Knowledge grows

The Nutrition of Citrus

completecitrus™
by Yara

Crop Knowledge

The Complete**Citrus** crop solution provides citrus growers with the best available information and tools to manage their production optimally, with minimum environmental impact, consistently from one year to the next. Tree health is recognized as a major element in sustainable production. Balanced nutrition is also fundamental in establishing and maintaining optimal performance and tree longevity that together support increased crop production.

The term "balanced nutrition" directly supports the 4R approach of Right Source, Right Placement, Right Rate, and Right Time. The benefits of pursuing balanced nutrition through 4R stewardship ensure that citrus trees have the greatest fighting chance against many abiotic stresses but also diseases such as citrus greening (HLB).

The three most essential nutrients that are observed in the tree are N, K, and Ca. These nutrients have many roles including tree growth, fruit production, and disease resistance. The significance of utilizing these nutrients and philosophies must not waiver in this new era of citrus production.

Use this table to compare your program.

Nutrient	Lbs per Acre	Current	Balance
K	225		
Ca	175		
N	150 - 200		
S	125		
Mg	35		
P	16		
Micros	1.25Zn, 0.65Mn, 0.4B		

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The tables below illustrate the need for balanced nutrition. Beyond just the fruit, the entire tree requires additional nutrition for robust growth and long term health of the tree. Balanced nutrition is important however N, K, and Ca are the most important nutrients needed in the greatest amounts for tree health, optimal yield and quality.

Element	Abbreviation	umol/g Dry Weight
Molybdenum	Mo	0.001
Copper	Cu	0.10
Zinc	Zn	0.30
Manganese	Mn	1.0
Iron	Fe	2.0
Boron	B	2.0
Chlorine	Cl	3.0
Sulfur	S	30
Phosphorus	P	60
Magnesium	Mg	80
Calcium	Ca	125
Potassium	K	250
Nitrogen	N	1000

Table 1 total nutrient found in healthy citrus tree shoot.

	Nutrient in tree components (kg ha^{1})					
	Leaves	Twigs	Trunk	Fruits	Roots	Total
N	17.2	11.8	2.0	18.0	17.5	66.5
K	8.7	6.9	1.4	23.2	11.8	52.0
P	1.4	2.1	0.3	2.8	1.7	8.3
Ca	27.9	25.9	≥2.4	8.7	13.5	78.4
Mg	1.8	2.1	0.2	1.7	2.9	8.7
S	1.8	1.2	0.2	1.3	2.3	6.8

Table 2 Citrus tree nutrient partitioning identifies Calcium is needed in the greatest quantities.

Macronutrients

Nitrogen

As we begin to discuss N as it relates to citrus production, it helps to remember that while there are many forms of N, Nitrate is the preferred option for HLB infected and non-infected trees.

Growers with inadequate nitrate nitrogen can experience deficiencies. While most citrus groves receive ample amounts of N in the urea and ammoniacal form, calcium nitrate rises above with superior agronomic benefits with 100% nitrate nitrogen and soluble calcium. These benefits can be capitalized on throughout the year and during multiple growing stages.

Inadequate N Symptoms	YaraLiva Benefits
Stunted growth	Immediately plant available
Leaf Chlorosis (mature leaf first)	Increase cation (K, Ca, Mg) uptake
Leaf drop	No soil acidification
Soil acidification	No conversion time
Ammonium Toxicity	No volatilization
Root loss	Low impact on soil microorganisms
Nutrient immobilization	Increased root growth and health

Potassium

Alongside nitrogen, potassium is one of the most important nutrients for citrus production. It is needed for enzyme activation, cell division, photosynthesis, photosynthate transport and osmoregulation. Potassium has a big impact on leaf size, tree health and vigor. It is also largely responsible for many important internal and external fruit quality characteristics including fruit size, rind thickness and color. The potassium forms best suited for citrus production include potassium nitrate and sulfate of potash.

Inadequate K Symptoms	PN/ SOP Benefits
Chlorotic blotching on leaves	Increase fruit size/ number per tree
Fruit splitting	Increase peel thickness
Decrease fruit size/number per tree	Increase fruit acidity
Increased fruit drop	Increased pound solids
Reduction in acidity	Increase tree disease tolerance
Decrease overall yield	Reduction in splitting and blemishing

Calcium

Calcium is a key component of cell walls and has a direct influence on the regulation of enzyme systems, phytohormone activities and nutrient uptake. This nutrient also influences pollen tube elongation and seed formation. Also adequate calcium and potassium are key to signaling the natural plant defenses.

YaraLiva calcium nitrate contains the most superior form of Ca that is the key to citrus tree health and production, but also in battling HLB and other biotic stresses. Not all Ca forms are similar, or even available to the tree. Lime and gypsum historically have been used to increase Ca levels in the soil. The amount of time, water, and other variables needed for the calcium to become plant available are exponentially greater than when using Calcium Nitrate.

Inadequate Ca Symptoms	YaraLiva Benefits
Stunted growth	Water soluble
Leaf drop	Plant available
Increase to disease susceptibility	Stronger cell walls
Root loss	Disease tolerance
Abnormal dark green foliage	Increased pound solids
Peel pitting/ splitting	Increase root growth/ health
Fruitlet drop	Fruit size/ number per tree

Phosphorus

Phosphorus contributes to better root growth and is a key component in energy production and transfer in cells. Cell membranes as well as DNA and RNA contain phosphorus. Phosphorus is mobile in the plant so deficiencies are expressed on older leaves. Phosphorus availability is reduced in cold, wet soils and this can lead to deficiency during dormancy break and early spring growth when the stage is set for top yield.

Phosphorus is required in lesser concentration than other macronutrients, but a phosphorus deficiency will reduce yields and quality. Leaf concentration of 0.12 to 0.16% phosphorus is considered adequate. Typical phosphorus application rates range from 50 to 100 lbs P2O5/acre to prevent depleting the phosphorus in the soil and allow for phosphorus fixation in unavailable forms.

Inadequate P Symptoms	Sufficient P Benefits
Reduction in flowering	Higher fruit weight
Fruit size reduction	Increase in juice content
Leaf bronzing	Greater energy transfer
Soft/ spongy fruit	Sugar and acid balance
Weak branches	Increase in tree metabolism

Sulfur

Sulfur and nitrogen go hand-in-hand, and both are needed for structural and functional proteins, DNA, and RNA. Sulfur is taken up as the sulfate ion (SO_4=) and like nitrate, sulfate can be leached from the surface soil. Most sulfur in soil is found in the organic fraction of the soil, so soils with low organic matter are more likely to exhibit sulfur deficiency. Fortunately, most citrus orchards receive sufficient sulfur from the potassium sulfate used to supply potassium.

Inadequate S Symptoms	Sufficient S Benefits
Abnormally thick peels	Increase in Yield
Necrotic lesions on leaf	Increase in fruit number per tree
Leaf drop	Higher chlorophyll production
Leaf chlorosis (young leaf first)	Increase in plant protein formation
Reduction in fruit size	Higher enzyme synthesis

Magnesium

Magnesium is a key component of chlorophyll and up to 10% of the magnesium in plants is found in chlorophyll. In addition, magnesium helps contribute to cell wall integrity and activates many plant enzymes. Magnesium is mobile within plants so a deficiency is evident on older tissues.

Inadequate Mg Symptoms	Sufficient Mg Benefits
Yellowish green blotching near leaf base	Increase in fruit number per tree
Leaf drop	Reduction in peel blemishes
Fruit cracking	Higher fruit acidity
Sugar reduction	Higher chlorophyll production

Micronutrients

Micronutrients, including boron, iron, manganese, and zinc, are needed in low concentrations by citrus, but a deficiency of any of these essential nutrients can reduce yield and affect overall tree health. In many cases, soil applications of the micronutrients are of limited value and foliar applications or combinations of soil and foliar applications are more effective.

Boron

Boron plays a critical role in flowering and pollination including pollen tube growth which results in more fertilized flowers and greater fruit set. Higher boron levels are associated with reduced flower losses and early fruit abortion. Boron is considered immobile within the plant so deficiencies appear at the growing point such as the buds. Boron and calcium are both involved in nutrient and sugar translocation. Boron can be applied to the soil or foliage. Boron can be toxic so consult your local Certified Crop Adviser for specific recommendations.

Iron

Iron is essential for chlorophyll formation and enzyme activation in plants. Iron is immobile within plants so an iron deficiency is expressed by interveinal chlorosis with green veins in young leaves. Iron is less available on high pH soils or when high levels of zinc or manganese are present. Soils contain much iron, but almost all of it is unavailable to plants. Soil testing and leaf analysis for iron is of limited value.

Manganese

Manganese plays a role in chlorophyll synthesis and it is a critical component in the chlorophyll molecule itself; it also is responsible for activation of plant enzymes. Availability of manganese is reduced as the soil pH increases so manganese deficiency is more common in the western US because of the high pH soils. Manganese is immobile within the plant so a deficiency appears as interveinal chlorosis on young leaves.

Zinc

Zinc is the most commonly deficient micronutrient in the western US because it is less available on high pH soil. Zinc's primary function is synthesis of indoleacetic acid, a key plant hormone, energy metabolism and protein. Maintaining appropriate levels of zinc helps ensure a strong bud burst and subsequent crop development. Zinc is mobile within plants so a deficiency is observed in older tissues. Symptoms of zinc deficiency include decrease in stem and shoot growth, rosetting of terminal growth, interveinal chlorosis, and smaller leaves.

Soil application of zinc may be effective but multiple applications are often necessary; foliar applications of zinc are often used along with soil applications.

YaraLiva®

YaraLiva is the global brand name for Yara's calcium nitrate fertilizers. The essence of YaraLiva is quality. These calcium nitrate-based products optimize the quality of crops. YaraLiva keeps your crop healthier longer, improving shelf life, firmness, strength and the overall appearance of the crop.

YaraLiva provides nitrogen and calcium that are immediately available for plants. Nitrate is the nitrogen form directly available for plant uptake. It is non-volatile and not adsorbed to soil particles, leaving it readily available to plants. YaraLiva products include the preferred nitrogen source for most horticultural and high value agricultural crops, because nitrate improves the plant uptake of the cations potassium, calcium and magnesium. The calcium from YaraLiva products improves cell wall strength and cell membrane integrity, leading to better quality, longer shelf life and increasing marketable crop yields. Greater cell wall strength and membrane integrity also help trees better tolerate stresses such as diseases, heat and cold and salinity. In addition, the calcium in YaraLiva products help to maintain an optimum root environment for high yielding crops. YaraLiva is the superior nitrogen fertilizer for low volume irrigation systems because it does not lower soil pH.

YaraVita®

YaraVita is the global brand name for Yara's range of micronutrients. The essence of YaraVita is attention to detail and this pays dividends when planning crop nutrition programs. Optimum crop yield and quality require application of the right micronutrient inputs at the right time.

A formulated multi-nutrient product with proven and reliable performance, it's formulated for safe application at critical growth stages to satisfy crop requirements.

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