Importance of nutrients for citrus trees

By Mongi Zekri and Tom Obreza

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.

INTRODUCTION

Seventeen elements are considered necessary for the growth of green plants: carbon (C), hydrogen (H), oxygen (O), nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sulfur (S), iron (Fe), zinc (Zn), manganese (Mn), boron (B), copper (Cu), molybdenum (Mo), chlorine (Cl) and nickel (Ni). The importance of N, P, and K when managing nutrients for citrus trees was discussed in previous issues of *Citrus Industry* magazine.

FUNCTIONS AND IMPORTANCE OF Mg

Magnesium is an essential constituent of chlorophyll; it is the center of the chlorophyll molecule. Magnesium is involved in photosynthesis and plays an important role as an activator of several enzymes. It is also involved in carbohydrate metabolism and synthesis of nucleic acids. Magnesium influences the movement of carbohydrates from the leaves to other parts of the tree, and it also stimulates P uptake and transport. Seedy citrus varieties may need more Mg than seedless ones

Let's talk about magnesium (Mg).

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

	Deficient	Low	Optimum	High	Excess
Mg	<0.20	0.20 – 0.29	0.30-0.49	0.50 – 0.70	>0.70

Adjusting fertilization based on soil analysis

	When below sufficiency level	When above sufficiency level
Soil pH	Lime to pH 6.0	1. Do nothing 2. Use acid-forming N fertilizer 3. Apply elemental sulfur 4. Use tolerant rootstocks to high pH
Mg	1. Check soil pH and adjust with dolomitic lime if needed 2. Check leaf Mg status	1. Do nothing 2. Check leaf K status

If soil Mg level is low, apply Mg fertilizer at a rate equal to 20 percent of the N rate. Magnesium nitrate may also be applied as a foliar spray. Curtail Mg fertilizer application if a subsequent soil test shows Mg in the high range.

Interpretation of soil analysis data for Mg (ppm)* using the Mehlich 1 (double-acid) extractant			
	Low	Medium	High
Mg	<15	15 – 30	>30
*parts per million (ppm) x 2 = lbs/acre			

because seeds store a large amount of Mg. Dolomitic limestone is often used to correct acidity; this liming material supplies slowly available Mg as well as Ca. Calcium is abundant in alkaline soils, which can be antagonistic to Mg uptake.

Mg BEHAVIOR IN FLORIDA SOILS

Magnesium exists as solid compounds in the soil (mostly in combination with carbonate or phosphate) and in ionic forms held by the cation exchange complex.

Solid forms of Mg are sparingly soluble; they can reside in the soil for many years if the pH is not highly acidic. Dissolution is more rapid at low pH, which is the basis of the liming reaction.

Effects of Mg on citrus fruit quality

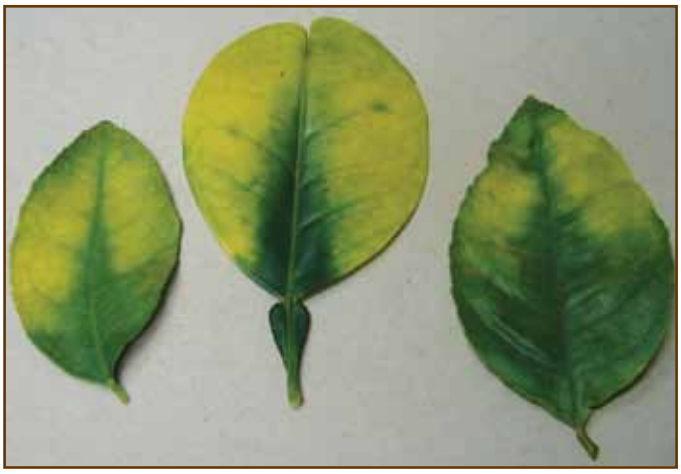
Variable	Mg
Juice Quality	
Juice Content	0
Soluble Solids (SS)	+
Acid (A)	0
SS/A Ratio	+
Juice Color	?
Solids/Box	+
Solids/Acre	+
External Fruit Quality	
Size	+
Weight	+
Green Fruit	0
Peel Thickness	-

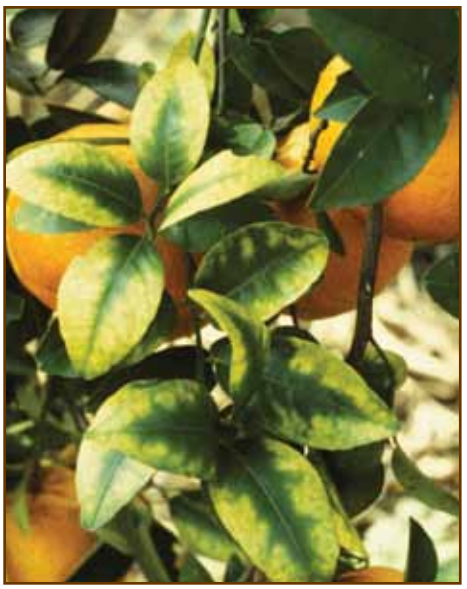
Increase (+), Decrease (-), No effect (0), No information (?)
Magnesium slightly increases total soluble solids per box and per acre, and soluble solid-acid ratio. It also slightly increases fruit size and weight, but decreases rind thickness.

MAGNESIUM DEFICIENCY

Magnesium deficiency has been a major problem in citrus production. In Florida, Mg deficiency is commonly referred to as "bronzing." Trees with inadequate Mg supply may have no symptoms in the spring growth flush, but leaf symptoms will develop as the leaves age and the fruit expand and mature in the summer and fall. Magnesium deficiency symptoms occur on mature leaves following the removal of Mg to satisfy fruit requirements. During the summer, when a rapid increase in fruit size occurs, the symptoms appear on leaves close to the developing fruit. Magnesium deficiency symptoms appear as a result of translocation of Mg from the leaves to the developing fruit, although there may also be a translocation from older leaves to young developing leaves on the same shoot.

Leaf symptoms appearing as disconnected yellow areas or irregular yellow blotches start near the base along the midribs of mature leaves that are near developing fruit. These blotches become gradually larger and eventually coalesce to form a large area of yellow tissue on each side of the midrib. This yellow area enlarges until only the tip and the base of the leaf are green, showing an inverted V-shaped green area pointed on the midrib. In acute deficiency, the yellow area may gradually enlarge until the entire leaf becomes yellow or bronze in color. Leaves that have lost most of their green color drop freely with unfavorable conditions such as cold weather, water stress or concentrated foliar sprays. Defoliated twigs are weak and usually die by the following spring, necessitating pruning of trees. There are neither primary twig symptoms nor striking fruit symptoms associated with Mg deficiency, but a secondary effect following defoliation may lead to twig dieback. Severe defoliation will





Above, *magnesium deficiency symptoms showing disconnected yellow areas with midribs displaying an inverted V-shaped green area*
Left, *magnesium deficiency symptoms showing an inverted V-shaped area pointed on the midrib*
Below, *severe Mg deficiency symptoms showing entire yellowing and bronzing of leaves*

reduce the average size of individual fruit and will cause a general decline in fruit production.

The mobility of Mg in the tree differentiates it from Fe, Zn, Mn and Cu. Deficiency symptoms of these micronutrients develop on new growth, while Mg deficiency occurs only on mature leaves that were previously normal in appearance, usually on limbs bearing a heavy crop. Heavily fruited limbs develop extreme Mg deficiency symptoms and may even become completely defoliated, while limbs with little or no fruit may not show any deficiency symptoms. Cultivars producing seedy fruit are more severely affected by Mg shortage than cultivars producing seedless fruit. Alternate bearing is common in seedy cultivars growing in an Mg-deficient condition. The loss of wood as a result of defoliation reduces the fruit-bearing wood for the following year. Magnesium deficiency can greatly reduce both fruit yield and fruit quality. Fruits from Mg-deficient trees are lower in soluble solids, acidity and vitamin C. Magnesium-deficient trees are more susceptible to cold injury than non-deficient trees.

In Florida, Mg deficiency is caused primarily by low soil Mg concentration. It is particularly severe on acidic sandy soils where Mg readily leaches. Leaching of added Mg is particularly serious and substantially rapid when soil pH is 4.5 to 5.0. Under such conditions, the use of dolomite to raise the pH to 6.0 to 6.5 will furnish Mg at the same time. Soil application of Mg sulfate or oxide can successfully correct Mg deficiency when soil pH is raised. Soil salinity, fertilizers high in potassium salts, and manures have induced or aggravated Mg deficiency. Magnesium deficiency can also be attributed to calcareous soils relatively low in Mg or to unbalanced conditions in the soil due to excessive K or Ca. Under these conditions, the amount of Mg applied must be greater than that applied to soils lower in Ca or K.

In Florida, one foliar spray application of Mg is not always sufficient in correcting the deficiency when the amount of Mg needed is greater than the amount that can be absorbed by the leaves. Foliar sprays of Mg nitrate can be effective when applied to the spring and summer flush leaves when they are two-thirds to fully expanded, but not hardened off. Leaves that have already developed the deficiency pattern will not completely recover when Mg is applied, but deficiency symptoms can be prevented the following season.

Common solid Mg sources for soil application include:

- Magnesium carbonate (dolomitic lime)
- Potassium-magnesium sulfate (sul-po-mag)
- Magnesium sulfate
- Magnesium oxide

Mg nutrient sources used to manufacture fertilizer solutions or applied in foliar sprays include magnesium nitrate.

CONCLUSION

Supplying sufficient tree nutrition should be a high-priority management practice for every citrus grower. Achieving optimum citrus nutrition through fertilizer management involves the proper balance of plant nutrients. If an element is below the critical level, yield production will fall, even though the other elements are kept in good supply. 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, and develops tree tolerance to pests, diseases and other stresses.

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