Florida Cattle Enhancement Grant
Final Report
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Increasing Soil Fertility to Manage Broomsedge in Bahiagrass Pastures

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Background: Broomsedge (*Andropogon*) species are native, warm-season, short-lived perennial bunchgrasses with an average life span of 3 to 5 years. While some species are desirable in many natural areas and native rangeland, they are becoming problematic in improved bahiagrass pastures throughout central and south Florida as mature broomsedge is typically avoided by cattle. There is no easy answer to this increasing problem as there are no herbicides that will selectively remove broomsedge from desirable forage grasses. Therefore, some type of management program is needed to help reduce broomsedge infestations and invasion, especially in bahiagrass pastures.

Limited research has been conducted concerning pasture management to reduce broomsedge infestations. Many extension specialists in the southeastern US indicate that soil testing followed by the appropriate amendments to increase the competitive ability of desirable species is the only way to manage broomsedge. However, with over 18 species of broomsedge present in Florida, an across the board recommendation for all species is not likely attainable. For example, bushy bluestem appears to grow in alkaline soils (pH >7) than in acidic soils, while other species are observed growing in more acidic soils. Therefore, liming alone may or may not result in a decrease in broomsedge density over time. Furthermore, the pH target levels for

desirable grasses may not inhibit the growth of broomsedge species. Applications of phosphorus have also been suggested to decrease broomsedge invasion, but this has not been documented in Florida where subsoils are typically rich in phosphorus.

Preliminary results from our research has indicated that bushy bluestem density decreases over time as a result of NPK fertilization at 50, 25, and 50 lb/A, respectively, when applied annually as early as 2 years after the first application, and density was approximately 50% of non-fertilized plots. Liming resulted in a 50% decrease in purple bluestem density within 3 years after application, and application of NPK fertilizer applied annually at 50, 25, and 50 lb/A, respectively, resulted in a 58% reduction in density compared to non-treated plots 4 years after the first application. However, broomsedge bluestem has not responded to application of NPK at these rates over a 4 year period, indicating that more time may be necessary to observe a decline in broomsedge bluestem density. Micronutrient applications have not resulted in a decrease in any broomsedge species over a 4 year period.

Currently, it is unknown if NPK fertilization or soil pH management will have a long-term impact on broomsedge bluestem densities, or which macronutrient is responsible for the observed reduction in bushy and purple bluestem densities in our research. Since no herbicides selectively remove these species, different management programs must be evaluated for their effectiveness. Therefore, our objectives are to determine what soil amendments will result in a reduction broomsedge density, and which macronutrient is responsible for reducing broomsedge density. Our hypothesis is that increasing the fertility levels of the pasture will increase the competitive ability of the desirable forage and limit new broomsedge seedlings from becoming established. Since

broomsedge has a life span of 3 to 5 years, it will likely take several years before significant results can be achieved.

Since selective herbicides are not available for managing broomsedge in bahiagrass pastures, soil fertilization may be our only approach. Additionally, the invasion of broomsedge species ultimately results in reduced stocking rates as these species are typically not consumed by cattle. Since our ongoing study is indicating that at least two broomsedge species can be managed through increasing soil fertility, providing this information to cattlemen will ultimately increasing stocking rates through long-term management programs.

Approach.

Continuation of existing experiments. Three experiments were established at Ona (Range Cattle REC) and commercial ranches in St. Cloud and Arcadia in 2012 to determine the impact of soil pH and fertilizer on broomsedge density. Soil pH and initial macro- and micro-nutrient levels were determined at all three locations prior to beginning the experiments. Broomsedge density is recorded at 4 geo-referenced locations within each plot prior to the application of any soil amendments. Treatments included lime (according to soil tests) or elemental sulfur (Arcadia; annual application of 100 lb S/acre), and annual applications of NPK fertilizer (10-5-10 at 500 or 0 lb/acre) and a micronutrient mix at 25 or 0 lb/A (Frit 503G). The experiment was conducted as a factorial experiment so that all treatment levels are investigated concomitantly; each location has a total of 32 100 x 100 ft plots (8 treatments with 4 replications in a randomized complete block design).

Broomsedge density is evaluated annually by counting plants in a 10-ft diameter circle around the four geo-referenced locations of each plot; this allows for the number of broomsedge plants to be tracked at the same location in each plot over several years. Soil and bahiagrass tissue samples are collected from each plot in the fall of each year.

Effect of single macronutrients on broomsedge density. Plots were established in pastures infested with broomsedge species at Ona and Lake Placid in June, 2017. Prior to initiating the experiments, soil and tissue were sampled for baseline measurements of soil pH as well as soil and tissue nutrient concentrations. Plots measure 100 x 100 ft, and each treatment is replicated 4 times in a randomized complete block design. Broomsedge density was recorded prior to beginning the experiment in geo-referenced locations within each plot, and will be recorded annually prior to fertilization. Treatments will include: 1) N (50 lb N/A) ± P (based on soil and tissue testing); 2) 25 lb P/A; 3) K (50 lb K_2O/A), 4) N + P (50 lb N/A + 25 lb P/A); 5) N + K (50 lb N/A + 50 lb K_2O/A; 6) P + K (25 lb P/A + 50 lb K_2O/A); and 7) N + P + K (50 lb N/A + 25 lb P/A + 50 lb K_2O/A). An untreated check will also be included to be able to observe any natural changes in time due to other management imposed on the pasture. Fertilizer is applied annually in the spring (March-April) of each year, but is dependent upon environmental conditions.

Bahiagrass production will be measured in both studies by placing 4 x 4 ft exclusion cages in each plot at the time of fertilization. Bahiagrass inside each of the cages will be clipped to 2 inches above the soil surface at 30 and 60 days after fertilization. Changes in bahiagrass root biomass will also be evaluated at the end of the

growing season by extracting 10 4-inch soil cores and removing soil from bahiagrass roots to obtain bahiagrass root dry matter production.

Current results.

Broomsedge density. Broomsedge density was not impacted at any of the existing locations within one year after the first application of soil amendments. A reduction in bushy bluestem density was observed following 2 years of application of NPK fertilizer ($P = 0.0047$) at the Arcadia location; applications of elemental S or micronutrients had no impact on bushy bluestem density. Bushy bluestem density in 2014 was 67% of the initial density recorded in 2012 without NPK fertilizer (Table 1), but density in plots fertilized with NPK was 43% of the initial density. The effect of NPK was similar in 2015 ($P = 0.0036$) and 2016 ($P = 0.0135$) with bushy bluestem densities declining to 33 and 35% of the initial densities recorded in 2012, respectively; however bushy bluestem increased throughout the entire study and is nearly 95% of the initial densities in 2017 (Table 1). Purple bluestem density at the Ona location was not impacted by soil amendments until 2015 when the 2012 application of lime ($P = 0.0211$) resulted 50% of the initial densities recorded in 2012 (Table 2). Purple bluestem densities were affected by both lime ($P = 0.0299$) and NPK application ($P = 0.0313$) in 2016 as densities were 47 and 48% of the initial 2012 densities, respectively. Broomsedge densities appear to have increased dramatically at this location as well as an increase was observed in nearly every plot (data not shown). No soil amendment treatment resulted in a significant reduction in broomsedge density by year five; the reason for this is unknown, but plots will be recounted this fall to ensure no false measurements were recorded. As of 2017, broomsedge bluestem densities at St. Cloud have not been affected by soil

amendments (data not shown). Baseline broomsedge bluestem densities at the two new locations is fairly uniform across the entire experimental area with approximately 13 plants per 20 ft^2 (data not shown).

Table 1. Impact of NPK fertilizer on bushy bluestem density at Arcadia, FL from 2012 through 2017.

NPK[1]	2014	2015	2016	2017
lb/acre	——————————% of initial——————————			
0	67 a[2]	60 a	71 a	95 a
500	43 b	33 b	35 b	93 a

[1]10-5-10 NPK fertilizer was utilized in this experiment at an application rate of 500.

Table 2. Impact of Lime and NPK fertilizer on purple bluestem density at Ona, FL from 2012 through 2017.

Treatment[1]	2015	2016	2017
	——————————% of initial——————————		
0 Lime	87 a[2]	115 a	303 a
Lime	50 b	47 b	52 a
0 NPK	-	115 a	-
NPK	-	48 b	-

[1] Lime application rate applied in 2012 was according to soil test results. 10-5-10 NPK fertilizer was applied at 500 lb/acre.

[2] Values within each column and treatment type (Lime or NPK) followed by different letters are significantly different at $P<0.05$.

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research on their ranch properties as well as assisting us with scheduling application of soil amendments.

Percentage of Completion for 2017: 100%

BUDGET FOR FLORIDA CATTLE ENHANCEMENT FUND- BUDGET JUSTIFICATION					
PROJECT TITLE: Increasing Soil Fertility to Manage Broomsedge in Bahiagrass Pastures, FCEB 26					
DETAILED LINE ITEM DESCRIPTION	QTY	% Complete	TOTAL	EXPLANATION/JUSTIFICATION OF DELIVERABLE	COMPLETION DATE
Chemical analysis – soil	Various	100%	$ 1,620.00	Costs for materials and services to perform analysis for soil P, K, Ca, MG, S, B, Zn, Mn, Fe, and Cu	9/1/2017
Chemical analysis - soil/tissue combina	Various	100%	$ 36.00	Costs for materials and services to perform analysis for soil and plant tissue concentrations of P, K, Mg, S, B, Zn, Mn, Fe, and Cu	9/1/2017
Plot prepartion	N/A	100%	$ 14,652.08	Expenses associated with plot preparation: includes but not limited to: plot markers, equipment maintenance, blades, soil sampling equipment, sample bags, and hand clippers.	9/1/2017
Materials and supplie	Various	100%	$ 5,704.92	Costs for materials to build temporary exclusion cages and for supporting cages while in the field, fertilizer and lab supplies	9/1/2017
Indirect Cost	N/A		$ 2,549.24		N/A
GRAND TOTAL: (equal to percentage of completion)			**$ 24,562.24**		