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# APPROPRIATE USES OF SOIL FERTILITY TESTING AND THE UF-IFAS STANDARDIZED FERTILIZATION RECOMMENDATION SYSTEM: A POSITION PAPER FROM THE UF-IFAS PLANT NUTRIENT OVERSIGHT COMMITTEE

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*Abstract*. **The UF-IFAS Standardized Fertilization Recommendation System (SFRS) is the resource of fertilization recommendations for commercial crops and homeowner situations. It was developed to advise individuals on liming and fertilization practices. Working Groups appointed by the Chair (UF-IFAS Dean For Extension) of the UF-IFAS Plant Nutrient Oversight Committee review fertilization research and prepare papers summarizing the research and indicating areas of need for more research. Modifications in the UF-IFAS fertilization recommendations are recommended to the Committee. The UF-IFAS SFRS has not been proposed or calibrated for use to determine fertilizer management for environmental regulatory purposes. This paper summarizes the history of the UF-IFAS SFRS, describes the process in use for developing and instituting fertilization recommendations, and documents the UF-IFAS position on the appropriate use of soil testing.**

There are many agencies, private organizations, and private individuals making nutrient management, fertilization, and waste management recommendations in the state of Florida. The UF-IFAS Plant Nutrient Oversight Committee, chaired by the UF-IFAS Dean for Extension, Dr. Christine Waddill, determined a need to document the UF-IFAS position on making recommendations pertaining to nutrient, fertilizer, and waste management in Florida. This position paper describes the process for documenting fertilization recommendations and states the appropriate uses for which the UF-IFAS SFRS and soil testing have been developed. The paper also points out a common misconception about soil testing and some of the consequences of using the system for other than its intended and tested purposes. Finally, recommendations about how to proceed in addressing this issue are made.

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## Some History of the Nutrient Management Issue

The Standardized Fertilization Recommendation System (SFRS) is the University of Florida, Institute of Food and Agricultural Sciences (UF-IFAS) resource of fertilization recommendations for many crops. This system was formalized in 1981 when the reports from the UF-IFAS Extension Soil Testing Laboratory were first computer generated. The SFRS is a compilation of recommendations provided by UF faculty specializing in the respective crops for which fertilization recommendations are being made. The Plant Nutrient Oversight Committee is the body responsible for the peer review and final approval of changes in fertilization recommendations. It has been operating in this capacity since the early 1990s. Working Groups prepare position papers that summarize plant response, laboratory, field, plant tissue, and soil test information. Position papers are reviewed by the Plant Nutrient Oversight Committee to ensure that the recommendation is reasonable (common sense), has validity through field testing, and controversial portions have been properly discussed, usually with appropriate clientele.

The U.S. Environmental Protection Agency (EPA) and the Florida Department of Environmental Protection (FDEP) are pursuing implementation of the Total Maximum Daily Loading (TMDLs) concept for all identified water bodies. To that end, they are proposing:

1. To use the SFRS as a basis for land applications of phosphorus;
2. To use soil and plant tissue testing as an indicator of adequacy of fertilization and for setting limits on additional nutrient loading (fertilization);
3. To use soil and plant tissue testing as an indicator of environmental health or acceptability regarding nutrients.

The Florida Department of Agriculture and Consumer Services (FDACS) and other agencies are interested in establishing nutrient Best Management Practices (BMPs), which are directly tied legally to TMDLs.

In June 1999, the Southern Extension Research Activity-Information Exchange Group 6 (SERA-IEG-6), consisting of scientists from 13 southern land-grant institutions, issued the following statement: *"Routine soil testing methods for phosphorus have been developed for decades and have been calibrated using agronomic parameters, primarily crop yield or similar performance measures. The SERA-IEG-6 group and its predecessors, which represent many years of professional work in soil testing and calibration, wish to express serious reservations about inadequately researched efforts which attempt to interpret such P soil test results in terms of potential for causing environmental damage. We urge that research continue to be supported which would lead to development and calibration of environmental P tests."*

## The Process for Determining Appropriate Recommendations Under SFRS

The Plant Nutrient Oversight Committee is responsible for the peer-review and final approval of UF-IFAS fertilization recommen-

dations. Working Groups prepare position papers that summarize laboratory, field, plant tissue, and soil-testing information gleaned from the research literature. Only in recent years have the Working Groups included water quality data in their proposed position or summary papers. Certainly economical crop production is an important factor in determining an appropriate fertilization recommendation. For example, data collected on grazed Bahia grass pastures in southern Florida demonstrated an economical response to N fertilization. Bahia grass yield was increased by inorganic sources of P and K, but responses were not economical. This analysis led to a revision of UF-IFAS fertilization recommendations. Based on the use of *inorganic* sources of plant nutrients, fertilization with only N was shown to be the most cost-effective nutrient management practice in grazed Bahia grass pastures.

The Working Group identifies significant aspects of the recommendation, or the need for modifications to the recommendation. These aspects are used as the basis for a review of all previous work, including refereed journal articles, state and regional journal articles (Florida State Horticultural Society or Soil and Crop Science Society of Florida), regional or multistate documents, e.g., SERA-IEG-6, Extension Service publications, research reports, and Research and Education Center reports.

Only written reports should be used in the review. Experience or personal beliefs are useful for identifying additional areas for research, but not for defining UF-IFAS fertilization recommendations.

The types of information in the written reports of particular interest would include predictive soil test values or other analytical measurements, such as soil organic matter content or water-release curves. Plant tissue nutrient concentration measurements are important data for corroborating plant responses to fertilization. Authors of the position papers should evaluate fertilizer management techniques used by the researchers, including fertilizer rates, placement, timing, and nutrient sources and forms. Potential recommendations or changes to existing recommendations should be made with strong consideration of crop yields, crop quality, ground water quality effects, and economics of crop production. Finally, the summary should point out any priority areas where further research is needed.

Position papers are reviewed by the Plant Nutrient Oversight Committee, or Committee-appointed reviewers, to ensure that the recommendations are reasonable, have validity through field testing, and that controversial parts have been discussed, often with appropriate clientele.

### Comments on the Use of This Review System to Date

The research summaries should include as many reports as possible. Sometimes there might be a paucity of reports for certain crops. For example, extrapolations to related crops and cultural systems were made for vegetable crops and production systems having minimal research documentation.

The dominant fertilizer sources used in most fertilization research in Florida were inorganic or manufactured fertilizers. New and on-going research is addressing other fertilizer sources including livestock wastes, organic waste products, composts, garbage and food wastes, and commercially prepared organic materials. Research must be concerned with mineralization rates of these organic products so that organic fertilizer application is timed with crop nutrient need and uptake.

Soil testing in organically amended soils in Florida has not been calibrated. For example, the Mehlich-1 extractant used by five land-grant laboratories in the southern region was developed for soils of low cation exchange capacity. Soil and plant tissue data are excellent sources of information for inclusion in the analysis process of developing fertilization recommendations.

Few experiments have included any water quality measurements in the research. For the determination of nutrient best management practices, effects of the nutrient management program on water quality will need to be determined. Recent research in the United States on environmental soil testing has shown poor correlation with resulting water quality. Additional measurements are needed, such as soil types, landscape, hydroperiod, water movement, etc. There is a paucity of fertility research data relating the economics of fertilization with crop yield, quality, and farm profitability.

### Appropriate Uses of SFRS

The UF-IFAS Plant Nutrient Oversight Committee has determined that there are three major areas that constitute appropriate use of the SFRS:

1. Advise producers of various agricultural crops regarding appropriate rates of lime and of N, P, and K fertilizers to apply to ensure adequacy of soil pH and those nutrients under production conditions typical of the respective crops in Florida.
2. Advise persons dealing with lawns, gardens, and similar landscaping situations as to the rates of lime and of N, P, and K fertilizers to apply to ensure adequacy of soil pH and those nutrients under conditions typical of Florida.
3. Advise clients when no production or plant performance benefits are expected from added phosphorus or potassium fertilizer, or from liming the soil.

### Inappropriate Uses of Soil Tests and Some Reasons Why

The UF-IFAS Plant Nutrient Oversight Committee has identified several areas where soil testing and nutrient recommendation processes have been applied inappropriately. The most important of these for Florida situations are:

1. *Measuring the amount of phosphorus or potassium in the soil*. Soil testing measures only a portion of those nutrients. The test measurements are in turn correlated with the crop's production at the measured levels. The chemistry of nutrients in soil is complex. Soil tests solubilize in a few minutes in a lab what plants will utilize over months or, in the case of perennials, years. A good test method will give results that correlate well with plant performance under the specified soil conditions.
2. *Predicting the potential for environmental pollution caused by nutrients moving off site and into ground and surface waters.* Soil tests were developed and calibrated in the context of economic crop production. It takes years of work to develop a reliable soil test with its accompanying interpretations. Many tests have failed and fallen into disuse when they were found to be unreliable predictors of crop response. Attempts at correlating soil tests with off-site environmental pollution have a very short history and are far from being proven generally effective.
3. *Restricting applications of manures or biosolids to land without evidence that phosphorus is leaving the site and causing undesirable effects off-site.* There are many soils that have the capacity to retain phosphorus at levels far greater than those

needed by plants. Unnecessary restriction of land application of manure and biosolids generally results in the need for more manufactured fertilizer for crops and more energy-consuming means of manure and biosolids disposal.

### A Common Misconception About Soil Testing

There exists a common belief that soil tests measure the amount of the three macronutrients, N, P, and K in the soil. This misunderstanding is abetted by the fact that fertilization recommendations for all three nutrients commonly come with soil test results. However, N is not measured in most soil testing programs. This is because, with the exception of the presidedress test for corn, there is no reliable soil test for N. Recommendations for N fertilization are not based on soil tests. Rather, they are based on results from field trials where the crop responses are measured at different levels of applied N fertilizer to determine the optimum rate. That level is usually chosen so that N will not limit production under the best growing conditions.

### Some Consequences of Inappropriate Uses of UF-IFAS SFRS

Use of the UF-IFAS Standardized Fertilization Recommendation System and soil testing for regulatory rather than crop advisory purposes will have the following consequences:

1. Will use interpretations of tests that have not been correlated or shown to be valid.
2. Will fix into laws/regulations the test procedures and interpretations.
3. Will further confuse the distinction between fertilizing for crop response and applying wastes as an environmentally-sound disposal practice.
4. Will damage the image of soil testing as a predictor of crop response.
5. Will erode confidence in science-based measurements.

Use of the UF-IFAS P fertilization recommendations for limiting land application of manure and biosolids will have the following consequences:

1. Will restrict land application of manure and biosolids under the guise of scientific measurement.
2. Will require commercial fertilizer to substitute for other nutrients (especially N and K) which would have been supplied from manure or biosolids.
3. Will increase the expenditure of fuel energy used for waste disposal or processing.
4. Will not necessarily change the impact of phosphorus on surface and ground water quality.

### Recommendations

The UF-IFAS Plant Nutrient Oversight Committee recommends:

1. That the UF-IFAS Standardized Fertilization Recommendation System be used only for its intended purposes, e.g. soil fertility testing for crop production.
2. That a concerted research effort be placed on the environmental impacts of waste application to land and on uses of organic sources of nutrients in commercial agriculture.