Effects of calcium sprays and AVG on fruit quality at harvest and after storage

Principal Investigators
Chuck Ingels and Beth Mitcham/Bill Biasi

Collaborators
Thom Wiseman and Michelle Leinfelder-Miles

Grower Cooperator
Daniel Wilson
Many physiological disorders in fruits are associated with Ca deficiency.

Ca foliar sprays have been shown to reduce fruit diseases and physiological disorders.

Fruits with a high level of Ca have lower respiration rate and longer potential storage life than fruits containing low Ca.
The easiest way to maximize fruit calcium level is through a foliar spray.

Fruit Ca content shown to significantly increase by foliar Ca sprays (mostly CaCl$_2$).
## Ca and Mg in Soil
### Out of Balance in Delta Orchards

### PEAR Soil Analysis

<table>
<thead>
<tr>
<th>Test Description</th>
<th>Result</th>
<th>Units</th>
<th>Optimum Range</th>
<th>Graphical Results Presentation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary Nutrients</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrate-Nitrogen</td>
<td>9.5</td>
<td>PPM</td>
<td>20 - 30</td>
<td></td>
</tr>
<tr>
<td>Ammonium Nitrogen</td>
<td>3</td>
<td>PPM</td>
<td>10 - 20</td>
<td></td>
</tr>
<tr>
<td>Phosphorus-P₂O₅</td>
<td>45.8</td>
<td>PPM</td>
<td>39 - 73</td>
<td></td>
</tr>
<tr>
<td>Potassium-K₂O (Exch)</td>
<td>277</td>
<td>PPM</td>
<td>100 - 600</td>
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</tr>
<tr>
<td>Potassium-K₂O (Sol)</td>
<td>13.3</td>
<td>PPM</td>
<td>37 - 130</td>
<td></td>
</tr>
<tr>
<td><strong>Secondary Nutrients</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium (Exch)</td>
<td>2670</td>
<td>PPM</td>
<td>2600 - 3400</td>
<td></td>
</tr>
<tr>
<td>Calcium (Sol)</td>
<td>36</td>
<td>PPM</td>
<td>74 - 210</td>
<td></td>
</tr>
<tr>
<td>Magnesium (Exch)</td>
<td>891</td>
<td>PPM</td>
<td>260 - 520</td>
<td></td>
</tr>
<tr>
<td>Magnesium (Sol)</td>
<td>21.5</td>
<td>PPM</td>
<td>34 - 76</td>
<td></td>
</tr>
<tr>
<td>Sodium (Exch)</td>
<td>40</td>
<td>PPM</td>
<td>0.0 - 250</td>
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</tr>
<tr>
<td>Sodium (Sol)</td>
<td>16</td>
<td>PPM</td>
<td>0.0 - 190</td>
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<tr>
<td>Sulfate</td>
<td>63.4</td>
<td>PPM</td>
<td>62 - 990</td>
<td></td>
</tr>
<tr>
<td><strong>CEC</strong></td>
<td>21.4</td>
<td>meq/100g</td>
<td>14 - 35</td>
<td></td>
</tr>
<tr>
<td><strong>% Base Saturation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CEC - Calcium</td>
<td>62.1</td>
<td>%</td>
<td>60 - 80</td>
<td></td>
</tr>
<tr>
<td>CEC - Magnesium</td>
<td>34.3</td>
<td>%</td>
<td>10 - 20</td>
<td></td>
</tr>
<tr>
<td>CEC - Potassium</td>
<td>2.71</td>
<td>%</td>
<td>1.0 - 6.0</td>
<td></td>
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<tr>
<td>CEC - Sodium</td>
<td>0.780</td>
<td>%</td>
<td>0.0 - 5.0</td>
<td></td>
</tr>
<tr>
<td>CEC - Hydrogen</td>
<td>0.00</td>
<td>%</td>
<td>0.0 - 3.0</td>
<td></td>
</tr>
</tbody>
</table>

Good: Green  | Problem: Red  | Indicates physical conditions and/or phenological and amendment requirements.
**Ca and Mg in Leaves**

**Ca Levels are a Bit Low**

### PEAR PLANT TISSUE ANALYSIS - HARVEST

<table>
<thead>
<tr>
<th>Test Description</th>
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<th>Optimum Range</th>
<th>Graphical Results Presentation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Macro Nutrients</strong></td>
<td></td>
<td></td>
<td></td>
<td>Deficient</td>
</tr>
<tr>
<td>Total Nitrogen (Leaf)</td>
<td>2.50</td>
<td>%</td>
<td>2.3 - 2.8</td>
<td>-green</td>
</tr>
<tr>
<td>Phosphorus (Leaf)</td>
<td>0.14</td>
<td>%</td>
<td>0.060 - 0.80</td>
<td>-green</td>
</tr>
<tr>
<td>Potassium (Leaf)</td>
<td>1.11</td>
<td>%</td>
<td>1.0 - 14</td>
<td>-green</td>
</tr>
<tr>
<td>Calcium (Leaf)</td>
<td>1.95</td>
<td>%</td>
<td>1.0 - 8.0</td>
<td>-green</td>
</tr>
<tr>
<td>Magnesium (Leaf)</td>
<td>0.41</td>
<td>%</td>
<td>0.25 - 2.0</td>
<td>-green</td>
</tr>
<tr>
<td><strong>Micro Nutrients</strong></td>
<td></td>
<td></td>
<td></td>
<td>Deficient</td>
</tr>
<tr>
<td>Zinc (Leaf)</td>
<td>28.2</td>
<td>ppm</td>
<td>18 - 250</td>
<td>-green</td>
</tr>
<tr>
<td>Manganese (Leaf)</td>
<td>23</td>
<td>ppm</td>
<td>20 - 250</td>
<td>-green</td>
</tr>
<tr>
<td>Iron (Leaf)</td>
<td>61</td>
<td>ppm</td>
<td>59 - 250</td>
<td>-green</td>
</tr>
<tr>
<td>Copper (Leaf)</td>
<td>36</td>
<td>ppm</td>
<td>4.0 - 25</td>
<td>-green</td>
</tr>
<tr>
<td>Boron (Leaf)</td>
<td>27.8</td>
<td>ppm</td>
<td>21 - 70</td>
<td>-green</td>
</tr>
<tr>
<td>Sodium (Leaf)</td>
<td>0.009</td>
<td>%</td>
<td>0.0 - 0.25</td>
<td>-green</td>
</tr>
</tbody>
</table>

**Notes:** Calcium levels are a bit low. Other levels are within acceptable ranges.
Ca Problem in Delta Orchards

- OK by UC guidelines (decades old, unknown criteria), but longer storage sometimes needed
- 2009 – high fruit loss (Argentina dumping)
- Growers use 200 lbs. $\text{CaNO}_3$ May & June in part to add Ca, thought to improve quality
- Many growers include Ca in blight sprays
- There may be a rate effect
**Background**

ReTain – aminoethoxyvinylglycine (AVG)

- Ethylene biosynthesis inhibitor, derived by fermenting a naturally occurring antibiotic (rhizobitoxine)
- May enhance fruit color and size by allowing fruit to remain on the trees longer, extending harvest
- More consistent effects on apple than pear
Ca and ReTain Cost

- Vigor-Cal = $22/gal., Agro-K 9-24-3 = $16 gal.
- 2 qts./acre each → $19/application
- 4 tank-mixed applications = $76 total, no application cost

- ReTain applied at 11.7 oz./acre (1 bag) = $265
- Could be tank mixed with NAA, but timing might not be ideal
Objectives

1. Evaluate effects of foliar Ca sprays and ReTain on fruit size and quality on Bartlett fruit

2. Compare effects on postharvest fruit quality after storage and ripening
Treatments
RCBD, 5 treatments, 8 single-tree reps

1. Vigor-Cal + 9-24-3 (2 qts./acre each)
2. Vigor-Cal + 9-24-3 (4 qts./acre each)
   – 4 weekly applications starting late March
3. ReTain (1 bag/acre)
   – 1 application 2 weeks before harvest
   – Applied 6/26, harvest 7/9 (13 days later)
4. Both #2 and #3
5. Untreated
10 leaves/tree (80 total), 4-7’ high from around tree
Swished in soap water, double rinse
Analyzed for N, P, K, Ca
Evaluations
First Harvest

- Sampled 40 high, 40 low fruit per tree (1¾”)
- Evaluations at Mitcham lab:
  - Fruit weights
  - Color, firmness, starch, SS, TA
    » 10 fruit/rep immediately and after ripening
    » Cool 60 fruit/rep, evaluate color, firmness, and scald/internal browning (none):
      » 15 fruit/rep after 1.5 and 3.5 months, with and without ripening
Random (strip) pick
Evaluate 20 fruit/rep for fruit size & weight, skin color, firmness, SS, TA
Leaf Nutrient Content
Apr. 22

VigorCal + 9-24-3 (2 qts. vs. 4 qts.)

Adequate = 1-8%

% of Nutrient Content

N  P  K  Ca

Untreated
2 Qts.
4 Qts.
Leaf Nutrient Ratios
Apr. 22

VigorCal + 9-24-3 (2 qts. vs. 4 qts.)

%  

N/Ca  

K/Ca  

Untreated  
2 Qts.  
4 Qts.
Total Soluble Solids
1st pick July 9 (1¾”), 2nd pick July 14

- Untreated
- 2 Qts.
- 4 Qts.
- ReTain
- 4 Qts. + ReT
## Fruit Firmness (lbs.)

Weeks of storage, Days of ripening

### 1st pick 7/9 (1 3/4”)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>0W0D</th>
<th>0W7D</th>
<th>6W0D</th>
<th>0W0D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated</td>
<td>19.1 a</td>
<td>2.65 bc</td>
<td>18.1 a</td>
<td>20.8 a</td>
</tr>
<tr>
<td>2 qts.</td>
<td>18.9 a</td>
<td>2.68 bc</td>
<td>17.9 a</td>
<td>20.4 a</td>
</tr>
<tr>
<td>4 qts.</td>
<td>19.4 a</td>
<td>2.44 c</td>
<td>18.0 a</td>
<td>20.9 a</td>
</tr>
<tr>
<td>ReTain</td>
<td>18.7 a</td>
<td>2.94 ab</td>
<td>17.8 a</td>
<td>20.4 a</td>
</tr>
<tr>
<td>4 qts. + ReTain</td>
<td>18.8 a</td>
<td>3.13 a</td>
<td>18.4 a</td>
<td>20.9 a</td>
</tr>
</tbody>
</table>

### 2nd pick 7/14
No storage problems in any treatment
  » Fruit likely had sufficient Ca and nutrient balance
No leaf Ca increase days after last application
  » Translocated? (Immobile) Didn’t get in?
Ca treatments had no effect on fruit firmness
  » Consistent with results of other Ca trials
ReTain increased firmness 0.5 lb.
  » Only after 7 days ripening
Notes on VigorCal
Agro-K Rep

- Apply VigorCal every 7-10 days starting 10% bloom, every 10-14 days starting 30 days after petal fall to just before harvest
  » Most growers make 4-5 applications
- Apply micronutrients (esp. Zn, Mg) as leaves are expanding
- 2 vs. 4 qt. rate effect more obvious on varieties other than Bartlett
2014 Treatments
RCBD, 4 treatments, 8 single-tree reps

1. Vigor-Cal + 9-24-3 (4 qts./A)
   – 4 weekly applications in April,
2. 12% liquid CaCl2 (1 qt./100 gal.)
   – 4 applic. every 3 weeks, late April-June
3. ReTain (1 bag/A)
   – 1 applic. 2 weeks before harvest, 1 bag
4. Both #1 and #3
5. Untreated
Questions?