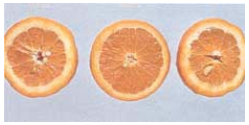
General guide to plant nutrients in citrus

Element	*Deficiency symptoms*	*Excess symptoms*	*Movement in the*		*Other information*
			Plant	*Soil*	
Nitrogen (N) 	Found first in **old leaves**. Pale green-yellow leaves. Stunted growth, thin foliage cover & dieback of twigs. Poor fruit set & fruit size.	Promotes luxurious vegetative growth. Poor fruit quality & shorter storage life. Fruit thick-skinned large, puffy, delays colour break and increases regreening.	Mobile	Mobile	Most N is contained in the soil organic matter. Effects of too much N worse when P is low. There is an antagonistic effect between N & P.
Phosphorus (P) 	Found first in **old leaves**. Dull bronzed green leaves which shed readily. Reduced flower formation. Misshapen fruit, open centers, thick coarse rinds.	Decrease in fruit size.	Mobile	Immobile	Soils high in clay fix more P. Optimum soil moisture conditions promote more available P. Most available in range 6-7. Too much P can result in deficiencies of Fe, Zn and Cu. In alkaline soils P forms insoluble compounds with Ca and Mg and in acid soils with compounds of Fe, Mn and Al.
Potassium (K) 	Found first in **old leaves**. Slower tree growth, small leaves, and heavy leaf fall. Fruit small, thin skinned, colour early, split easily, more creasing. Severe deficiency causes heavy fruit/flower drop.	In oranges delays colour break, increases rind thickness, and regreening.	Mobile	Mobile in sandy and organic soils	High pH induces a deficiency. K can outcompetes and reduce uptake of Mg and Ca. Low soil temperature reduces availability and uptake of K. Optimum soil moisture needed for K uptake. Waterlogged of dry soils reduce K uptake. K is held tightly in clay soils.
Calcium (Ca)	Found first in **young leaves**. Stunted roots, fruit quality problems.	Reduction in availability of trace elements. Iron chlorosis.	Immobile	Immobile	Deficient in low pH (acid) soils often associated with high Al and Mn levels. Heavy applications of K induce deficiencies, especially in acid soils. Ca is taken up and moved around in the plant in the water system. Too high or low humidity can reduce Ca uptake.
Magnesium (Mg) 	Found first in **old leaves**. Yellowing towards apex of leaves with a triangular area remaining green at base. Defoliation, twig dieback and poor root growth.		Mobile	Attaches to organic matter and clay particles.	Frequently deficient in coastal sandy soils and deficiency more acute when N levels low. Uptake is also reduced by high potassium levels. Mg has a synergistic effect on Zn & Mn and a Mg deficiency accentuates deficiencies of these two elements.
Sulfur (S)	Found first in **young leaves**. Small pale green-yellow leaves with lighter veins		Immobile	Mobile	High pH induces a deficiency. Most S held in the soil organic matter.
Copper (Cu) 	Found first in **young leaves**. Dieback of twigs. Dark brown gum pockets on young shoots. Rind can be brown, with gum stained areas, split fruit.	Stunted growth. Toxic to plant roots, especially small feeder roots.	Slightly mobile	Mobile in acid soils	Dependent on pH, organic matter content, presence of Al, Mo & Fe. Becomes unavailable as pH rises above 7.0 Excess induces Fe deficiency. Deficiencies common in sandy soils. Copper can depress leaf Zn and Mn levels.

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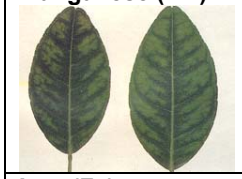
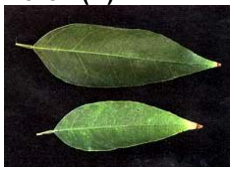
			Plant	*Soil*	
Zinc (Zn) 	Found first in **young leaves**. Creamy white to yellow blotches in leaves. Small, narrow leaves. Retarded terminal growth, reduced leaf size. Small twigs die.		Immobile	Mobile in acid soils.	Becomes less available as pH rises or in soils with high P. There is an interaction between Zn and P, and high levels of one element reduce the uptake of the other. Deficiencies can occur when soils are cold & wet due to poor root growth. Can depress Mn leaf levels.
Manganese (Mn) 	Found first in **young leaves**. Mottled pale green leaves, reduced cropping and growth. Intervienal yellowing.	Bright yellowing on leaf edges (old), dark brown tar spots on leaves.	Immobile	Mobile in acid and water-logged soils	Soil moisture affects availability. Toxicity common in high rainfall areas, organic, acid or waterlogged soils. Becomes unavailable as pH rises above 5.5 and deficiencies may occur with imbalances of Ca, Mg and Fe. Increases the availability of P and Ca.
Iron (Fe) 	Found first in **young leaves**. Chlorosis of leaves, stunted abnormal growth. Tips/margins and veins stay green longest.		Immobile	Mobile in water-logged soils.	Deficiency trigged by high pH, excessive P, lime or bicarbonate levels and wet cold soils. High Fe levels can induce a Mn deficiency. Soil organic matter an important source. P.*trifoliata* rootstock is more sensitive to iron deficiency than sweet orange, rough lemon or Troyer citrange.
Boron (B)  Boron toxicity ↑	Found first in **young leaves**. Lopsided fruit heavy fruit shedding & yellow leaf veins. Fruit grey to brown with gum pockets throughout rind & flesh.	Yellow, dead leaf tips, leaf fall and dieback.	Immobile	Mobile	Optimum in pH 5-7. Soil organic matter an important source. Dry periods and over liming can induce a deficiency. Easily leached. Boron toxicity: Citrus on rough lemon stock are more affected than those on sweet orange or P. trifoliata rootstock. Lemons are the most susceptible scion, followed by mandarins, grapefruit and oranges.
Sodium (Na) 	Found first in **old leaves**.	Leaf burn, leaf fall and dieback.		Mobile	A problem in alkaline soils. Na ions are displaced by Ca.
Aluminum (Al)	Stunted root growth and lack of root hairs.			Immobile	Al toxicity is common in acid soils. Al fixes P.