FERTILIZATION OF ESTABLISHED BAHIAGRASS PASTURE IN FLORIDA

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INTRODUCTION

There are about 2.5 million acres of bahiagrass pasture used for beef production in Florida. A major expense of maintaining this resource is its annual fertilization. Recognizing this expense, and the importance of good fertilization practices, the Florida Cattleman's Association recommended in 1985 that the University of Florida, IFAS, reevaluate the fertilization needs of pasture grasses.

A three-year research study conducted at the Ona Agricultural Research and Education Center in the early 1960s (McCaleb et al., 1966) showed that bahiagrass yield was not increased by phosphate (P_2O_5) fertilization, and a response to potash (K_2O) fertilization was not obtained at rates higher than 24 pounds per acre (lb/A) annually, even with 120 lbs nitrogen (N)/A applied as a split application. Based on soil test values reported in the study, IFAS fertilizer recommendations called for annual applications of 48 lb of P_2O_5 and 96 lb of K_2O/A (Jones et al., 1974). Later modifications of IFAS recommendations indicated that 40 lb P_2O_5 and 80 lb K_2O/A should have been applied annually (Whitty et al., 1977).

Research at the Beef Research Unit near Gainesville (Blue, 1970) showed that around 70% of the P applied to a limed Leon fine sand pasture over an 18-year period had remained in the surface soil. Further study (Rodulfo and Blue, 1970) showed that bahiagrass responded to added P_2O_5 when grown in the surface horizon of a virgin soil, but did not respond to P_2O_5 when grown in the surface horizon of soil from previously-fertilized pasture.

Considering evidence that the P_2O_5 and K_2O requirements of bahiagrass need to be evaluated under conditions present on commercial ranches that have been in production for many years, a field study was conducted with the following objectives: 1) to determine if bahiagrass pasture responds to P_2O_5 and K_2O fertilization when N fertilization is 60 lb/A/yr, a rate commonly used by ranchers (IFAS, 1986); and 2) to compare the response of bahiagrass pasture when fertilized according to IFAS standard recommendations based on soil tests with the response of bahiagrass fertilized at lower rates of N, P_2O_5 and K_2O.

FIELD STUDY METHODS

In 1986, one site in each of nine south Florida counties was selected. Site locations and descriptions are presented in the appendix. Each site was a bahiagrass pasture on which a cow/calf management system had been in effect for more than 10 years. A site in Pasco County was discontinued after the first year due to severe mole cricket damage of the bahiagrass pasture.

At each site, five 50 x 100 ft areas were selected and assigned one of five fertilization treatments. These were: 1) no fertilizer; 2) 60 lb N/A applied in March; 3) 60 lb N, 45 lb P_2O_5 and 45 lb K_2O/A applied in March; 4) 60 lb N/A applied in March and 60 lb N/A applied again in September; and 5) 60 lb N. 90 lb P_2O_5 and 45 lb K_2O/A applied in March and 60 lb N and 45 lb K_2O/A applied in September. Nitrogen, phosphate, and potash were applied as ammonium nitrate, superphosphate, and potassium chloride, respectively. Treatment 5 represented University of Florida, IFAS standard recommendations (Whitty et al, 1977) for fertilizing bahiagrass pasture based on test of soil samples from each site when the demonstration was initiated.

Soil samples were obtained from each treatment area immediately prior to fertilization in March and September each year of the demonstration. Each soil sample consisted of a composite of five 6-inch deep cores from each treatment area. Soil samples were analyzed for pH and for Mehlich-I extractable P, K, calcium (Ca), zinc (Zn), copper (Cu), magnesium (Mg), and manganese (Mn).

Two 4 x 8 ft wire cattle-exclusion cages were placed on each 50 x 100 ft treatment area in March. Cages were positioned on an area where the bahiagrass had been previously staged to a 2-inch stubble height, if needed, with a plot harvester. Forage from a 20-sq-ft area inside and outside each cage was harvested to a 2-inch stubble every 30 to 60 days from April or May through December. On each harvest date, each cage was moved to a pasture area harvested outside that cage, thus cages were moved around the 50 x 100 ft treatment areas throughout the year.

Total fresh forage harvested inside and outside each cage was weighed and sampled for analysis. Dry matter content was determined on samples dried in a forced-air dryer at

60°C. Dry matter yield was calculated from fresh weight data and dry matter content. Crude protein content and total digestible nutrients (TDN) were determined with a near-infrared analyzer. Forage samples were ashed at 600 deg C and acid digested to determine P, K, Ca, Mg, Zn, Mn, Cu and iron (Fe).

The field study was initiated in March 1987 and completed in December 1989.

FORAGE YIELDS AND ADDITIONAL PRODUCTION COST

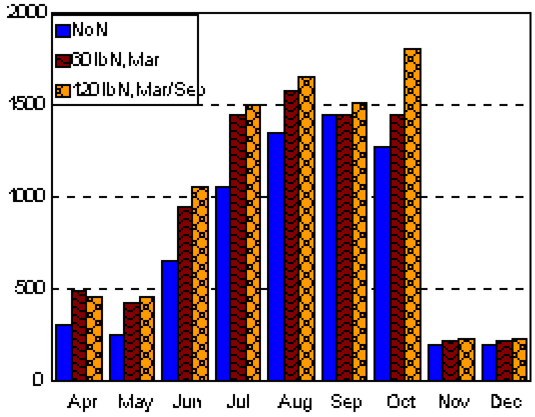
Two important terms are used in this publication to describe the type of forage harvested during the study. *Regrowth* forage is bahiagrass harvested inside an animal exclusion cage which had grown from a 2-inch stubble since the last harvest. *Available* forage is bahiagrass harvested outside the cage and is forage actually available to the grazing animal. Yield data were obtained from regrowth harvests.

There was a consistent increase in forage yield to 60 lb of N/A applied in March over the no fertilizer treatment (Table 1, Appendix Table 1A). Over three years the treatment receiving 60 lb N/A averaged 1,760 lb more dry matter per acre annually than the treatment receiving no fertilizer. It presently costs about $20/A to apply 60 lb of N. including $4 per acre spreading cost. This expense appears justifiable, costing about $23 for each ton of additional dry forage produced (Table 2).

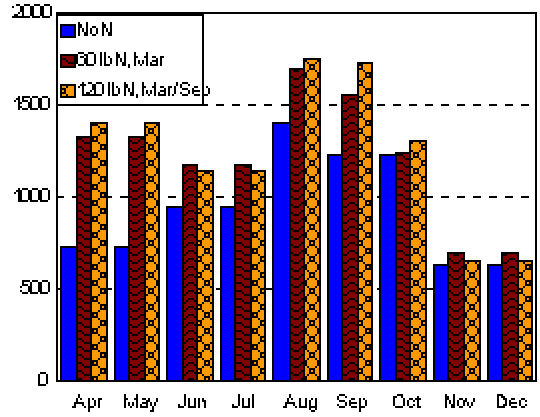
In comparison to 60 lb of N/A only, a positive response in dry matter yield was obtained when 45 lb of P_2O_5 and 45 lb of K_2O/A were applied in March along with 60 lb of N/A (Table 1). However, the increased production was only 400 lb of dry forage per acre annually. It costs about $14/A for the P_2O_5 and K_2O and approximately $72 for each additional ton of dry forage produced.

Applying 60 lb of N/A in March and then again in September produced an average of 480 lb more dry matter per acre than one 60 lb N application in March (Table 1). It would cost about $20/A for the second N application, and the cost for each additional ton of dry forage would be about $84 (Table 2). Several research studies have shown a linear response in dry matter yield of bahiagrass to increasing rates of N fertilization, even when N was applied as split applications (Blue, 1966; Blue and Graetz, 1977). However, these studies did not evaluate a situation in which one half of the N was applied as a second application as late as September, a practice used on some ranches in Florida because of heavy summer rains.

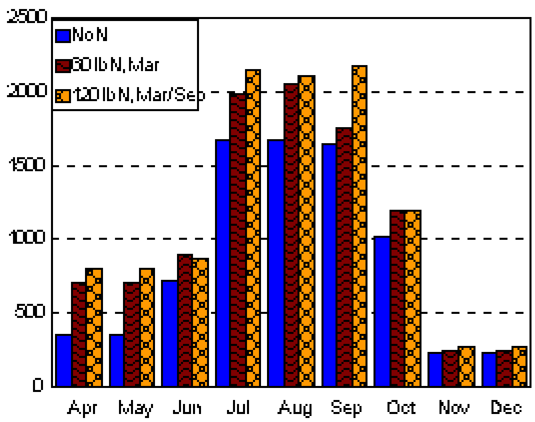
Forage Dry Matter Yield, lb/A 1987



Forage Dry Matter Yield, lb/A 1988



Forage Dry Matter Yield, lb/A 1989



In comparison to two applications of 60 lb N/A, a positive response was obtained in dry matter yield with the addition of 90 lb of P_2O_5 in March, and 90 lb/A of K_2O equally split between March and September, along with 120 lb of N (Table 1). The increased yield averaged 700 lb more dry forage per acre annually than the 120 lb of N/A alone. It presently costs about $29/A for the P_2O_5 and K_2O applied, thus costing approximately $82 for each additional ton of dry forage produced.

EFFECT OF N ON BAHIAGRASS GROWTH DISTRIBUTION

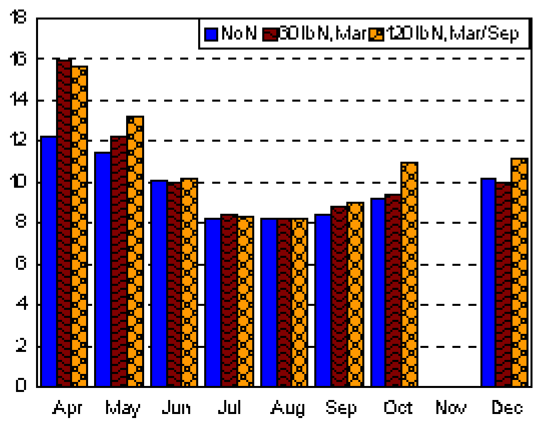
Increased yield due to the application of N in March was immediate, and continued throughout the summer period (Figure 1). Early spring growth of pasture forage is important because of low forage availability after the winter months, and demands by cows which are usually nursing calves and being rebred. Typical low spring rainfall was experienced in all three years of this field study, and yet substantial responses in forage growth and forage quality to N fertilization were obtained both in April and in May. This points out the importance of applying N fertilizer to bahiagrass pasture as early as February or March.

The response to N application in September was also immediate but limited only to the September or October harvests. Forage growth in general was reduced after October, because of shorter days, so a response to N fertilization might not be expected. The results of this field study document the poor response of bahiagrass to N applied in September, and suggest that N should be applied to bahiagrass as a single application in the spring, but if split, the second application should be well before September. Research data developed previously at Gainesville (Blue, 1966; Blue and Graetz, 1977) support this conclusion.

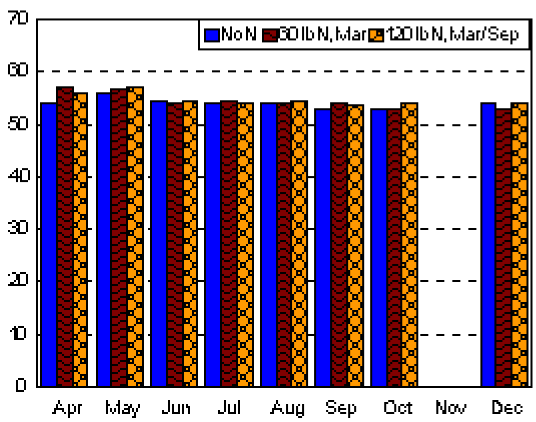
EFFECT OF N ON BAHIAGRASS QUALITY

When averaged across all harvests in a season, crude protein content of bahiagrass regrowth forage increased with increasing rates of N fertilization (Table 1), but increases were relatively small. Crude protein increases were most pronounced immediately following N application in March and September and rapidly diminished within 4 to 8 weeks (Figure 2). Short-term increases in crude protein content of the magnitude observed would be important in spring grass when cows grazing this forage are usually nursing young calves and being rebred. Nitrogen fertilization also increased TDN of bahiagrass, but increases, when averaged over the entire year, were relatively small (Table 1). Increases in TDN were most evident immediately following N application (Figure 3). Fertilization with P and K had little effect on crude protein content and TDN of bahiagrass

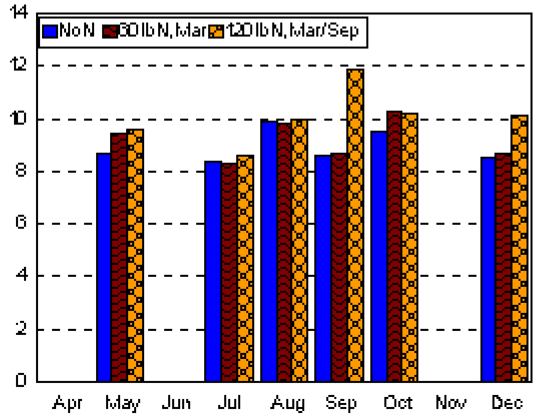
Percent Crude Protein 1987



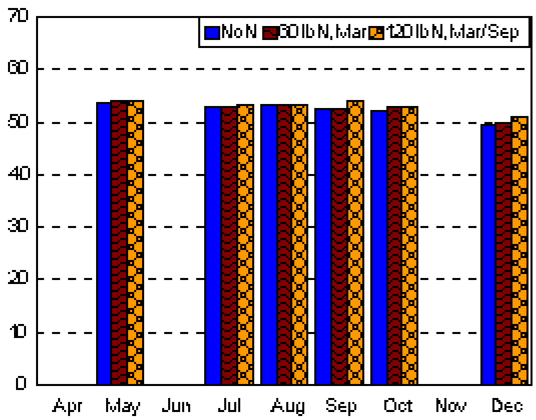
Percent TDN 1987



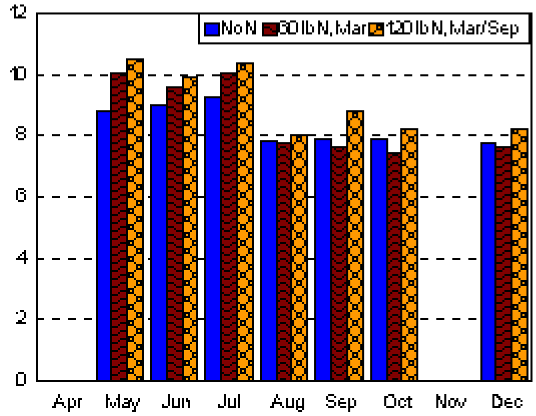
Percent Crude Protein 1988



Percent TDN 1988



Percent Crude Protein 1989



Percent TDN 1989

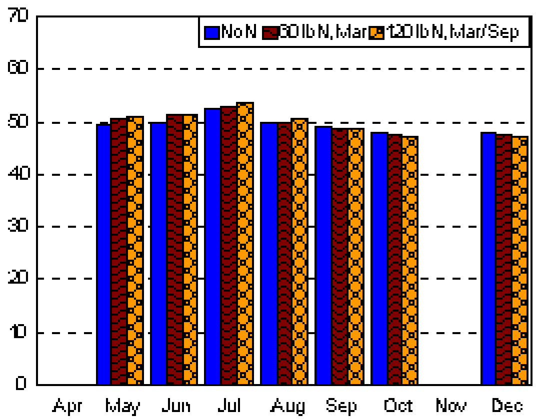


Table 1. Effect of fertilization treatment on annual yield and quality of regrowth bahiagrass harvested from April to December from nine commercial ranch sites in south Florida.

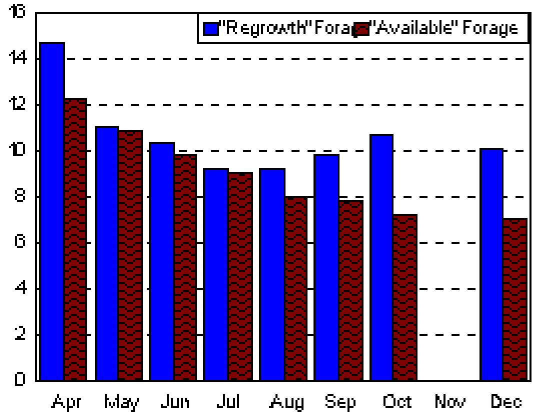
Item	No fert.	N(a) March	NPK(b) March	N(a) March, N(a) Sept.	NPK(c) March, NK(d) Sept.
Annual yield. t/A					
1987	3.32(i)	4.06(i)	4 4.09(j)	4.36(j)	4.51(j)

1988	3 97	5.06(j)	5.32(j)	5 11 (jk)	5.72(k)
1989	4.60(i)	5 47(j)	5.82(jk)	5.91 (jk)	6.30(k)
Avg.	3.73	4.58	4.78	4.82	5.18
Crude protein. %(h)					
1987(e)	9.8	10.3	10.4	11.0	10.8
1988'	8.9	9.0	9.4	10.0	10.4
1989(g)	10.5	10.3	10.7	11.2	11.4
Avg.	9.8	10.0	10.2	10.8	10.9
TDN. %(h)					
1987	54.0	54.2	54.6	54.7	54.6
1988	52.5	52.7	53.0	53.2	53.6
1989	53.6	54.2	53.9	54.3	54.5
Avg.	53.4	53.8	54.0	54.2	54.3
(a) at 60 Ib/A.					
(b)N at 60 Ib/A, P2O5 at 45 Ib/A, K2O at 45 Ib/A.					
(c)n at 60 Ib/A, P2O5 at 90 Ib/A, K2O at 45 Ib/A.					
(d)n at 60 Ib/A, K2O at 45 Ib/A.					
(e) Each 1987 value is an average of 144 samples taken from 9 sites over 8 harvests.					
(f) Each 1988 value is an average of 96 samples taken from 8 sites over 6 harvests.					
(g)Each 1989 value is an average of 112 samples taken from 8 sites over 7 harvests.					
(h)values are expressed as a % of the dry matter.					
(i,j,k)Annual yield means in a line which are followed by a different superscript differ at the.05 probability as determined by Duncan's Multiple					
Range. Mean square for error was .38, .51, and .48 ton/A in 1987, 1988, and 1989,					

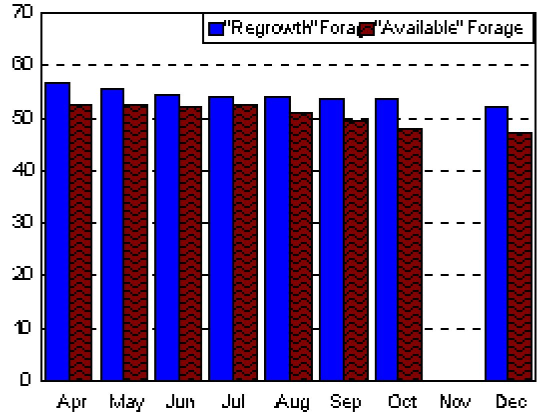
respectively.

Table 2. Benefits and cost of bahiagrass fertilization treatments.			
Fertilization treatment comparisons	Increased yield of dry forage(a)	Increased cost of fertilizer to produce forage(b)	Cost of each additional ton dry forage of produced(c)
Ib/acre	Ib/acre	$/acre	$/ton
60 lb N in March vs. no fertilizer	1760	20	23
60 lb N in March plus 60 lb N in September vs. 60 lb N in March	480	20	84
60 lb N,45 lb P2O5 45 lb K2O in March vs. 60 lb N in March	400	14	72
60 lb N. 90 lb P2O5 45 lb K2O in March plus 60/2/lb N, 45lb K2O in September vs 60 lb N in March plus 60 lb N in September	700	29	82
(a)Based on three-year forage yield averages.			
(b)N, P2O5 and K2O are charged at 0.27, 0.17 and 0.15 $ per lb, respectively. Spreading cost was $4/A and charged only to N application since P2O5 and K2O were applied in addition to N.			

Percent Crude Protein



Percent TDN



(c)Cost per ton of additional forage ($) = increased cost per acre for additional fertilizer ($)/(increased yield of dry forage (Ib)/2000).

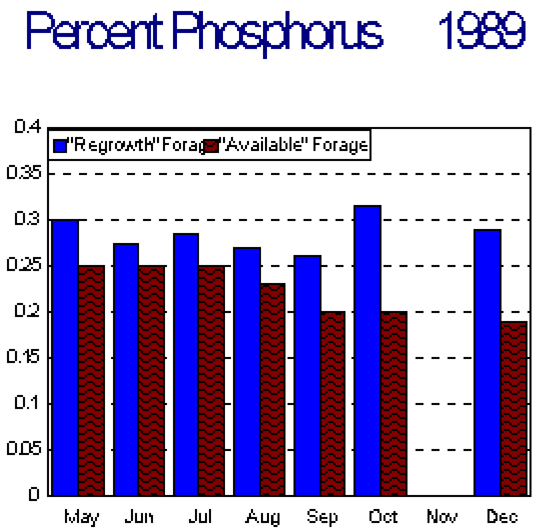
QUALITY OF REGROWTH VS AVAILABLE FORAGE

Forage quality values for available forage responded to fertilization in a manner similar to that for regrowth forage (data not shown). However, available forage was lower in crude protein content and digestibility than regrowth forage, and from July through the fall this difference became progressively larger (Figure 4). The crude protein and TDN requirements for a brood cow nursing a calf and having average milking ability are about 10% and 58% of the dry matter, respectively (National Research Council, 1984). During the spring, summer, and early fall, cattle would selectively graze bahiagrass having quality similar to regrowth forage which would come close to meeting the requirements of lactating brood cows for crude protein and TDN. However, in late fall and winter when bahiagrass stops growing and forage availability becomes limited, the quality of forage eaten by cattle would be similar to that shown for available forage harvested in October and December. This forage would only meet the needs of dry, pregnant cows, which are about 8% and 54% of the dry matter, respectively (National Research Council, 1984).

FERTILIZATION EFFECT ON MINERALS IN BAHIAGRASS

Fertilization with P_2O_5 and K_2O increased P and K content of bahiagrass regrowth forage, and the degree of increase was related to the amount of P_2O_5 and K_2O applied (Table 3, Appendix Table 2A).

Dietary P levels recommended by the National Research Council (1984) for the types of beef cattle grazing in Florida range from 0.18% of the dry matter for dry cows to 0.23% of the dry matter for lactating cows of average milking ability (most Florida brood cows), and to 0.29% of the dry matter for lactating cows with superior milking ability. Phosphorus levels in regrowth forage were highest in 1987 (Table 3). Only one site had average P level below that recommended for most beef cattle and that was in treatments



not fertilized with P_2O_5. Levels of P in bahiagrass were lowest in 1988, and average P levels of treatments not receiving P_2O_5 at two sites were slightly below that required by most lactating cows.

The P content in available forage was lower than the P content in regrowth forage (Figure 5). The P level was particularly low in available forage in the fall and winter. These levels would cause P deficiency in lactating brood cows not supplemented with P. A deficiency in P could have a negative effect in rebreeding

Although a mineral supplement containing P is recommended for all grazing cattle in Florida, mineral supplementation would be more critical if pastures are not fertilized with P_2O_5. A mineral supplement similar to one commonly recommended for Florida (Cunha et al., 1964) would satisfy the P needs of cattle, and would be more economical than fertilizing bahiagrass to provide P nutrition for cattle.

The National Research Council (1984) recommends a dietary K level for beef cattle of 0.5 to 0.7% of the dry matter. Bahiagrass K levels were below this range at several sites in 1988. Other minerals were present in bahiagrass forage in adequate amounts as recommended by the National Research Council, with the exception of Cu. The National Research Council recommends that cattle diets contain 4 to 10 ppm of Cu. Forage copper levels were at or below the lower end of this range in many cases. Possibilities of a Cu deficiency for cattle grazing Florida pastures has long been recognized, so the addition of this element to the mineral supplement is recommended routinely (Cunha et al., 1964).

SOIL ANALYSES FROM DEMONSTRATION SITE

Soil P values were very low (< 10 ppm) to low (10 to 15 ppm) at seven sites and medium (16 to 30 ppm) at only one site (Table 4). Soil K values were very low (< 20 ppm) to low (20 to 35 ppm) at five sites, medium (36 to 60 ppm) at two sites and high (61 to 125 ppm) at only one site. All soil parameters were variable among sites and with there being no obvious relationships between any parameter and bahiagrass yield. Fertilization treatment also had no effect on any soil parameters. These data indicate that soil testing as now commonly used to manage the fertilization of Florida bahiagrass pastures is of limited value. This could be because soil test data and plant response relationships were developed with annual crops and bahiagrass is a deep-rooted perennial plant.

FERTILIZER RECOMMENDATIONS FOR ESTABLISHED BAHIAGRASS

From data developed in this field study in conjunction with other data from the literature, the following recommendations are presented for fertilizing established bahiagrass pasture in Florida. These recommendations support revised University of Florida, IFAS recommendations (Kidder et al., 1990).

1. With the annual application of 60 lb or less N/A of bahiagrass pasture, do not apply any P_2O_5 and K_2O for at least 3 years. The field study is continuing (1990) and future recommendations of 60 lb/A of N only may be extended to periods longer than 3 years.

2. For the most efficient use of the fertilizer budget, only after 60 lb of N have been applied to every bahiagrass acre to be used for grazing should consideration be given to applying P_2O_5 and K_2O. At N rates of 100 to 120 lb/A, apply 25 lb/A of P_2O5 and 50 lb/A of K_2O if these plant nutrients test low for the soil. Do not apply P_2O_5 and K_2O if these nutrients test medium or higher for the soil.

3. When applying up to 120 lb of N/A, it appears to be most efficient to apply all of the N as a single application in the spring. If a split application is used, the second should be applied before the first of July.

4. Apply N fertilizer to bahiagrass pasture in February or March. Bahiagrass produces growth in the early spring, so a response in both forage growth and forage quality to N fertilizer will be obtained. Bahiagrass should continue to benefit into the growing season from an early N application.

5. A mineral supplement containing P and trace elements should be available to all cattle grazing bahiagrass pastures, especially those grazing pastures not fertilized with P_2O_5.

Table 3. Average phosphorus and potassium levels in regrowht bahiagrass receiving different fertilizer treatments at nine commercial ranch sites from April through December of 1987, 1988, and 1989.

Item	No Fert.	N(a) March	NPK(b) March	N(a) March, N(a) Sept.	NPK(c) March, NK(d) Sept.
Phosporus, %(h)					
1987(e)	0.30	0.31	0.34	0.29	0.36
1988	0.22	0.21	0.27	0.21	0.28
1989	0.27	0.25	0.31	0.24	0.35
Avg.	0.27	0.26	0.31	0.25	0.33

Potassium,%(h)					
1987	0.70	0.79	0.86	0.77	0.93
1988	0.41	0.40	0.45	0.36	0.50
1989	0.88	0.97	1.04	0.84	1.19
Avg.	0.68	0.74	0.81	0.69	0.90
(a)(b)(c)(d)(e)(f)(g)(h) See respective footnotes on table 1					

Table 4. Soil analysis for eight south Florida commercial ranch sites across all fertilization treatments and for fertilization treatments across all sites.(e)

Item	pH	P	K	Mg	Ca	Zn	Cu	Mn
	-------------------ppm Mehlich-l extractable-----------------------							
County Location								
Desoto	6.3	11	14	77	372	1.2	0.3	1.0
Hardee	6.1	10	19	51	802	1.2	0.8	1.8
Highlands	5,5	9	70	90	824	1.6	0.4	1.1
Hillsborough	4.7	11	29	44	428	2.4	0.2	1.0
Manatee	4.9	7	36	59	446	2.2	0.2	1.7
Okeechobe	6.1	25	40	48	617	4.2	1.1	3.6
Polk	6.2	3	22	88	678	0.8	0.2	0.7
Sarasota	5.0	6	21	43	474	1.5	0.4	0.4
Fertilization treatment								
No fertilizer	5.6	12	35	62	570	1.8	0.4	1.5
N March(a)	5.6	10	28	62	582	1.8	0.5	1.5
NPK March(b)	5.6	10	29	62	587	1.9	0.5	1.3
N March, N Sept(c)	5.6	10	29	62	597	2.0	0.4	1.5

NPK March, NK Sept (d)	5.6	9	38	62	576	1.9	0.4	1.4
(a,b,c,d)See respective footnotes on table 1.								
(e) Data obtained from composite of five 6-inch cores from each treatment on each site for three spring and three fall samplings. County values are the average of 30 samples and treatment values are the average of 120 samples.								

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APPENDIX

SITE DESCRIPTIONS AND LOCATION

Desoto County - Carlton 2 x 4 Ranch

Site is located approximately 7 miles south of Arcadia on State Road 31. It is mapped as Malibar fine sand on flat high ground. The pasture was limed and fertilized prior to the study as follows: 2/ 26/82 -1 ton/acre dolomite; 3/9/82 - 60 lb N. 30 lb P_2O_5 and 55 lb K_2O/acre; 11/22/82 - 40 lb N. 10 lb P_2O_5 and 20 lb K_2O/acre. The pasture received no fertilizer after 11/82. Stocking rate was approximately 2.6 acres per cow.

Hardee County - J. P. Platt Ranch

Site is located approximately 6 miles east of Zolfo Springs on State Road 66 at the Grass Valley Ranch. The site is relatively flat and located on a poorly drained Pomona fine sand soil. Annual fertilization practices since 1980 have been 70 lb N, 18 lb P_2O_5 and 35 lb K_2O/acre in the spring with 65 lb N applied in the fall. The pasture received 1 ton/acre of dolomite in 1982. Stocking rate was approximately 2 acres per cow.

Highlands County - Oscar Clemons Ranch

Site is located approximately 5 miles north of State Road 70 on county road 721. Soil is mapped as an Immokalee sand. The site is flat and poorly drained. The pasture was fertilized with 1 ton/acre of lime every 3 years and 300 lbs/acre of 16-8-8 every other year prior to the study. Stocking rate was approximately 1 acre per cow.

Hillsborough County - Warren Allen Ranch

Site is located east of Brandon near Lithia off county road 640. The study is located on a flat poorly drained Ona fine sand. Fertilization practices were: 4/85 - 65 lb N/acre; 6/85 - 60 lb N, 30 lb P_2O_5 and K_2O/acre; 3/86 - 60 lb N. 30 lb P_2O_5 and K_2O/acre; 7/86 - 65 lb N. 30 lb P_2O_5 and 45 lb K_2O/ acre. All fertilizer treatments included a complete micronutrient mix except in 4/85. Stocking rate was approximately 2.5 acres per cow.

Manatee County - Russell Reagan Ranch

Site is located near Bradenton, approximately 8 miles east of Interstate 75 off of State Road 64 on Rye Road. It is located on high ground and not subject to standing water. Soil type is mapped as an Eau Gallie fine sand. The pasture was established over 20 years ago and had not received fertilizer since 1981 and perhaps earlier. Stocking rate was approximately 1.5 acres per cow.

Okeechobee County - Dirr Farms

Site is located east of Kissimmee River and west of Okeechobee on State Road 70. The plots are located on a poorly drained flatwoods Immokalee fine sand. The pasture was renovated in 1976 and was fertilized annually from 1974-1984 with 30 lb N and 25 lb P_2O_5 and K_2O respectively, plus micronutrients. Fertilizer had not been applied since 1984. The 150 acre pasture was stocked with approximately 80 dry cows and 4 bulls.

Pasco County - Joe Barthle Ranch

Site is located west of Dade City on the west side of county road 581, 1.3 miles north of county road 578 and 1.2 miles south of Johnston road. The plots are located on a well-drained Kendrick fine sand. The site was fertilized in 1984 with poultry layer waste at the rate of 2 tons/acre. Stocking rate was approximately 4 acres per cow.

Polk County - Jerry Keen Ranch

Site is located approximately 11.5 miles west of Lake Wales on State Road 60. The site is a poorly drained flatwoods Myakka fine sand. The pasture is over 20 years old, was rotovated in the fall of 1985 and overseeded with cool-season annual grasses. Fertility practices have been as follows: 1980 - 1 ton dolomite/acre; 1982 - 50 lb N/acre; 1983 - 40 lb N. 10 lb P_2O_5 and 20 lb K_2O/acre; 1984 - 90 lb N. 25 lb P_2O_5 and K_2O/acre, plus micronutrients; 1985 - 120 lb N. 20 lb P_2O_5 and 35 lb K_2O/acre, plus 1 ton dolomite/acre; and 1986 - 65 lb N/acre. Stocking rate was approximately 2 acres per cow.

Sarasota County - Mabry Carlton Ranch

Site is located 21 miles east of Interstate 75 on State road 72. It is west of Gill Road and approximately 3 miles west of the Desoto Co./Sarasota Co. line. The site is on a relatively flat Myakka fine sand. The pasture had not been fertilized for 10 years prior to 1987. Stocking rate was approximately 5 acres per cow.

Table 1A. Annual yield and average crude protein and TDN content of regrowth bahiagrass receiving different fertilizer treatments at nine commercial ranch sites in south Florida from April to December (3-year average).

County of site	Item	No Fert.	N(a) March	NPK(b) March	N(a) March N(a) Sept.	NPK(c) March NK(d) Sept.
Desoto	Yield, t/A	2.70	3.76	4.25	4.40	4.33
	CP, %(e)	8.0	8.6	8.9	9.3	9.4
	TDN, %(e)	52.4	52.7	53.2	53.7	53.9
Hardee	Yield, t/A	4.33	5.19	5.25	5.40	5.83
	CP, %	10.0	10.6	10.6	11.1	11.1
	TDN, %	54.1	55.0	54.9	53.1	55.1
Highlands	Yield, t/A	3.85	5.89	5.43	5.76	6.24
	CP, %	10.8	11.1	10.9	11.6	12.0
	TDN, %	54.7	55.2	54.9	55.4	55.5
Hillsborough	Yield, t/A	3.13	4.28	4.26	4.61	4.99
	CP, %	9.2	9.8	9.9	10.8	11.1
	TDN, %	53.0	53 7	53 7	53 9	54 3
Manatee	Yield, t/A	4.87	5.37	6.26	5.54	5.91
	CP, %	11.2	10.9	11.3	11.6	11.8

	TDN, %	53.7	52.3	53.8	53.8	54.0
Okeechobee	Yield t/A	6.19	6.25	7.36	7.36	7.60
	CP, %	10.3	10.7	10.9	11.9	11.8
	TDN, %	53.6	53.8	53.7	54.1	54.3
Pasco(f)	Yield, t/A	1.58	2.09	1.71	2.44	2.85
	CP, %	10.0	10.4	9.8	11.0	10.9
	TDN, %	53.9	53.9	54.1	54.3	53.7
Polk	Yield, t/A	2.72	3.81	3.45	3.25	4.33
	CP, %	9.4	9.4	9.8	10.4	10.4
	TDN, %	53.0	53.4	52.8	53.7	53.7
Sarasota	Yield, t/A	2.90	3.07	3.15	3.28	3.19
	CP, %	9.6	8.9	10.0	10.0	10.0
	TDN, %	53.1	53.1	53.6	54.0	53.9
(a)N at 60 Ib/A.						
(b)N at 60 Ib/A, P2O5 at 45 Ib/A, K2O at 45 Ib/A.						
(c)N at 60 Ib/A, P2O5 at 90 Ib/A, K2O at 45 Ib/A.						
(d)n at 60 Ib/A, K2O at 45 Ib/A.						
(e)values are averages of 42 samples, and presented as % of dry matter.						
(f)Average of one year.						

Table 2A. Average mineral content of regrowth bahiagrass receiving different fertilizer treatments at nine commercial ranch sites in south Florida from April through December (3-year average).

County of site	Mineral(a)	No Fert.	N(b) March	NPK(c) March	N(b) March N(b) Sept.	NPK(d) March NK(e) Sept.
Desoto	P, %	0.24	0.22	0.29	0.25	0.28
	K, %	0.41	0.47	0.65	0.53	0.70
	Ca, %	0.49	0.54	0.48	0.47	0.46
	Mg, %	0.44	0.43	0.42	0.50	0.40
	Zn, ppm	59	58	50	47	44
	Cu, ppm	5	10	5	6	7
	Mn, ppm	60	40	49	29	38
	Fe, ppm	86	93	89	88	84
Hardee	P, %	0.34	0.30	0.34	0.28	0.39
	K, %	0.65	0.77	0.83	0.62	0.92
	Ca, %	0.49	0.46	0.45	0.50	0.44
	Mg, %	0.31	0.36	0.27	0.34	0.27
	Zn, ppm	39	41	36	39	39
	Cu, ppm	7	6	5	6	5
	Mn, ppm	52	55	54	61	66
	Fe, ppm	71	75	69	72	72

Highlands	P, %	0.25	0.33	0.32	0.30	0.40
	K, %	0.67	0.94	0.82	0.86	1.01
	Ca, %	0.45	0.39	0.38	0.38	0.39
	Mg, %	0.24	0.24	0.23	0.24	0.22
	Zn, ppm	31	35	31	37	35
	Cu, ppm	4	6	4	5	5
	Mn, ppm	25	52	41	51	71
	Fe, ppm	74	61	59	59	57
Hillsborough	P, %	0.32	0.31	0.37	0.30	0.38
	K, %	0.79	0.86	0.87	0.68	0.99
	Ca, %	0.35	0.35	0.40	0.35	0.32
	Mg, %	0.36	0.34	0.37	0.49	0.34
	Zn, ppm	75	79	63	68	64
	Cu, ppm	4	5	5	5	5
	Mn, ppm	93	87	90	90	88
	Fe, ppm	84	79	73	77	73
Manatee	P, %	0.29	0.25	0.32	0.26	0.33
	K, %	0.91	0.85	0.95	0.84	0.99
	Ca, %	0.35	0 35	0.33	0.39	0.33
	Mg, %	0.28	0.28	0.28	0.36	0.28
	Zn, ppm	45	52	52	53	47
	Cu, ppm	5	10	5	5	6
	Mn, ppm	104	88	102	93	96
	Fe, ppm	74	88	71	81	86

Okeechobee	P, %	0.32	0.31	0.35	0.31	0.34
	K, %	0.93	0.88	1.07	0.99	1.14
	Ca, %	0.40	0.45	0.40	0.45	0.40
	Mg, %	0.23	0.26	0.23	0.27	0.23
	Zn, ppm	50	64	52	53	53
	Cu, ppm	5	6	5	6	6
	Mn, ppm	61	70	58	67	78
	Fe, ppm	66	70	64	67	72
Pasco	P, %	0.27	0.28	0.29	0.27	0.30
	K, %	0.70	0.78	0.88	0.74	0.90
	Ca,%	0.57	0.52	0.45	0.46	0.42
	Mg, %	0.28	0.28	0.30	0.30	0.25
	Zn, ppm	66	49	54	60	51
	Cu, ppm	6	6	6	6	6
	Mn, ppm	72	68	78	79	87
	Fe, ppm	169	158	139	132	114
Polk	P, %	0.17	0.18	0.24	0.16	0.27
	K, %	0.60	0.68	0.67	0.50	0.78
	Ca, %	0.42	0.40	0.42	0.42	0.35
	Mg, %	0.35	0.35	0.37	0.45	0.41
	Zn, ppm	40	40	38	39	40
	Cu, ppm	4	5	4	5	5
	Mn, ppm	21	22	23	23	28

	Fe, ppm	72	84	71	79	76
Sarasota	P, %	0.21	0.19	0.28	0.20	0.28
	K, %	0.48	0.43	0.56	0.43	0.63
	Ca, %	0.44	0.38	0.41	0.40	0.38
	Mg, %	0.37	0.38	0.36	0.44	0.32
	Zn, ppm	66	55	54	57	53
	Cu, ppm	6	5	6	6	5
	Mn, ppm	69	57	63	65	59
	Fe, ppm	74	63	59	62	60
(a) Values presented on dry matter basis; average of 42 samples taken over 3 years.						
(b)N at 60 Ib/A.						
(c)N at 60 Ib/A, P2O5 at 45 Ib/A, K2O at 45 Ib/A.						
(d)n at 60 Ib/A, P2O5 at 90 Ib/A, K2O at 45 Ib/A.						
(e)N at 60 Ib/A, K2O at 45 Ib/A.						