

# **Effects of P and K Fertilization on Young Citrus Tree Growth**

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## **Introduction**

In Florida, the most important factors affecting growth of newly-planted citrus trees are irrigation and 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 P and 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 orchards. Studies with P are particularly needed due to this nutrient's association with surface water pollution as a result of leaching or run-off from agricultural production areas.

When studying the effects of N fertilizer on young tree growth in Florida, P and K fertilizers are applied concurrently, often in a specified ratio of N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O. 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 change as the N rate changes. The Univ. of Florida's 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 were planted on a previously non-fertilized soil, the recommendation is to apply N using an 8-8-8 fertilizer mixture. If the land had previously received P fertilizer, then an 8-4-8 blend is recommended.

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. 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.

### **Field Experiment**

Young 'Flame' grapefruit and 'Hamlin' orange trees obtained from a commercial citrus nursery were planted at the Univ. of Florida research citrus orchard 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 Univ. of Florida soil test interpretations. The trees were micro-sprinkler irrigated and were grown using standard horticultural practices for south Florida citrus. The orchard 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). All plots received the optimum annual N fertilizer rate according to Univ. of Florida recommendations.

Soil and leaf tissue samples were taken in late summer each year. The soil 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

Visual differences in tree growth as a result of varying P and K rates under optimum N management were difficult to discern. Another way of expressing this was that during the first 2 years, it was difficult if not impossible for an observer to distinguish between plots without looking at a field map. Only in the 3<sup>rd</sup> year did some subtle tree growth differences begin to emerge, and they were stronger for K than for P.

Soil test results reflected the ability of the Immokalee soil to hold some P fertilizer, but also showed that the soil had little capacity to hold K. 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 (Fig. 1). The 100 lbs/acre annual rate of K<sub>2</sub>O 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. The native soil was not entirely devoid of P, and the irrigation water contained 70 ppb of dissolved P, so it is possible that the non-fertilized trees received sufficient P nutrition from these sources.

Grapefruit tree canopy volume responded positively up to an annual K<sub>2</sub>O rate of 200 lbs/acre (Fig. 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 addition of K produced a wider, more

open canopy (Fig. 3). An effect of P fertilizer on canopy growth habit could not be distinguished.

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

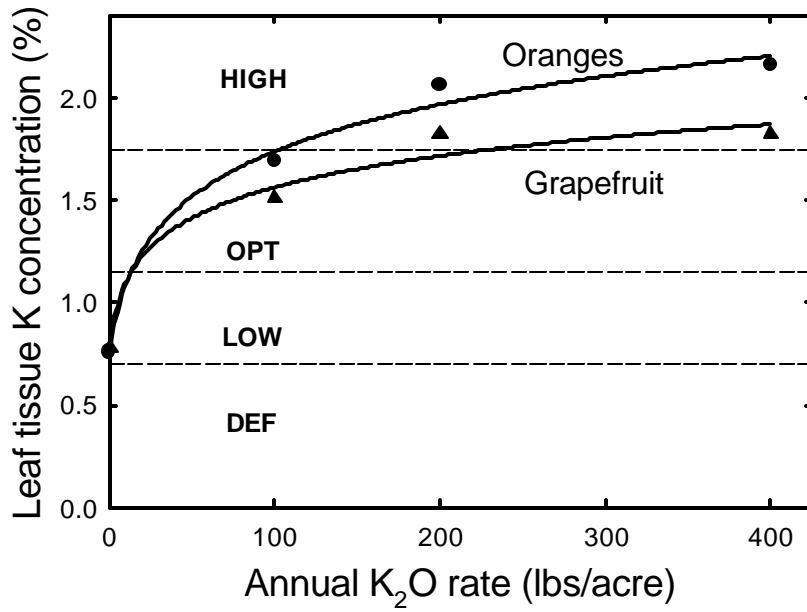
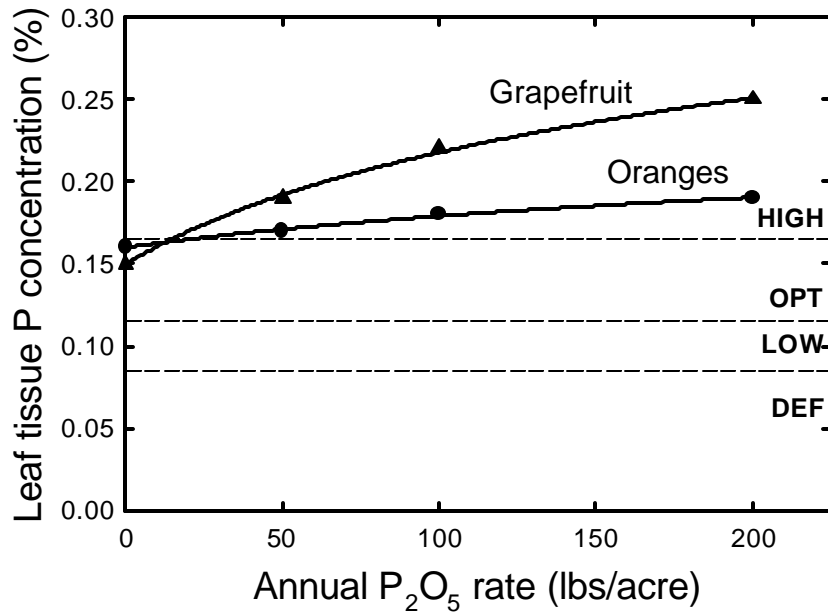


Fig. 1. Response of P and K concentrations in leaf tissue sampled from 3-year-old citrus trees to annual P and K fertilization rates.

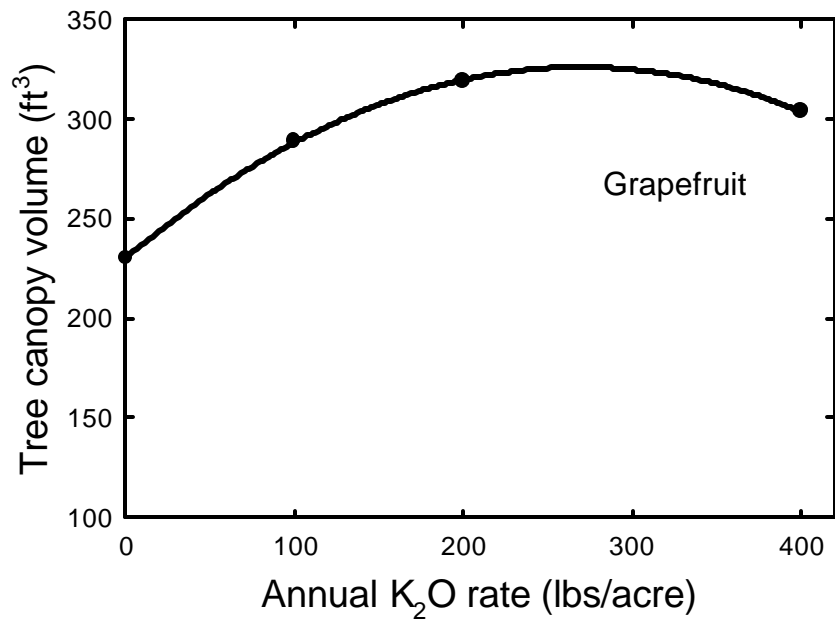




Figure 2. Response of 3-year-old grapefruit tree canopy volume to annual K fertilizer rate.

Figure 2. Effects of P and K fertilizer on canopy shape and size of three-year-old grapefruit trees.

	0 lbs K <sub>2</sub> O/acre	200 lbs K <sub>2</sub> O/acre
0 lbs P <sub>2</sub> O <sub>5</sub> /acre		
200 lbs P <sub>2</sub> O <sub>5</sub> /acre	