Importance of nutrients for citrus trees

Let's talk about boron (B) and chlorine (Cl).

By Mongi Zekri and Tom Obreza

BORON FUNCTIONS

• Important in sugar translocation and carbohydrate metabolism

• Particularly needed at the location of active cell division

• Plays an important role in flowering, pollen-tube growth, fruiting processes, N metabolism, and hormone activity

• Maintains Ca in a soluble form, thus ensuring its proper utilization

CHLORINE FUNCTIONS

Although the essentiality of chlorine (Cl) has been established for most higher plants, its need for fruit crops has not yet been demonstrated and its importance in citrus tree metabolism is not clear. The plant requirement for Cl is quite high as compared with other micronutrients, but its exact role in plant metabolism is still obscure.

Chlorine is:

• associated with turgor in the guard cells of stomata through the osmotic pressure exerted by imported potassium (K) ions

• involved with oxygen production in photosynthesis

• involved in chlorophyll and photosynthesis because its deficiency causes chlorosis, unusual bronze discoloration of foliage, and reduction in growth.

BORON DEFICIENCY

Native Florida soils are low in boron (B), and a deficiency of this element occasionally occurs in field conditions. In acidic soil, B is more water-soluble, very mobile in the soil profile of sandy soils, and readily leaches by rainfall or excessive irrigation. Boron deficiency may be aggravated by severe drought, excessive lime applications, or irrigation with alkaline water that can result in reduced B availability and uptake.

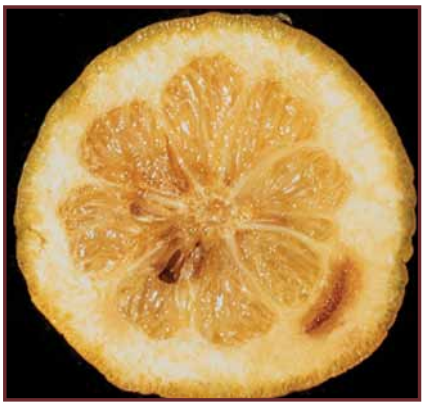

Figure 1 (top left). Boron deficiency: small size and misshapen fruit, thick albedo containing gum pockets, and aborted seeds with gum deposits around the axis of the fruit.

Figure 2 (top right). Boron deficiency: thickening of the leaves, vein splitting, a tendency for the leaves to curl downward, and chlorosis.

Figure 3 (above). Boron deficiency: corking and enlargement of the upper surface of the main veins and leaf chlorosis.

Boron deficiency is known as "hard fruit" because the fruit is hard and dry due to lumps in the rind caused by gum impregnations. The chief fruit symptoms include premature shedding of young fruit. Such fruit have brownish discolorations in the white portion of the rind (albedo), described as gum pockets or impregnations of the tissue with gum and unusually thick albedo. Older fruit are undersized, lumpy and misshapen with an unusually thick albedo containing gum deposits. Seeds fail to develop and gum deposits are common around the axis of the fruit (Figure 1).

Boron is relatively immobile in plants. The first visual symptoms of B deficiency are typically the death of the terminal growing point of the main stem. Further symptoms include brittle and slightly-thickened leaves, vein splitting, a tendency for the leaf blade to curl downward, and sometimes chlorosis (Figure 2). Boron deficiency also tends to cause corking and enlargement of the upper surface of the main veins (Figure 3). Associated with this symptom is a premature shedding of leaves beginning at the treetop that soon leaves the tree almost completely defoliated.

Fruit symptoms are the most con-sistent and reliable tool to diagnose B deficiency. Boron deficiency is associated with citrus greening (HLB) disease. It is likely caused by restrictions of nutrient uptake and/or transport.

CHLORINE DEFICIENCY

Deficiency symptoms of Cl are not commonly observed in most crops growing in the field. Chlorine deficiency has not been seen on citrus. On other plant species, the most commonly described symptom of

Cl deficiency is wilting of leaves, especially at the margins. As the deficiency progresses and becomes more severe, the leaves exhibit curling, bronzing, chlorosis and necrosis.

CORRECTION OF B DEFICIENCY

Borax (sodium borate) is commonly used to treat B-deficient citrus. This source can be applied either to the foliage or to the soil. Because of its greater solubility, boric acid might be preferred over borax for foliar spray application. Foliar spray applications are safer and more efficient than soil applications. Foliar sprays may be applied during the dormant period through post bloom, but preferably during early flower development. Treating at this growth stage is important because B does not move readily from other parts of the tree to the buds. Applying B at this time will also assist in flower initiation and pollen production, satisfy the needs for pollen tube growth, and enhance fruit set.

For maintenance spray applications, 0.25 lb./acre of B may be used. Where deficiency symptoms are present, double the amount suggested. Use care not to apply more than the recommended amount because the margin between B sufficiency and toxicity is narrow. Applying B to the soil frequently fails to give satisfactory results during dry weather. Soil application may result in toxicity problems if applied during the summer rainy season. As a maintenance program, apply B in the fertilizer at an annual rate equivalent to 1/300 of the N rate. If trees are irrigated with reclaimed water, B fertilization may not be necessary.

Leaf analysis standard to assessing Cl and B nutrient status of citrus trees in 4-to 6-month-old spring-cycle leaves from non-fruiting terminals.

Element	Deficient less than	Low	Satisfactory	High	Excess more than
Chlorine (Cl) (%)	-------	-------	less than 0.5	0.5-0.7	0.7
Boron (B) (ppm)	20	20-35	36-100	101-200	250

BORON TOXICITY

In Florida, boron toxicity of citrus usually results from the addition of excess borax or similar B materials. The first symptom of B toxicity in the leaves begins with yellowing and death of the leaf tip. These chlorotic areas gradually expand and extend along the leaf margins, creating a mottling effect (Figure 4, see page 11). Similar symptoms can be caused by urea spray burn and biuret toxicity. Dead areas may develop along the margins near the tips, and leaf drop occurs. The new growth flush following partial defoliation will also show symptoms if toxic levels of B are still present. In severe cases, leaf drop can be extensive, leading to total defoliation, dieback, reduced cropping and tree death.

Because B accumulates progressively as citrus leaves age, the apical mottling is usually more pronounced in late summer and fall. Toxicity due to high B levels in the soil can be reduced by leaching the root zone with low-B irrigation water. Liming of acid soils also has been found to be effective. Boron toxicity can be prevented by exercising care to apply no more than the recommended fertilizer rate.

CHLORINE TOXICITY

The most common source of chlorine toxicity is from chloride in irrigation water. Chloride moves

Figure 4. Boron toxicity: Chlorotic areas from the tip expand and extend along the leaf margins.

Figure 5. Chloride toxicity: Leaf burn progresses from the tip down along the edges as severity increases.

readily with soil water. It can be taken up by the crop, moves in the transpiration stream, and accumulates in the leaves. If the chloride concentration in the leaves exceeds the tolerance of the crop, leaf burn will develop and leaves can abscise. Normally, plant injury occurs first at the leaf tips and progresses from the tip down along the edges as severity increases (Figure 5). Excessive necrosis (dead tissue) is often accompanied by leaf drop.

Many sensitive tree crops begin to show injury with more than 0.3 percent chloride (dry weight basis). In case of severe defoliation, dieback and even death of the tree can result. Older leaves usually show the symptoms first. Similar symptoms can be caused by drought and fertilizer salt burn.

ALLEVIATION OF CHLORINE/ SALT TOXICITY

• Frequent irrigation intervals help maintain a low soil water tension and reduce salt accumulation within the irrigated zone. The volume of irrigation water should be great enough so that any accumulated salts are leached below the root zone.

• Split fertilizer applications and use nutritional materials with low salt index. Avoid the addition of chloride from the application of muriate of potash (potassium chloride).

• Well-managed fertigation with dilute weekly applications at low rates is probably the best solution.

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.