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Fertilization of Agronomic Crops [1]

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Development of fertilization programs for Florida field or forage crops requires that consideration be given to nutrient requirements for each crop, soil nutrient levels, reactions of the soil with added nutrients, and the ability of the soil to retain and deliver nutrients and water. These factors are used to determine rates, placement, and timing of fertilizer applications.

Suggested fertilization rates are based on soil tests currently used by the University of Florida Soil Testing Laboratory at Gainesville and are given in SL-129 *UF/IFAS Standardized Fertilization Recommendations for Agronomic Crops* (http://edis.ifas.ufl.edu/SS163). Sugarcane grown for sugar is an exception. Soil tests and correlations were made by the Everglades Research and Education Center, Belle Glade. Thus, sugarcane for sugar will be excluded from this discussion. Suggested fertilization rates are based on broadcast application while lower rates would be suitable in a band in or near the row.

A soil sample must be representative of the area to be fertilized. Take samples to a depth of 6 to 8", except when sampling to determine the need for gypsum by peanuts; in this case, samples should be taken to a depth of 3" from the potential pegging zone of the plant.

If fertilization recommendations are made without the aid of soil test results, the following guidelines should be used:

1. Nitrogen rates are the same as recommended in IFAS publication SL-129.
2. Phosphorus rates are influenced by soil texture. For sand or light loamy sand soils use the rates listed under "medium" soil test. For heavy loamy sand, heavy loam, or organic soils use the rates listed under "low" soil test.
3. Use the potassium rates listed under "low" soil test.
4. All appropriate comments in SL-129 or UF Extension soil test reports should be considered.

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Soil Nutrient Recommendations

Nitrogen

Recommendations for N fertilization are not based on soil tests. The complex nature of soil N precludes the use of rapid, inexpensive and reliable tests to measure this element. Fertilizer N is not normally needed for field crops grown on organic soils. Nitrogen can be leached from sandy soils by heavy rainfall. If this occurs, it may be desirable to apply more N as an adjustment to leaching or to use smaller but more frequent applications in an attempt to minimize leaching losses.

Phosphorus

Many fields used for agronomic crops have received annual applications of P-containing fertilizers for many years. As a result, the P levels of these soils are high or very high as measured by soil test. Since crop responses to even more P is unlikely, this element may not be needed until soil tests indicate that the soil levels have declined to the medium category. Phosphorus recommendations are given in SL-129.

Potassium

Potassium can be leached below the root zone of agronomic crops grown on sandy soils if excessive rainfall occurs. This may be especially true for annual crops. If so, it would be desirable to replace the leached nutrient or to make smaller but more frequent applications. Do not apply K-containing fertilizer to emerged peanuts, as high levels in the soil can interfere with the uptake of calcium by the peanut pods.

Magnesium

If the magnesium soil test is below the target level and dolomitic limestone was not applied, soluble Mg should be included in the basic application of fertilizer for most field crops. Application of at least 10 lb/A of Mg is recommended. Since lime is seldom used for flue-cured tobacco, the fertilizer for this crop should contain at least 20 lb/A Mg.

Sulfur

Indications are that at least 16 lb/A of S should be applied annually in either the fertilizers or the pesticides used in field crop production programs. Except for areas close to certain industrial establishments, very little sulfur is added to Florida soils in rain water. Also, high-analysis fertilizers usually contain little or no sulfur. Fertilizer materials that contain relatively high percentages of sulfur include ammonium sulfate, ordinary superphosphate, sulfate of potash, sulfate of potash-magnesia, agricultural gypsum, and magnesium sulfate.

Calcium

If the soil pH is appropriate for the field crop in question, there will be sufficient Ca for proper plant nutrition. Peanuts are an exception since that crop requires relatively high levels of Ca in the pegging zone for proper kernel development and subsequent germination if grown for seed purposes.

Micronutrients

Iron (Fe), copper (Cu), manganese (Mn), zinc (Zn), boron (B), and molybdenum (Mo) are the essential micronutrients. Deficiencies of one or more of the micronutrients have been noted on some crops in all sections of Florida. Perennial grasses and clovers on certain mineral soils in central and southern Florida, and all field crops on organic soils in the same area, have responded to applications of Fe, Cu, Mn, Zn, and B. Small grains and peanuts on phosphatic soils in central and northern Florida have responded to applications of Cu. Zn has controlled "white bud" of corn. Peanut "hollow heart" has been prevented by applications of B. Chlorosis of perennial grasses, generally on new growth in the spring on soils with a high pH or on light gray sands in central and southern Florida has been overcome by applications of Fe. As a seed treatment, Mo has improved the nodulation of soybeans grown on unlimed or inadequately limed soils. There are numerous other instances where one or more of the micronutrients have limited crop production.

Soil tests for micronutrients are expensive and difficult to interpret. Fertilization studies with micronutrients have not always been conclusive

because many factors affect the response of plants to these elements. Therefore, local experience should serve as the primary guide as to the need for these nutrients. Micronutrient deficiencies are most likely to occur on organic soils, soils with pH >6.0, and virgin flatwood soils.

For new plantings of forages on virgin flatwood soils, 3 lb/A of copper should be applied with the initial fertilization.

In instances where deficiencies are probable, micronutrient applications serve as insurance against reduced yields. Some growers of peanuts and other high-value crops make routine applications of B and other micronutrients, especially when the soil pH is 6.0 or above. Soybean and some other legumes grown on soils with pH >6.0 often show Mn or other deficiency symptoms which can be corrected with periodic applications of micronutrients. Corn has shown manganese deficiency symptoms at early growth stages that tend to disappear as the root system develops.

Cu, Zn, Mn, and Fe may be supplied as oxides or sulfates. B is usually applied as borax or other borates. Plants respond equally well to all of these sources, but oxides are usually more economical to use than sulfates. Since there is a very small difference between sufficient and toxic amounts of B, care must be exercised when applying this micronutrient. Recommended amounts should not be exceeded.

When forages are grazed there is recycling of nutrients within the soil-plant-animal system. Livestock mineral mixtures containing micronutrients make small but important contributions of these elements to the soil. Harvest of hay or silage removes these elements from the soil.

Under grazing conditions, the metallic micronutrients (Fe, Cu, Mn, and Zn) should be applied once every 5 to 10 years unless deficiencies are confirmed by soil and/or plant analyses. Boron should be applied to legume pastures every 3 to 4 years. Where forage is removed as silage or hay it may be necessary to shorten this interval.

Application of Micronutrients

Micronutrients may be applied to the soil or to the growing plant. Mo may also be applied as a seed treatment. Soil applications usually involve mixing and then applying the micronutrients with fertilizers or pesticides. Since small amounts of micronutrients are used, the mixtures can be applied more uniformly and economically than in a separate operation. Foliar applications may be made in sprays or dusts. Compatibility must be known before mixing elements with foliar-applied pesticides. Soluble micronutrients can also be applied as a tank mix with herbicides that will be incorporated with soil. Availability and characteristics of materials and equipment and the crop conditions determine the most suitable method of application.

Legume Seed Treatment

Molybdenum may be added to soybean and other legume seed to be planted on mineral soils that have not been limed to a pH of 6.0. To treat a bushel of soybean seed with Mo and bacterial inoculant, first dissolve 1/2 oz of either ammonium molybdate or sodium molybdate in 1/2 pt of hot water and then add a few drops of syrup or molasses. Cool, and mix the solution with the seed and then add the inoculant. Plant before the seed coats are completely dry.

Soil Applications

Solubility of Mn, Zn, Cu, and Fe decreases rapidly as pH increases above 6.0. This has important consequences. A deficiency of one of these nutrients is often caused or aggravated by an elevated soil pH. Thus over liming can provoke micronutrient deficiencies. Also, when soluble forms of Mn, Zn, Cu, or Fe are applied to deficient soil, the nutrients are rapidly changed to insoluble forms. This effect is much worse when micronutrients are broadcast than when they are banded. The best method of soil application of these nutrients is in a band together with elemental sulfur. The resulting low pH in the band will keep the nutrients soluble throughout the growing season. Borax to supply B and sulfates of Cu, Mn, and Zn are common soluble sources of micronutrients that may be mixed with fertilizer for soil applications. Care must be taken not to apply

excess amounts of the materials or toxicities may result.

Micronutrient Mixtures

There has been a tendency in the past to recommend commercially available mixes of micronutrients. These were used in a "shotgun" approach to fertilization -- throw a bit of all the micronutrients at the plant, and if one of the elements is limiting yield your application will do some good. This approach should be discouraged for the following reasons: 1) it is an added cost with questionable returns; 2) repeated additions could result in build-up to toxic levels of some metals; 3) if a deficiency of a particular micronutrient does exist, the quantity applied in the mix will probably not be sufficient to completely correct the problem and may mask a serious deficiency. Producers should watch for signs of deficiency, determine which nutrient is needed (by responses to single-element applications), and subsequently apply the needed element.

Foliar Applications

Foliar applications of micronutrients will normally result in a rapid response if a deficiency exists. Also, a response can be obtained with less material than in soil applications. However, there is a danger of burning the foliage if excessive rates are applied. Only meager information is available on the tolerance of agronomic plants to foliar sprays. Species, age, and condition of the plants will greatly affect tolerance to nutrient sprays. Since there is often more foliage burning with mixtures of certain pesticides and nutrient sprays, they should be applied separately. If there is a synergistic effect, they should be applied together because they are more effective together. In general, fine mists that do not result in run-off will cause less damage to leaf tips and margins than will coarse sprays.

Rates of Cu, Fe, Mn, or Zn sulfates that should be effective and safe for agronomic crop plants are about 1 lb of material in water sufficient to cover one acre. Borax and other soluble forms of B should be used at this same rate. If more than one nutrient is applied, do not exceed a total of 2 lb/A of salts. Follow label directions if commercial mixtures of micronutrients are used.

Chelates are generally more effective on firm and thick leaves of trees than on the soft and succulent foliage of herbaceous plants. Other sources of micronutrients are available for foliar application and may be satisfactory.

Timing and Placement of Fertilizer

Mixing seed with fertilizer and broadcasting both in the same operation has given fair to good stands of ryegrass, small grains (rye, oats, and wheat), pearlmillet, sorghum-sudangrass, bahiagrass, and other crops. Legume seed should not be mixed with fertilizers since the inoculant can be killed or its effectiveness greatly reduced by these materials.

Seed distribution when mixed with fertilizer has been a problem in many cases. Conventional seeding methods, drilling or broadcasting on a well-prepared seedbed, are preferred, since seed can be more uniformly distributed. Broadcasting operations should be followed with a light disk and/or cultipacker.