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 to 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, $P_2O_5$, and $K_2O$ fertilizer to apply; and (2) footnotes which give important information about 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$_2$O$_5$ and K$_2$O 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$_2$O$_5$ and K$_2$O in spring or early summer when seedlings or regrowth are 3 to 4 inches tall. Species included are aeschynomene, 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$_2$O$_5$ and 50% of the K$_2$O fertilizer in late fall. Apply the remaining K$_2$O in early spring. If the alfalfa is mechanically harvested rather than grazed, apply an additional 30 lb P$_2$O$_5$/A and 60 lb K$_2$O/A after each harvest. An additional application of 100 lb K$_2$O/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.

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$_2$O$_5$, and 50% of the K$_2$O as soon as plants have emerged. Apply the remaining K$_2$O 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$_2$O$_5$ and 50% of the K$_2$O in early spring. Apply 80 lb N and the remaining K$_2$O 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$_2$O$_5$ and 50% of the K$_2$O in early spring, follow with 50 lb N/A in mid-season, and
70 lb N/A and the remaining K₂O in mid- to late September.

*Making Hay, Silage, or Green Chop*

Apply 80 lb N/A and all of the recommended P₂O₅ and K₂O in early spring. Apply an additional 80 lb N and 40 lb K₂O/A after each cutting, except the last in the fall. Include 20 lb of P₂O₅ 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 P₂O₅, 50% of the K₂O, and 40 lb N/A at planting. Topdress the remaining N and K₂O 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 P₂O₅ and K₂O recommendations by 20 lb/A. If yields from this field have never exceeded 25 bu/A, reduce P₂O₅ and K₂O 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 P₂O₅ and K₂O 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 P₂O₅ and 40 pounds of K₂O per ton of hay removed, unless the soil tested high or very high.

131. **FERTILIZATION MANAGEMENT NOTES FOR BAHIAGRASS**

Bahiagrass is probably the most widely-used improved 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. If soil pH is tested below 5.5, a lime requirement test will be conducted and a recommendation for lime application will be made. For lime requirement to be calculated and recommended, the tested soil pH should be at least 0.2 pH units lower than the target pH of 5.5.

Lime should be applied 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.
Producers are encouraged strongly to submit both a soil and a tissue sample together when submitting samples to the ESTL when considering phosphorus fertilization. As per the preliminary research findings, soil tests alone were not found to be adequate to determine Bahiagrass phosphorus needs. A complementary tissue test has therefore been added to the testing procedures along with the soil test to determine the phosphorus fertilization needs. Both the consolidated soil and the tissue samples should be collected simultaneously from each field of up to 40 acres.

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

If the soil tests Very Low or Low in P, a tissue P analysis is conducted. Phosphorus application is not required 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 concentrations, neither P application nor tissue analysis is recommended since no added benefit from P fertilization on bahiagrass yields has been demonstrated. This is summarized in Table 3.

**Table 3. Interpretation for Bahiagrass Soil and Tissue Test**

<table>
<thead>
<tr>
<th>Soil Test</th>
<th>Tissue Test</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>P Med / High</td>
<td>No Tissue Test</td>
<td>0</td>
</tr>
<tr>
<td>P Low / V Low</td>
<td>P &gt; 0.15%</td>
<td>0</td>
</tr>
<tr>
<td>P Low / V Low</td>
<td>P &lt; 0.15%</td>
<td>25 lbs/acre P₂O₅</td>
</tr>
</tbody>
</table>

Establishment of New Plantings

For new plantings, apply 80 lb N/A split as follows: apply 30 lb N/A, all of the P₂O₅, and 50% of the K₂O as soon as plants have emerged. Apply the remaining K₂O and 50 lb N/A 30 to 50 days later. If manure or biosolids are used as the main source of nutrients, apply the entire annual application once the plants are large enough to withstand physical damage from the application.

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 be only 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 the grazing animals may not be worth the added cost.

Low-Nitrogen Option (for Grazed Pastures Only). 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 around 50 lb N/A in the early spring to maximize much-needed forage. Do not apply P or K recognizing that N will be the limiting nutrient in this low-cost option.

As described above, a consolidated soil and a tissue sample from each field should be submitted to the Lab for determining the lime requirement and phosphorus fertilization needs. Lime and phosphorus recommendations will be made as per the interpretation provided above.

Medium-Nitrogen Option. Apply 100 lb N/A in the early spring to provide much-needed forage. At this level of N fertilization, P and K may be limiting if your soil tested low in these nutrients. Apply 25 lb P₂O₅/A if your soil tested very low or low in P and none if it tested medium or high. Apply 50 lb K₂O/A if your soil tested very low or low in K and none if it tested medium or high. Retest your soil every second or third year to verify P and K levels.

High-Nitrogen Option. Apply 160 lb N/A and the soil-test recommended rates of P₂O₅ and K₂O for each of your pastures. Split the N into two applications of 80 lb N/A each, applying in early spring and early summer. 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.

**Fertilization of Pastures with Biosolids or Manure.** Apply no more than 160 lb of total N/A per application and no more than 320 lb of total N/A per year. (Note: In areas designated as phosphorus sensitive, the rate of application will be determined by other criteria).

**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.

**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 and the soil-test recommended amount of P\(_2\)O\(_5\) and K\(_2\)O no later than six weeks before the growing season ends. If you used the **Medium-N option** of pasture fertilization, apply 80 lb N and 40 lb K\(_2\)O/A no later than six weeks before the growing season ends. If you used the **High-N option** of pasture fertilization, you do not need any additional fertilization to make one cut of hay.

**Bahiagrass Grown Only for Hay**

**For Multiple Cuts of Hay.** Apply 80 lb N/A and the soil-test recommended P and K in February or March. 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 the soil test recommended P and K and 60 to 80 lb N/A before seed heads first appear. 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\(_2\)O\(_5\) and K\(_2\)O in early spring. Apply an additional 80 lb N and 40 lb K\(_2\)O/A after each cutting, except the last in the fall. Include 20 lb of P\(_2\)O\(_5\)/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\(_2\)O\(_5\) and K\(_2\)O. 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\(_2\)O\(_5\) and K\(_2\)O. 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\textsubscript{2}O\textsubscript{5}, and 50% of the K\textsubscript{2}O as soon as plants have emerged. Apply the remaining K\textsubscript{2}O 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\textsubscript{2}O\textsubscript{5} and K\textsubscript{2}O 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\textsubscript{2}O\textsubscript{5} and K\textsubscript{2}O in late winter or early spring. Apply an additional 80 lb N and 40 lb K\textsubscript{2}O/A after each cutting, except the last in the fall. Include 20 lb of P\textsubscript{2}O\textsubscript{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, P$_2$O$_5$, and K$_2$O fertilizer rates for agronomic crops. Phosphorus and K rates are based on interpretation of a Mehlich-1 soil test.

<table>
<thead>
<tr>
<th>Crop Code</th>
<th>Crop Description</th>
<th>Target pH</th>
<th>N</th>
<th>P$_2$O$_5$</th>
<th>K$_2$O</th>
<th>Footnotes</th>
<th>References*</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Non-irrigated Corn</td>
<td>6.5</td>
<td>150</td>
<td>125</td>
<td>100</td>
<td>50</td>
<td>0</td>
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<tr>
<td>5</td>
<td>Irrigated Corn</td>
<td>6.5</td>
<td>210</td>
<td>175</td>
<td>140</td>
<td>70</td>
<td>0</td>
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<tr>
<td>7</td>
<td>Grain Sorghum or Forage Sorghum for Silage</td>
<td>6.5</td>
<td>150</td>
<td>125</td>
<td>100</td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>Triticale, Oats, or Rye for Grain or Silage</td>
<td>6.0</td>
<td>70</td>
<td>100</td>
<td>80</td>
<td>40</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>Cotton</td>
<td>6.5</td>
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<td>120</td>
<td>90</td>
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<td>10</td>
<td>Peanuts</td>
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<td>100</td>
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<td>11</td>
<td>Soybeans</td>
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<td>12</td>
<td>Flue-cured Tobacco</td>
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<td>13</td>
<td>Sugarcane for Syrup</td>
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<td>100</td>
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<td>14</td>
<td>Summer Annual Grasses</td>
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<td>Warm Season Legumes or Legume-grass Mixtures</td>
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<td>22</td>
<td>Cool Season Legumes or Legume-grass Mixtures</td>
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<td>100</td>
<td>100</td>
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<tr>
<td>23</td>
<td>Alfalfa</td>
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<td>125</td>
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<td>25</td>
<td>Improved Perennial Grasses (excluding bahia and limpo)</td>
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<td>26</td>
<td>Cool Season Annual Grasses</td>
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Archival copy: for current recommendations see http://edis.ifas.ufl.edu or your local extension office.
Table 2. Target pH, and recommended annual N, P$_2$O$_5$, and K$_2$O fertilizer rates for agronomic crops. Phosphorus and K rates are based on interpretation of a Mehlich-1 soil test.

<table>
<thead>
<tr>
<th>Crop Code</th>
<th>Crop Description</th>
<th>Target pH</th>
<th>N (lb/A)</th>
<th>P$_2$O$_5$ (lb/A)</th>
<th>K$_2$O (lb/A)</th>
<th>Footnotes</th>
<th>References*</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>Perennial Peanuts</td>
<td>6.0</td>
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<td>30</td>
<td>30</td>
<td>60</td>
<td>60</td>
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<tr>
<td>32</td>
<td>Hay or Silage (perennial grass)</td>
<td>5.5 **</td>
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<td>80</td>
<td>60</td>
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<td>0</td>
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<td>33</td>
<td>Limpograss (Hemarthria)</td>
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<td>Bahiagrass</td>
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<td></td>
<td>High-N option</td>
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<td>50</td>
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<td></td>
<td>Low-N option</td>
<td>5.5</td>
<td>50</td>
<td>25</td>
<td>25</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>


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

*** See Footnote 131. Decisions concerning liming and N fertilization of bahiagrass pastures are very sensitive to cattle productivity and prices.