

UF/IFAS Standardized Fertilization Recommendations for Agronomic Crops ¹

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Introduction

This publication presents in abbreviated form the fertilization recommendations for agronomic crops based on soil tests performed by the UF/IFAS Extension Soil Testing Laboratory (ESTL). It contains the basic information from which ESTL soil-test reports and fertilization recommendations are generated.

General Background

Soil testing is a tool in crop fertilization management. Its successful use requires that: (1) you send the lab soil samples that best represent your field or management unit; (2) the laboratory uses legitimate methods for predicting fertility; and (3) the fertilizer recommendations are based on measured crop responses.

The ESTL extracts phosphorus (P), potassium (K), magnesium (Mg), and calcium (Ca) with the Mehlich-1 extractant and bases fertilization recommendations for those nutrients on the test

results. Current interpretation of test results are presented in Table 1. Nitrogen (N) fertilization is **not** based on soil tests but rather is based on crop needs as documented in research literature.

Liming recommendations are based on the Adams-Evans lime requirement test, a calibration equation developed for Florida soils, and on the target pH for the crop for which the recommendation is being made.

Soil test reports from the ESTL are computer-generated from lab data and crop codes. If a cropping situation is not in the list of crop codes, routine soil tests may not be appropriate. In such instances, the local county agent should be consulted **before** soil samples are sent for testing. Reports contain the results of the tests (soil pH, ppm extractable P, K, Mg, and Ca), a rating of the P, K, and Mg (very high to very low), and the fertilization recommendation for the specified crop. The recommendation is composed of two parts: (1) the rates of N, P₂O₅, and K₂O fertilizer to apply; and (2) footnotes which give important information about

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All chemicals should be used in accordance with directions on the manufacturer's label.

Table 1. Current Mehlich-1 soil-test interpretations used for agronomic crops.

Element	Very low	Low	Med	High	Very high
----- parts per million soil -----					
P	<10	10-15	16-30	31-60	>60
K	<20	20-35	36-60	61-125	>125
Mg		<15	15-30	>30	

fertilization management such as application timing, special crop requirements, etc.

Table 2 of this document contains crop codes, crop descriptions, target pH, N recommendation, P_2O_5 and K_2O recommendations for each of the five soil-test rating levels, the footnotes which will be printed for each of the crop codes, and the references upon which the recommendations are based.

The text of the footnotes referred to in Table 2 is given below.

Text of Footnotes

102. Apply all of the P_2O_5 , 30% of the K_2O , and 30 lb N/A in a preplant or at-planting application. Four weeks after planting, sidedress the remaining 70% of the K_2O . Apply the remaining 120 lb N/A in two or more sidedressings, one of which should be at 4 weeks after planting.

104. Apply all of the P_2O_5 , 30% of the K_2O , and 30 lb N/A in a preplant or at-planting application. Four weeks after planting, sidedress the remaining 70% of the K_2O . Apply the remaining 180 lb N/A in three or more sidedressings, one of which should be at 4 weeks.

106. Apply all of the P_2O_5 and 30% of the K_2O and N in a preplant or at-planting application. Topdress or sidedress the remaining 70% of the K_2O and N. For small grains grown for grain, silage, or hay, topdress during late January or early February. For grain sorghum or forage sorghum, sidedress before plants are too tall to cultivate or approximately 4 weeks after planting.

107. Apply all of the P_2O_5 and 30% of the K_2O and N in a preplant or at-planting application. Apply the remaining 70% of the K_2O and N in one sidedressing.

108. Application of 20 to 30 lb N/A may give vegetative response but is unlikely to increase harvested yield.

109. If peanuts are grown for seed or if they are virginia type, regardless of soil test, apply gypsum in a band over the potential pegging zone at early flower. Apply 400 lb gypsum/A for runner types and 800 lb gypsum/A for virginia types. Double these rates if broadcasting granular or phosphogypsum (bulk wet). For peanuts not grown for seed, apply gypsum as recommended above only if the calcium soil-test level is below 250 ppm Ca.

110. Apply 50% of the fertilizer at or before transplanting and the other half within 3 weeks of transplanting.

111. Apply 30 lb N/A, 50% of the K_2O , and all of the P_2O_5 fertilizer in a preplant or at-planting application. Apply 50 lb N/A and the remaining K_2O after the first grazing period. Apply an additional 50 lb N/A after each subsequent grazing period.

112. When planting on a prepared seed bed, apply 30 lb N/A, 50% of the K_2O , and all of the P_2O_5 fertilizer in a preplant or at-planting application. Apply 50 lb N/A and the remaining K_2O after the first grazing period. Apply an additional 50 lb N/A after each subsequent grazing period.

When overseeding established perennial grasses with cool season annual grasses, apply 50 lb N/A plus all of the P_2O_5 and K_2O after emergence. Apply an additional 50 lb N/A after each subsequent grazing period.

115. Apply all of the P_2O_5 and K_2O fertilizer in late fall. If legumes are planted in combination with oats, rye, wheat, and/or ryegrass, apply 30 lb N/A in a preplant or at-planting application plus one additional 50 lb N/A application after the grass is well established.

118. Apply 0.75 lb boron/A in the fertilizer or 0.5 lb boron/A as a foliar spray with the first fungicide application.

120. Fertilizer should contain 15 to 20 lb sulfur/A. Apply as a sulfate (e.g., gypsum, ammonium sulfate, magnesium sulfate, potassium sulfate, potassium magnesium sulfate), since elemental sulfur will react too slowly to supply the sulfur needs of the current crop.

121. Apply all of the P_2O_5 and K_2O in spring or early summer when seedlings or regrowth are 3 to 4 inches tall. Species included are aescynomene, alyceclover, desmodiums, hairy indigo, perennial peanut, and other tropical legumes.

122. Species included are all true clovers (white, red, arrowleaf, crimson, subterranean), vetches, lupines, and sweet clover.

123. Apply all of the P_2O_5 and 50% of the K_2O fertilizer in late fall. Apply the remaining K_2O in early spring. If the alfalfa is mechanically harvested rather than grazed, apply an additional 30 lb P_2O_5 /A and 60 lb K_2O /A after each harvest. An additional application of 100 lb K_2O /A in June or July may increase summer survival of alfalfa. Apply 3 lb boron/A per year to alfalfa in three 1 lb/A applications. Copper and zinc fertilizer may be needed if soil pH is above 6.5. The lime requirement shown is adequate for established alfalfa. However if the alfalfa has not yet been planted, apply and incorporate one ton of lime/A if the soil pH is below 6.6. Lime is especially important for establishment of alfalfa. It is not practical to incorporate lime once the alfalfa is planted.

124. UF/IFAS fertilization and liming recommendations are advisory in nature and emphasize efficient fertilizer use and

environmentally sound nutrient management without losses of yield or crop quality. It is generally assumed the nutrients will be supplied from purchased, commercial fertilizer and the expected crop yields and quality will be typical of economically viable production. Growers should consider IFAS recommendations in the context of their entire management strategy, such as return on investment in fertilizer and the benefits of applying manure or biosolids (sewage sludge) to their land.

There is insufficient research available to support the use of UF/IFAS soil test results for environmental nutrient management purposes. Such use is discouraged until correlation is proven.

125. Grass species included are bermuda, star, digit, and rhodesgrass.

126. FERTILIZATION MANAGEMENT NOTES FOR BERMUDAGRASS, STARGRASS, DIGITGRASS, AND RHODESGRASS

Establishment of New Plantings

For establishment of new plantings, apply 100 lb N/A and split as follows: apply 30 lb N/A, all of the P_2O_5 , and 50% of the K_2O as soon as plants have emerged. Apply the remaining K_2O and 70 lb N/A 30 to 50 days later.

Maintenance Fertilization of Established Pastures

For grazed, established stands, apply 80 lb N/A, all of the P_2O_5 , and 50% of the K_2O in early spring. Apply 80 lb N and the remaining K_2O at mid-season.

Under intensive management in central and south Florida, up to 200 lb N/A may be economically viable for stargrass and bermudagrass. In that situation, apply 80 lb N/A, all of the P_2O_5 and 50% of the K_2O in early spring, follow with 50 lb N/A in mid-season, and

70 lb N/A and the remaining K_2O in mid- to late September.

Making Hay, Silage, or Green Chop

Apply 80 lb N/A and all of the recommended P_2O_5 and K_2O in early spring. Apply an additional 80 lb N and 40 lb K_2O /A after each cutting, except the last in the fall. Include 20 lb of P_2O_5 in the supplemental fertilizer if the soil tested low or medium in P.

Special Note if Applying Manure or Biosolids

A different set of economic factors are usually considered when waste materials rather than purchased fertilizer are supplying the nutrients. Additionally, it is often impractical to follow the application timings discussed above when using waste materials from other operations.

127. Apply all of the P_2O_5 , 50% of the K_2O , and 40 lb N/A at planting. Topdress the remaining N and K_2O in late January. On land which lacks clayey soil within the top 6 to 8 inches of the surface, apply 5 to 10 lb sulfate-sulfur/A at planting and 10 lb sulfate-sulfur/A in the topdressing. Wettable or other elemental forms of sulfur will react too slowly to supply the sulfur needs of the current crop. On flatwoods soils with pH above 6.1, apply 10 lb manganese/A. On better-drained sands with pH above 6.5, apply 6 to 10 lb manganese/A.

128. The recommended rates of fertilizer are sufficient to produce soybean yields in the 60 bu/A range. If yields from this field have never exceeded 40 bu/A under current management, reduce P_2O_5 and K_2O recommendations by 20 lb/A. If yields from this field have never exceeded 25 bu/A, reduce P_2O_5 and K_2O recommendations by 40 lb/A. Often this adjustment will mean that you will achieve your yield potential without any P or K fertilizer additions.

129. These recommendations are made assuming adequate soil moisture will be available either from rainfall or irrigation. In south Florida, lack of adequate rainfall during the cool season frequently causes stand failure or

limits growth. Under nonirrigated conditions in south Florida, the probability of inadequate moisture is high, and the likelihood that the crop will benefit from applied fertilizer is low, especially on the drier soils.

130. For grazing or hay production of perennial peanuts, apply all of the P_2O_5 and K_2O in early spring. For hay production, make an annual application of 20 to 30 lb sulfur/A. Apply as a sulfate (e.g., gypsum, ammonium sulfate, magnesium sulfate, potassium sulfate, potassium magnesium sulfate). After each hay harvest, apply an additional 15 pounds of P_2O_5 and 40 pounds of K_2O per ton of hay removed, unless the soil tested high or very high.

131. FERTILIZATION MANAGEMENT NOTES FOR GRAZED BAHIAGRASS

Bahiagrass is probably the most widely-used planted forage grass in Florida. It responds well to grazing management and inputs such as fertilization. However, it also can persist and give satisfactory yields under low inputs. Because of the wide range of possible use and management levels, recommendations for bahiagrass fertilization differ with the level of management and the economic inputs. Management decisions concerning liming and fertilization of bahiagrass pastures are very sensitive to cattle productivity and prices.

Liming

In order to obtain maximum fertilization efficiency, soil pH should be maintained at 5.5 or higher. If soil pH is tests below 5.3 or lower, a lime requirement test will be conducted and a recommendation for lime application will be made. Optimal use of lime is to apply at least 3 to 6 months prior to fertilization to provide adequate time for the lime reaction to occur and the soil pH to adjust to the desired level.

Soils should be tested for pH every 2-3 years.

Phosphorus Fertilization

In order to receive phosphorus fertilizer recommendations for established bahiagrass, soil AND tissue samples should be submitted to the ESTL at the same time. As per the preliminary research findings, soil tests alone are not adequate to determine bahiagrass P needs. A companion tissue test has therefore been added to the testing procedures along with the soil test to determine the P fertilization needs. Producers are strongly encouraged to simultaneously test soil and tissue samples if bahiagrass pastures have not received P fertilization for long periods. Phosphorus should not be applied if tissue P concentrations are at or above 0.15%, even if soil tested Very Low or Low in P. For Medium and High soil P levels, P application is not recommended since there is no added benefit of P fertilization on bahiagrass yields.

If P recommendations are not desired and the producer is only interested in either the test for soil pH and lime requirement recommendations, or the test for soil pH, lime requirement, K, Mg, and Ca recommendations, the soil sample alone can be submitted to the ESTL. In this case, the soil test report will not include P fertilizer recommendations. (Please choose the appropriate test from the Producer Sample Submission Form).

Both the consolidated representative soil and the tissue samples should be collected simultaneously from each field of **up to** 40 acres.

The testing procedures and the recommendations for P for bahiagrass may be adjusted as and when field research data become available.

Maintenance Fertilization of Established Bahiagrass Pasture

Four fertilization options are presented below for bahiagrass pastures. Choose the option which most closely fits your fertilizer budget, management objectives, and land capability. If you will only be grazing your bahiagrass, you should carefully consider the potential for economical return on your investment in fertilizer before using the Medium-Nitrogen or High-Nitrogen options described below. The added forage produced for grazing animals may not be worth the added cost.

Low-Nitrogen Option. Do not use this option if you cut hay since nutrient removal by hay is much greater than by grazing animals. This option results in the lowest cost of purchased fertilizer. Apply 50 to 60 lb N/A in the early spring. Do not apply K recognizing that N will be the limiting nutrient in this low-cost option. Apply 25 lb P₂O₅/A if your soil tests Very Low or Low in P and tissue P concentration is below 0.15%. Do not apply P if tissue P concentration is at or above 0.15%, even if the soil tests Very Low or Low in P. For Medium and High soil P levels, neither P application nor tissue analysis is recommended since there will be no added benefit of P fertilization on bahiagrass yields.

Medium-Nitrogen Option. Apply 100 lb N/A in the early spring. Apply 25 lb P₂O₅/A if your soil tests Very Low or Low in P and tissue P concentration is below 0.15%. Do not apply P if tissue P concentration is at or above 0.15%, even if the soil tests Very Low or Low in P. For Medium and High soil P levels, neither P application nor tissue analysis is recommended since there will be no added benefit of P fertilization on bahiagrass yields. Apply 50 lb K₂O/A if your soil tests Very Low or Low in K

Table 3. Interpretation for Bahiagrass Soil and Tissue Test

Soil Test	Tissue Test	Recommendations
P Med / High	No Tissue Test	0
P Low / V Low	P ≥ 0.15%	0
P Low / V Low	P < 0.15%	25 or 40 lbs P ₂ O ₅ /acre [†]

[†]Recommended amount of P₂O₅ depends upon nitrogen option chosen.

and none if it tests Medium or High.

High-Nitrogen Option. Apply 160 lb N/A in two applications of 80 lb N/A in early spring and early summer. Apply 40 lb P_2O_5/A if your soil tests Very Low or Low in P and tissue P concentration is below 0.15%. Do not apply P if tissue P concentration is at or above 0.15%, even if the soil tests Very Low or Low in P. For Medium and High soil P levels, neither P application nor tissue analysis is recommended since there will be no added benefit of P fertilization on bahiagrass yields. Apply 80 lb K_2O/A if your soil tests Very Low or Low in K and 40 lb K_2O/A if it tests Medium. No K should be applied if your soil tests High or Very High in K. The fertilization rates suggested in this option are high enough to allow bahiagrass pasture to achieve well above average production. Management and environmental factors will determine how much of the potential production is achieved and how much of the forage is utilized. A single cutting of hay can be made without need for additional fertilization.

Bahiagrass Cut Sometimes for Hay

For a Single Cut Per Year from Pastures. If you used the **Low-N option** of pasture fertilization, apply 80 lb N/A no later than six weeks before the growing season ends. Apply 50 lb K_2O/A if your soil tests Very Low or Low in K and none if it tests Medium or High. Apply 25 lb P_2O_5/A if your soil tests Very Low or Low in P and tissue P concentration is below 0.15%. Do not apply P if tissue P concentration is at or above 0.15%, even if the soil tests Very Low or Low in P. If you used the **Medium-N option** of pasture fertilization, apply an additional 80 lb N no later than six weeks before the growing season ends. Apply 50 lb K_2O/A if your soil tests Very Low or Low in K and none if it tests Medium or High. Apply 25 lb P_2O_5/A if your soil tests Very Low or Low in P and tissue P concentration is below 0.15%. If you used the **High-N option** of pasture fertilization, you do not need any additional N fertilization to make one cut of hay. Apply 80 lb K_2O/A if your soil tests Very Low or Low in K and 40 lb K_2O/A if it tests Medium. Apply 40 lb

P_2O_5/A if your soil tests Very Low or Low in P and tissue P concentration is below 0.15%.

Bahiagrass Grown Only for Hay

For Multiple Cuts of Hay. Apply 80 lb N/A in early spring. Also in spring, apply 80 lb K_2O/A if your soil tests Very Low or Low in K and 40 lb K_2O/A if it tests Medium. Apply 40 lb P_2O_5/A if your soil tests Very Low or Low in P and tissue P concentration is below 0.15%. Apply an additional 80 lb N and 40 lb K_2O/A after each cutting, except the last in the fall. Include 20 lb of P_2O_5/A after each cutting if the soil tested Very Low or Low in P.

Bahiagrass for Seed Production

Apply 60 to 80 lb N/A in February or March. At the same time, apply 80 lb K_2O/A if your soil tests Very Low or Low in K and 40 lb K_2O/A if it tests Medium. Apply 40 lb P_2O_5/A if your soil tests Very Low or Low in P and tissue P concentration is below 0.15%. Graze until May, June, or July, depending on variety. Remove cattle before seed heads start to emerge and apply an additional 60 to 80 lb N/A.

If the bahiagrass is not grazed, do not apply fertilizer in February or March since this may stimulate excessive top growth. Mowing from February to April may be needed to remove excessive top growth. Apply 60 to 80 lb N/A before seed heads first appear. Apply 25 lb P_2O_5/A if your soil tests Very Low or Low in P and tissue P concentration is below 0.15%. Do not apply P if tissue P concentration is at or above 0.15%, even if the soil tests Very Low or Low in P. For Medium and High soil P levels, neither P application nor tissue analysis is recommended. Apply 50 lb K_2O/A if your soil tests Very Low or Low in K and none if it tests Medium or High. Fertilize Pensacola in March/April and Argentine and Paraguay in May/June.

132. HAY OR SILAGE (PERENNIAL GRASS)

For Multiple Cuts

Apply 80 lb N/A and all of the recommended P_2O_5 and K_2O in early spring. Apply an additional 80 lb N and 40 lb K_2O/A after each cutting, except the last in the fall. Include 20 lb of P_2O_5/A in the supplemental fertilizer if the soil tested low or medium in P.

For a Single, Late Season Cut from Pastures.

If you have not applied N in the past two months, apply 80 lb N/A and the soil-test recommended amount of P_2O_5 and K_2O . If you have applied N in the past two months, do not apply any N now, but do apply the soil-test recommended amount of P_2O_5 and K_2O . Any application of fertilizer should be made no later than six weeks before the growing season ends.

Special Note if Applying Manure or Biosolids

A different set of economic factors are usually considered when waste materials rather than purchased fertilizer are supplying the nutrients. Additionally, it is often impractical to follow the application timings discussed in this footnote when using waste materials from other operations.

133. FERTILIZATION MANAGEMENT NOTES FOR LIMPOGRASS (Hemarthria)*Establishment of New Plantings*

For establishment of new plantings, apply 100 lb N/A and split as follows: apply 30 lb N/A, all of the P_2O_5 , and 50% of the K_2O as soon as plants have emerged. Apply the remaining K_2O and 70 lb N/A 30 to 50 days later.

Maintenance Fertilization of Established Pastures

For grazed, established stands, apply 60 lb N/A and all of the P_2O_5 and K_2O in late winter or early spring. Apply an additional 60 lb N in late summer or early fall. For a minimum fertilization alternative, ignore the P and K recommendation and apply only 60 lb N per year.

Making Hay, Silage, or Green Chop

Apply 80 lb N/A and all of the recommended P_2O_5 and K_2O in late winter or early spring. Apply an additional 80 lb N and 40 lb K_2O/A after each cutting, except the last in the fall. Include 20 lb of P_2O_5 in the supplemental fertilizer if the soil tested low or medium in P.

Special Note if Applying Manure or Biosolids

A different set of economic factors are usually considered when waste materials rather than purchased fertilizer are supplying the nutrients. Additionally, it is often impractical to follow the application timings discussed above when using waste materials from other operations.

Table 2. Target pH, and recommended annual N, P₂O₅, and K₂O fertilizer rates for agronomic crops. Phosphorus and K rates are based on interpretation of a Mehlich-1 soil test.

Crop Code	Crop Description	Target pH	lb/A/year												Footnotes	References*
			N			P ₂ O ₅			K ₂ O			VH				
			lb/A	VL	LO	MED	HI	VH	VL	LO	MED	HI	VH			
2	Non-irrigated Corn	6.5	150	125	100	50	0	0	120	100	60	0	0	102, 120, 124	AF70	
5	Irrigated Corn	6.5	210	175	140	70	0	0	175	140	70	0	0	104, 120, 124	AF70	
7	Grain Sorghum or Forage Sorghum for Silage	6.5	150	125	100	50	0	0	125	100	50	0	0	106, 124	AF70	
8	Triticale, Oats, or Rye for Grain or Silage	6.0	70	100	80	40	0	0	100	80	40	0	0	106, 124	SSAGR45 & SSAGR46	
9	Cotton	6.5	60	120	90	60	0	0	125	100	70	0	0	107, 124	AF111	
10	Peanuts	6.0	0	100	80	40	0	0	100	80	40	0	0	108	AF70	
11	Soybeans	6.5	0	60	40	20	0	0	60	40	20	0	0	108, 124, 128	NSS23	
12	Flue-cured Tobacco	5.8	80	100	80	60	0	0	200	160	120	0	0	110, 124	AF70	
13	Sugarcane for Syrup	6.0	90	100	80	40	0	0	100	80	40	0	0	106, 124	AF70	
14	Summer Annual Grasses	6.0	**	80	80	40	0	0	80	80	40	0	0	111, 124	AF70	
21	Warm Season Legumes or Legume-grass Mixtures	6.0	0	30	30	30	0	0	60	60	30	0	0	121, 124	SSAGR46	
22	Cool Season Legumes or Legume-grass Mixtures	6.5	0	100	100	60	0	0	160	160	120	0	0	115, 122, 124, 129	SSAGR46	
23	Alfalfa	7.0	0	125	125	80	0	0	160	160	120	0	0	120, 123, 124	SSAGR46	
25	Improved Perennial Grasses (excluding bahia and limpo)	5.5	160	40	40	0	0	0	80	80	40	0	0	124, 125, 126	AF70 & SSAGR46	
26	Cool Season Annual Grasses	6.0	**	80	80	40	0	0	80	80	40	0	0	112, 124	AF70 & SSAGR46	
27	Wheat for Grain	6.0	80	100	80	40	0	0	100	80	40	0	0	124, 127	SSAGR45 & SSAGR46	

Table 2. Target pH, and recommended annual N, P₂O₅, and K₂O fertilizer rates for agronomic crops. Phosphorus and K rates are based on interpretation of a Mehlich-1 soil test.

Crop Code	Crop Description	Target pH	lb/A/year										Footnotes	References*	
			N		P ₂ O ₅			K ₂ O							
			lb/A	VL	LO	MED	HI	VH	VL	LO	MED	HI	VH		
28	Perennial Peanuts	6.0	0	30	30	30	0	0	60	60	60	0	0	124, 130	Cir S275 & RWR
36	Bahiagrass, grazed High-N option	5.5	160	***	***	0	0	0	***	***	0	0	0	124, 131	AF70 & SSAGR46
	Medium-N option	5.5	100	***	***	0	0	0	***	***	0	0	0	124, 131	AF70 & SSAGR46
	Low-N option	5.5	50	***	***	0	0	0	0	0	0	0	0	124, 131	-----
32	Hay or Silage (perennial grass)	5.5	**	80	80	60	0	0	80	80	60	0	0	124, 132	SP253
33	Limpograss (Hemarthra)	5.0	120	20	20	0	0	0	40	40	20	0	0	124, 133	MBA

* AF refers to Agronomy Facts, SSAGR refers to the special series fact sheets of the Agronomy Department available on the web at <http://edis.ifas.ufl.edu>, NSS refers to Notes in Soil Science, RWR to R.W. Rice's 1993 dissertation.

** The N recommendation for this crop is discussed in Footnote 111, 112, or 132.

*** The P and K recommendations for this crop are discussed in Footnote 131.