



## Apple Nutrition Recommendations. Revised 2005 by J. Clements, UMass Extension

Adapted from Clements, Schmitt, and Costante, University of Vermont

NUTRIENT	PHYSIOLOGY	IDEAL FOLIAGE RANGE	DEFICIENCY
<b>CAPITALIZED</b> nutrients- the 'big five', are of particular importance for tree maintenance and fruit quality	An appreciation for the complex physiological role played by mineral nutrients helps explain their importance in orchard nutrition	Leaf analysis results in this range should be considered ideal for maintaining tree health, adequate vigor, and fruit quality	Deficiency symptoms are important indicators of a nutrient deficiency or imbalance.
<b>NITROGEN (N)</b>	Primary building block for all plant parts—leaves, shoots, roots, fruit buds etc.	Young, non-bearing trees 2.4 to 2.6%; young, bearing 2.2-2.4%; mature, soft fruit 1.8 to 2.2%; mature, hard and processing 2.2-2.4%	Older leaves affected first. Leaves are small, uniformly light green or yellowish. Tips and margins may show necrosis. Bark is yellowish orange. Shoots/spurs-short, thin and spindly. Fruit set may be reduced. Current season's growth less than six inches.
<b>POTASSIUM (K)</b>	Enzyme activator, necessary for the formation and translocation of sugars, proteins, plant growth hormones	1.3 to 1.5%	Older leaves affected first, necrosis advancing from margins toward mid-rib; slender shoots and weak spurs; more susceptible to winter injury; smaller, poorly colored, low acid fruit.
<b>CALCIUM (Ca)</b>	Component of cell wall; regulates nutrient uptake and movement in plant	1.1 to 1.6 %	Deficiency symptoms difficult to identify in leaves. Shoot and root growth inhibited; storage disorders-bitter pit, cork spot, internal breakdown.
<b>MAGNESIUM (Mg)</b>	Molecular component of chlorophyll ; enzyme activator	0.30 to 0.50	Older and mid-shoot leaves, and those on spurs bearing fruit are affected first. yellow-brown necrotic areas; shoots and spurs are thin, weak, and brittle; blind wood and premature fruit drop.
<b>BORON (B)</b>	Aids in formation of pollen tube and feeder roots, and translocation of Ca, sugars, plant hormones	25 to 50 ppm	Flower development and fruit set decreased; young leaves often small, misshapen; corkiness in fruit flesh, wrinkled skin.
<b>Phosphorous (P)</b>	Cellular energy transfer and storage; nucleic acid component or regulator cofactor	0.16 to 0.30%	Deficiencies generally not seen in fruit trees. New leaves are small, bluish green, margins or main veins or undersides of leaves having purple pigmentation. Older leaves drop early. Flowering is reduced.
<b>Zinc (Zn)</b>	Component or regulator cofactor of enzymes, plant hormones proteins (i.e.. aids in normal growth and fruiting)	20 to 40 ppm	Leaves at shoot tip are stunted and misshapen with mottled necrosis; "little leaf" disease; leaf rosettes may be confused with winter injury; reduced fruit set and, quality, and size.
<b>Manganese (Mn)</b>	Aids in chlorophyll synthesis; involved in photosynthetic oxygen evolution	50 to 80 ppm	Older and mid-shoot leaves affected first. 'Herringbone' chlorosis between main veins. Shoot dieback may occur. Flowering and fruit set are reduced.
<b>Iron (Fe)</b>	Required for chlorophyll formation; a chloroplast enzyme component	50+ ppm	Chlorosis of tip leaves while veins remain green. Shoot growth is stunted and may die back.
<b>Copper (Cu)</b>	Important enzyme component	10 to 20 ppm	Younger leaves are affected first. Leaves are stunted or misshapen with irregular margins. Whitish, mottled chlorosis between veins. Fruit color, quality, and size are affected.

## Apple Nutrition Recommendations, cont.

NUTRIENT	EXCESS	FOLIAR APPLICATION	GROUND APPLICATION	COMMENTS
<b>CAPITALIZED</b> nutrients—the 'big five', are of particular importance for tree maintenance and fruit quality	<i>If an element is in excess in soil or plant tissues, expect to see the following, sometimes debilitating, toxicity symptoms</i>	<i>Most/foliar sprays are 'quick-fix' solutions to nutrient deficiencies that supplement ground applications</i>	<i>The preventive approach to orchard nutrition—a ground fertilization program based on soil and leaf analysis results</i>	<i>Be sure to consult an orchard nutrition reference or your Extension fruit specialist for more detail.</i>
<b>NITROGEN (N)</b>	Excessive shoot growth; soft, green fruit (poor CA storage candidate); more susceptible to winter injury and diseases such as fire blight	Urea @ 9#/acre, IX-3X; apply at pink and 1st cover; boosts spur vigor; do not apply with oil	Ammonium nitrate (34-0-0) @ 0-75#/acre (see comments)	In bearing trees, a rule of thumb for applying <u>actual N on a per tree basis would be</u> : 8-15 bushels: 0.66 lb; 15-25 bushels :0.66-1.0 lb; >25bushels: 1.33-2.0 lb.
<b>POTASSIUM (K)</b>	Mg, and Ca deficiencies become pronounced w/ excess K	None	Muriate of potash (0-0-60) @ app. 150-200 #/Ac annually; if Mg low use Sul-Po-Mag	Potassium deficiencies are more common with heavy crop loads, high N and inadequate water supply; annual fertilization advisable.
<b>CALCIUM (Ca)</b>	No distinctive symptoms	CaCl @ 1-4 # / 100 gal, in 4-6 sprays 14 days apart, begin 7-10 days after petal fall	Lime, 4 tons/Ac every 4-5 years or as indicated by soil test; if low in Mg use dolomitic lime	Sprays necessary to offset fruit quality problems, however, maintain soil calcium supply via liming. Fluctuations in soil moisture increase severity of deficiency symptoms.
<b>MAGNESIUM (Mg)</b>	Can hinder Ca uptake (Ca deficiency symptoms become more prevalent) when soil Ca supply is low	Epsom salts @ 15 # /Ac @ PF, 1st and 2nd covers; generally tank-mix compatible	Dolomitic (high Mg lime) @ 4 tons /Ac every 4-5 years	Supplement ground application w/foliar sprays; if K high, Mg requirement increases. Deficiencies more pronounced in young trees or trees with heavy crop loads.
<b>BORON (B)</b>	Chlorosis of leaf tissue along the midrib. Premature defoliation from shoot tip toward base. Fruit drop likely; fruit cracking. Excess symptoms similar to deficiency.	Pre-bloom to bloom (if leaf sample < 35ppm)—Solubor @0.5-1.0/100 gal; at PF or 1st-3rd cover sprays Solubor at 1lb/100 gal not compatible with oils, EC's	Granular Borate 2-3# (young trees) up to 7-8 # (older trees)/Ac often blended w/ other fertilizers	Foliar and ground applications should be used to supplement one another. Deficiencies more pronounced in trees with heavy crop loads or under dry weather conditions.
<b>Phosphorous (P)</b>	Zn and Cu deficiencies exacerbated	No application necessary	Super-phosphate (0-20-0) or triple super-phosphate (0-45-0) to maintain soil levels at 300-400 # / Ac	P fertilization of bearing orchards usually not necessary; pre-plant P in root zone is desirable.
<b>Zinc (Zn)</b>	Cu deficiency symptoms induced	Zn sulfate @ (22-36 % Zn); apply 3-5 # actual Zn/ 100 gal. Dilute only, up to silver tip	Trees generally unresponsive to ground applications	Maintain pH of 6.0-6.5 to reduce likelihood of Zn deficiency
<b>Manganese (Mn)</b>	Necrotic bark tissue (measles on Delicious); otherwise not evident	Mn sulfate @ 2-4 # / 100 gal. 1 week before PF; EDBC fungicides also contain Mn	None	Delicious most sensitive to excess Mn; toxicity symptoms commonly associated w/Ca deficiency.
<b>Iron (Fe)</b>	None	None	None	Maintain soil pH at 6-6.5 to avoid Fe deficiency problems.
<b>Copper (Cu)</b>	Root death; other micronutrients likely to become exaggerated	Choose bordeaux mixture or other Cu containing fungicide for disease control (i.e.. Fire blight, scab if warranted)	None for bearing orchards; pre-plant incorporation of Cu sulfate (90-120# Cu /Ac)	Treat foliar application of Cu with caution, as fruit russeting and/or foliage injury possible; do not apply after green-tip.