Micronutrient Deficiencies in Blueberries and Their Correction

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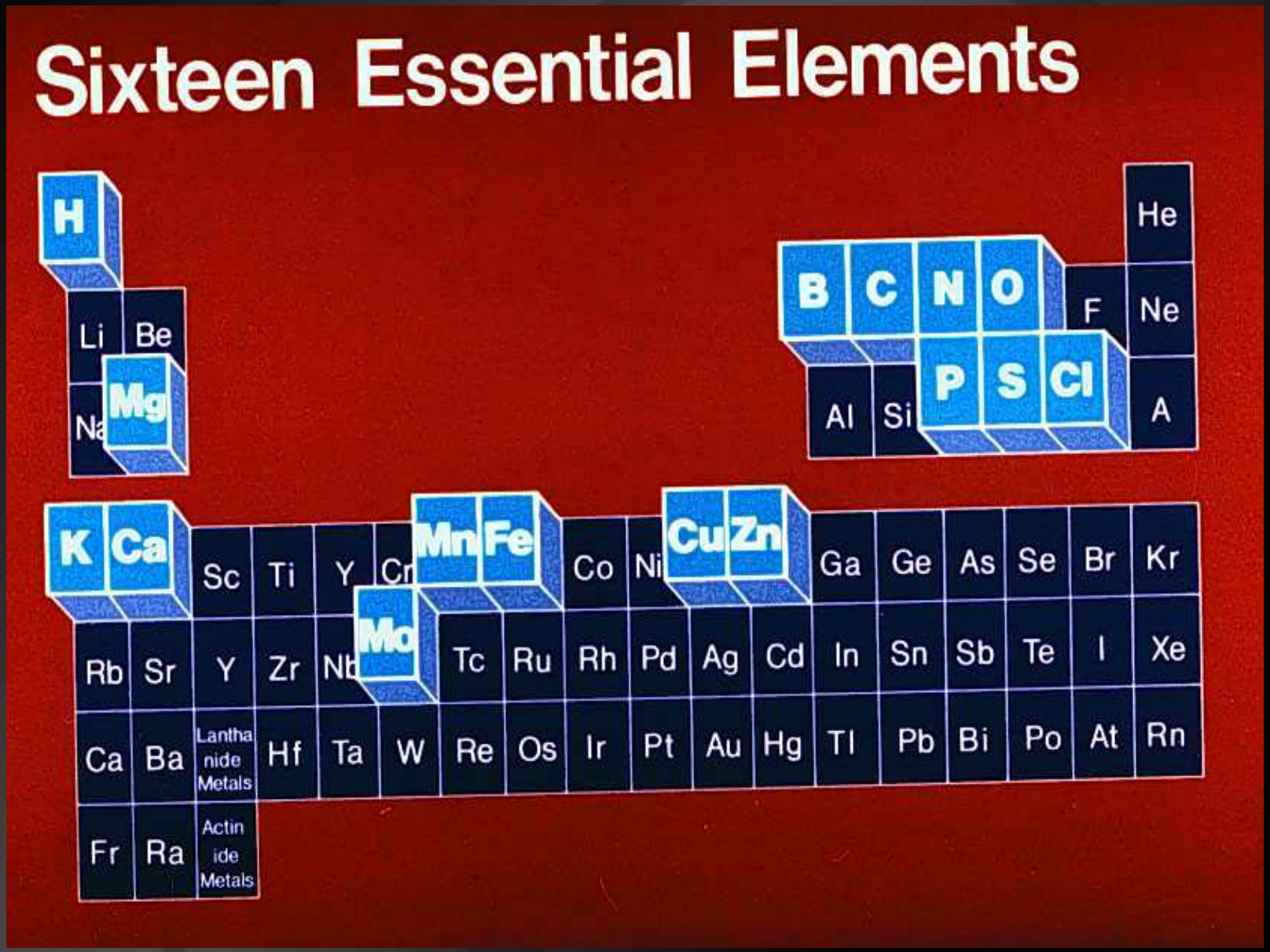
Micronutrient Topics

- Functions of micronutrients in plants.
- What concentrations of micronutrients in blueberry leaves are considered ideal?
- The role of soil/media pH and water quality.
- Some special problems- hydrogen sulfide in water, high manganese, others.
- Micronutrient deficiencies in GA Blueberries


Sixteen Essential Elements
H
He
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Mg
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Actin ide Metals

17 Essential Elements Needed by Plants

- Carbon, hydrogen, oxygen (from the air and water)
- Macroelements (%): nitrogen, phosphorus, potassium, sulfur, calcium, magnesium (from soil)
- Microelements (ppm): iron, zinc, manganese, copper, boron, chloride, molybdenum and nickel (from the soil)
- Also required by some plants: sodium, cobalt, vanadium, and silicon

Some Plant Nutrient Functions

- Zinc-Important in several enzyme systems, IAA synthesis
- Iron-Required in chlorophyll formation, activator for several biochemical processes
- Manganese-Activator of enzymes for plant growth processes, assists iron in chlorophyll formation
- Copper- Activator of several enzymes

Some Plant Nutrient Functions

- Boron - Important in cell formation, carbohydrate metabolism, pollen germination
- Chloride - Important in cell osmotic regulation, however, blueberries are sensitive to excessive chlorine
- Molybdenum - Required for utilization of nitrogen
- Nickel - Component of urease enzyme, important in plants fertilized with urea

Plant Nutrient Response Curve

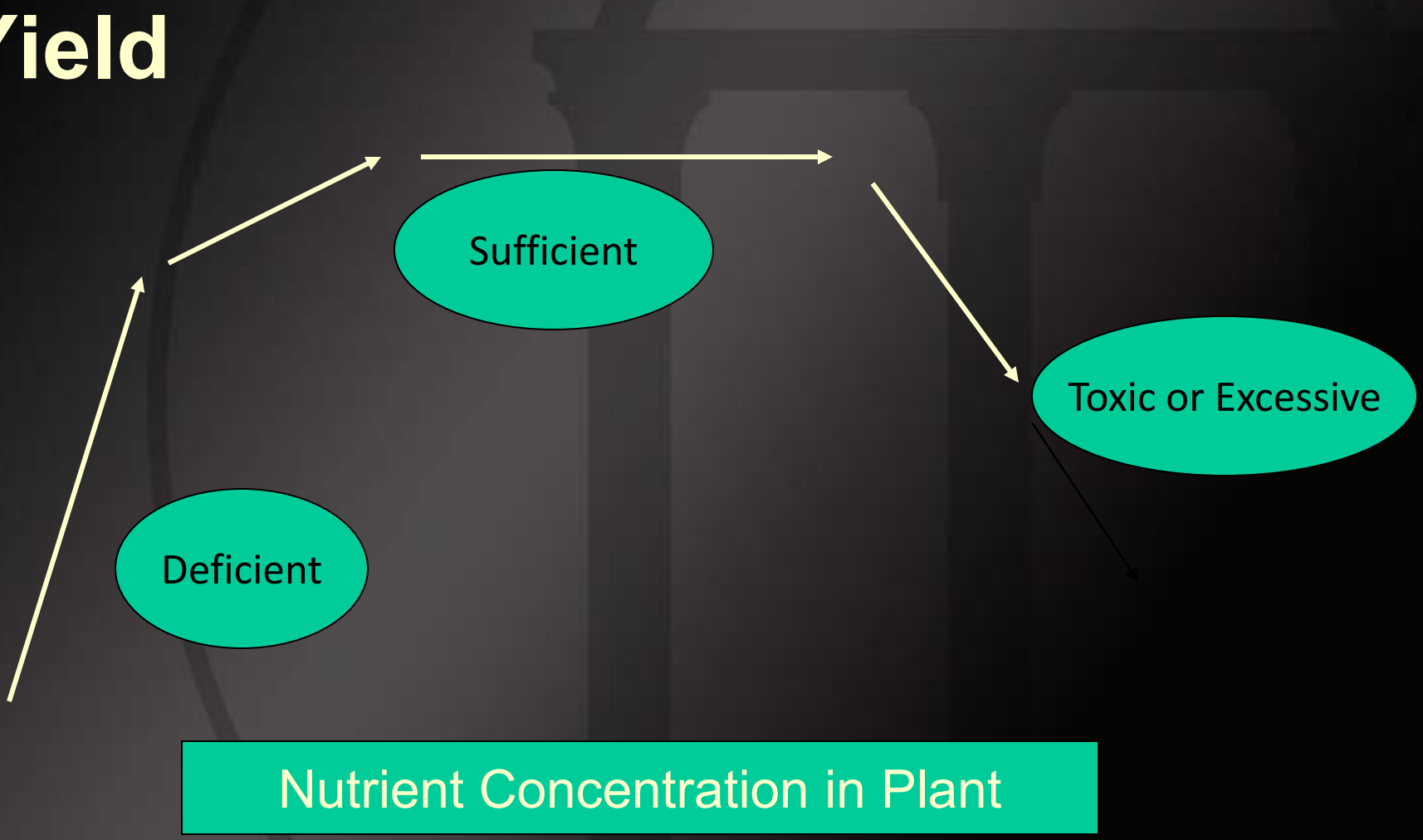


Table 1: Suggested critical nutrient levels in highbush and rabbiteye blueberry leaves.

ELEMENT	DEFICIENCY BELOW %	STANDARD RANGE FOR HIGHBUSH AND (RABBITEYE) Minimum (%)	Maximum (%)	EXCESS ABOVE (%)
Nitrogen(N)	1.70	1.80(1.20)	2.10(1.70)	2.50
Phosphorus(P)	0.10	0.12(0.08)	0.40(0.17)	0.80
Potassium(K)	0.30	0.35(0.28)	0.65(0.60)	0.95
Calcium(Ca)	0.13	0.40(0.24)	0.80(0.70)	1.00
Magnesium(Mg)	0.08	0.12(0.14)	0.25(0.20)	0.45
Sulfur(S)	0.10	0.12(NA)	0.20(NA)	NA
	ppm	ppm	ppm	ppm
Manganese(Mn)	23	50(25)	350(100)	450 (125 max.???)
Iron(Fe)	60	60(25) 40 OK??	200(70)	400
Zinc(Zn)	8	8(10)	30(25)	80
Copper(Cu)	5	5(5)	20(10)	100
Boron(B)	20	30(12)	70(35)	200

Monitoring Fields

- Take soil / media samples to check pH and EC
- At least once a year
- Track soil pH
- Take leaf samples to make adjustment in fertilizer rates.
- Collect leaf samples at least twice a year. Preharvest and postharvest. Recently matured leaves are the best for analysis.

gression analyses for most elements were more linear from late June to early August. Therefore, optimum time for the collection of leaf samples of rabbiteye blueberries for mineral analyses appears to be a 4-week interval coinciding with the last 2 weeks of the harvest season through a 2-week period immediately following harvest.

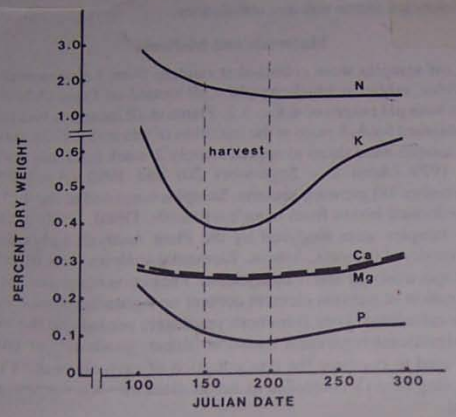


Fig. 1. Seasonal N, P, K, Ca, and Mg content regression curves in 'Tifblue' rabbiteye blueberry leaves, significant at the 5% level.

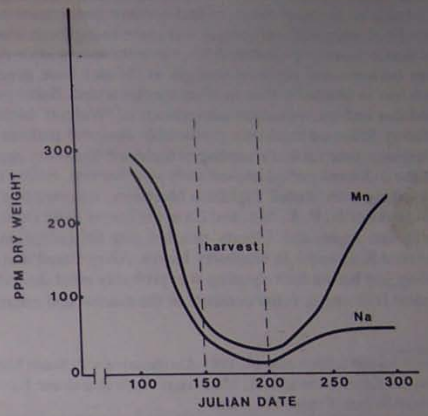


Fig. 2. Seasonal Mn and Na content regression curves in 'Tifblue' rabbiteye blueberry leaves, significant at 5% level.

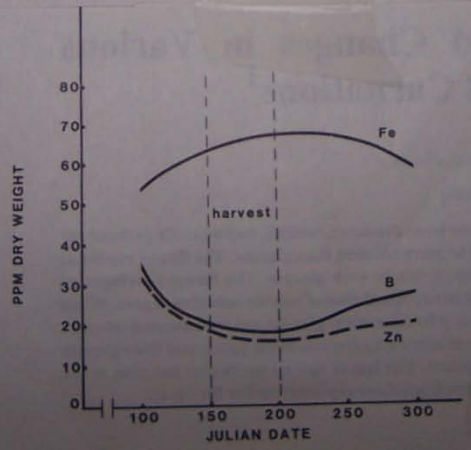


Fig. 3. Seasonal B, Fe, and Zn content regression curves in 'Tifblue' rabbiteye blueberry leaves. B and Zn significant at 5% level. Fe significant at 10% level.

300 = OCT.

K and Mn dip at Harvest on rabbiteyes Many other Elements are Fairly stable.

Spiers, 1982

Getting Soil or Media Chemistry Right

Southern Highbush Blueberry

- Soil or media pH should be 4.0 to 5.3
- Target is 4.5 to 4.8
- Better availability of nutrients at 4.8 than at 4.0, but still plenty of iron is available

Water Quality

Acid Injection

- Acid injection is widely used if pH or bicarbonates are high. Often needed for drip if water pH over 7.2 or bicarbonates over 150 ppm.
- Typically sulfuric acid, phosphoric acid or urea sulfuric acid (N-phuric) is used to lower the pH to about 5 to 5.5 for blueberries
- N-phuric also has about 0.5 pounds of N per gallon.
- Other options??

Water Quality

- pH: if very high (near 8), iron chlorosis can develop quickly even in low pH soil-Acid can correct
- Sodium: can be a problem, toxic to blueberries at high levels, SAR (Sodium Adsorbtion Ratio) below 4 is desirable, generally not a problem. But some salty areas are present in Fla.
- Total EC (Electrical conductivity) below 1.2 is best, better Fla. water typically has .2 to .3, before fertilizer is added. Water from the lower Floridan maybe be .6

Water Quality

- Chloride: usually not a problem in Ga or Southeast, but toxic to blueberries at high levels (Above 350 ppm??)
- Boron: Can be toxic if too high, a problem in some parts of Carolinas. Small amount in irrigation water in GA and FL.
- Iron and sulfur: If high can cause bacteria to grow, resulting in drip emitter plugging.
- Treat water with C-quest for sulfur?? Chlorine or Hydrogen peroxide cleaning of lines for sulfur and iron bacteria.

Important Nutrients in Florida Blueberry Production

Typically the Most Limiting Elements in Blueberry Georgia Blueberry Production

- Primary Elements: Nitrogen, Phosphorus and Potassium
- Secondary: Magnesium
- Micros: Iron, Copper, Boron, Manganese (excessive)

Common Deficiencies Iron

- Appears most often at pH above 5.3
- Diagnosis by soil sample and symptoms (leaf analysis not reliable)
- Often seen during drought on shoot tips using high pH irrigation water or in wet spots.
- Long term treatment is with sulfur and acid injection.
- Soil applications of iron chelate and iron sulfate can be use. Repeated foliar may also work.

Copper

- Increasing problem on virgin soils
- Small mouse ear shoots in late summer, die back
- Treat with copper chelate (rate-read label) or copper sulfate 1/2 lbs. injected, 4 lbs. banded
- Use copper chelate if sulfur water is present
- “Bucket” test recommended

Copper Sulfide formation

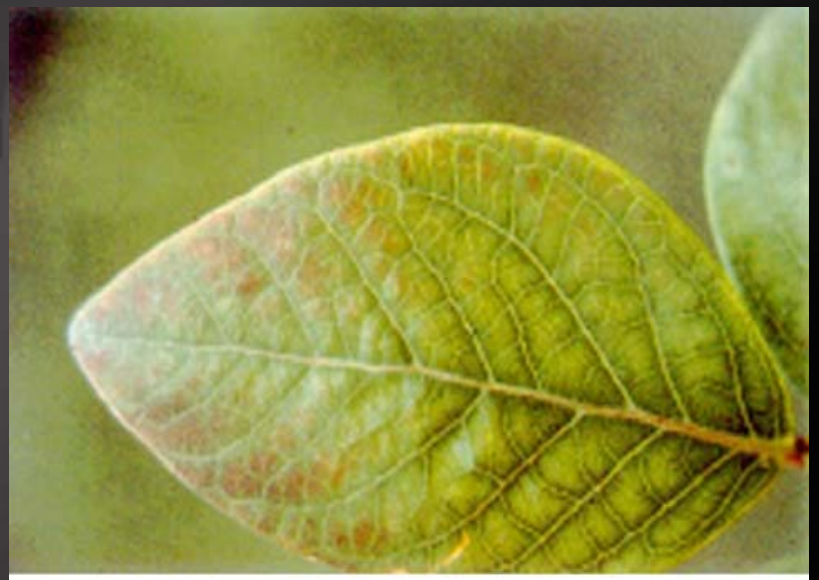
- Copper sulfate plus sulfur water
- Cloudy and material floating in the water
- Not safe to inject and not very available to the blueberry

Stem Blight

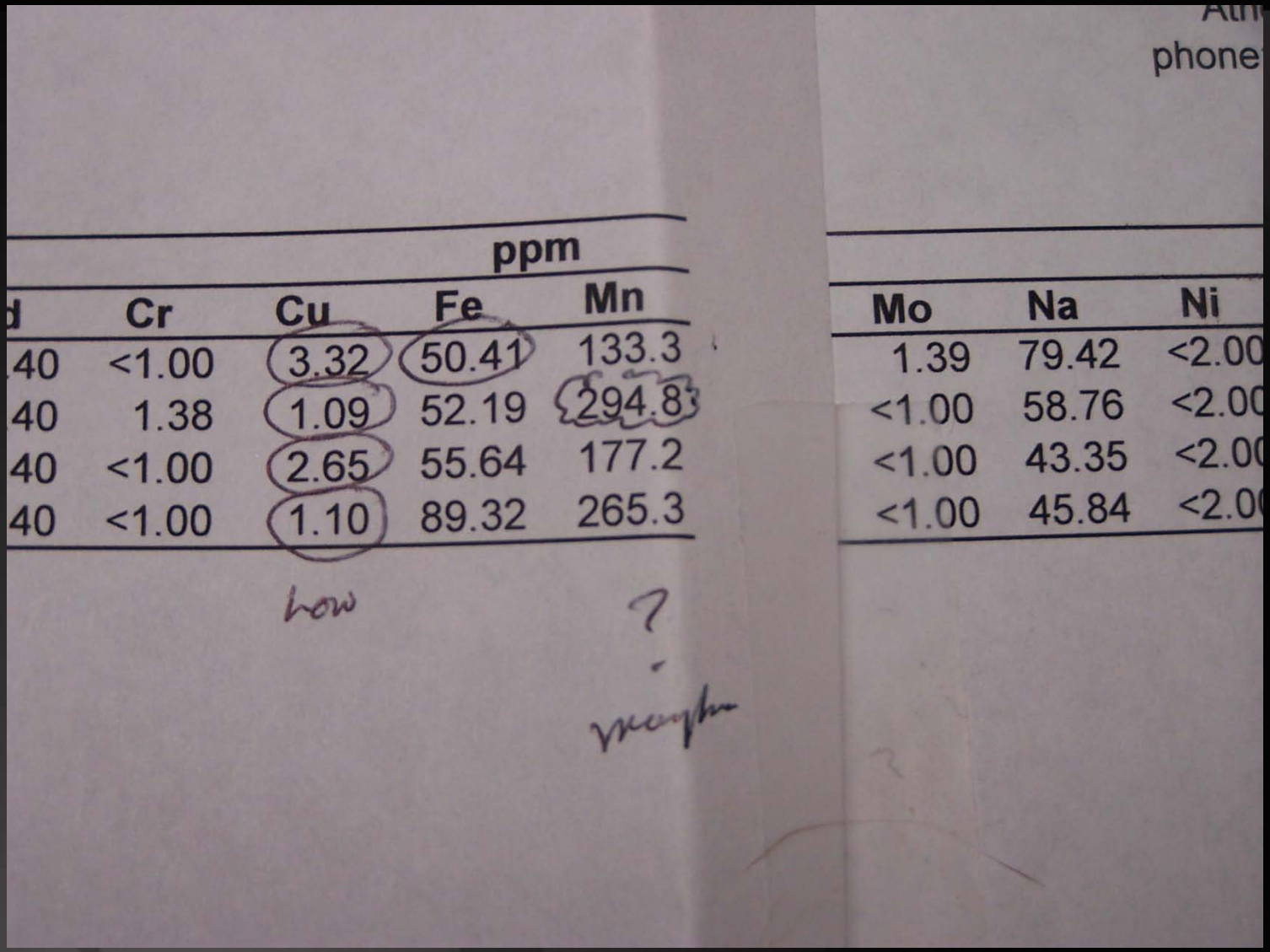
- Copper deficiency can cause dead shoot tips.
- Stem blight the spring after copper deficiency in the fall.
- A very serious problem on some Georgia farms in 2008 and 2010.
- Moves rapidly down stems and can kill plant.

Manganese (excessive)

- Found in pine bark and abundant at low pH
- Combination of fertilizer with Mn plus low pH has lead to toxicity
- Red leaves
- Growth may be reduced above 125 ppm on both southern highbush and rabbiteyes
- Defoliation in Bacon Co., Ga. at 2000 ppm



Mn Toxicity Symptoms in Blueberry



		ppm					
d	Cr	Cu	Fe	Mn	Mo	Na	Ni
40	<1.00	3.32	50.41	133.3	1.39	79.42	<2.00
40	1.38	1.09	52.19	294.8	<1.00	58.76	<2.00
40	<1.00	2.65	55.64	177.2	<1.00	43.35	<2.00
40	<1.00	1.10	89.32	265.3	<1.00	45.84	<2.00

how ? maybe

357 grower leaf samples, Rabbiteye, submitted to UGA Lab, 2008-2010

Element	Sufficiency range	% below (deficient)	% above
Magnesium	0.14 - 0.20%	20	23
Manganese	25 - 100 ppm	11	45
Iron	25-70 ppm	3	25
Zinc	10-25 ppm	12	27
Copper	5-10 ppm	89	2
Boron	12-35 ppm	3	40

206 grower leaf samples, Southern Highbush, to UGA Lab, 2008-2010

Element	Sufficiency range	% below (deficient)	% above
Magnesium	0.12 - 0.25%	7	21
Manganese	50 - 350 ppm	13	20
Iron	60-200 ppm	34	8
Zinc	8-30 ppm	7	3
Copper	5-20 ppm	92	0.5
Boron	30-70 ppm	18	27

Go to http://aesl.ces.uga.edu/ for UGA information for plant analysis and soil testing.

Questions?