Final Report

Management of Broomsedge Species in Bahiagrass Pastures

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Introduction

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. For example, calls to the Range Cattle Research and Education Center for methods of control continue to increase. 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 better 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. However, since no herbicides can selectively remove these species, different management programs must be evaluated for their effectiveness. Therefore, our objective is to determine what soil amendments will result in a reduction broomsedge density over a 5 year period. 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.

Methods

Three experiments were established at Ona (UF/IFAS Range Cattle REC) and Arcadia in 2012 as well as St. Cloud in 2013 to determine the impact of soil pH and fertilizer on broomsedge density. Soil chemical properties as well as broomsedge species and initial densities are provided in Table 1. Soil pH and initial macro- and micro-nutrient levels were determined at all three locations prior to beginning the experiments. Broomsedge density was recorded at 4 geo-referenced locations within each plot prior to the application of any soil amendments and were recorded annually. Treatments included lime (as needed 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 were investigated concomitantly; each location has a total of 32 plots (8 treatments with 4 replications). Cattle were allowed to graze the experimental areas throughout the experiment.

Table 1. Initial soil parameters as well as broomsedge species and densities present at each location at the start of experiments in 2012.

			Mehlich-1 extractable						
Location	Soil Series	Soil pH	P	K	Cu	Mn	Zn	Species	Density
			———lb/acre———						plants/m^2
Arcadia	Basinger, Myakka, & Smyrna	7.7	26	20	0	4	4	Bushy bluestem	5.0
Ona	Ona & Pomona	4.3	4	38	0	0	0	Purple bluestem	2.8
St. Cloud	Smyrna	5.5	4	44	0	0	0	Broomsedg e bluestem	4.4

Broomsedge density was evaluated annually by counting plants in a 10-ft diameter circle around the four geo-referenced locations of each plot. Densities were converted to percent of the initial densities in 2012 prior to analysis. Soil and bahiagrass tissue samples were collected from each plot in the fall of each year. Soil (Mehlich-1 extractable) and tissue analyses were conducted at a commercial laboratory.

Results

Broomsedge Density. Broomsedge density was not impacted at any location within one year (2013) 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;. At this location, bushy bluestem density in 2014 was 67% of the initial density recorded in 2012 without NPK fertilizer (Table 2), 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. Bushy bluestem densities in 2015 and 2016 in untreated (0 NPK) remained nearly stead at 60 and 71%, respectively. Applications of elemental S or micronutrients had no impact on bushy bluestem density. At the Ona location, purple bluestem density 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 3). After 4 years purple bluestem densities in Ona were significantly (P = 0.03) by 47 to 48%% following either lime or NPK application. As of 2016, broomsedge bluestem densities at the St. Cloud location have not been affected by soil amendments (data not shown).

Table 2. Impact of NPK fertilizer on bushy bluestem density at Arcadia, FL from 2012 through 2016.

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

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

[2] Values within each column followed by different letters are significantly different at P≤0.05.

Table 3. Impact of Lime and NPK fertilizer on purple bluestem density at Ona, FL from 2012 through 2016.

Treatment[1]	2015	2016
	—% of initial—	
0 Lime	87 a[2]	115 a
Lime	50 b	47 b
0 NPK	ns[3]	115 a
NPK	ns	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.

[3] NS = not significant (P 0.05)

Soil pH. At the Ona location, soil pH increased from 4.3 in 2013 to 4.9 in 2015. This result indicates that an additional lime application is warranted at this location. Repeated applications of elemental sulfur for 3 yr (100 lb/A annually) at the Arcadia location has not resulted in a decrease in soil pH. No lime has been applied at the St. Cloud location as values were 5.5 at study initiation; however, soil pH declined to near 5.0 in 2015, indicating that a lime application is warranted in future years.

Soil phosphorus. Application of NPK fertilizer generally had no impact on soil phosphorus concentrations (0 to 4 inches depth), except in 2013 (P = 0.04) at the St. Cloud location, where plots receiving fertilizer contained 40 lb/A of Mehlich-1 extractable P compared to 35 lb/A P in unfertilized plots. Phosphorus concentrations in the soil were estimated to be 42, 33, and 23 lb/A in 2012, 2014, and 2015, respectively at the St. Cloud Location. Soil P averaged over all plots at the Arcadia location has remained near 48 lb/A in all years, but has declined at the Ona location from 38 lb/A in 2012 to 17 lb/A by 2015.

Soil potassium. Application of NPK fertilizer had no impact on soil potassium concentrations (0 to 4 inches depth), except at the Arcadia location (Table 4). Soil K levels at this location was at least 21% greater following application of 500 lb/A NPK fertilizer in all years (2012 samples were lost in transit to the laboratory). Soil K levels at the St. Cloud location ranged from 39 to 53 lb/A from 2012 to 2015, regardless of fertilizer treatment. Soil K levels at the Ona location declined from 117 lb/A in 2012 to 47 lb/A in 2015.

Table 4. Soil postassium levels at the Arcadia location following application of NPK fertilizer at 500 lb/A.

NPK	2013	2014	2015
lb/acre	——lb/acre——		
0	31 b[1]	22 b	19 b
500	48 a	39 a	24 a

[1]Values within each year are significantly different at P≤ 0.05. No data were collected from 2012 as samples were lost in transit to the laboratory.

Bahiagrass crude protein concentration. Bahiagrass crude protein concentrations were only affected in 2012 at all three locations (data not shown), and was likely due to sampling time as samples were collected in August rather than in October in 2013 through 2015. At all three locations, crude protein concentrations ranged from approximately 6.2% (unfertilized treatments) to 8.1% in the treatments receiving NPK fertilization. The only other time where NPK fertilization resulted in an increase in tissue N was at the St. Cloud location in 2015 (0.92 versus 0.95%).

Plant phosphorus. Plant P concentrations were affected by applications of NPK in all years, except 2014 at the St. Cloud location (Table 5). Plant P concentrations were at or below the critical P concentration for bahiagrass in all years at the Arcadia location. Conversely, P concentrations were above the critical limit at the Ona location in all years, except 2014. Fertilization with NPK at the St. Cloud location resulted in P concentrations greater than 0.15%

Table 5. Impact of NPK fertilization on plant phosphorus concentrations at Arcadia, Ona, and St. Cloud from 2012 through 2015.

	Arcadia		Ona		St. Cloud	
Year	0 NPK	NPK[1]	0 NPK	NPK	0 NPK	NPK
	——%——					
2012	0.07 b	0.13 a	0.15 b	0.17 a	0.09 b	0.12 a
2013	0.10 b	0.15 a	0.26 b	0.30 a	0.15 b	0.18 a
2014	0.07 b	0.12 a	0.13 b	0.15 a	NS (0.15)	
2015	0.09 b	0.14 a	0.15 b	0.17 a	0.09 b	0.13 a

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

[2] Values within each year and location are significantly different at P<0.05. NS denotes non-significance.

Plant potassium. Plant K concentrations were affected at all locations and years except Ona in 2014 and 2015 and St. Cloud in 2014 (Table 6). Plant K concentrations were at least 17% greater in fertilized versus non-fertilized plots at the Arcadia location in all four years. Fertilization at the Ona location resulted in higher tissue K concentrations only in 2012 and 2013. At the St. Cloud location fertilization resulted in increased tissue K concentrations in all years, except 2014.

Table 6. Impact of NPK fertilization on plant potassium concentrations at Arcadia, Ona, and St. Cloud from 2012 through 2015.

	Arcadia		Ona		St. Cloud	
Year	0 NPK	NPK[1]	0 NPK	NPK	0 NPK	NPK
	%					
2012	0.4 b	0.6 a	1.0 b	1.1 a	0.4 b	0.6 a
2013	0.8 b	1.1 a	1.6 b	1.7 a	1.1 b	1.2 a
2014	0.5 b	0.7 a	NS (0.8)		NS (1.0)	
2015	0.5 b	0.6 a	NS (1.0)		0.6 b	0.9 a

[1]10-5-10 NPK fertilizer was utilized in this experiment at an application rate of 500 lb/acre.
[2]Values within each year and location are significantly different at P<0.05. NS denotes non-significance; average concentration across the entire experiment in parentheses.

Plant boron. At the Arcadia location plant B concentrations were at least 27% greater in plots that received micronutrient fertilizer (Table 7). Similarly, plots receiving the micronutrient fertilizer had at least 17% greater B concentrations in plant tissues compared to non-fertilized plots. Micronutrient fertilization at the St. Cloud location resulted in at least a 38% increase in plant B concentrations, but only in 2012 and 2015; no differences were observed in 2013 and 2014.

Table 7. Impact of micronutrient fertilization on plant boron concentrations at Arcadia, Ona, and St. Cloud from 2012 through 2015.

	Arcadia		Ona		St. Cloud	
Year	No	Yes[1]	No	Yes	No	Yes
	ppm					
2012	5.1 b	7.0 a	4.1 b	10.1 a	8.5 b	13.7 a
2013	8.1 b	10.4 a	3.4 b	4.6 a	NS (5.3)	
2014	5.4 b	9.8 a	4.1 b	4.9 a	NS (6.1)	
2015	7.5 b	13.8 a	4.5 b	5.9 a	13.2 b	29.8 a

[1]Frit 503-G micronutrient fertilizer was utilized in this experiment at an application rate of 25 lb/acre.
[2]Values within each year and location are significantly different at P<0.05. NS denotes non-significance; average concentration across the entire experiment in parentheses.

Plant zinc. At the Arcadia location plant Zn concentrations were at least 15% greater in plots receiving micronutrient fertilizer compared to those not fertilized, except in 2013 where concentrations were similar regardless of fertilization (Table 8). Zinc concentrations in plant tissues at the Ona location were at least 23% greater in fertilized versus non-fertilized plots in all years. At the St. Cloud location, zinc concentration in tissue samples collected from fertilized plots were at least 19% greater in 2012 and

2015. Conversely, zinc concentration was 24% greater in non-fertilized plots in 2014, and there were no differences detected in 2013.

Table 8. Impact of micronutrient fertilization on plant zinc concentrations at Arcadia, Ona, and St. Cloud from 2012 through 2015.

	Arcadia		Ona		St. Cloud	
Year	No	Yes[1]	No	Yes	No	Yes
	ppm					
2012	20.2 b	27.7 a	15.8 b	25.5 a	40.3 b	49.9 a
2013	NS (19.0)		20.9 b	31.3 a	NS (24.5)	
2014	16.0 b	18.9 a	12.2 b	20.9 a	56.2 a	42.6 b
2015	15.0 b	22.0 a	12.7 b	16.4 a	37.6 b	68.2 a

[1]Frit 503-G micronutrient fertilizer was utilized in this experiment at an application rate of 25 lb/acre.

[2]Values within each year and location are significantly different at P<0.05. NS denotes non-significance; average concentration across the entire experiment in parentheses.

Plant manganese. Plant Mn concentrations at the Arcadia location were at least 36% greater in fertilized versus non-fertilized plots in 2012 and 2015, but no differences were detected in 2013 and 2014. At the Ona location plant Mn concentrations were at least 34% greater in fertilized versus non-fertilized plots in all four years. At the St. Cloud location, plant Mn concentrations increased from 2012 through 2015 across the entire experimental area; no differences were detected in fertilized compared to non-fertilized plots until 2015 when Mn concentrations were 37% greater in fertilized plots.

Table 9. Impact of micronutrient fertilization on plant manganese concentrations at Arcadia, Ona, and St. Cloud from 2012 through 2015.

	Arcadia		Ona		St. Cloud	
Year	No	Yes[1]	No	Yes	No	Yes
	ppm					
2012	18.1	28.3	38.9	63.8	NS (14.0)	
2013	NS (14.3)		29.8	59.2	NS (57.9)	
2014	NS (24.3)		47.9	97.8	NS (147.1)	
2015	34.7	78.4	35.2	53.4	132.0	208.0

[1]Frit 503-G micronutrient fertilizer was utilized in this experiment at an application rate of 25 lb/acre.

[2]Values within each year and location are significantly different at P<0.05. NS denotes non-significance.

Plant iron. There were no differences in plant tissue Fe concentrations at any location or year due to micronutrient fertilization (data not shown).

Plant copper. Micronutrient fertilization did not impact tissue Cu concentrations in any year at the Arcadia location. Conversely, fertilization with micronutrients resulted in at least an 8% increase in plant Cu concentrations in all years at the Ona location except in 2015 when there were no differences. Similarly, Cu concentrations at the St. Cloud location were at least 10% greater in fertilized plots in all years, except 2013.

Table 10. Impact of micronutrient fertilization on plant copper concentrations at Arcadia, Ona, and St. Cloud from 2012 through 2015.

	Arcadia		Ona		St. Cloud	
Year	No	Yes[1]	No	Yes	No	Yes
	ppm					
2012	NS (6.4)		4.4 b	5.3 a	5.4 b	6.0 a
2013	NS (5.1)		6.5 b	7.0 a	NS (5.4)	
2014	NS (4.6)		3.7 b	4.2 a	6.1 b	7.8 a
2015	NS (4.7)		NS (3.9)		4.6 b	6.8 a

[1]Frit 503-G micronutrient fertilizer was utilized in this experiment at an application rate of 25 lb/acre.

[2]Values within each year and location are significantly different at $P<0.05$. NS denotes non-significance; average concentration across the entire experiment in parentheses.