Importance of nutrients for citrus trees

By Mongi Zekri and Tom Obreza

Let's talk about potassium (K).

To maintain a viable citrus industry, Florida growers must consistently produce large, high-quality, economic fruit crops from year to year. Efficiently producing maximum yields of high-quality fruit is difficult without an understanding of soils and nutrient requirements of bearing citrus trees. Most Florida citrus is grown on soils inherently low in fertility with low cation exchange capacity (CEC) and low water-holding capacity; thus soils are unable to retain sufficient quantities of available plant nutrients against leaching by rainfall or excessive irrigation.

Potassium (K) is one of the most important nutrients applied as fertilizer in Florida citrus groves. Potassium (also called potash) is listed on the fertilizer label as K_2O. Potassium plays a key nutritional role in determining yield, fruit size and quality. Florida sandy soils used to produce citrus are naturally low in K. Furthermore, K is not fixed and does not accumulate in those sandy soils, even with repeated fertilizer applications. Thus, K fertilizer application is required every year in Florida citrus groves. Potassium deficiency is not common when a grove is fertilized normally, but deficiency can develop on high pH soils or when high N rates stimulate high fruit production.

Apply K fertilizer at a K_2O rate equal to the N rate.

If leaf K is consistently less than optimum from year to year, increase the K_2O rate by 25 percent. Low leaf K concentrations are common in groves planted on calcareous soils. If low yield, small fruit, fruit splitting and/or creasing are observed, application of additional K fertilizer is justified. If trees do not respond to K soil application, an alternative approach to increasing leaf K is foliar sprays of potassium nitrate (KNO_3) or monopotassium phosphate (MKP), (KH_2PO_4). Precautions should be taken to avoid foliar burn from high spray concentrations. Fruit burn was not observed when 25 lbs. KNO_3/acre were applied in 125 gal. of water/acre, 15 lbs. MKP/acre were applied in 32.5 gal. of water/acre, or when 15 lbs. MKP/acre were applied in 10 gal. of water/acre by airplane.

Guidelines for interpretation of orange tree leaf K (%) analysis based on 4- to 6-month-old spring flush leaves from non-fruiting twigs

Deficient	Low	Optimum	High	Excess
<0.7	0.7 – 1.1	1.2 – 1.7	1.8 – 2.4	>2.4

Tree age	Oranges	Grapefruit	Other cultivars
	Pounds of K_2O/acre/year (range)		
4-7	120 – 200	120 – 160	120 – 200
8 and up	140 – 250 Yield based	120 – 160	120 – 300 Yield based

Tree age	Pounds of K_2O/tree/year (range)
1	0.15 – 0.30
2	0.30 – 0.60
3	0.45 – 0.90

POTASSIUM FUNCTIONS

Citrus fruits remove large amounts of K compared with other nutrients. Potassium moves from leaves to fruit and seeds as they develop. Potassium is necessary for several basic physiological functions like the formation of sugars and starch, synthesis of proteins, normal cell division and growth, and neutralization of organic acids. Potassium is important in fruit formation and enhances fruit size, flavor and color. This nutrient also helps to reduce the influence of adverse weather conditions like drought, cold and flooding.

Potassium is known to influence many enzymatic reactions and is associated with almost every major plant function. Potassium helps regulate the carbon dioxide supply to plants by controlling stomata opening and closing. Potassium improves the efficiency of plant water and sugar use for maintenance and normal growth functions. Additionally, K moves sugars from the site of photosynthesis to other storage sites. Potassium works with phosphorus (P) to stimulate and maintain rapid root growth of plants, and stimulates the synthesis of protein from amino acids. Potassium improves plant health and resistance to disease and tolerance to nematodes and insects. The rate of photosynthesis drops sharply when plants are K deficient.

Effects of K on citrus fruit quality

Variable	K
Juice Quality	
Juice Content	–
Soluble Solids (SS)	–
Acid (A)	+
SS/A Ratio	–
Juice Color	–
Solids/Box	–
Solids/Acre	+
External Fruit Quality	
Size	+
Weight	+
Green Fruit	+
Peel Thickness	+

Increase (+), Decrease (-)

Increasing potassium in the tree from deficient to optimum concentration increases yield, fruit size, fruit weight, green fruit, peel thickness and acid content. Concurrently, juice content, total soluble solids (TSS), TSS/acid ratio and juice color decrease.

Sufficient potassium reduces incidence of fruit splitting, creasing, fruit plugging and stem-end rot of fruit in storage.

Timing is important for K applications to enhance fruit size and yield. Potassium is a primary component of cell walls, accounting for more than 40 percent of fruit mineral content. About 70 percent of final fruit size is related to the number of cells in the fruit, so more cells usually means larger fruit. Cell division typically stops by late April; thus fruit size change throughout the rest of the year comes from cell enlargement. Therefore, the maximum effect of foliar K (8 lbs./acre K_2O) is achieved from applications that make this important nutrient available during bloom and post-bloom when it can be used during both cell division and rapid cell enlargement phases.

POTASSIUM DEFICIENCY

The rate of photosynthesis drops sharply when plants are K deficient. Too much N with too little K can result in a backup of the protein building blocks, set the stage for disease problems, reduce production of carbohydrates, reduce fruiting and increase fruit splitting, fruit creasing, plugging and drop. A shortage of K can result

in decreased yield and low fruit quality. Negative effects of low K on fruit yield and quality generally precede appearance of leaf deficiency symptoms. Decreased yield and small fruit have been observed on trees with leaf K in the range of 0.5 to 0.8 percent, while K concentrations of 1.2 percent or more have been associated with maximum yield of high quality fruit. Moderately low concentrations of K in the tree will cause a general reduction in growth without visual deficiency symptoms. The onset of visual deficiency symptoms means that production has already been seriously impaired.

In Florida, low K fertilization can lead to deficiency symptoms that develop in late summer and fall on the recently matured spring flush leaves. When K is low, the general leaf pattern begins as a yellowing of the tips and margins, which then gets broader. Necrotic areas and spotting can develop on the leaves. Symptoms appear first on older leaves because K tends to concentrate in the rapidly growing tissues. Potassium deficiency will cause slow vegetative growth, small leaves, fine branches, thin canopy, an increase in susceptibility to drought and cold, reduction in fruit size, very thin peel of smooth texture, premature shedding of fruit, and lower acid concentration in the fruit.

Potassium deficiency symptoms usually result from an insufficient K supply in the soil. Potassium deficiency may occur on acid sandy soils where leaching may be considerable. The supply of K to plants may be decreased by soils that have very high concentrations of calcium and magnesium or by heavy application of N. Decreased K uptake is typical on some calcareous soils. Lack of soil moisture also reduces K uptake and may lead to K deficiency. If the supply of N and P is high relative to that of K, growth may be rapid at first, but the K concentration in the plant may ultimately decrease to cause deficiency. Addition of K would be necessary to maintain the nutrient balance required for uniform and continued growth. In situations where available K is high compared with the N or P supply, luxury consumption of K can occur. (Luxury consumption means the plant takes up more of the nutrient than it actually needs for maximum growth.)

Under most soil conditions, K deficiency can be corrected by applying potassium chloride (muriate of potash) or potassium sulfate to the soil. However, in fine textured, saline or calcareous soils, K applications to

FDOC is on a Mission
Strategic Plan to Identify Future Goals

By Douglas Ackerman

"A good plan is like a road map:
It shows the final destination and usually the best way to get there."
— H. Stanley Judd

It's been several years since the current Florida Department of Citrus (FDOC) mission statement was created and approved by the Florida Citrus Commission (FCC). With a new FCC and FDOC executive director, the time is right to take a fresh look at the FDOC's role in charting the course for a sustainable future for the Florida citrus industry.

To initiate this process, the FDOC leadership team is conducting a series of strategic planning sessions to discuss very basic questions such as, "Who is the FDOC? What is the role of the FDOC? How can the FDOC best serve the needs of the Florida grower?" Our goal is to develop a mission and an action plan that will guide FDOC efforts over the next few years.

Our first step was to review the current mission statement adopted in 2005. We believe there is an opportunity to further refine the language so that our purpose is more clearly defined and understood.

Next, we identified strengths, weaknesses, opportunities and threats for the FDOC. We also began to outline a list of core values that describe how we conduct ourselves and our business.

As the strategic planning process continues, the leadership team will draft key strategic initiatives (KSIs) which will serve as guiding principles for the future. We will create an action plan that maximizes FDOC strengths and opportunities while minimizing weaknesses and external threats. Each KSI will include a specific timeline and measurements so that we can determine progress toward goals.

When completed, the staff will present the proposed mission statement and FDOC Strategic Plan to the FCC and industry for input and consideration. Having a well-thought-out strategic plan will allow us to align all department functions and allocate resources effectively and efficiently. Our goal is to provide the maximum return on investment for growers and help ensure the sustainability and economic well-being of the Florida citrus industry.

The mission of the Florida Department of Citrus is to grow the market for the Florida citrus industry to enhance the economic well-being of the Florida citrus grower, citrus industry and the state of Florida. Douglas Ackerman, executive director, can be reached at (863) 537-3999. For more information, visit www.FDOCGrower.com

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From top left, clockwise, potassium deficiency symptoms (small fruit, chlorosis and necrotic spotting of leaves)

the soil are sometimes ineffective or slow to correct K deficiency. Foliar application of potassium nitrate or mono-potassium phosphate can be very effective and rapid to correct K deficiency. The recommended foliar K spray for mature citrus trees is 8 lbs. K_2O/acre per application. Foliar spray application of K has been demonstrated to increase fruit size. Foliar-applied K has also corrected K deficiency of citrus on calcareous soil. Foliar application of potassium nitrate (KNO_3) increased leaf K more rapidly compared with soil-applied fertilizers because plant uptake was much faster, but the positive effect was shorter-lasting.

Common solid sources of K applied to citrus groves include:

- Potassium chloride (muriate of potash)
- Potassium sulfate
- Potassium-magnesium sulfate
- Potassium nitrate

K nutrient sources used to manufacture solutions include:

- Potassium chloride
- Potassium nitrate
- Potassium sulfate
- Potassium thiosulfate

K nutrient sources applied in foliar sprays include:

- Potassium phosphite
- Potassium nitrate
- Potassium thiosulfate
- Monopotassium phosphate
- Dipotassium phosphate

CONCLUSION

Supplying sufficient nutrition should be a high-priority management practice for every grower. Furthermore, to achieve optimum plant nutrition, an appropriate nutrient balance is necessary. Correct ratios of nutrients are critical to fertilizer management and sustainability. If an element is below the critical level, yield production will fall, even though the other elements are kept in sufficient supply. Too much N with too little K can reduce fruiting and result in lost crop yield and quality. High K with low N and P supply will induce luxury consumption of K, delay fruit development and reduce juice content. Balanced use of plant nutrients corrects nutrient deficiencies and toxicities, improves soil fertility, increases nutrient and water use efficiency, enhances crop yields and fruit quality, develops tree tolerance to pests, diseases and other stresses, and improves environmental quality.

Mongi Zekri is a multi-county citrus Extension agent and Tom Obreza is a professor and interim associate dean for Extension; both with the University of Florida-IFAS.