagrass dry matter yield in 2013 was considerably lower than those reported in 2012 and 2014 due to unfavorable climatic conditions experienced during that year. Average crude protein concentrations across the 3-yr study were greater in the controls compared to the treatments receiving K (**Table 1**). This occurred because of a dilution effect as a result of greater dry matter yield observed in the treatments receiving K.

Regardless of the K fertilization rates, bermudagrass dry matter yield generally decreased over time during the study period. These data indicated that K fertilizer rates applied during the 3-yr study were not sufficient to sustain the production. In addition, considerable stand losses and concomitant weed infestation occurred at the end of the 3-yr study, particularly in the treatments receiving no K (**Table 1**). Bermudagrass frequency (i.e., species occurance within a given area) and ground cover both ranged from 50 to 54% in the treatments receiving K compared to 31 to 37% in the control treatments.

Limpograss Responses

Limpograss dry matter yields increased linearly as K fertilization increased (**Table 2**). Relative to the control treatments (no K added), K fertilization increased annual dry matter yield by 17 to 24% when K was added at an annual rate of 40 lb K_2O/A and from 38 to 47% when 80 lb K_2O/A was applied. In the absence of K fertilization, dry matter yield decreased significantly during the 3-yr study. However, during the same period, no significant decline in dry matter yield was observed for the treatments receiving K, indicating that limpograss can maintain adequate production with relatively low rates of K fertilization. Treatments receiving K sustained adequate ground cover over the study period (average of 88% ground cover); however, there was a significant stand loss (65% ground cover) in the treatments that did not receive K. This response suggested that despite the apparent lower requirement, adequate K fertilization is important to maintain limpograss persistence. Limpograss crude protein concentrations also decreased as K fertilization rates increased (**Table 2**).

Summary

Potassium fertilization resulted in greater bermudagrass and limpograss dry matter yield and decreased stand loss in the 3-yr study. Despite the positive effect of K, bermudagrass dry matter yield observed in year 3 was significantly lower than those obtained in the first year of study. Considerable stand losses and concomitant weed infestation occurred by

Table 1. Jiggs bermudagrass dry matter yield, frequency, ground cover, and crude protein concentration as affected by K application rate.

	----- Dry matter yield -----					
Annual K_2O application	2012	2013	2014	Frequency[1]	Ground cover[1]	Crude Protein[2]
-------------------- lb/A/yr				------------- %		
0	4,536	820	1,124	37	31	15.2
40	5,719	1,815	3,959	50	52	14.0
80	6,517	2,216	5,357	54	54	13.7
Standard error	343	129	267	1	1	0.2
Orthogonal Contrast	Linear***	Linear**	Linear***	Linear***	Linear***	Linear***

[1]Frequency and ground cover were measured at the end of 2014 growing season.
[2]Values represent the 3-yr average.
**$p \leq 0.01$; *** $p \leq 0.0001$

Table 2. Limpograss dry matter yield, frequency, ground cover, and crude protein concentration as affected by K application rate.

	----- Dry matter yield -----					
Annual K_2O application	2012	2013	2014	Frequency[1]	Ground cover[1]	Crude Protein[2]
-------------------- lb/A/yr				------------- %		
0	12,408	4,189	8,779	60	65	6.7
40	11,015	4,921	10,947	92	87	6.2
80	12,135	5,798	12,900	94	89	6.1
Standard error	1,200	360	900	1.2	1.4	0.1
Orthogonal Contrast	NS	Linear***	Linear***	Linear**	Linear***	Linear*

[1]Frequency and ground cover were measured at the end of 2014 growing season.
[2]Values represent the 3-yr average.
NS= not significant; *$p \leq 0.05$;**$p \leq 0.01$; ***$p \leq 0.0001$

the end of the study. Although the amounts of K exported via above-ground biomass were, in general, similar or less than those applied as fertilizer, K fertilization at application rates tested in this study were likely not sufficient to sustain production during the 3-yr study. Data also indicated that limpograss might require relatively lower application rates of K fertilization than bermudagrass to sustain production and stand persistence. No effects of P on bermudagrass and limpograss responses were observed. Results from this study suggested that continuous aboveground removal without proper K fertilization will result in decreased forage performance, stand loss, and increased weed infestation. Adequate K supply is essential to sustain bermudagrass and limpograss productivity and long-term persistence. BC

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