

Foliar fertilization in citriculture

By Mongi Zekri

Foliar fertilizer application is certainly not a new concept to the citrus industry. For more than five decades, foliar fertilization of citrus has been recommended to correct zinc, manganese, boron, copper and magnesium deficiencies. It is now common knowledge in agriculture that properly nourished crops may tolerate insect pests and diseases. Traditionally, citrus growers try to achieve optimum nutrition through direct soil management. Currently, with the introduction of citrus greening in Florida, many growers and production managers consider foliar fertilization a key factor to stimulate the natural defense mechanisms of their trees, to induce pest and disease tolerance, and to improve fruit yield and fruit quality.

In Florida, foliar nutrition programs are becoming very common and extensively used to deliver all of the essential nutrient elements to citrus trees. Furthermore, economic and environmental considerations require the utilization of more efficient methods for nutrient applications. Foliar application of fertilizers is more efficient



Foliar feeding of citrus trees.

than traditional soil application because of better, faster nutrient uptake and reduced losses. Although field research has shown that supplemental foliar feeding can increase yield by 10 to 25 percent compared with conventional soil fertilization, foliar fertilization should not be considered a substitute for a sound soil-fertility program.

Foliar fertilizer application is highly efficient because the materials are targeted to areas where they can be

directly absorbed into the plant. However, nutrients foliarly applied prior to a rainfall are subject to being washed off the leaves and onto the soil. Foliar fertilizer application also provides a more timely and immediate method for delivery of specific nutrients at critical stages of plant growth. Foliar nutrition programs are therefore valuable supplements to soil applications.

As indicated previously, foliar feeding is not intended to replace soil-applied fertilization of the macronutrients (nitrogen, potassium and phosphorus). Foliar applications of macronutrients can, however, be alternatively applied in sufficient quantities to influence both yield and fruit quality. Citrus trees can have a large part of the annual nitrogen requirements met through foliar applications. Foliar applications of other macronutrients (calcium, magnesium and sulfur) and micronutrients (zinc, manganese, copper, boron and molybdenum) have proven to be an excellent means for satisfying citrus tree requirements.

Because fertilizer applications to the soil can be subjected to undesirable processes such as leaching, runoff and being tied up in the soil in unavailable forms, foliar applications of nutrients have been designed to be an integral component of overall tree nutrition programs. They are used in other situations to help trees through short but critical periods of nutrient demand, such as vegetative growth, bud differentiation, fruit set and fruit growth.

Foliar application of nutrients is of great importance when the root system is unable to keep up with crop demand or when the soil has a history of problems that inhibit normal nutrient uptake.

Foliar nutrition is proven to be useful under prolonged periods of



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wet conditions, drought conditions, calcareous soil, cold weather or any other condition that decreases the tree's ability to take up nutrients when there is a demand.

Foliar feeding may be effectively utilized when a nutritional deficiency is diagnosed. Foliar application is absolutely the quickest method of getting the most nutrients into plants. However, if the deficiency can be observed on the tree, the crop has already lost some potential yield.

FOLIAR BURN

While foliar feeding has many advantages, it can burn leaves at certain

rates under certain environmental conditions. It is important, therefore, to foliar feed within some established guidelines. There are a number of plant, soil and environmental conditions that can increase the chances of causing foliar burn to foliar fertilizer application. For example, a tree under stress is generally more susceptible to damage. Stressful conditions include drying winds, disease infection and unfavorable soil conditions. The environmental conditions at the time of application are also important factors. Applications when the weather is hot (above 80°F) should be avoided. This means

that during warm seasons, applications should be made in the morning or evening when the temperature is right, wind is minimal and the stomates on citrus leaves are open, allowing leaves to efficiently exchange water and air.

Nutrient absorption is increased when spray coverage reaches the undersides of the leaves where the stomates are located. Favorable results from foliar feeding are most likely to occur when the total leaf area is large. Foliar applications of micronutrients with the exception of iron are more effective and efficient when the spring, summer, and fall new flush leaves are about fully expanded. Additionally, applications should be at least two weeks apart to give the tree sufficient time to metabolize the nutrients and deal with the added osmotic stress. To be efficient and to avoid crop damage, dilute solutions of nutrient formulations are recommended. Highly concentrated sprays, especially those including salt-based fertilizers, have the potential to cause leaf burn and/or drop.

Another important factor when applying nutrients foliarly is to ensure that the pH of the spray solution is in the proper range (between 5.5 and 6.5). This is particularly important in areas where water quality is poor.

NITROGEN SOURCES

In order to enhance uptake and thus the effectiveness of any foliar application, nitrogen should be added to the solution. Urea may be the most suitable nitrogen source for foliar applications due to its low salt index and high solubility in comparison with other nitrogen sources. Urea has been shown to stimulate absorption of other nutrients by increasing the permeability of leaf tissue. However, the urea utilized in foliar sprays should be low in biuret content (0.2 percent or less) to avoid leaf burn.

Other sources of nitrogen can be obtained from ammonium polyphosphates, ammoniated ortho-phosphates, potassium nitrate, calcium nitrate and ammonium thiosulfate. These sources, when utilized at low rates of foliar application, are excellent supplemental nitrogen carriers with minimal foliage burn side-effects. Triazone nitrogen has been shown to significantly reduce leaf burn and enhance foliar-absorbed nitrogen, compared with urea, nitrate and ammonium nitrogen sources.

The use of a combination of poly and ortho-phosphates has been shown to lessen leaf burn and aid in leaf phosphate absorption. Phosphites have



Mg

Magnesium

- Primarily utilized in chlorophyll production
- Promotes Phosphorous uptake
- Needed in formulation of sugars & translocation of starches
- Influences carbohydrate metabolism

Mn

Manganese

- Critical component of amino acid & protein production
- Utilized in the activation of various enzymes in the plant
- Involved in nitrate reduction
- Needed for chlorophyll formation & photosynthesis

Zn

Zinc

- Crucial for enzyme activation and metabolic processes throughout the plant
- Essential in the formation of auxins, an important promoter of plant growth
- Needed for chlorophyll formation & photosynthesis
- Improves water uptake

Timely applications of Magnesium Nitrate, Manganese Nitrate and Zinc Nitrate can be utilized in your citrus programs to promote nutrient efficiency during the growing season and realize your maximum yield potential. The nitrate form of nitrogen is the preferred form of Nitrogen in the citrus plant, and is most efficiently absorbed through the plant tissue and leaves.

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also been found useful, safe and not phytotoxic as foliar sprays on citrus trees. Potassium polyphosphates, potassium hydroxide, potassium nitrate and potassium thiosulfate sources combine both low salt index and high solubility characteristics. Foliar application of calcium, magnesium, sulfur, zinc, manganese, copper, boron and molybdenum can be highly effective to satisfy nutrient requirements. However, there can be difficulties associated with leaf tissue absorption and translocation of calcium, magnesium, boron and molybdenum. Choosing the correct fertilizer sources for these nutrients can be critical. Good sources for supplying many of the micronutrient elements are the sulfate sources.

CHEMICAL INTERACTIONS

Be careful about possible chemical interactions among foliar fertilizers. Some materials are incompatible and should not be mixed together. They may create precipitates that tie up and make some nutrients unavailable and/or clog spray nozzles. Many product labels warn of such incompatibilities. If there is no specific packaging information, small quantities of the materials should be mixed with water in a jar



Citrus tree performance under a soil-applied fertilizer program supplemented with foliar nutrition.

and shaken. If there is no precipitate, there should be no problem.

Foliar fertilization can sometimes be combined with pesticide application. However, timing conflicts and material incompatibilities can sometimes make combining such sprays unwise. Be sure to read all product labels and do the jar test if uncertain.

Foliar applications of low biuret

urea at 12 to 14 gallons or at 53 to 60 lbs. (24 to 28 lbs. N) per acre or phosphite (PO_3) at 3 pints (60 percent P) to 2 quarts (26 percent P) per acre in late December to early January (six to eight weeks before bloom) have been demonstrated to increase flowering, fruit set and fruit production. Postbloom foliar applications of potassium nitrate or mono-potassium phosphate at 8 lbs. K_2O per acre have also been found to increase yield and fruit size. Foliar spray applications of 3 to 5 lbs./acre of magnesium, manganese, zinc and copper, and 0.25–0.50 lb./acre of boron and molybdenum are also recommended for citrus trees to prevent nutrient deficiencies and improve production.

Today, foliar feeding is playing an important role in Florida citrus production. It is rapidly gaining ground as a nutritional supplement to soil-applied fertilizers to improve yield and fruit quality, particularly in the face of HLB (citrus greening). Foliar nutrition is also a very important and effective way of addressing diagnosed problems with specific deficiencies observed within the grove and a best management strategy for supplying micronutrients, with the exception of iron. The concept that foliar sprays should be applied only after the appearance of a deficiency is unsound, since reductions in yield and quality usually precede the appearance of visual symptoms. In addition to soil-applied fertilizers, foliar sprays of nutrients should be used with the objective of maintaining citrus tree health at an optimal level.

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