COVER STORY

Increasing efficiency and reducing the cost of nutritional programs

By Mongi Zekri, Thomas Obreza and Arnold Schumann

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 soil characteristics 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, most Florida soils are unable to retain sufficient quantities of available plant nutrients against leaching by rainfall or excessive irrigation.

NITROGEN AND POTASSIUM

Nitrogen (N) and potassium (K) are the two most important nutrients applied as fertilizer in Florida citrus groves. Nitrogen influences vegetative growth, flowering and fruit yield more than any other nutrient. Potassium plays a key nutritional role in determining yield, fruit size and fruit quality. Fertilizer application ratios of N to K_2O are usually 1:1, but a ratio of 1:1.25 may be useful on high pH or calcareous soils if K is low in the tree.

Management practices that improve fertilizer efficiency include:

- Checking leaf analysis results for nutritional deficiencies or excesses
- Basing N fertilizer rates on IFAS recommendations and expected production
- Selecting fertilizer formulations appropriate for existing conditions
- Carefully placing fertilizer within the root zone
- Timing applications to avoid the rainy season
- Splitting applications
- Irrigating to meet the needs of the tree while minimizing leaching

LEAF ANALYSIS

Leaf sampling and analysis is a useful management tool for making fertilization decisions. One indicator of successful fertilizer management is a citrus tree with leaf nutritional standards within optimum ranges. Trends of leaf N and K results throughout several years provide the best criteria for adjusting rates within the recommended ranges. Soil analysis is useful to determine soil pH and extractable phosphorus (P), calcium (Ca) and magnesium (Mg).

RECOMMENDED FERTILIZER RATES

Numerous N fertilizer rate and timing studies conducted by University of Florida and U.S. Department of Agriculture-Agricultural Research Service scientists over many years on a wide range of soil types, tree ages, varieties, rootstocks and cultural conditions have verified that N rates in excess of 180 to 210 lbs./acre are not justified except for unusually productive groves (e.g., > 700 boxes/acre for round oranges). Excessive rates of N can reduce yields and fruit size.

GROVE CONDITIONS

In a mature grove where there is little net increase in tree size, N used for leaf growth is largely recycled as leaves fall, decompose and mineralize. Replacing N removed by fruit harvest becomes the main focus of fertilization, and nutrient requirements should vary as the crop load changes.

Nutritional programs should also be adjusted when leaf or tree canopy loss occurs due to severe pruning or freezes, or if extensive root damage occurs following flooding, tropical storms or hurricanes. In the case where leaves and fruit have been lost but the root system remains intact, fertilizer rates may need to be elevated to support the growth of replacement leaves and fruit. If both roots and canopy suffer damage, fertilizer rates should be reduced proportionally to the amount of canopy loss. With the reduction in rates, application frequency should be increased.

Inorganic and synthetic organic N fertilizers are high-analysis materials and are generally most economical for use in citrus groves. These high-analysis materials are rapidly available unless formulated as a controlled-release product. The use of high-analysis fertilizers almost eliminates the need for filler, so a substantial portion of the mixing, transportation and application cost is reduced. Loss of N through ammonia volatilization on calcareous soils is a concern when ammoniacal-N is applied to the soil surface without being incorporated by rainfall or irrigation. The use of controlled-release fertilizers for resets in established groves is a viable option.

APPLYING FERTILIZER

Two-thirds of the fertilizer applications to citrus each year should occur between February and early June, timed so that nutrients are available during the flowering and fruit-setting period. The remaining one-third can be applied in September or October. Split fertilizer applications or fertigation combined with sound irrigation management increases fertilizer efficiency by consistently supplying nutrients and by reducing leaching if an unexpected rain occurs. With these circumstances, less fertilizer is required. Fertilizer reduction can also be realized by targeted placement within the root zone and timing applications to avoid rainy periods.

Carefully place fertilizer within the root zone.

When fertigating, nutrients are placed in the wetted area where feeder roots are most extensive. The fertilizer can be applied frequently in smaller amounts so it is available when the tree needs it. Thus, application costs with fertigation are lowered when compared with dry or foliar fertilizers. Efficiency and cost savings of fertigation are greatest for young trees. Fertigation is not a recommended production practice if the irrigation system is non-uniform or poorly designed. Remember that fertilizer and water are wasted when a calendar-based fertigation schedule applies nutrients to wet soil. Water and nutrient uptake are drastically

reduced in saturated soil conditions.

Nutrient uptake is enhanced by foliar feeding when a soil is calcareous or possesses any other condition that decreases the roots' ability to take up nutrients. Foliar applications of low-biuret urea (25 to 28 lbs. N/acre) or phosphorous acid (2.6 quarts/acre of 26 to 28 percent P_2O_5 material) in late December or early January are known to increase flowering, fruit set and fruit yield. Post-bloom foliar applications of potassium nitrate or mono-potassium phosphate (8 lbs./acre K_2O) in late April have been found to increase fruit size and yield.

Variable-rate equipment can greatly increase the efficiencies of both foliar-applied nutrients and granular ground-applied fertilizers. The most popular variable-rate fertilizer application technique involves optimized targeting of nutrients to tree roots and canopies. The variable-rate equipment senses the location of tree canopies while driving down the grove middles, and uses that information to apply granular fertilizer only under tree canopies and nutrient spray only to citrus foliage, thus avoiding dead trees or empty spaces. If trees are being removed due to decline from diseases, the fertilizer not being applied in the remaining spaces constitutes an immediate cost saving for the grower. Additional savings can be realized by programming the variable-rate equipment to apply different rates of nutrients according to tree canopy size.

PHOSPHORUS

Phosphorus applied to citrus groves during establishment and early growth stages does not leach significantly, but rather accumulates in the soil where P becomes slowly available. Consequently, fertilizer applications containing P can be reduced or omitted in mature groves. Phosphorus does not leach readily when the soil pH is 6 or higher, and the fruit crop removes only small amounts of P. Therefore, regular P fertilizer applications are not necessary. Some soils used for new citrus plantings may be naturally low in P. An example is the commonly known "sand-soaked" area. In this situation, P fertilizer should be applied, but only until soil tests show P is no longer necessary.

MICRONUTRIENTS

The application of most micronutrients used to be recommended only when deficiency symptoms appeared. However, with the introduction of HLB (citrus greening disease), many growers and production managers have been foliar feeding with micronutrients several times a year. Foliar spray applications of micronutrients [manganese, zinc, copper (Cu), boron and molybdenum (Mo)] are much more effective and economically practical than soil applications. These micronutrients should be included with post-bloom and summer foliar sprays after full leaf expansion of the new growth flush. Cu should not be included in the fertilizer if Cu fungicides are used or if a soil test shows sufficient Cu is present (5 to 10 lbs./acre). Mo deficiency occurs on soils that have become very acidic (< pH = 5.0) and can serve as an indicator of potential problems with aluminum toxicity. A lime application will raise soil pH and usually corrects this problem. Iron (Fe) deficiency can be corrected by applying an Fe chelate, for example Fe-EDTA where soil pH < 7 and Fe-EDDHA where soil pH > 7.

Nutrient uptake is enhanced by foliar feeding when a soil is calcareous.

Use leaf and soil sampling to guide fertilization programs.

SOIL pH

Targeted soil pH should be between 5.5 and 6.5. Soils high in Cu should be maintained at the high end of this range. A distinct advantage of pH 6 compared with pH 5 has been demonstrated in several studies, and pH of 7 was no better than 6. Soil pH can be increased by application of either calcitic or dolomitic lime.

Dolomite supplies both Ca and Mg, so the choice of dolomite would be more advantageous if Mg is also necessary. Liming a soil that has a pH of 6 or greater is costly and unnecessary. In groves where soils have a favorable pH, but a soil test or leaf analysis indicates low Ca, gypsum (calcium sulfate) can be applied as a source of Ca that will not affect soil pH. Applying dolomite as a source of Mg is not a recommended practice if the soil pH is in the desired range. Given these conditions, soil application of Mg sulfate or foliar application of Mg nitrate are effective for correcting Mg deficiency.

KEY POINTS SUMMARIZED

- Increasing the efficiency of applied nutrients is a key to economic citrus production.
- Nitrogen and potassium fertilizers affect fruit production and quality more than any other applied nutrients.
- Management practices that improve fertilizer efficiency include:
  1. Using leaf and soil analysis to guide fertilization programs
  2. Choosing realistic fertilizer rates based on established guidelines and expected production
  3. Selecting fertilizer sources appropriate for grove conditions
  4. Careful placement and timing of fertilizer applications; use variable-rate equipment
  5. Managing irrigation to minimize leaching of soluble nutrients
- Foliar feeding of most nutrients is more efficient than soil application and appropriate when soil conditions prevent sufficient uptake of nutrients to meet tree demands.
- Phosphorus fertilizer should be applied judiciously because P can accumulate in the soil.
- Keep soil pH in the range of 5.5 to 6.5. Do not overlime.

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HLB Projects: Transition with Establishment of New Federal Funding Programs

By Harold Browning

The Citrus Research and Development Foundation (CRDF) is working in concert with new federal sources of funding for HLB research to maintain the momentum of research and to transition roles in the presence of recent allocation of significant USDA programs addressing HLB. Those programs are:

- The USDA, National Institute of Food and Agriculture, Specialty Crop Research Initiative, Citrus Disease Research and Extension Program is a national competitive grant program designed specifically to support developmental and problem-solving research to address citrus HLB. The first cycle of the competitive process has been completed, and the results will be announced soon. A second cycle of solicitation for pre-proposals will be announced within the next few months, and all HLB researchers are encouraged to respond to this funding opportunity. This program is authorized for $25 million per year for five years.
- The USDA, Animal and Plant Health Inspection Service was awarded funding to support delivery of near-term solutions to HLB across U.S. citrus states, with $21 million to be expended over two years. This program is overseen by a Multi-Agency Coordination Group and has approved a number of projects since the program began. These funds will complement citrus industry and state legislative investments in research. Researchers should follow news and announcements relating to this funding program as well.

In the context of these new funding sources, CRDF recognizes that there is considerable additional funding available to address all aspects of HLB and to address citrus across all producing states. We strive to remain engaged in all aspects of the search for and delivery of solutions to HLB and will be communicating closely with the USDA programs and funded projects, as we have done in the past with the California and Texas industry HLB research efforts.

During this transition in funding availability, CRDF is also being impacted by the reduced funding associated with smaller citrus crops in recent years. Regardless, CRDF resources remain strong, and our goal is to transition more to field delivery of near-term solutions and to accelerate their evaluation, commercialization and regulatory approval. At the same time, we recognize the gaps that may occur in funding of critical projects during the initial periods of the new funding programs. To that end, we are carefully analyzing our current portfolio, paying special attention to those projects that are ending within 2015. Where federal sources have been committed or are pending, we can allow CRDF projects to transition to new funding. For others that have not yet obtained funding from the other programs, we will analyze results to date and assess the need for continuation of efforts. Where needs occur and other funding has not been committed, we are working toward a process for consideration of new proposals to continue critical work. Communication with project investigators is underway, and we have engaged the CRDF Research Management Committee and Commercial Product Delivery Committee in discussion and later will seek recommendations on projects to be considered for future funding. A process and timeline to address this need is under development and will be addressed by the board in upcoming meetings. Our goal is to prevent critical projects from being interrupted during this transition period. CRDF pledges to continue efforts to discover and deliver solutions to HLB.

Harold Browning is Chief Operations Officer of CRDF. The foundation is charged with funding citrus research and getting the results of that research to use in the grove.

CRDF Grower Dollars at work for you

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