Nutrient Management

Nutrient Management

First Steps

- **Test soil**
- **Preplant, adjust major nutrient levels**
- **Adjust pH to 6.5**
  - **pH affects all nutrient elements**

Nutrient Management

First Steps

LIMING

- **% Total base saturation** = K + Mg + Ca
- **% Acicity** = 100% - Total base saturation
- **Exchange acidity** = CEC x % acidity

Calculating Exchange Acidity

SOIL pH 5.8 NITROGEN: NO3-N = 15 ppm NH4-N = 2 ppm
BUFFER pH 6.6 ORGANIC MATTER: 6.4 % (Desirable range 4-10%)

NUTRIENT LEVELS:		PPM	Low Medium High	Very High
Phosphorus	(P)	12	XXXXXXXXXXXXXXXXX	
Potassium	(K)	127	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	
Calcium	(Ca)	799	XXXXXXXXXXXXXXXXXXXXXXXX	
Magnesium	(Mg)	114	XXXXXXXXXXXXXXXXXXXXXXXXXX	

CATION EXCH CAP: 13.6 Meq/100g

PERCENT BASE SATURATION: K= 3.5 Mg=10.0 Ca=42.5

MICRONUTRIENT LEVELS: ALL NORMAL

EXTRACTABLE ALUMINUM: 39 ppm (Soil range: 10-250 ppm)

- **% Total base saturation** = 3.5 + 10.0 + 42.5 = 56%
- **% Acicity** = 100% - 56% = 44%
- **Exchange acidity** = 13.6 x 44% = 5.0

Table 20. Tons of 100% ENV lime per acre required to increase pH to 7.0 for topsoil (0 to 8 inches)

	Exchange Acidity (me/100g soil)																				
Soil pH	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
4.4 - 4.5	2.7	3.2	3.7	4.3	4.8	5.3	5.9	6.4	6.9	7.4	8.0	8.5	9.0	9.6	10.1	10.6	11.2	11.7	12.2	12.8	13.3
4.6 - 4.7	2.6	3.2	3.7	4.2	4.7	5.3	5.8	6.3	6.9	7.4	7.9	8.4	9.0	9.5	10.0	10.5	11.1	11.6	12.1	12.7	13.2
4.8 - 4.9	2.6	3.1	3.7	4.2	4.7	5.2	5.7	6.3	6.8	7.3	7.8	8.3	8.9	9.4	9.9	10.4	11.0	11.5	12.0	12.5	13.0
5.0 - 5.1	2.6	3.1	3.6	4.1	4.6	5.1	5.6	6.1	6.6	7.2	7.7	8.2	8.7	9.2	9.7	10.2	10.7	11.2	11.8	12.3	12.8
5.2 - 5.3	2.4	2.9	3.4	3.9	4.3	4.7	5.3	5.7	6.3	6.8	7.2	7.7	8.2	8.6	9.2	9.6	10.2	10.6	11.1	11.6	12.0
5.4 - 5.5	2.1	2.6	3.0	3.4	3.8	4.2	4.7	5.1	5.5	5.9	6.3	6.7	7.2	7.6	8.1	8.5	8.8	9.3	9.7	10.2	10.6
5.6 - 5.7	2.0	2.3	2.7	3.1	3.5	3.9	4.2	4.6	5.0	5.4	5.8	6.2	6.5	6.9	7.3	7.7	8.1	8.5	8.8	9.2	9.6
5.8 - 5.9	1.8	2.1	2.4	2.8	3.1	3.5	3.8	4.2	4.5	4.9	5.2	5.5	5.9	6.2	6.7	6.9	7.2	7.6	7.9	8.3	8.6
6.0 - 6.1	1.6	1.9	2.2	2.5	2.8	3.2	3.5	3.8	4.1	4.4	4.7	5.0	5.4	5.7	6.0	6.3	6.6	6.9	7.2	7.6	7.9

Table 21. Tons of 100% ENV lime per acre required to increase pH to 6.5 for subsoil (8 to 16 inches)

	Exchange Acidity (me/100g soil)																				
Soil pH	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
4.4 - 4.5	2.4	2.8	3.3	3.8	4.2	4.7	5.2	5.7	6.1	6.6	7.1	7.6	8.0	8.5	9.0	9.4	9.9	10.4	10.9	11.3	11.8
4.6 - 4.7	2.3	2.8	3.3	3.7	4.2	4.7	5.1	5.6	6.0	6.5	7.0	7.4	7.9	8.4	8.8	9.3	9.8	10.2	10.7	11.2	11.6
4.8 - 4.9	2.3	2.7	3.2	3.7	4.1	4.6	5.0	5.5	5.9	6.4	6.9	7.3	7.8	8.2	8.7	9.1	9.6	10.0	10.5	10.9	11.4
5.0 - 5.1	2.2	2.7	3.1	3.5	4.0	4.4	4.9	5.3	5.7	6.2	6.6	7.0	7.5	7.9	8.3	8.7	9.2	9.6	10.1	1.05	11.0
5.2 - 5.3	2.0	2.4	2.8	3.2	3.6	4.0	4.4	4.8	5.2	5.6	6.0	6.4	6.8	7.2	7.6	8.0	8.4	8.8	9.2	9.6	10.0
5.4 - 5.5	1.6	1.9	2.2	2.6	2.8	3.1	3.5	3.8	4.1	4.4	4.7	5.0	5.4	5.6	6.0	6.3	6.6	6.9	7.2	7.6	7.9
5.6 - 5.7	1.3	1.6	1.8	2.1	2.4	2.6	2.8	2.9	3.4	3.6	3.9	4.1	4.4	4.6	4.9	5.1	5.4	5.6	5.9	6.2	6.4
5.8 - 5.9	1.0	1.21	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.0
6.0 - 6.1	0.8	0.9	1.1	1.3	1.4	1.6	1.7	1.9	2.0	2.2	2.4	2.5	2.7	2.8	3.0	3.1	3.3	3.5	3.6	3.8	3.9

Table 22. General lime recommendations for a depth of 16 inches (tons of 100% ENV lime per acre)

Soil pH	Sands	Sandy Loams	Loams & Silt Loams	Silty Clay Loams
4.5	4.5	10.0	16	22
4.6 - 4.7	4.5	10.0	15.5	21.5
4.8 - 4.9	4.5	9.5	14.5	20.5
5.0 - 5.1	3.5	8.5	13.0	18.0
5.2 - 5.3	2.5	7.0	11.0	14.5
5.4 - 5.5	1.7	5.0	7.0	10.2
5.6 - 5.7	1.7	3.5	5.0	7.7
5.8 - 5.9	1.2	2.5	4.5	6.0
6.0 - 6.1	1.0	2.5	3.5	5.0
6.2 - 6.3	0.7	1.7	2.5	3.5
6.4 - 6.5	0.5	1.2	1.7	2.5
6.6 - 6.7	0.4	0.9	1.2	1.7

Nutrient Management

Primary elements

- **Nitrogen**
- **Potassium**
- **Magnesium**
- **Calcium**
- **Boron**
- **Manganese**
- **Zinc**
- **Copper**

Nitrogen -- Apple

Deficiencies

- **Small fruit**
- **Weak growth**

Nitrogen -- Peach

Deficiencies

- **Poor growth**
- **Leaves yellow at shoot tips**
- **Leaves reddish-yellow at shoot bases**
- **Red, brown, necrotic spots**
- **Purplish- to brownish-red bark**

Nitrogen

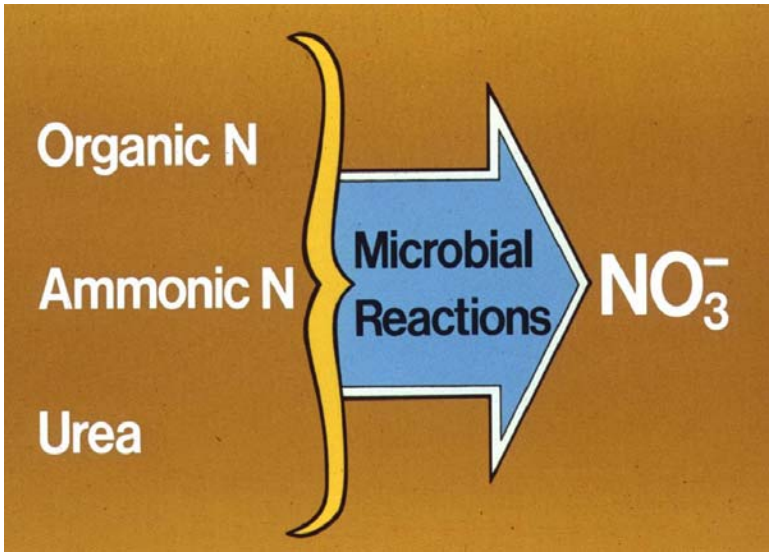
Excess

- **Excessive vegetative growth**
- **Poor fruit color and quality**
- **Reduced fruit calcium**

Nitrogen -- Sources

Management

- **Little difference among standard N sources**
- **USE CHEAPEST**
- **Other consideration:**
  - **Nitrate does not reduce pH**
  - **Ammonium reduces pH**
  - **Nitrate more readily leached than ammonium**



Nitrogen -- Year of planting

Management

- **Water to settle soil around roots**
- **0.6-1 ounce N per tree at bud break**
- **Repeat 4 weeks after bud break**
- **Liquid fertilizer best**

Nitrogen -- Nonbearing years

Management

- **0.5-2 ft of growth optimal, v/ system**
- **Apple, plum, cherry**
  - **0.05-0.1 lbs N per tree per year of age**
- **Pear**
  - **0.01-0.05 lbs N per tree per year of age**
- **Peach**
  - **0.1-0.2 lbs N per tree per year of age**

Nitrogen -- Bearing years

Management

- **6-15 in of growth optimal**
- **Often, N fertilization can be reduced**
- **Leaf analysis should be used**

Nitrogen -- Bearing years

Management – General considerations

- **Apples utilize 50-100 lbs N/acre/year**
  - **15-40 lbs N/acre permanently removed in a crop**
  - **Soil can supply between 35 and 80 lbs N/acre/year**
  - **Nitrogen fertilizer efficiency varies 50-80%**
- **Peaches utilize 200 lbs N/acre/year**
  - **60-70 lbs N/acre permanently removed in a crop**

Nitrogen -- Leaf analysis

Management

- **Hard, processing, & nonbearing apples**
  - **2.2-2.4% N**
- **Soft apples & pears**
  - **1.8-2.2% N**
- **Mature McIntosh apples**
  - **1.8-2.0% N**
- **Peaches**
  - **2.6-3.4% N**

Nitrogen -- Leaf analysis

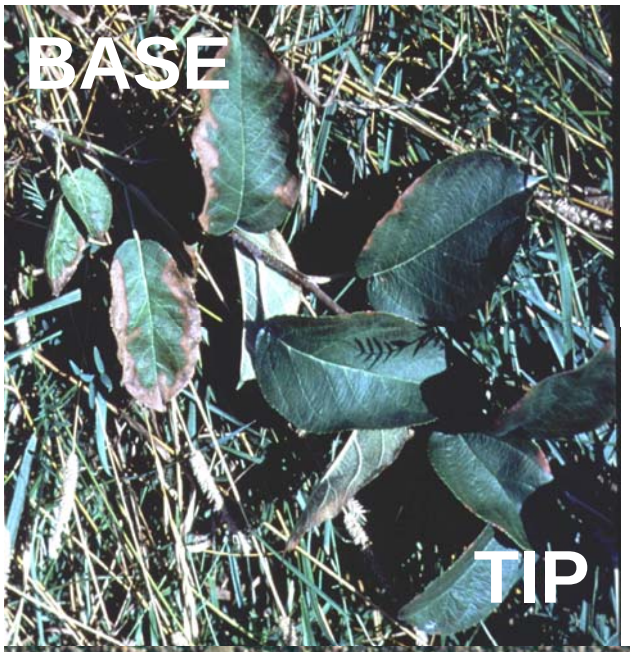
Management

- **If N > optimum**
  - **reduce by 10% for each 0.1% above**
- **If N < optimum**
  - **increase by 10% for each 0.1% below**

Potassium -- Apple

Deficiencies

- **Marginal leaf scorch -- first on older leaves**
- **Excessive fruit drop**
- **Small, poorly colored fruit**



Potassium -- Peach

Deficiencies

- **Light green leaves**
- **Leaf edges curl inward**
- **Leaf scorch at tips and margins**

Potassium

Excess

- **Reduced Ca uptake**
- **Potential for Ca deficiency**

Potassium

Management

- **Generally, required annually on mature trees, particularly if fruiting**
- **Required on nonbearing trees only if land recently cleared or soil sandy, gravelly, or very acid**

Potassium -- Leaf analysis

Management

- **Apple**
  - **1.2-1.8% K**
- **Pear**
  - **1.3-2.0% K**
- **Peach**
  - **2.0-3.3% K**

Potassium

Management

- **Treatment based on leaf analysis**
- **Optimum**
  - **60-90 lbs K_2O/acre (100-150 lbs KCl)**
- **Deficient**
  - **120-180 lbs K_2O/acre (200-300 lbs KCl)**
- **Excess**
  - **discontinue for a year**

Potassium -- Per-tree

Management

- **0.5 bu – 0.05 lbs K_2O (0.08 lbs KCl)**
- **1 bu – 0.09 lbs K_2O (0.15 lbs KCl)**
- **5 bu – 0.45 lbs K_2O (0.75 lbs KCl)**
- **10 bu – 0.90 lbs K_2O (1.50 lbs KCl)**

Magnesium -- Apples

Deficiency

- **Interveinal chlorosis to necrosis**
- **Oldest leaves affected first**
- **Drop of oldest leaves**
- **Enhanced fruit ripening and drop**

Magnesium -- Peaches

Deficiency

- **Watersoaked to gray blotch on leaves**
- **Oldest leaves affected first**
- **Leaves near terminals yellow**
- **Reduced hardiness**
- **Fewer flower buds**

Magnesium

Management

- **Use leaf analysis**
- **Apple & pear -- 0.35-0.50%**
- **Peach -- 0.40-0.80%**
- **Regularly use dolomitic limestone**

Magnesium

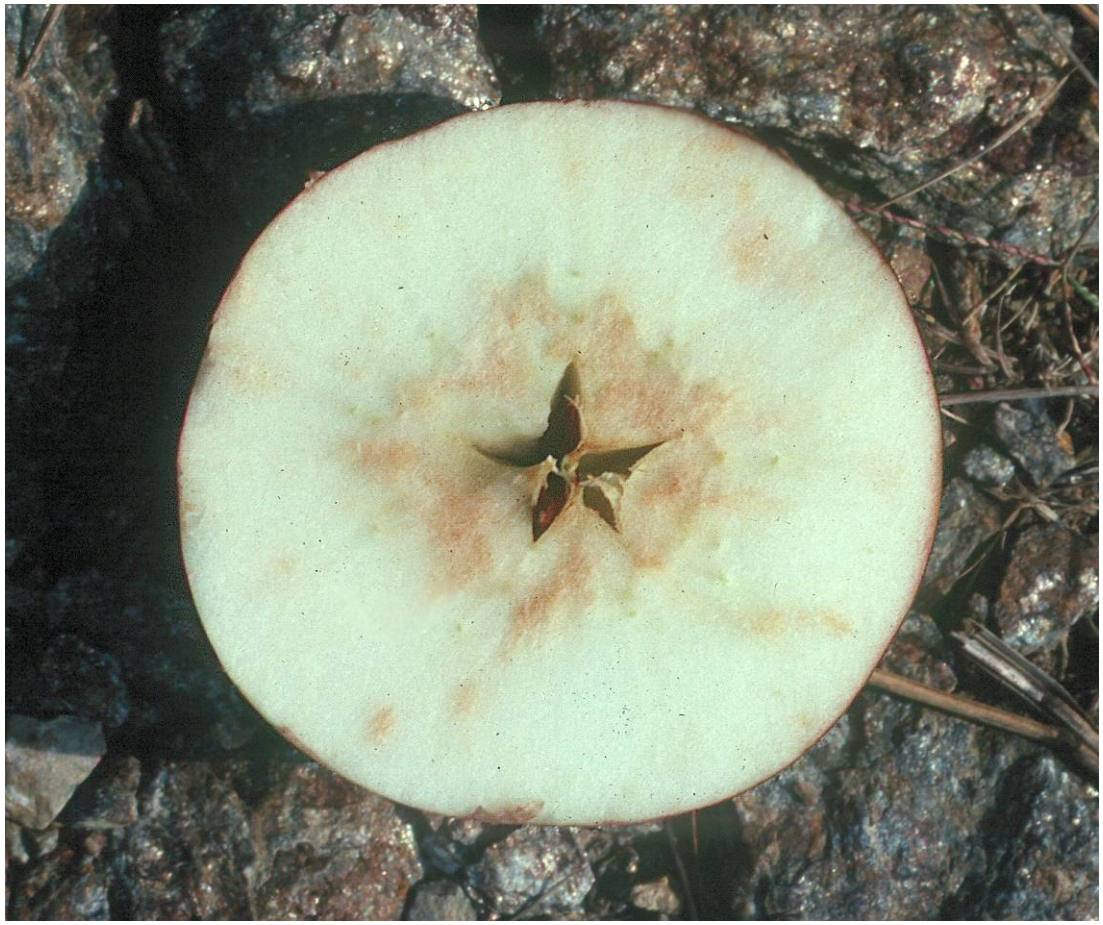
Management -- if Mg deficient

- **Epsom salts (15 lbs/100 gal)**
  - **PF, 1st cover, + 2nd cover**
  - **Compatible with most pesticides**
  - **Can concentrate to 8x**
  - **Avoid heat and slow drying**
- **Or 100 lbs Mg sulfate/acre -- soil**

Boron -- Apple

Deficiencies

- **Internal corking**
- **Highly colored fruit**
- **Premature drop**



Boron -- Pear

Deficiencies

- **Cracking**

Boron -- Peach

Deficiencies

- **Small leaves**
- **Interveinal chlorosis**
- **Twig dieback**

Boron

Management

- **Boron should be part of a regular fertilizer program for pears and apples**
  - 1-2 pounds of B per acre is common
- **Occasionally required for peaches**

Boron

Management

- **Leaf analysis**
  - **Apples: 35-50 ppm**
  - **Peaches & Pears: 25-50 ppm**

Boron -- Peaches

Management

- **<25 ppm -- 1 lb B/acre and retest**

Boron -- Apples

Management

- **<25 ppm:**
  - **Solubor: PH (5 lbs/acre) + TC (3 lbs/acre) OR**
  - **Solubor: TC, 1st, + 3rd cover (3 lbs/acre) OR**
  - **2-3 lbs B/acre soil + Solubor TC (3 lbs/acre)**
- **25-35 ppm:**
  - **Present program + Solubor TC or PF (3 lbs/acre)**
- **35-50 ppm: Present program (1-2 lbs B/acre)**
- **>50 ppm: Discontinue for a year**

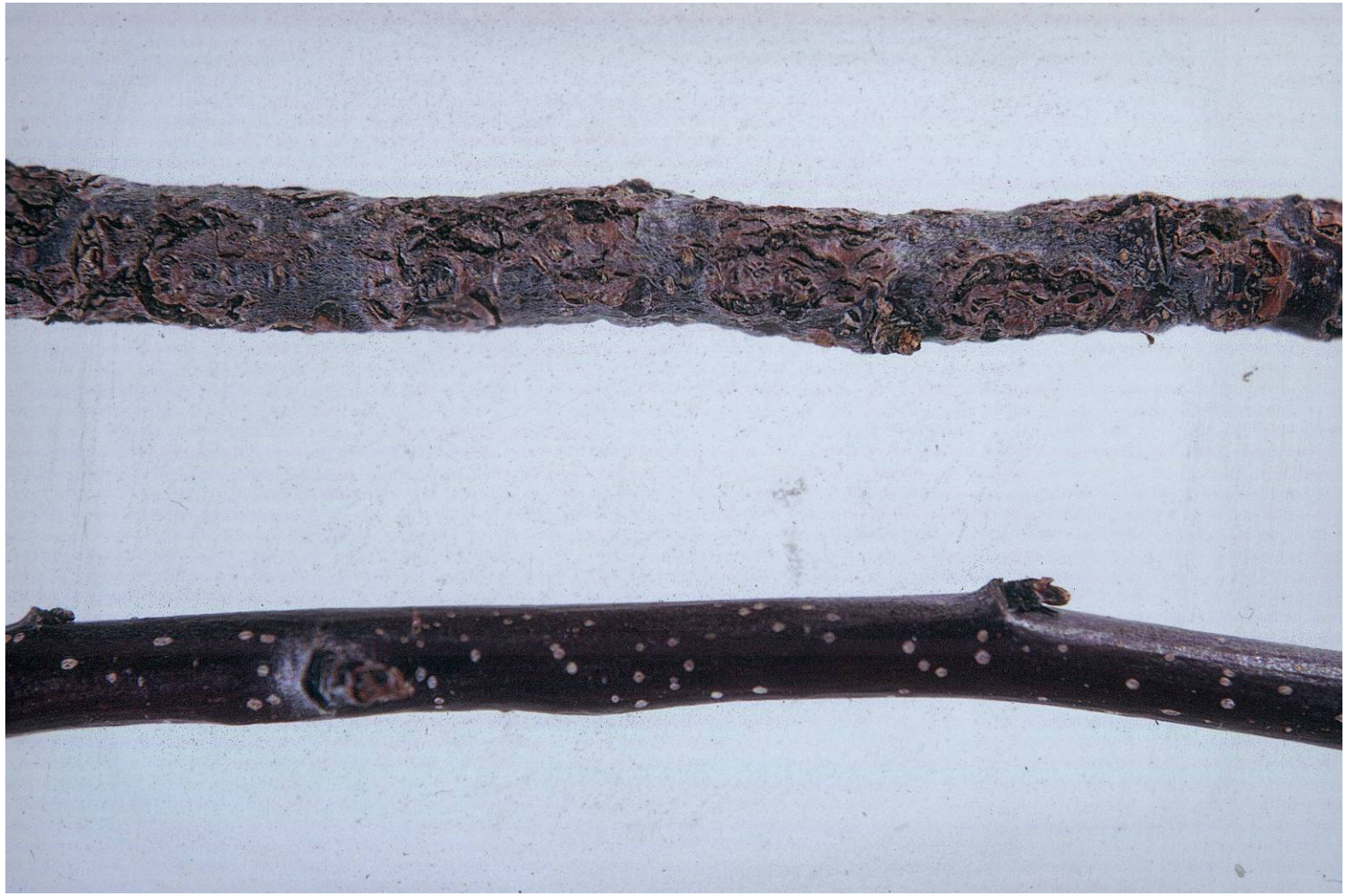
Manganese

Deficiency

- **Interveinal chlorosis, young + spur leaves**

Manganese

Toxicity



Manganese

Management

- **Leaf analysis -- 35-135 ppm**
- **If deficient**
  - **Mn-containing fungicides OR**
  - **Mn sulfate (4 lbs/100 gal) -- 1st cover**

Zinc

Management

- **Deficiency**
  - **Rosetting at ends of shoots**
- **Leaf analysis -- 25-50 ppm**
- **If deficient**
  - **Zn chelate (EDTA) (3 lbs or 3 qts/acre) -- TC and 2nd cover**

Copper

Management

- **Leaf analysis -- 7-12 ppm**
- **If deficient (GT to 1/4-inch Green)**
  - **2-4 pounds of a fixed copper (C-O-C-S or Kocide)/100 gallons**

Soil application -- Apples

- If trees are growing well?
- Optimal mature apple orchard blend
  - 10-0-30-5Mg-0.5B
  - Apply at a rate of 200-300 pounds/acre
    - Delivers (per acre):
      - 20-30 pounds N
      - 60-90 pounds K_2O
      - 10-15 pounds Mg
      - 1-1.5 pounds B

Pre-bloom Foliar Nutrients – Apples

- **Green tip**
  - 2-4 pounds fixed copper/100 gallons
- **Tight cluster**
  - 3 pounds urea (<0.25% biuret)/100 gallons
  - 1 pound Solubor/100 gallons
  - Zn-EDTA chelate at label rates

Soil application -- Peaches

- If trees are growing well?
- Optimal mature peach orchard blend
  - 10-0-30-5Mg
  - Apply 200-300 pounds/acre in early/mid April
    - Delivers (per acre):
      - 20-30 pounds N
      - 60-90 pounds K_2O
      - 10-15 pounds Mg
  - Apply 20-30 pounds N/acre at shuck split
    - 125-185 pounds Calcium Nitrate OR
    - 60-90 pounds Ammonium Nitrate OR
    - 45-65 pounds Urea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