

Agronomic Technical Bulletin



CROP NUTRITION IN CITRUS PRODUCTION

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Citrus production in the United States of America is located in three regions due to their conducive climates. Those areas include Florida, California (San Joaquin Valley and southern California), and Texas (lower Rio Grande Valley). Based on USDA statistics, 18.1 million pounds of citrus was produced in the United States in 2014-2015. Florida is the primary production area, producing approximately 54% of oranges and 64% of grapefruit. Approximately 90% of the lemons are produced in California. Due to disease issues Florida is projected to experience an estimated 18% reduction in yields in 2015-2016. There was 16% loss in citrus production between 2013-2014 and 2014-2015. These production losses create an economic environment where fine tuning a nutrient management plan is of major importance.

The soils in all three production areas are calcareous with pH values greater than 7.0. Soil pH has direct influence on plant nutrient availability. Therefore, fertilizer management in alkaline soil conditions requires attention to details. The elevated soil pH levels results in less available plant nutrients due to some chemical interactions and the loss/fixation mechanisms within the soil environment. Generally, when the soil pH is greater than 7.2 there is excess calcium carbonate (CaCO_3) that alters the availability of the primary nutrients and manganese (Mn), zinc (Zn), and iron (Fe). Plant nutrient sulphur (S) availability is not significantly reduced under the alkaline conditions. Although, the bacteria that converts elemental sulphur to sulphate is somewhat less active under alkaline conditions. Sulphur is applied as a plant nutrient, but utilized more as a soil amendment when the soil pH is above 7.2. Sulphur as a soil amendment is elemental sulphur or sulphur bentonite applied in sufficient quantities to reduce the pH value. The application rate of sulphur bentonite is a function of soil texture, depth of incorporation, and amount of CaCO_3 present in the soil. Whenever sulphur bentonite is employed as a soil amendment an intensive soil pH monitoring plan should be implemented. Further details on the use of S as a soil amendment can be located in a previous Agronomic Tech Bulletin "Rectify Soil Conditions with TIGER 90CR Sulphur" May, 2014.

SULPHUR AND NITROGEN SYNERGISM

The S concentration in a citrus tree is about equal to the phosphorus (P) concentration. The uptake and assimilation of S and nitrogen (N) by plants are strongly interrelated and depend on each other because of their mutual occurrence in amino acids and proteins. Sulphur is an essential constituent of proteins. As a result protein synthesis, amino acid, and chlorophyll production are retarded in S-deficient plants (Zekri & Obreza, 2013). When a plant is lacking a specific nutrient it displays unique symptoms in its foliage. Since S and N are interactive in same metabolic functions, the deficiency symptoms are similar. Plants are stunted with pale yellowish discoloration in leaves (Photo 1.0). A visual differentiation can be difficult in citrus trees; therefore, plant tissue analysis should be conducted to confirm the deficiency (Table 1.0). A sulphur deficiency can be amplified when above optimum rates of N are applied. This can result in an imbalance of N to S within the plant which disrupts some metabolic processes.



Photo 1.0
Sulphur deficiency symptoms in orange tree leaves. Yellowish-green discoloration in young leaves. Photo: M. Zekri, Univ. of Florida



Photo 2.0
Manganese deficiency in orange tree leaves. Interveinal chlorosis with dark green veins. Photo: M. Zekri, Univ. of Florida

MICRONUTRIENT DEMAND IN CITRUS

Manganese and Zn are the micronutrients that tend to be deficient in Florida and California citrus production regions. Manganese has an active role in plant respiration and N metabolism. Manganese deficiency symptoms include interveinal chlorosis of leaves and veins remain dark green (Photo 2.0). "Manganese deficiency may greatly reduce crop volume and fruit color. Manganese deficiency is frequently associated with Zn deficiency. Generally, it is not recommended to soil apply $MnSO_4$ on calcareous soils as the high pH environment results in rapid chemical reactions such that the Mn is not plant available" (Zekri & Obreza, 2014).



Zinc is essential in formation of chlorophyll and the growth regulator auxin. Zinc deficiency symptoms are characterized by irregular green bands along the mid-rib and main veins on a yellow background (Photo 3.0).

"A Zn deficiency may be exacerbated by excess phosphorus or nitrogen. Insufficient Zn adversely affects tree vigor, resulting in reduced production, smaller fruit size and lower fruit quality" (Fake, 2004). Application rates of Zn vary depending on application method and source. Zinc's reaction in alkaline or calcareous soils is similar to Mn. It is not recommended to soil apply $ZnSO_4$ as it quickly reacts chemically and the Zn is not plant available. However, TIGER Micronutrients Zn 18% contain ZnO and Tiger Micronutrients Mn 15% contains MnO when soil applied the S oxidation releases sulphuric acid that acidulates the oxide to render the Zn and Mn plant available and the acid also lowers the soil pH in a narrow zone around the S pastille to enhance plant availability and uptake of the Zn or Mn. As the sulphur oxidizes the Zn and/or Mn are gradually released throughout the growing season and minimize the chemical fixation reaction. "The best tool growers have for determining tree nutrient status is leaf tissue analysis. By providing an accurate assessment of plant, rather than soil, nutrient status/ deficiencies can be identified and corrected" (Fake, 2004). Periodic

plant tissue analyses are recommended to monitor plant nutrient status. Plant nutrient adjustments should be based on values as shown in table 1.0.

Some areas may experience a boron (B) deficiency. "If you suspect a deficiency, do not apply B until you have results from a leaf tissue analysis. The range between deficiency and excess is very narrow and excess B can be damaging to trees" (Fake, 2004).



Photo 3.0
Advanced stage of Zn deficiency in orange tree leaves. Interveinal chlorosis with dark green midrib and primary veins. Photo: M. Zekri, Univ. of Florida

Table 1.0

Critical nutrient concentration in orange tree leaves analysis from 4-6 month old leaves from non-fruiting twigs.

Nutrient *	Deficient	Low	Optimum	High	Excess
Sulphur	< 0.14	0.14 – 0.19	0.20 – 0.40	0.41 – 0.60	> 0.60
Manganese	< 18	18 – 24	25 – 100	101 – 300	> 300
Zinc	< 18	18 – 24	25 – 100	101 – 300	> 300
Boron	< 21	21 – 30	31 – 100	101 – 260	> 260

* Sulphur values are in %, Mn, Zn, B values in ppm

Adapted from Zekri & Obreza, 2014. Fake, 2004





BALANCED NUTRIENT MANAGEMENT PLAN

Providing adequate crop nutrition has to be a critical management priority to achieve optimum citrus yields. Approximately 65% of crop yield is influenced by soil fertility level. "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 (Zekri & Obreza, 2014). Therefore, the 4Rs best management strategy can directly impact soil fertility with right rate, right source, right time, and right placement of product.

TIGER-SUL provides wide range of products that may be employed to eliminate or minimize some citrus yield limiting factors. Some of those products include: TIGER 90CR, TIGER XP, TIGER Micronutrients Zn 18%, TIGER Micronutrients Mn 15%, TIGER Micronutrients Citrus Mix, TIGER Micronutrients Manga-Sul, or TIGER Greening Guard Citrus Mix. These products contain S and varying levels of micronutrients.

References:

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