UNIVERSITY OF FLORIDA
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Institute of Food and Agricultural Sciences

SL 185

Effects of P and K Fertilization on Young Citrus Tree Growth[1]

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Introduction

In Florida, the most important factors affecting growth of newly planted citrus trees are irrigation and nitrogen (N) fertilization. Since N fertilization has been linked to groundwater water quality degradation in some agricultural areas, recent nutrient management studies with young Florida citrus trees have focused on N fertilizer rates and sources in combination with irrigation water management. While the effects of phosphorus (P) and potassium (K) nutrition have been documented for mature citrus trees in terms of fruit yield and quality, the influence of these two macronutrients on non-bearing tree growth has not been studied under the modern production conditions found in today's citrus groves. Studies with P are particularly needed due to this nutrient's association with surface water pollution when it leaches or runs off from agricultural production areas.

Past studies of the effects of N fertilizer on young tree growth in Florida have applied P and K fertilizers concurrently, often in a specified ratio of N-P_2O_5-K_2O. For example, a young tree fertilization experiment might involve several rates and application frequencies of an 8-8-8 fertilizer. Thus, the P and K rates changed as the N rate changed. The UF/IFAS citrus fertilization recommendations for the first 3 years after planting reflect this scheme, where the applied P and K rates are directly related to the selected annual N rate. If trees are planted on a previously non-fertilized soil, the recommendation is to apply N using an 8-8-8 fertilizer mixture. If the land previously received P fertilizer, then an 8-4-8 blend is recommended (UF/IFAS Bulletin SP-169 Nutrition of Florida Citrus Trees).

Experience in Florida tells us that a positive tree growth or fruit yield response to an increasing rate of a complete fertilizer can be attributed almost entirely to N. The dominance of the N effect does not allow us to examine the subtle growth effects of increasing P or K nutrition unless an experiment is designed to equalize the N effect across a range of independently varying P and K fertilizer rates.

Purpose

In 1998, an experiment was initiated in south Florida to study P and K fertilizer rate effects on young tree growth where a constant, non-limiting N fertilizer rate was applied to all trees. This report focuses on the initial findings of that experiment.

1. This document is SL185, one of a series of the Soil and Water Science Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Published October 2001. Visit the EDIS Web Site at http://edis.ifas.ufl.edu.

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Field Experiment

Young Flame grapefruit and Hamlin orange trees obtained from a commercial citrus nursery were planted at a 15 ft (within-row) by 22 ft (between-row) spacing at the University of Florida research citrus grove in Immokalee, FL on a previously-uncultivated Immokalee fine sand. This soil had never been fertilized before and contained P and K concentrations that were rated "very low" according to University of Florida soil test interpretations (5 and 10 ppm Mehlich 1 P and K, respectively). The trees were micro-sprinkler irrigated and were grown using standard horticultural practices for south Florida citrus. The grove was divided into three-tree plots that received varying rates of P and K fertilizer (P_2O_5 rates of 0, 50, 100, and 200 lbs/acre/year, and K_2O rates of 0, 100, 200, and 400 lbs/acre/year, in all possible combinations applied uniformly to the herbicide band beneath the trees). All plots received the optimum annual N fertilizer rate according to University of Florida recommendations.

Soil and leaf tissue samples were taken in late summer each year. The soil (0- to 8-inch depth taken from the dripline) was subject to routine soil testing, and leaves were analyzed for total N, P, and K concentrations. Young tree growth was evaluated by estimating canopy volume from measurements of canopy diameter and tree height, and by visually evaluating the trees for vigor and growth habit.

Results

During the first 2 years, there were no visible differences in tree growth due to P or K fertilization. Only in the third year did some subtle tree growth differences begin to emerge, and they were stronger for K than for P. In 2000, increasing P and K fertilizer rates resulted in a concurrent increase in leaf tissue P and K concentrations of both grapefruit and oranges, but again K fertilizer had a stronger effect (Figure 1). The 100 lbs/acre annual rate of K_2O was sufficient to raise leaf K from a near deficient concentration into the optimum range. The fact that leaves from trees receiving no P fertilizer had P concentrations in the optimum range was somewhat surprising. Since the native soil tested 5 ppm Mehlich-1 P and the irrigation water contained 70 ppb of dissolved P, it is possible that the non-fertilized trees received sufficient P nutrition from these sources.

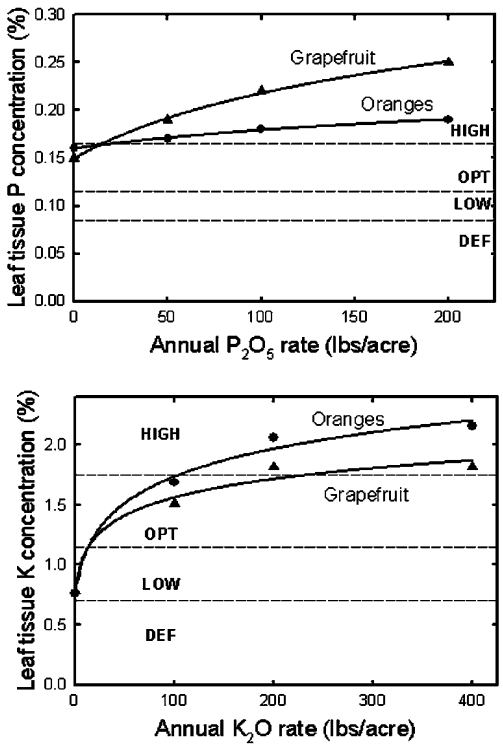

Figure 1. Response of P and K concentrations in leaf tissue sampled from 3-year-old citrus trees to annual P and K fertilization rates.

Grapefruit tree canopy volume responded positively up to an annual K_2O rate of 200 lbs/acre (Figure 2), but there was no response of canopy volume to P fertilizer (data not shown). Three-year-old grapefruit trees grown with no K fertilizer had a tighter, more compact canopy with shorter branches, while those grown with addition of K produced a wider, more open canopy (Figure 3). An effect of P fertilizer on canopy growth habit could not be distinguished.

Summary

Although the P and K fertilizer rates had no profound effect on young citrus tree growth during the first 3 years, the true test will come as the trees begin to bear fruit. Future fruit crops will represent a substantial demand for nutrients beyond that of the leaves and wood. The ultimate goal of this experiment

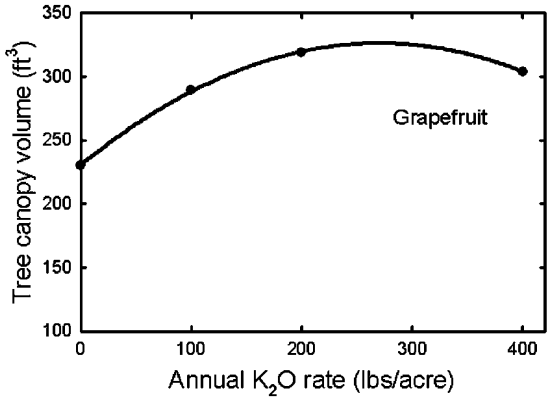

Figure 2. Response of 3-year-old grapefruit tree canopy volume to annual K fertilizer rate.

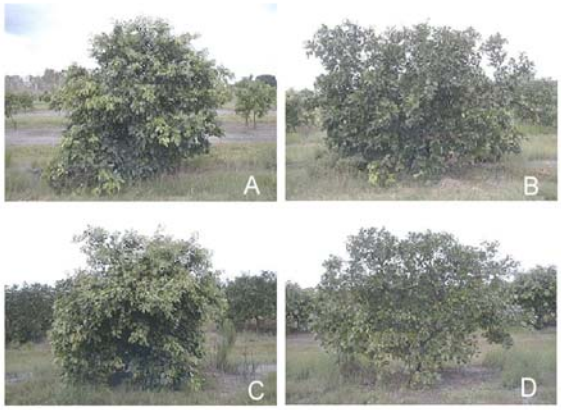

Figure 3. Effects of P and K fertilizer on canopy shape and size of 3-year-old grapefruit trees. A: 0 lbs P_2O_5/acre, 0 lbs K_2O/acre; B: 0 lbs P_2O_5/acre, 200 lbs K_2O/acre; C: 200 lbs P_2O_5/acre, 0 lbs K_2O/acre; D: 200 lbs P_2O_5/acre, 200 lbs K_2O/acre.

is to determine the main effects and interactions of P and K fertilization on yield and fresh fruit quality of grapefruit and oranges.