Citrus Nutrition

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Proper citrus nutrition

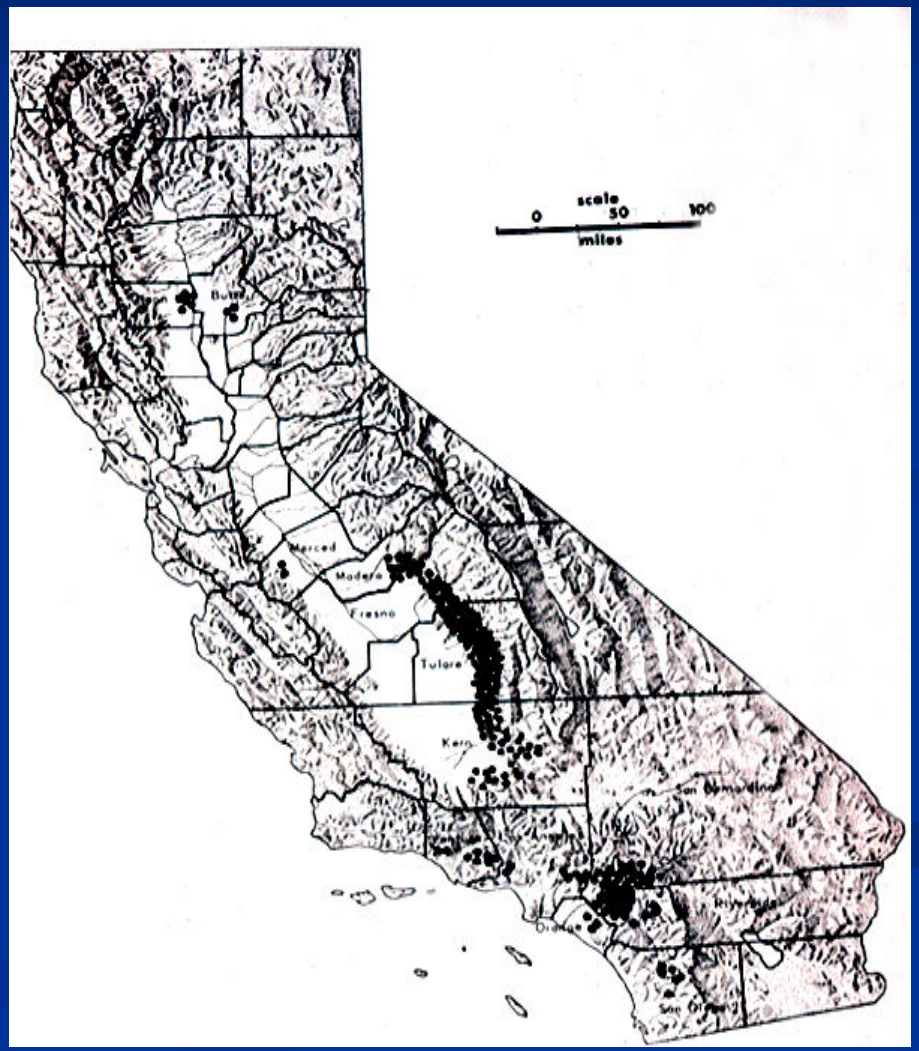
- Encourages:
  - New growth, vigorous, well expanded shoots with good color
  - Heavier production
  - Better fruit size and more regular bearing

Essential Plant Nutrients:

- ✓ 9 macro-nutrients needed in relatively large amounts
  - C, H, O, P, K, N, S, Ca, Mg
- ✓ 7 micro-nutrients or trace elements needed in small quantities
  - Fe, Mn, B, Zn, Cu, Cl, Mo

In citrus, 5 main nutrients of concern

- Nitrogen (N)
- Potassium (K)
- Zinc (Zn)
- Manganese (Mn)
- Boron (B)



Lab Analysis can help

- Confirm a diagnosis or identify a problem
- Leaf Analysis
  - assess nutrient status
  - develop a fertilizer program
- Soil Analysis
  - to diagnose problems, excesses

Citrus Leaf Analysis

- Best performed in Sept. - Oct.
  - leaf levels are stable
  - standards established
- Collect 5 to 7 month old terminal, spring cycle leaves from non-fruiting & non-flushing shoots

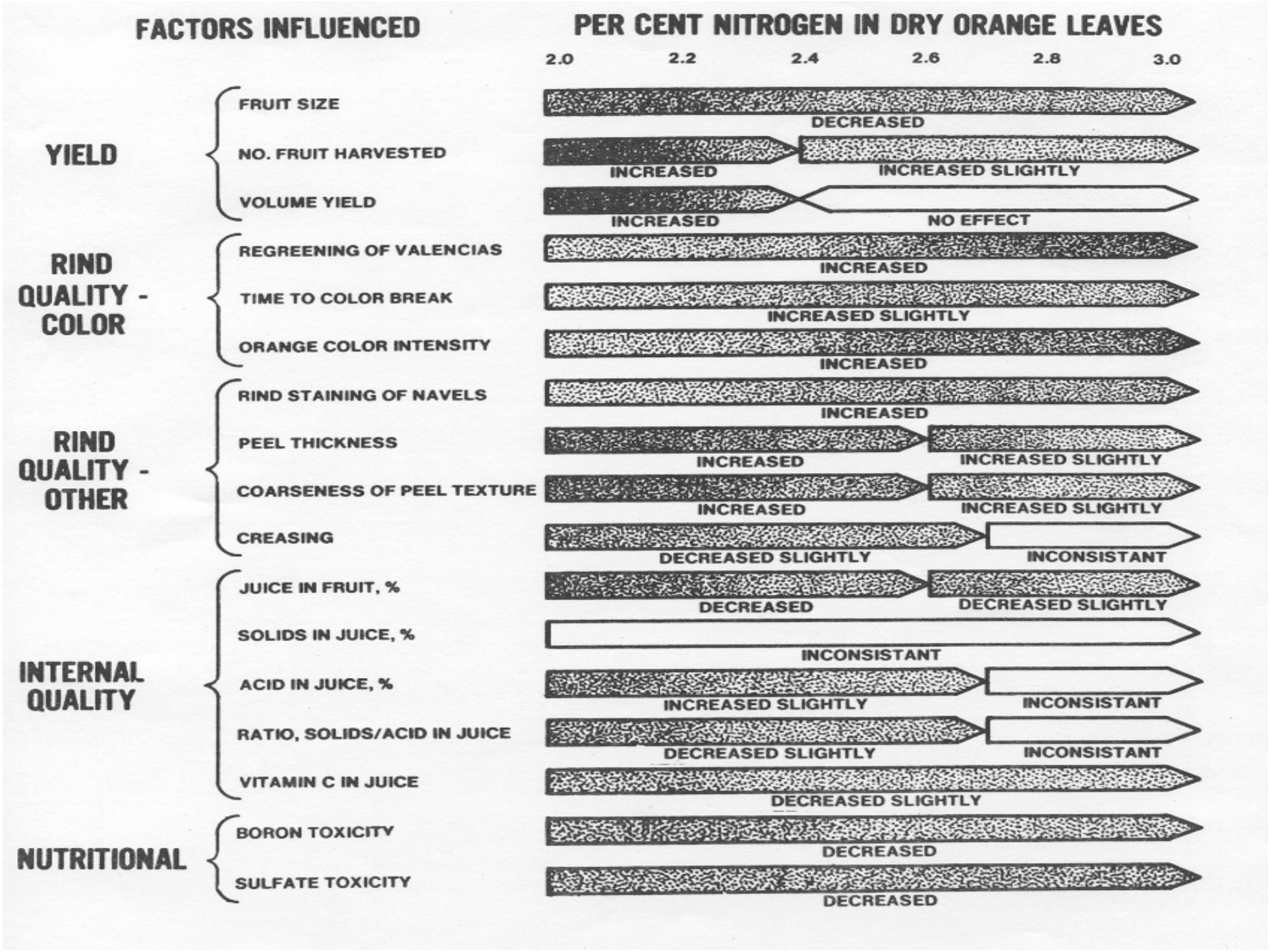
Citrus Critical Nutrient Levels:

	Deficient Below	Optimum
Nitrogen (N)	2.2%	2.4-2.6%
Phosphorus (P)	0.09%	0.12-0.16%
Potassium (K)	0.40%	0.70-1.09%
Zinc (Zn)	16 ppm	25-100 ppm
Manganese (Mn)	16 ppm	25-200 ppm
Boron (B)	21 ppm	31-100 ppm

Nitrogen deficiency

No Fertilizer for 1 year

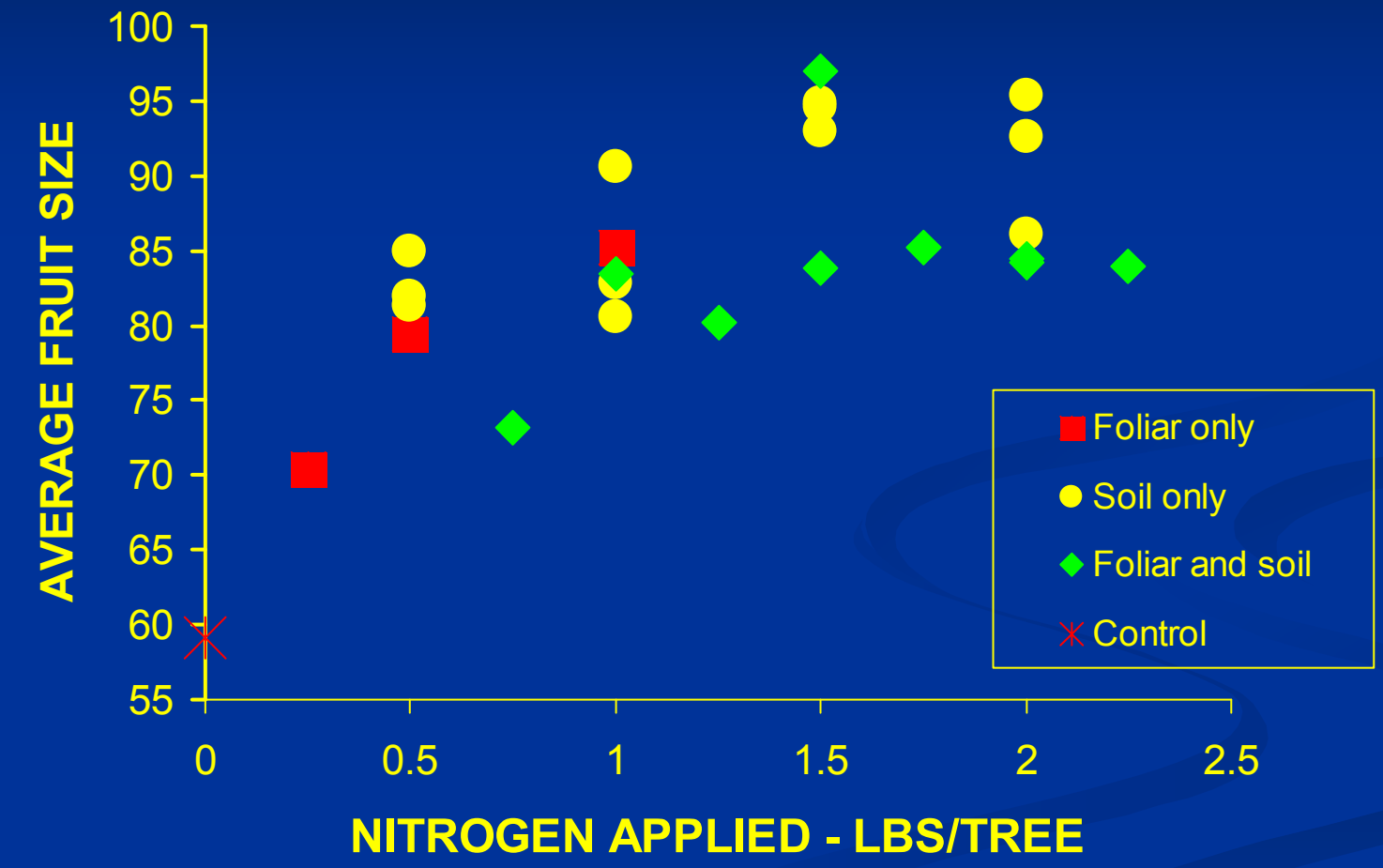
Sour Orange Rough Lemon


FACTORS INFLUENCED
PER CENT NITROGEN IN DRY ORANGE LEAVES
2.0
2.2
2.4
2.6
2.8
3.0
YIELD
FRUIT SIZE
DECREASED
NO. FRUIT HARVESTED
INCREASED
INCREASED SLIGHTLY
VOLUME YIELD
INCREASED
NO EFFECT
RIND QUALITY - COLOR
REGREENING OF VALENCIAS
INCREASED
TIME TO COLOR BREAK
INCREASED SLIGHTLY
ORANGE COLOR INTENSITY
INCREASED
RIND QUALITY - OTHER
RIND STAINING OF NAVELS
INCREASED
PEEL THICKNESS
INCREASED
INCREASED SLIGHTLY
COARSENESS OF PEEL TEXTURE
INCREASED
INCREASED SLIGHTLY
CREASING
DECREASED SLIGHTLY
INCONSISTANT
INTERNAL QUALITY
JUICE IN FRUIT, %
DECREASED
DECREASED SLIGHTLY
SOLIDS IN JUICE, %
INCONSISTANT
ACID IN JUICE, %
INCREASED SLIGHTLY
INCONSISTANT
RATIO, SOLIDS/ACID IN JUICE
DECREASED SLIGHTLY
INCONSISTANT
VITAMIN C IN JUICE
DECREASED SLIGHTLY
NUTRITIONAL
BORON TOXICITY
DECREASED
SULFATE TOXICITY
DECREASED

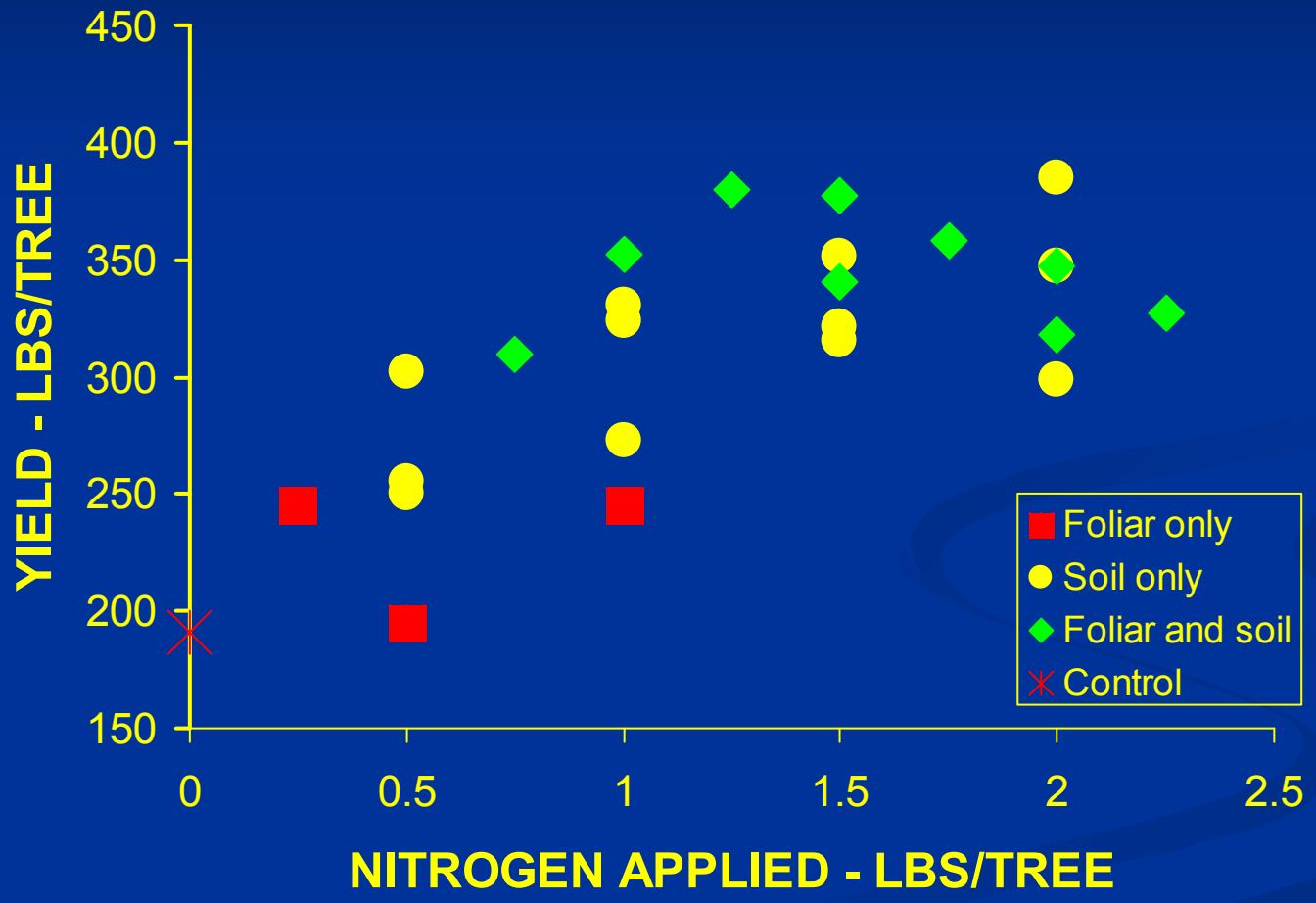
Nitrogen management in citrus

- Studied by Mary Lu Arpaia, Lanny Lund & Chris Corbett
- Project supported by the Citrus Research Board

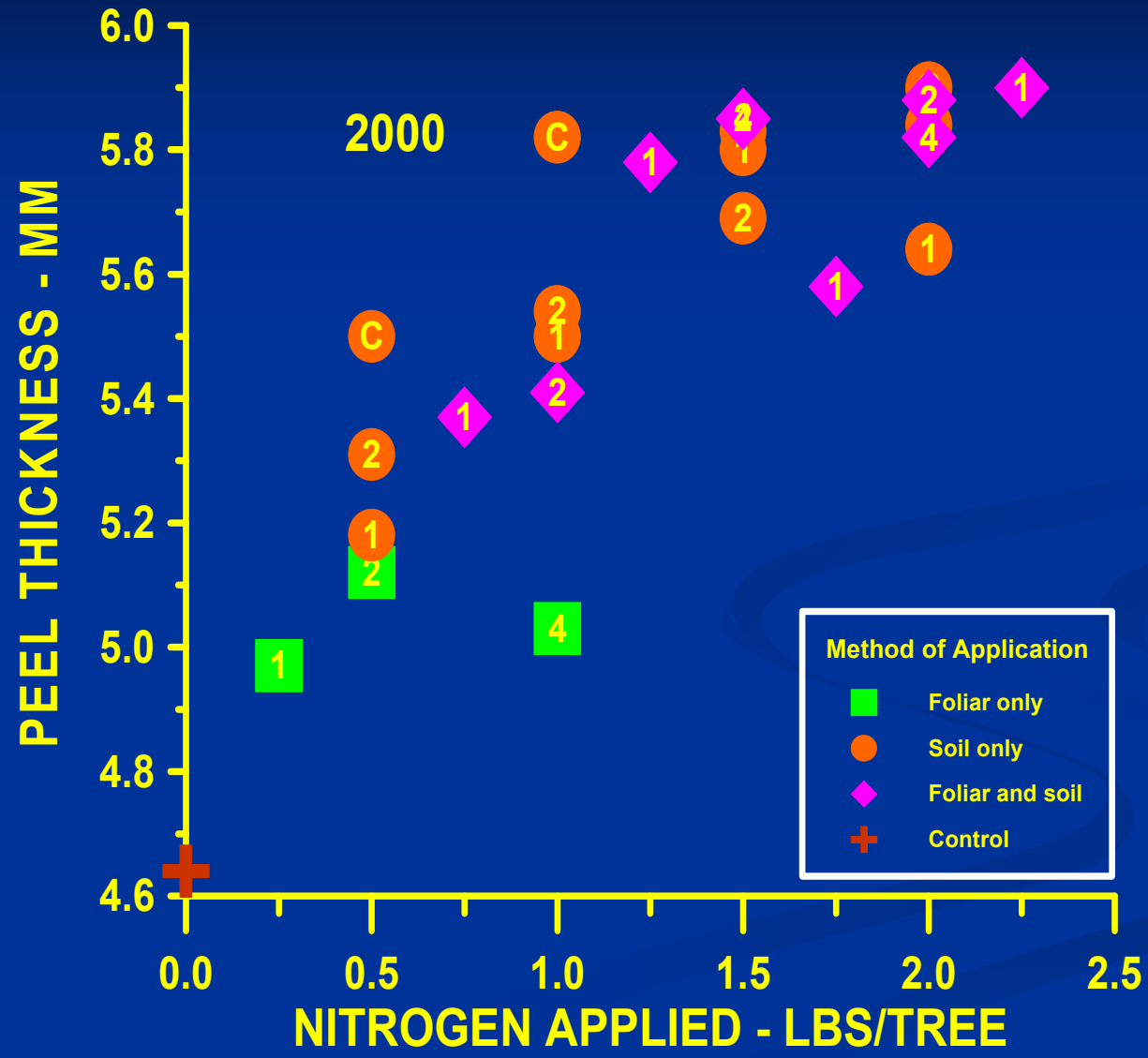
Fruit size --- 2000



Yield --- 2001


450
400
350
300
250
200
150
YIELD - LBS/TREE
0
0.5
1
1.5
2
2.5
NITROGEN APPLIED - LBS/TREE
Foliar only
Soil only
Foliar and soil
Control

Peel thickness --- 2000



Results --- with more N applied

- % leaf nitrogen increases
- fruit size increases, then levels off, & may decrease
- yield increases, levels off at 1 to 11/2 pounds N per tree
- No sig. relationship with puff/crease
- peel thickness increases significantly
- peel firmness decreases

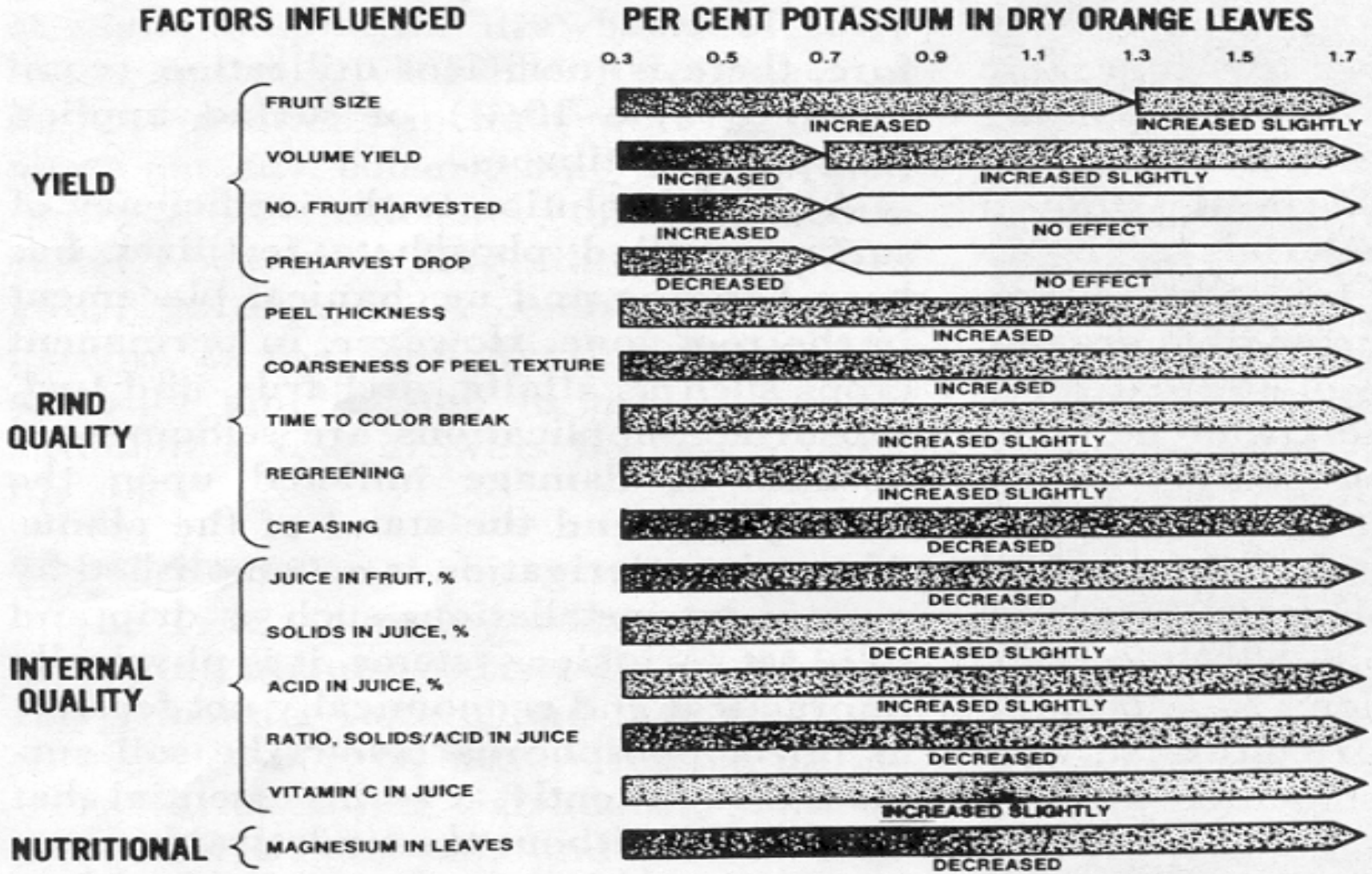
N Summary ---

- 1 to 11/2 pounds of nitrogen per tree per year seems optimum
- Any more than that and you're wasting N and reducing fruit quality
- Foliage applied N can effectively supplement soil applications while reducing NO_3 in the soil solution

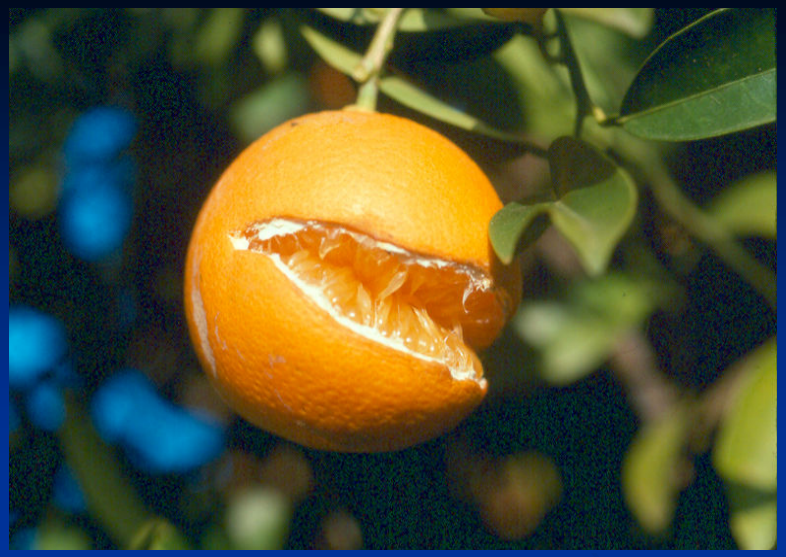
Potassium deficiency:

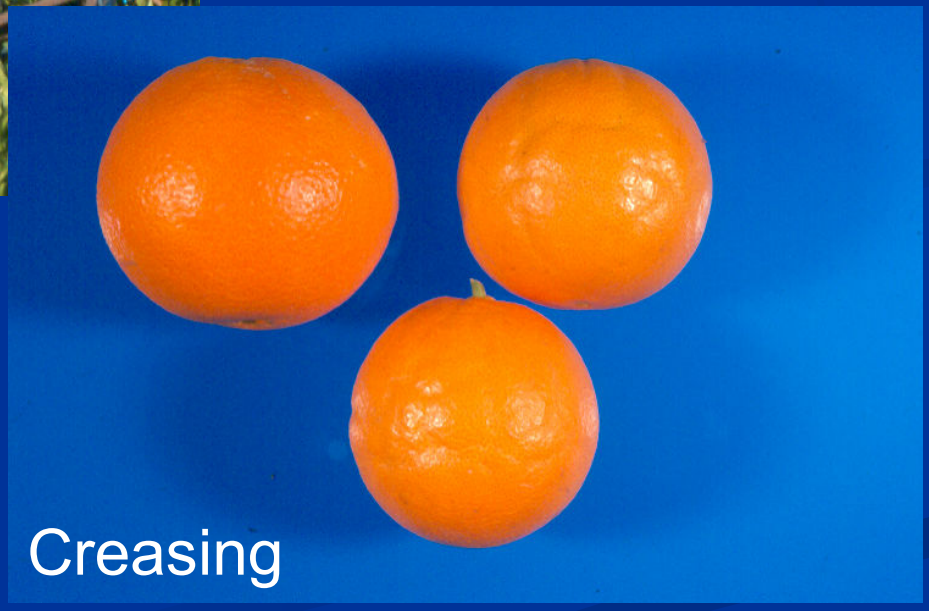
- Yellow-bronze chlorotic foliage often right behind fruit
- smaller fruit size, less yield
- slightly earlier maturity
- thinner peel
- more creasing

GRAPH 1. INFLUENCE ON YIELD, QUALITY AND MAGNESIUM NUTRITION RESULTING FROM CHANGES IN PERCENTAGE OF POTASSIUM IN 5- TO 7-MONTH-OLD, SPRING-CYCLE ORANGE-LEAVES.*



*Degree of shading indicates amount of effect on factor indicated.





Creasing

Potassium correction

- Foliar sprays
  - 30 lbs. potassium nitrate per 100 gal.
  - uptake & persistence is proportional to quantity deposited on the leaf surface (# sprays & gallonage applied)
    - Mild deficiency may require one annual spray
    - Severe deficiency - two sprays
- Best timing is after expansion of the major spring growth flush

Potassium correction:

- Soil application
  - 10 lbs. potassium sulfate per tree, applied in a band at the drip line
  - Avoid potassium chloride
- Soil application is especially effective through drip irrigation (fertigation)

Magnesium deficiency

- Symptoms appear on older mature leaves in summer, fall and winter
- Uncommon in our area, have high Mg soils
- Under acid conditions a soil application of magnesium sulfate or else a foliar spray of magnesium nitrate

Micronutrients

Lake Alfred, Florida
14 years, NPK only, no micros

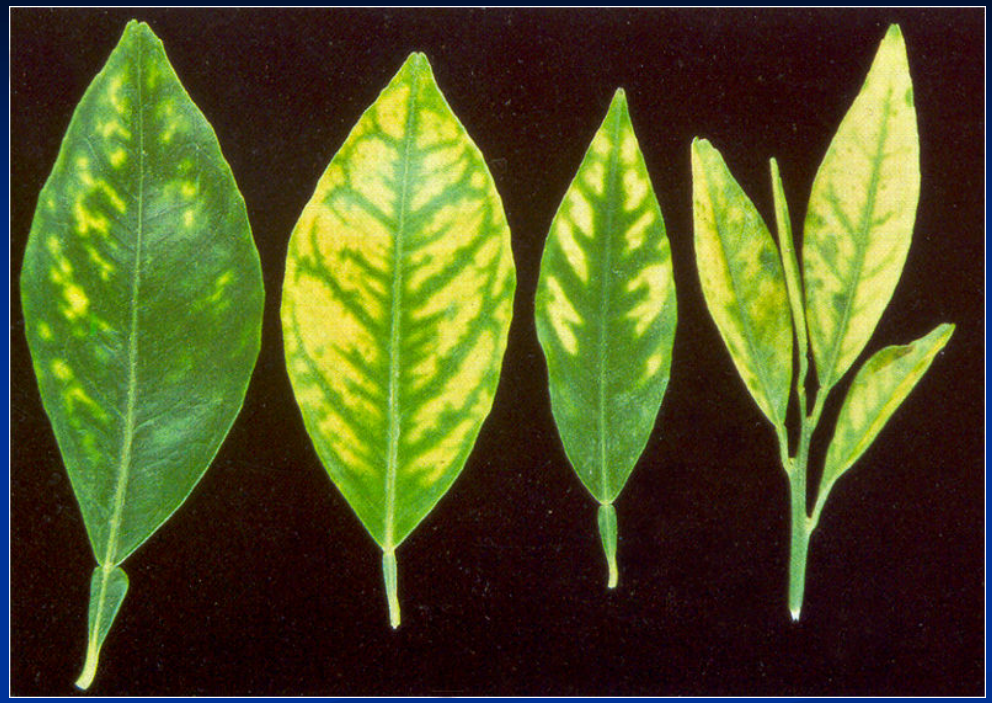
Leaf analysis guide for diagnosing micronutrient status of mature citrus trees

Element	Unit	Deficient	Low	Optimum	High	Excess
Boron (B)	ppm	< 21	21-30	31-100	101-260	> 260
Copper (Cu)	ppm	< 3.6	3.6-4.9	5-16	17-22?	> 22?
Iron (Fe)	ppm	< 36	36-59	60-120	130-200?	> 250?
Magnesium (Mg)	percent	< 0.16	0.16-0.25	0.26-0.6	0.7-1.1	> 1.2?
Manganese (Mn)	ppm	< 16	16-24	25-200	300-500?	> 1000?
Molybdenum (Mo)	ppm	< 0.06	0.06-0.09	0.10-0.29?	0.3-0.4?	> ---
Zinc (Zn)	ppm	< 16	16-24	25-100	100-200	> 300

? = Information not complete.

Zinc deficiency

- “mottle leaf” symptoms
- Smaller pale leaves
- Severe cases show twig dieback and brushy stunted trees
- Vigor is reduced, lower production, smaller fruit size, and lower quality are some results



Zinc deficiency

Zinc correction:

- Foliar dilute sprays (800 gal per acre)
  - 1 lb. 36.4% zinc sulfate per 100 gal water
  - Or, 2-3 lbs. zinc oxide per 100 gal water
- Treat spring and subsequent growth flushes when leaves are two-thirds to nearly fully expanded

Manganese deficiency

Manganese correction

- In our area, symptoms are often seen during winter-spring when soils are wet and cold
  - May self-correct when soils warm up and drain in the spring
- Foliar spray of 1 lb. manganese sulfate per 100 gallons water can be applied as a dilute spray (800 gal per acre)
- Can be combined with Zn & LB urea sprays

Boron deficiency

- Reduced growth or dieback
- multiple buds can form a “cabbage head” growth in the tree
- Leaves thicken, become brittle, curl downward and veins on the upper leaf surface enlarge, become corky and split

Boron correction

- A foliar spray of 1 lb. Solubor per 100 gallons water

- Soil application
  - 1 to 8 ounces of borax per tree depending on tree size

Iron deficiency

- symptoms in winter when soils are wet and cold
- Usually self-corrects when soils warm and drain in the spring
- Most persistent on high ph or calcareous soils
- Sequestrine 138 iron chelate

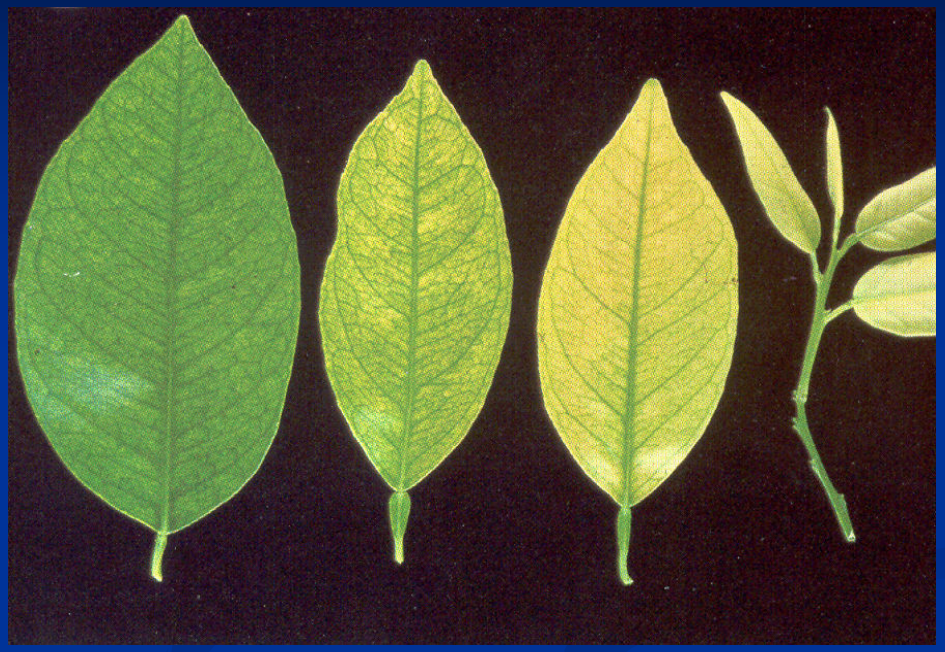



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TABLE 1. LEAF ANALYSIS GUIDE FOR DIAGNOSING NUTRIENT STATUS OF MATURE VALENCIA AND NAVEL ORANGE TREES.[1]

Element	Unit (total in dry matter)	Ranges[2]				
		Deficient	Low	Optimum	High	Excess
N	percent	< 2.2	2.2 to 2.3	2.4 to 2.6	2.7 to 2.8	> 2.8
P	percent	< 0.09	0.09 to 0.11	0.12 to 0.16	0.17 to 0.29	> 0.30
K[3]	percent	< 0.40	0.40 to 0.69	0.70 to 1.09	1.10 to 2.00	> 2.30?
Ca	percent	< 1.6?	1.6 to 2.9	3.0 to 5.5	5.6 to 6.9	> 7.0?
Mg	percent	< 0.16	0.16 to 0.25	0.26 to 0.6	0.7 to 1.1	> 1.2?
S	percent	< 0.14	0.14 to 0.19	0.2 to 0.3	0.4 to 0.5	> 0.6
B	ppm	< 21	21 to 30	31 to 100	101 to 260	> 260
Fe[4]	ppm	< 36	36 to 59	60 to 120	130 to 200?	> 250?
Mn[4]	ppm	< 16	16 to 24	25 to 200	300 to 500?	> 1000?
Zn[4]	ppm	< 16	16 to 24	25 to 100	110 to 200	> 300
Cu[4]	ppm	< 3.6	3.6 to 4.9	5 to 16	17 to 22?	> 22?
Mo[5]	ppm	< 0.06	0.06 to 0.09	0.10 to 3.0	4.0 to 100	> 100?
Cl	percent	?	?	< 0.3	0.4 to 0.6	> 0.7
Na	percent	?	?	< 0.16	0.17 to 0.24	> 0.25
Li	ppm	—[6]	—	< 3	3 to 35?	> 35?
As	ppm	—[6]	—	< 1	1 to 5	> 5?
F[5]	ppm	—[6]	—	< 1 to 20	25 to 100	> 100

[1] With the exception of N values this guide can be applied for grapefruit, lemon and probably other commercial citrus varieties.

[2] Based on concentration of elements in 5-to-7-month-old, terminal, spring-cycle leaves from nonfruiting and nonflushing shoots. Leaves selected for analysis should be free of chlorosis, obvious tipburn, insect or disease injury, mechanical damage, etc., and from trees not visibly affected by disease or other injury.

[3] Potassium ranges are for effects on number of fruit per tree.

[4] These standards are not applicable for leaves sprayed or dusted with the particular element in question. Leaves sprayed or dusted with Fe, Mn, Zn or Cu may analyze high or excessive in these elements, but the next growth cycle may have values in the deficient range.

[5] From fruiting shoots.

[6] These elements are not known to be essential for growth of citrus.