

## A Guide to Citrus Nutritional Deficiency and Toxicity Identification<sup>1</sup>

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Stephen H. Futch and David P.H. Tucker<sup>2</sup>

Citrus trees in commercial and dooryard plantings can exhibit a host of symptoms reflecting various disorders that can impact their health, vigor, and productivity to varying degrees. Identifying symptoms correctly is an important aspect of management, as inappropriate remedial applications or other actions can be costly and sometimes detrimental. Nutritional disorders addressed in this publication are an important aspect of citrus tree symptomology. Symptoms of deficiency or toxicity may have different forms of expression on foliage, stems, roots, and fruit, and may not in all cases resemble those illustrated in various publications. Symptoms can vary considerably from mild/incipient to chronic, particularly on foliage, and can also be expressed in leaf size. Because availability of some micronutrients like Zn, Mn, and Fe are soil-pH related, deficiency symptoms of these three elements may often occur simultaneously within a tree canopy and sometimes mask each other within a single leaf. To the untrained eye, nutritional disorders may be confused with herbicide, fungicide, physiological, and stress-related toxicities and physiological disorders. When in doubt, seek advice before

committing to costly and perhaps inappropriate corrective measures.

### Nitrogen Deficiency

Deficiency is expressed by light green to yellow foliage over the entire tree in the absence of any distinctive leaf patterns. With mild deficiency, foliage will be light green progressing to yellow as conditions intensify (Fig. 1). New growth usually emerges pale green in color, but darkens as foliage expands and hardens. With yellow vein chlorosis, the midribs and lateral veins turn yellow while the rest of the leaf remains a normal green color (Fig. 2). This chlorosis is frequently attributed to girdling of individual branches or the tree trunk. It may also occur with the onset of cooler weather in the fall and winter due to reduced nitrogen uptake by the plant from the soil. Nitrogen deficiency is also associated with senescing foliage which can develop a yellow-bronze appearance prior to leaf abscission (Fig. 3). Nitrogen deficiency will limit tree growth and fruit production, while high nitrogen applications produce excessive vegetative growth at the expense

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2. S.H. Futch, Extension Agent IV; and D.P.H. Tucker, professor, emeritus; Citrus REC, Lake Alfred, Florida, Horticultural Sciences Department, Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, 32611.

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of fruit production, reducing fruit quality and threatening groundwater, particularly on vulnerable soil types.



**Figure 1.** Nitrogen deficiency (Dark green leaf is normal; the other two leaves are deficient.)



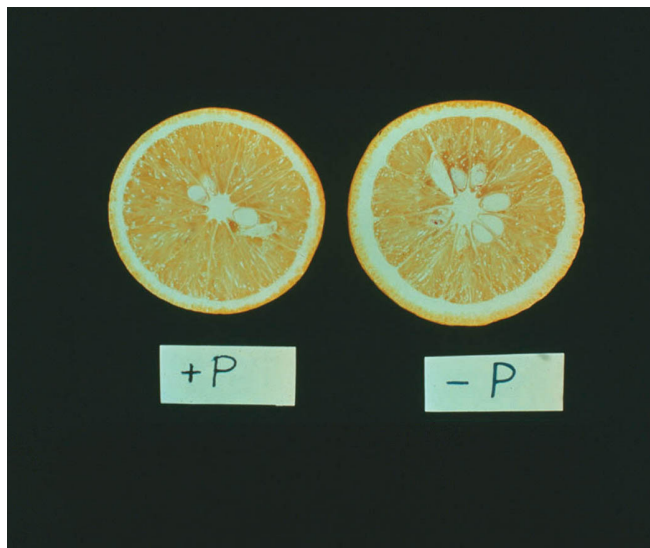
**Figure 2.** Yellow vein chlorosis



**Figure 3.** Nitrogen deficiency (Aging, senescing leaves.)

## Phosphorus Deficiency

Fruit are rather coarse with thick rinds (Fig. 4) and have lower juice content which is higher in acid. Although rarely observed, foliage may exhibit a bronze appearance. Phosphorus deficiency is unlikely to occur in groves that have received regular P applications in the past. However, new plantings on previously uncropped land usually require substantial initial phosphorus applications.



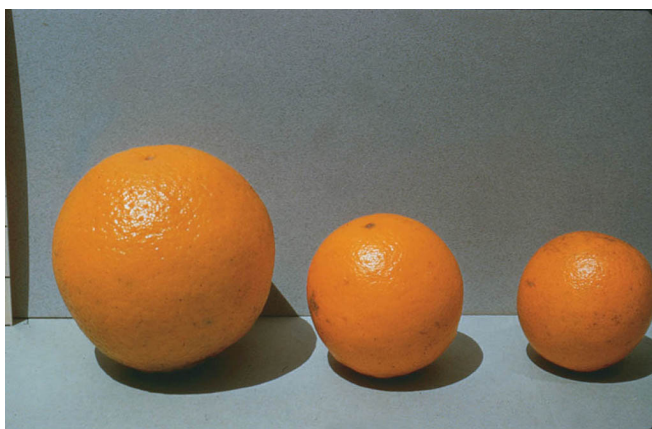
**Figure 4.** Phosphorus deficiency

## Potassium Deficiency

Fruit are smaller, have smoother, thinner rinds and may be subject to splitting and/or drop (Fig. 5). Potassium deficiency is likely to occur on calcareous soils due to elemental antagonism, and where large crops of fruit are produced with high nitrogen rates. A rarely observed bronzing of foliage may sometimes be observed, particularly on lemons.

## Magnesium Deficiency

The first symptom is a yellowish green blotch near the base of the leaf between the midrib and the outer edge. The yellow area enlarges until the only green remaining is at the tip and base of the leaf as an inverted V-shaped area on the midrib (Fig. 6). With acute deficiency, leaves may become entirely yellow-bronze and eventually drop. Dolomite will correct mild foliage symptoms in soils with low to neutral pH. Magnesium deficiency occurring in



**Figure 5.** Potassium deficiency (3 levels of K deficiency with the smallest fruit being the most deficient.)

calcareous soil may have to be corrected with foliar applications.



**Figure 6.** Magnesium deficiency

### Manganese Deficiency

Deficiency appears as dark green bands along the midrib and main veins surrounded by light green interveinal areas giving a mottled appearance (Fig. 7).

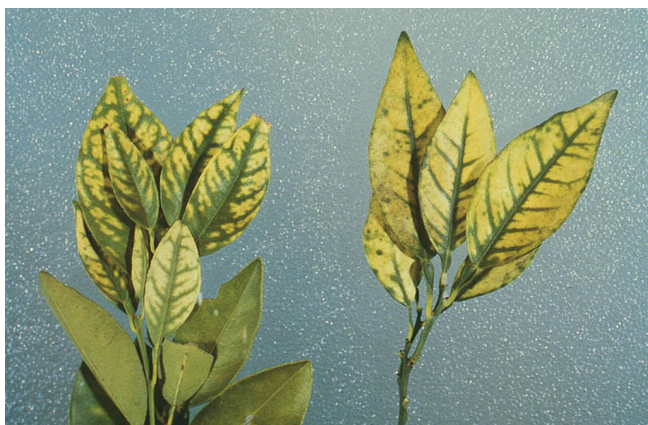
As severity increases, the light green interveinal areas give way to a yellow-bronze coloration. Both manganese and zinc deficiencies may occur on calcareous soil and may be more severe on trees with highly pH-sensitive rootstocks. Incipient manganese symptoms may sometimes disappear as the season progresses, so leaves should be observed several times before remedial action is taken. Soil and foliar applications may be effective in correction of manganese deficiency.



**Figure 7.** Manganese deficiency

### Zinc Deficiency

Early stages appear as small blotches of yellow between green veins on the leaf. With severe deficiency, leaves may become increasingly yellow except for the green veinal areas (Fig. 8). Under severe deficiency conditions, leaves will also be small with narrow pointed tips on terminal growth. Foliar fertilizer applications are usually recommended for correcting zinc deficiency. Trees with citrus blight will also show leaf symptoms of zinc deficiency.



**Figure 8.** Zinc deficiency

### Iron Deficiency

In mild cases, leaf veins are slightly darker green than interveinal areas with symptoms appearing first on new foliage (Fig. 9). In severe cases, interveinal areas become increasingly yellow with entire area eventually becoming ivory in color with emerging foliage, which is smaller. Trees may become partially defoliated with eventual twig and canopy dieback.

Iron deficiency is usually an indication of calcareous soil condition and is more likely to be expressed on high pH-sensitive rootstocks like Swingle citrumelo. An early expression of flooding damage to roots and of copper toxicity may be iron deficiency symptoms.



**Figure 9.** Iron deficiency

### Copper Deficiency

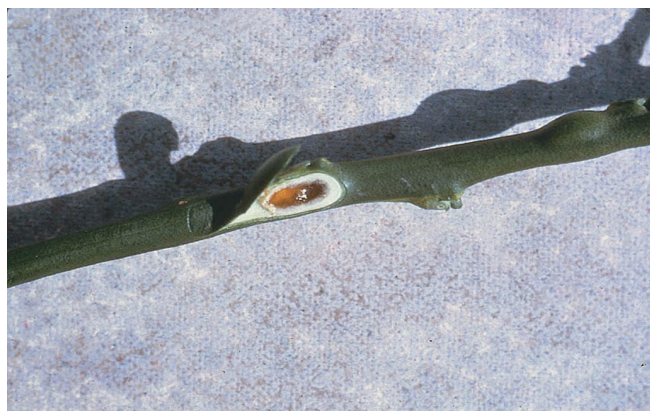
Mild copper deficiency is usually associated with large, dark green leaves on long soft angular shoots. Young shoots may develop into branches which appear curved or “S-shaped,” referred to as “ammoniation” usually resulting from excessive nitrogen fertilization (Fig. 10). Twigs can develop blister-like pockets of clear gum at nodes (Fig. 11). As twigs mature, reddish brown eruptions may occur in the outer portion of the wood. Severely affected twigs commonly die back from the tip with new growth appearing as multiple buds or “witches broom”. Necrotic-corky areas on the fruit surface may sometimes occur in extreme situations. Copper deficiency is more likely to occur in new plantings on previously uncropped soils, which are usually deficient or totally lacking in copper.

### Copper Toxicity

Symptoms can include thinning tree canopies, retarded growth and foliage with iron deficiency symptoms. Feeder roots may also become darkened, and show restricted growth. When extractable copper exceeds 100 pounds per acre, trees may begin to decline. Old citrus land should be checked for soil copper before replanting. High soil copper levels may be ameliorated by liming to pH 6.5. The rootstock



**Figure 10.** Copper deficiency (ammoniation)



**Figure 11.** Copper deficiency showing gum pocket at node

Swingle citrumelo is known to be quite susceptible to high soil copper.

### Boron Deficiency

Fruit symptoms most indicative of boron deficiency include darkish-colored spots in the white albedo of fruit and sometimes in the central core (Fig. 12). Fruit may be somewhat misshapen with a lumpy surface. Unlike other micronutrient deficiencies, boron can impact fruit quality and should therefore not be allowed to occur. Slight excess can cause toxicity, so maintenance or correctional applications should involve ground or foliage applications, but not both.

### Boron Toxicity

Early stages of boron toxicity usually appear as a leaf tip yellowing or mottling. In severe cases, gum spots occur on lower leaf surfaces (Fig. 13) with leaf drop occurring prematurely. Severe symptoms can include twig dieback.

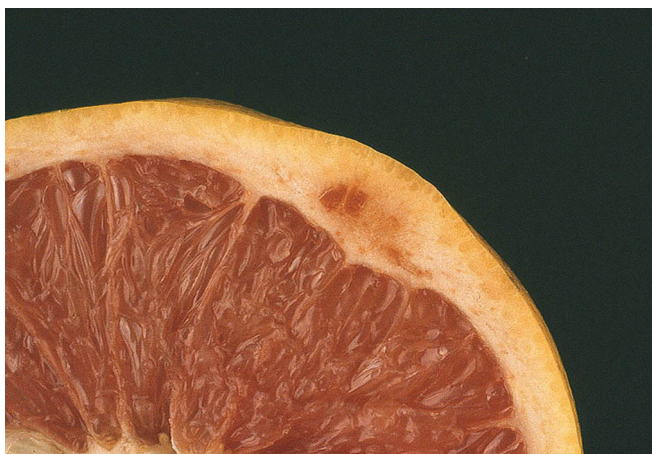


Figure 12. Boron deficiency



Figure 13. Boron toxicity (Gumming on underside of leaf.)

### Molybdenum Deficiency

Rarely observed, it can occur under acidic soil conditions. The most characteristic field symptoms are large yellow spots on the leaves that appear first as less defined water-soaked areas in spring (Fig. 14), later developing into distinct larger interveinal yellow spots.



Figure 14. Molybdenum deficiency

### Biuret Toxicity

Biuret is an impurity in urea fertilizer which may be avoided using only guaranteed low biuret urea products, particularly for foliar sprays. Leaf symptoms appear as irregular, yellowish-green interveinal chlorotic areas appearing first at leaf tips and spreading over the entire area of the leaf surface (Fig. 15). As severity increases, only the midribs and parts of the major veins remain green.



Figure 15. Biuret toxicity

### Salt Injury

Many salinity-induced symptoms are similar to drought stress symptoms, including reduced root growth, decreased flowering, smaller leaf size, and impaired shoot growth. These can occur prior to more easily observed ion toxicity symptoms on foliage. Chloride toxicity, consisting of burned necrotic or dry appearing edges of leaves, is one of the most common visible salt injury symptoms. Actual sodium toxicity symptoms can seldom be identified, but may be associated with the overall leaf "bronzing" (Fig. 16) and leaf drop characteristic of salt injury. Slightly different symptomology may occur depending on whether injury is due to root uptake or foliage contact. Excessive fertilizer applications, highly saline irrigation water, and storm-driven ocean sprays can all result in salinity-induced phytotoxic symptoms.



**Figure 16.** Salt injury