Nutrition of Florida Citrus Trees, 3rd Edition: Chapter 1. Introduction[1]

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This publication is part of SL253, *Nutrition of Florida Citrus Trees*, 3rd Edition. For references, a glossary, and appendices, please refer to the full document at https://edis.ifas.ufl.edu/ss478.

> The information provided in the 2008 2nd edition is still sound for healthy citrus trees under Florida production conditions. Much of the information provided in this document on nutrients, application methods, leaf and soil sampling, and irrigation scheduling are also effective for huanglongbing (HLB) affected citrus trees. However, research conducted since HLB was detected in Florida in 2005 has established changes in many production practices, including nutrient rates, irrigation scheduling, soil pH management, and use of Citrus Under Protective Screen (CUPS). Changes to the 2nd edition of SL253 will appear in boxes similar to this one at the beginnings of chapters 2, 6, 8, 9, and 11.

Preface

This publication is the second edition of UF/IFAS Bulletin SP169, which has provided guidelines for Florida citrus fertilization since 1995. The objective of the original edition was to provide background information and recommendations to develop a sound citrus nutrition program that will optimize financial returns while sustaining yields and maintaining soil and water quality. The objective of this publication is to incorporate the findings of numerous citrus nutrition research projects conducted during the past decade.

These updated guidelines reflect changes in fertilizer recommendations that have occurred as the Florida citrus industry has entered the era of Best Management Practices (BMPs). In addition to the original chapters, this publication has added chapters on 1) production areas and soil characteristics, 2) using precision agriculture to manage citrus nutrition, 3) irrigation and nutrient management, and 4) environmental issues and BMPs.

Supplemental information on subjects related to citrus nutrition appears in extensive appendices. Color plates depicting nutrient deficiencies and toxicities and a key to mineral deficiency symptoms in citrus are included to aid in visual analysis of tree nutritional status.

Nutrition of Florida Citrus Trees—a Historical Perspective

To maintain a viable citrus industry in Florida, growers must be able to economically produce large, high-quality fruit crops. Prior to the establishment of UF/IFAS and USDA research programs, high production was not possible because citrus nutritional requirements were poorly understood. Early classical studies by Michael Peech and T. W. Young showed that Florida's sandy soils had very low capacity to hold nutrients and water.

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The first commercial citrus growers had some understanding of the need for the macronutrients nitrogen (N), phosphorus (P), and potassium (K). Nitrogen was generally applied using natural organic sources like farm animal manure and bird guano. Some mineral N was mined and imported from Chile. Phosphorus was obtained from local mines, and K was imported from Germany.

Meanwhile, worldwide studies demonstrated that plants needed elements in addition to N, P, and K in order to grow properly. In 1939, A. F. Camp and B. R. Fudge showed that secondary and micronutrients were needed to grow citrus on Florida soils. Included were examples of deficiency symptoms of copper (Cu), zinc (Zn), manganese (Mn), magnesium (Mg), boron (B), and iron (Fe). They indicated how each of the above element deficiencies could be corrected with the exception of Fe. At that time, there was no known satisfactory fertilizer source of this element.

Other elements were later found to be necessary for Florida citrus. The problem of yellow spot disease was first reported in 1908. This disease was rather widespread and caused extensive defoliation and tree death. In 1951, Ivan Stewart and C. D. Leonard reported this problem was due to molybdenum (Mo) deficiency that could be corrected by a spray application of as little as 1 oz of sodium molybdate/acre.

Calcium (Ca) is commonly thought of as a soil amendment and is usually applied as lime. However, when W. F. Spencer and R. C. J. Koo planted citrus on new land at the Citrus Experiment Station (now the UF/IFAS Citrus Research and Education Center) in Lake Alfred, they did not add Ca to some of the plots, which resulted in stunted trees that showed leaf symptoms specific to Ca deficiency.

Copper (Cu) deficiency of citrus limited growth and fruit production in many early Florida groves. Following discovery of this problem, high rates of Cu were applied to trees in both foliar sprays and soil applications. Later, I. W. Wander and co-investigators found that Cu was not taken up in abundance by the trees, nor did it leach like many other fertilizer elements, which resulted in its accumulation in the surface soil.

Copper accumulation interfered with Fe uptake by citrus trees, causing leaf chlorosis and defoliation. By 1951, many trees were being removed due to this problem. Stewart and Leonard found that when organically chelated Fe (Fe-EDTA) was applied to the soil, yellow leaves on Fe-deficient trees re-greened.

While S is essential for citrus, its deficiency has not been reported in Florida, because it has been supplied through pesticide sprays and dusts, fertilizer components, irrigation water, and rainfall.

In 1954, the first Florida citrus fertilizer recommendations were made by a joint effort of UF/IFAS Citrus Research and Education Center and USDA Horticultural Laboratory scientists. Based on data accumulated from many years of experiments, Bulletin 536 was published. This bulletin was revised three times and for 41 years was the comprehensive guide for citrus tree nutrition. Rates and sources of eleven essential fertilizer elements were recommended based on results from field experiments.

In the 1960s, UF/IFAS CREC faculty recommended that growers change to high-analysis fertilizers, thus eliminating much of the filler. By so doing, a great deal of the mixing cost was eliminated and transportation and application cost reduced. Further reductions in costs were made when Spencer and Stewart reported that P applied to established groves had not leached but had accumulated in an available form, resulting in reduced P application rates to established groves. Finally, the use of minor elements was recommended only when deficiency symptoms persisted.

Numerous N rate and timing studies were conducted by UF/IFAS and USDA scientists for many years, covering a wide range of soil types, tree ages, varieties, rootstocks, and cultural conditions. The results showed N rates in excess of 200 lb/acre were justified only for very productive groves. In addition, Stewart and Leonard demonstrated that excess N could reduce yield. Maximum production may vary greatly depending on other limiting conditions, but fertilizer N requirements remain similar for a range of production levels and conditions. As a result of these findings, Bulletin SP169 was published in 1995 by D. P. H. Tucker, A. K. Alva, L. K. Jackson, and T. A. Wheaton. This bulletin de-emphasized projected yield or yield goal as the basis to determine mature citrus grove N fertilizer rates in favor of an N rate maximum capped at 200 lb/acre for typical groves and 240 lb/acre for "exceptional" groves (defined as groves producing 700 or more boxes/acre annually).

Florida Enters the BMP Era

In the late 1980s, the Florida Department of Environmental Protection (FDEP) surveyed drinking water quality across the state and detected nitrate-N in 63% of the wells tested. The nitrate-N concentration in 15% of the wells was greater than the EPA drinking water standard of 10 ppm. A large majority of the high-nitrate wells were located in Lake, Polk, and Highlands counties, the heart of Florida's central Ridge citrus production area.

Although the influence of citrus N fertilization on groundwater nitrate concentration was unknown, the combined circumstances of large citrus acreage, relatively high annual N fertilization rates, high annual rainfall, and extremely inert, porous soils led the Florida Department of Agriculture and Consumer Services (FDACS) to implement a set of voluntary BMPs for N fertilization of Ridge citrus trees designed to protect water quality. These were the first official nutrient BMPs for Florida citrus production. A grower implementing the program receives a presumption of compliance with water quality standards from FDACS.

Subsequently, citrus production BMP manuals were written for the Indian River, Peace River, and Gulf production areas, and grower implementation is now taking place. These BMPs go beyond nutrient management to include irrigation and drainage management, erosion prevention, pesticide use, and aquatic weed control. Essentially the entire commercial citrus industry in Florida now has access to a voluntary BMP umbrella. Producing citrus under BMP implementation allows a grower to farm profitably without the threat of administrative penalties if groundwater standards are violated.

This publication provides an understanding of concepts and issues of nutrition that can address environmental issues and concerns about profitability of Florida citrus in a highly competitive global market.