Florida Cattle Enhancement Board Grant Final Report

Award ID: AWD01714

Title: Defining the Importance of Soil pH, Potassium, and Phosphorus in Reversing Bahiagrass Pasture Decline on Florida Cattle Ranches

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Project Overview:

Perennial pasture grass decline has been identified as a significant problem in Florida. In 2015, the UF/IFAS Pasture Grass Task Force reported that pasture degradation was likely cumulative over time and that inadequate soil pH and P and K fertilization are possible causes. The task force recommended that on-ranch research be conducted to test whether liming and fertilization management can to restore declining pastures to a healthy status. Our studies are intended to assess the relative importance of appropriate liming to optimum soil pH and application of P and K fertilizer in reversing the decline of perennial grass pastures. Work was initiated under a previous grant in November 2015. Four, on-ranch sites were selected in cooperation with county extension faculty and treatments imposed throughout the 2016 growing season. In 2017, we have returned to the same pastures at each of these four ranches and carried out the experiments for the second year. Grant deliverables from the current project are below along with a statement describing completion of each deliverable.

Description of Deliverable	Progress with Deliverable as of 1 Sept. 2017
1. Plant tissue samples from the 2016 growing season will be ground and analyzed for chemical composition including K and P.	Plant tissue samples have been processed for laboratory analysis. All samples analyses have been completed and data analyzed.
2. Soil samples will be taken from each plot at each of the four sites in March 2017 and analyzed for pH, K, and P.	Soil samples were taken from each plot at each ranch during visits that occurred in March 2017. Samples were processed, submitted to the lab and analyses completed.
3. Fertilization treatments will be applied for a second year at each of the four ranches starting in March 2017, and cages will be installed to measure forage production.	Fertilization was applied at each ranch in March 2017 and cages were installed.
4. Forage production will be measured every 35 days at each ranch throughout the 2017 growing season.	Site visits have occurred at 5-week intervals starting in May 2017 and continued through August 2017 to measure forage production on each plot at each ranch.
5. Plant tissue sampling will occur every 35 days at each ranch throughout the 2017 growing season	Plant tissue sampling started in May 2017 and continued every 35 days through August 2017 from each plot at each ranch.

Project Completion: 100%

Project Summary (January – August 2017):

All deliverables are 100% completed as of August 29, 2017. A summary of expenditures is included on Page 6. Results from the 2016 growing season have been analyzed and summarized and show significant forage production responses to treatments at three of four participating ranches in the first year of this experiment. These results were discussed with cattlemen at the Levy County Cattlemen's Association spring meeting on April 20, 2017 and at the Florida Forage Workers' Tour in Citra on August 21, 2017. Results are summarized by location in the tables that follow. Each table shows the initial soil condition and the 2016 yield and tissue P and K results in response to the treatments imposed. A short summary follows each table, and an overall summary is at the end of the report (Pages 5 and 6).

Table 1. Pasco County site. At this location there were four replicates of each of eight treatments (2 levels of lime x 2 levels of P x 2 levels of K).

	pH		Mehlich-3 P		Mehlich-3 K	
Soil	4.68		7		20	
Trt.	Lime		P fertilizer		K fertilizer	
Level	No	Yes	No	Yes	No	Yes
Yield (lb/acre)	4600	4900	4580	4920	4540	4955
Tissue P (%)			0.13	0.19		
Tissue K (%)					0.77	1.11

At the Pasco County site, initial soil pH was well below the target pH of 5.5 for bahiagrass. All three of the treatments, lime, phosphorus fertilizer, and potassium fertilizer increased bahiagrass pasture yield. When plots were fertilized with P and K, plant tissue levels increased. Levels in unfertilized plots were below minimum levels recommended for optimum production (0.15% P and 1.4-1.5% K), so the yield response to addition of these nutrients supports proposed critical minimums for these nutrients in bahiagrass.

Table 2. Sumter County site. At this site there was space for only 16 plots, so the phosphorus treatment was omitted. Thus, there were four replicates of four treatments (2 lime levels x 2 K levels).

	pH		Mehlich-3 P		Mehlich-3 K	
Soil	4.74		28		38	
Trt.	Lime		P fertilizer[a]		K fertilizer	
Level	No	Yes	No	Yes	No	Yes
Yield (lb/acre)	3400	3630	---	---	3070	3960
Tissue P (%)			---	---		
Tissue K (%)					1.07	1.68

[a]The phosphorus treatment was not applied at this ranch because it was not deficient in the plot area.

In spite of low soil pH at this location, there was no significant effect of liming on bahiagrass yield, but there was a very large effect of potassium fertilization. At this location, plant tissue potassium level was below the recommended concentration for optimum growth when no potassium fertilizer was applied (1.07% vs. 1.40% when potassium was applied). Yield response to potassium fertilizer in this case supports a conclusion that when tissue potassium concentrations are below 1.4-1.5% a yield response is likely to occur.

Table 3. Hardee County Site 1. At this location, there were 32 plots, four replicates of each of eight treatments (2 levels of lime x 2 levels of P x 2 levels of K fertilizer).

	pH		Mehlich-3 P		Mehlich-3 K	
Soil	4.83		9		15	
Trt.	Lime		P fertilizer		K fertilizer	
Level	No	Yes	No	Yes	No	Yes
Yield (lb/acre)	6730	7470	7130	7080	6830	7380
Tissue P (%)			0.24	0.30		
Tissue K (%)					1.22	1.48

At Hardee County Site 1, there was a significant yield increase due to liming and to potassium fertilizer but not due to phosphorus fertilization. As observed at the Pasco site, soil pH was below target for bahiagrass and yield responded to lime. Also, tissue potassium concentrations of unfertilized plots was less than 1.4% and we observed a response of both tissue potassium and bahiagrass yield to application of potassium fertilizer. In this case, there was no response to phosphorus fertilization in spite of very low soil P, but plant tissue P of unfertilized bahiagrass was 0.24%, quite a bit greater than the proposed minimum threshold of 0.15%.

Table 4. Hardee County Site 2. At this location, there were 32 plots, four replicates of each of eight treatments (2 levels of lime x 2 levels of P x 2 levels of K fertilizer).

	pH		Mehlich-3 P		Mehlich-3 K	
Soil	5.51		6		12	
Trt.	Lime		P fertilizer		K fertilizer	
Level	No	Yes	No	Yes	No	Yes
Yield (lb/acre)	5440	5840	5710	5570	5610	5670
Tissue P (%)			0.16	0.26		
Tissue K (%)					0.44	0.87

At the Hardee County Site 2, there was no significant yield response to any of the treatments. Soil pH was very close to the target for bahiagrass which may explain lack of a lime response. Plant tissue P was above the minimum threshold recommended for bahiagrass and again there was no yield response. Plant tissue potassium, however, was well below recommended levels, but even so, there was no bahiagrass yield response to potassium fertilizer at this site. There was, however, and a doubling of grass tissue potassium concentration when potassium fertilizer was applied.

Overall Summary:

These data support the results of the survey conducted by the Pasture Grass Task Force. Specifically, producers with declining stands of bahiagrass need to pay greater attention to soil pH and potassium level in their soils. We draw this conclusion because at 75% of sites in this research there was a significant response of bahiagrass yield to added potassium and at 50% of sites there was a significant response to liming. When bahiagrass yield responses to phosphorus and potassium fertilization occurred, they were generally well associated with recommendations for bahiagrass plant tissue concentrations of these nutrients.

Data are still being collected in 2017 (one additional farm visit not included in this project will be carried out in early October), and these data will provide a longer time interval to assess degree of restoration of degraded bahiagrass pastures and longer-term forage productivity and nutritive value responses to addition of lime, and P and K fertilizers. These results will provide valuable guidance to producers to help them maintain perennial grass pastures for long-term sustainable livestock production.

BUDGET FOR FLORIDA CATTLE ENHANCEMENT FUND- BUDGET JUSTIFICATION

PROJECT TITLE: Defining the Importance of Soil pH, Potassium, and Phosphorus in Reversing Bahiagrass Pasture Decline on Florida Cattle Ranches

DETAILED LINE ITEM DESCRIPTION	QTY	% Complete	TOTAL	EXPLANATION/JUSTIFICATION OF DELIVERABLE	COMPLETION DATE
Sample processing and analysis of plant tissue samples from 2016 growing season	Various	100%	$16,183	Drying, grinding, bagging, labeling, organizing, and laboratory analyses of 448 samples collected during 2016, including analyses for P and K at Dairy One Laboratory and analyses for N and digestibility at the Forage Evaluation Support Laboratory. Data organization and analysis.	9/1/2017
Collection and analysis of soil samples from 2017	Various	100%	$7,977	Transportation to research sites, collection of soil samples, drying, bagging, and analyses of 112 soil samples collected during March 2017 for pH, P, K, Mg, and Ca. Data organization and analysis.	9/1/2017
Application of fertilizer treatments, cage installation and herbicide application for 2017	Various	100%	$2,133	Transportation to research sites, purchase of fertilizers and herbicide, and installation of cages at each location	9/1/2017
Measurement of forage production during the 2017 growing season through August	Various	100%	$10,953	Monthly transportation of sampling team to the research locations, sampling bags, clippers, clipper repairs, and clipping, bagging, drying, and weighing samples. Data management and analyses.	9/1/2017
Collection of plant tissue samples for analysis through August of the 2017 growing season	Various	100%	$8,498	Monthly transportation of sampling team to research location, purchase of sampling bags and clippers, field sampling, bagging, drying, and weighing samples.	9/1/2017
Final Research Project Report	1			Project report detailing research, which may include findings, future needs, results, conclusions, issues, risks, assessments and all other pertinent information.	9/1/2017
Indirect Cost	N/A		$5,381		N/A
GRAND TOTAL: (equal to percentage of completion)			**$51,125**		