Nut Crop Nutrition

Understanding the Principles to Optimize the Practices.

Fruit Growers Lab Conference
Tulare, March 16, 2010

Bob Beede, UC Farm Advisor
Kings County

http://cekings.ucdavis.edu/
Nutrition Management Involves

Knowledge of:

- Site/Soil characteristics and chemistry
- Plant requirements
- Cropping history
- Fertilizer inputs
- Cultural practices (Irrigation, vegetation management, pruning)
- Tissue analysis
- Observation and judgement
Annual Leaf Tissue Sampling:

• A plant-based measurement which integrates all the factors associated with nutrient extraction from the soil that it inhabits.

• Provides cause for further evaluation of soil and water quality, and fertilization practices.

• Best performed in July. Sample good and bad trees separately. Sample trees suspected of deficiency any time. Compare to good trees.
Effect of rootstock on micronutrient concentration in ‘Kerman’ pistachio leaves

<table>
<thead>
<tr>
<th>Rootstock</th>
<th>B (ppm)</th>
<th>Zn (ppm)</th>
<th>Cu (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>atlantica</em></td>
<td>194 a</td>
<td>16 b</td>
<td>15 b</td>
</tr>
<tr>
<td><em>integerrima</em></td>
<td>164 a</td>
<td>14 a</td>
<td>12 b</td>
</tr>
<tr>
<td><em>atl. x int.</em></td>
<td>148 b</td>
<td>14 a</td>
<td>13 b</td>
</tr>
</tbody>
</table>

Information courtesy of Louise Ferguson, et al.
Nutrient Fluxes (N, K, S, P) in Walnut

The scale of nutrient demand is determined largely by Yield.

- Stored Nutrients
- Current Year Uptake

N Flux (mg N/day/tree)

- Spring Growth
- Flowering
- Leaf Expansion
- Bud development
- Nutrient Storage, leaf senescence
- Nut Development
- Nut maturity

Excess Demand
Environmental Constraints
Cold Spring or Drought
Occurrence of Nutrient Deficiencies in California

• Common
  – Nitrogen
  – Zinc
  – Iron

• Occasional
  – Potassium
  – Magnesium
  – Manganese

• Rare
  – Phosphorus
  – Boron
  – Copper

• Unknown
  – Calcium
  – Sulfur
  – Molybdenum
Foliar Calcium Formulations
Foliar Calcium Trial
Flavorcrest Peach
% Decay after 3 wks at 32F

% Decay

0 10 20 30 40 50 60 70

Treatment

Con Chl Nit Act Carb S + P Car Acd Amino

% Decay
Foliar Calcium Trial
Flavorcrest Peach
Firmness at Harvest

Treatment

Firmness (lbs)

Con  Chl  Nit  Act  Carb  S + P  Car Acd  Amino
Nitrogen Deficiency
Nitrogen Response

Low N

High N
Nitrogen Fertilization

- 1980s survey
  - 150 lbs N/acre
- Recent experience
  - 50 to 75 lbs N/acre
- Improved efficiency
  - N in well water
  - Split applications
  - Better timing
  - Fertigation
### MICRONUTRIENT DEFICIENCIES IN NUT CROPS:

**HOW COMMON ARE THEY?**

<table>
<thead>
<tr>
<th></th>
<th>Zn</th>
<th>B</th>
<th>Fe</th>
<th>Cu</th>
<th>Mn</th>
<th>Ni</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ALMONDS</strong></td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td><strong>WALNUTS</strong></td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td><strong>PISTACHIOS</strong></td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td><strong>PECANS</strong></td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

**VISUAL SCALE:** 0 = never seen, 1 = rarely, 2 = occasional, 3 = often
The Role of Zinc in Plants

1. Required for Auxin (NAA) formulation
2. Auxin involved in cell elongation
3. Associated with chloroplast formulation
4. Essential for pollen development, flower bud differentiation and fruit set
February 7, 2005

Zn Deficient

Zn Sufficient
February 22, 2005

Zn Deficient

Zn Sufficient
Symptoms of zinc deficiency

Optimal leaf tissue concentration: 10 – 15 ppm
Shoot Zn Distribution Through A Dormant Peach Tree (ppm)

- 16.3
- 32.6
- 47.9 - shaded
- 19.1 - sun exposed
- 28.5 - sun exposed
- 39.7 - sun exposed
- 70.3 - shaded

Water sprout
Effect of Concentrated Fall 36% Zinc Foliar Application on % Leaf Drop  
Lonnie Hendricks and Ron Bekey- Merced County, 10/20/1983

<table>
<thead>
<tr>
<th>ZN RATE (LBS/GALLONS)</th>
<th>10 DAT</th>
<th></th>
<th>18 DAT</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>Nonpareil</td>
<td>Price</td>
<td>Nonpareil</td>
<td>Price</td>
</tr>
<tr>
<td>0</td>
<td>8</td>
<td>0.4</td>
<td>13</td>
<td>10</td>
</tr>
<tr>
<td>10/25</td>
<td>61</td>
<td>36</td>
<td>94</td>
<td>64</td>
</tr>
<tr>
<td>20/25</td>
<td>65</td>
<td>83</td>
<td>95</td>
<td>97</td>
</tr>
<tr>
<td>40/25</td>
<td>95</td>
<td>92</td>
<td>97</td>
<td>97</td>
</tr>
<tr>
<td>20/100</td>
<td>95</td>
<td>75</td>
<td>100</td>
<td>96</td>
</tr>
<tr>
<td>40/100</td>
<td>96</td>
<td>96</td>
<td>97</td>
<td>99</td>
</tr>
</tbody>
</table>

Shoot bud drop >only @ 50lb/25 gpa. Flower drop> @rates above 20lb/25 gpa
Comparing Zinc Formulations

Most Effective  =  Nitrate (Patrick’s mix)

Sulfate – 36%
Carbohydrate (Zicron)
Polyamine
EDTA
Leonardite
Oxysulfate – 52%

Least Effective  =  ZnO Suspension
## Comparing Zinc Formulations

### Phytotoxicity

<table>
<thead>
<tr>
<th>Formulation</th>
<th>Toxicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrate (Patrick’s mix)</td>
<td>High</td>
</tr>
<tr>
<td>Sulfate – 36%</td>
<td>Med</td>
</tr>
<tr>
<td>Carbohydrate (Zicron)</td>
<td>Med</td>
</tr>
<tr>
<td>Polyamine</td>
<td>Med</td>
</tr>
<tr>
<td>EDTA</td>
<td>Low</td>
</tr>
<tr>
<td>Leonardite</td>
<td>Low</td>
</tr>
<tr>
<td>Oxysulfate – 52%</td>
<td>None</td>
</tr>
<tr>
<td>ZnO Suspension</td>
<td>None</td>
</tr>
</tbody>
</table>
SPRING FOLIAR TREATMENT RECOMMENDATIONS FOR NUT CROPS:

PECANS:

A. BEGIN AT FIRST FLUSH, PRIOR TO BLOOM. APPLY 4-6 LBS 36% Zn AND 2-3 LBS L.B. UREA OR 2-3 LBS POTASSIUM NITRATE PER 100 GALS., 200 GPA.

B. REPEAT 2 WEEKS LATER

C. REPEAT 2 WEEKS LATER

D. REPEAT MONTHLY UNTIL LATE AUGUST

E. APPLICATIONS DURING BLOOM HAVE YET TO SHOW BURN

PISTACHIOS:

A. IF MARGINAL IN ZINC, APPLY 20 LBS ZN 36% IN 100 GPA OR 5 GALS OF 12% LIQUID ZN AT BUD SWELL (LATE FEB-EARLY MARCH). APPLY NO LATER THAN GREEN TIP.

B. AT 50% LEAF EXPANSION (LATE APRIL), APPLY 2 LBS 36% ZN IN 100 GPA. ACIDIFY TO pH=5 WITH CITRIC ACID, NOT PHOS ACID (MAKES ZN PHOSPHATE). OK TO ADD CHELATED CU
The Role of Boron in Plants:

- Functions in the differentiation of new cells
- When deficient, cells may continue to divide, but their structural parts are not properly or completely formed
- Regulates carbohydrate metabolism
- Low Boron limits pollen germination and pollen tube growth
- Does not move from to young leaves from old ones (immobile)
Correcting Boron (B) Deficiency

• Because B is phloem immobile in pistachio, adequate amounts must be present in the soil for uptake with water.

• For correction the following spring, soil treatments must occur by the end of August. Treat sooner if symptoms appear. Rate: 2-4 ounces of Solubor product per tree. (16-32 lbs/acre). Easily applied through the drip system or in the herbicide spray.

• To improve fruit set under marginal B levels, apply 5 pounds of Solubor per acre in the delayed dormant period (late February to early March). If combined with zinc, buffer to pH=5.0 for improved Zinc uptake.

• Monitor leaf and soil levels to avoid toxicity. Boron is VERY insoluble in the soil. Hence, it does NOT leach easily!
Symptoms of copper (Cu) deficiency
Correcting Copper Deficiency

• Apply one-third to one-half pound of 14.5% Copper EDTA as a foliar treatment at 50% leaf expansion (late April)

• Can be mixed with Zinc and pyrethroid insecticide treatment

• Include in nutrient mixes to be applied several times in the spring
THANK YOU!

Don’t Forget:
Area-Wide Symposium on Navel Orangeworm and Plant Bugs in Almonds and Pistachios
Tuesday, April 20, 2010
Ag-Expo Building