Fertility and Soil Health

Mike Robinson
Wenatchee, WA
What is the Goal?

- To produce maximum crops on an annual basis, of commercially preferred sizes and grades
- Leave the Soil better than I found it
- Provide tasty and nutritious food
- Contain the nutrients I use to the property I farm.
- MAKE A PROFIT (The key to sustainability)
What Tools do I have to accomplish my goals
Soil Analysis

- The cornerstone of modern fertility management
- Referred to in most extension publications and farm magazines as the basis for decisions on fertility.
- Its use is taught in classrooms across the US
- Required by the NOP and some GAP programs
A couple of common soil testing and fertility management systems

Soil Balancing approach

Nutrient target approach
Where did the target levels come from?

- The soil balancing approach started with a researcher named Albrecht in Missouri.
- It has been modified to fit our climate and soils through substantial trial and error.
- No scientific trials link test results to a result in the tree.

- The WSU Fertilizer guide from many years ago.
- The levels may have been derived from target levels developed for alfalfa.
- No scientific trials link test results to a result in the tree.
Samples don’t correlate

- Soil samples don’t correlate to the quality of the block
- The best producing / highest quality blocks should have numbers closest to optimum levels
- The results are often the opposite
Eliminate the block numbers, can you tell which block is which?

<table>
<thead>
<tr>
<th>BMR</th>
<th>BLK 15 Fuji (0.6 inches)</th>
<th>Apple Variety: Fuji 4B</th>
<th>Field Representative: Kenton Carman</th>
<th>Branch Office: Quincy Branch</th>
<th>Date of Analysis: September 15, 2010</th>
</tr>
</thead>
</table>

**SATURATED SOIL ANALYSIS**

<table>
<thead>
<tr>
<th>Test</th>
<th>Ideal</th>
<th>BLK 15 Fuji</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
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<tr>
<td>S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NCLC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Test Results**

- pH
- Calcium
- Magnesium
- Potassium
- Sodium
- Manganese
- Copper
- Zn
- Mo
- Nitrate
- Boron
- Molybdenum
- Chloride
- Zinc
- Sulfate
- Calcium
- Magnesium
- Potassium
- Sodium
- Manganese
- Copper
- Zinc
- Sulfate
- Calcium
- Magnesium
- Potassium
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- Magnesium
- Potassium
- Sodium
- Manganese
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- Zinc
- Sulfate

**SATURATED SOIL ANALYSIS**

<table>
<thead>
<tr>
<th>Test</th>
<th>Ideal</th>
<th>BLK 14 Granny (0.6 inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>K</td>
<td></td>
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<td>P</td>
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<tr>
<td>S</td>
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<tr>
<td>Rs</td>
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<tr>
<td>SAR</td>
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<tr>
<td>NCLC</td>
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</tbody>
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70 BPA Moderate Fuji

40 BPA Weak Granny
Why might this be?

- We are only looking at one piece of a complex problem.
- Treating living soil like a chemistry experiment
- Soil Biology plays a large role in nutrient availability and plant response
- Water can move the nutrients in the soil and plant
Blind men describing the elephant
We need a test, or tests, that can predict a response in the tree

- Research leadership
- Money
- Time

- The highest new research priority in horticulture for the WTFRC.
- We need a plan or roadmap before we start
What system do you use mike?

- Trial and Error with Snippets of Science
Vegetative Balance

Small fruit, low yields  Poor quality, low yields
The tools I use

- Nitrogen
- Mulch
- Lots of foliar calcium
- Foliar Phosphate and micronutrients
- Deficit irrigation
- Minimized cultivation
The Results are visible
I can often see the difference between 25 and 75 pounds of actual N on a moderate vigor block
Timing of N application has been shown by Righetti and Denise and Gerry Neilsen to make a big difference in how N is used by the tree.
Growing season applications have the most effect. Early fall or spring
Mulch

Haul it in

Mow and blow
Mulch

Moo and blow
Extensive research

- Seven year mulch trial at Summerland PARC
  Denise and Gerry Neilsen, Gene Hogue, Tom Forge
- Mulch Subplots in the PRD trial block at Quincy
- David Granatstein trials near Orondo, and Wenatchee
- Grow your own N trials, David Granatstein and Joan Davenport
- Multi year on farm trial in Canada and WA
  Denise and Gerry Neilsen, Gene Hogue, et al
Grow your own N

Year 3 after planting, Alfalfa supplies 47# N

David Granatstein
Mow and Blow

Legume residue in tree row after mow and blow
Mulch provides several positive effects

- Improved water use efficiency
- Better vegetative growth
- Larger Fruit
- Weed suppression
Balancing the checkbook

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>20 ton crop</th>
<th>1 ton mint compost</th>
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</thead>
<tbody>
<tr>
<td>Nutrient pounds</td>
<td>Removed</td>
<td>Added</td>
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<tr>
<td>Nitrogen</td>
<td>16.20</td>
<td>38.8</td>
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<tr>
<td>Phosphorous</td>
<td>12.96</td>
<td>11.8</td>
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<tr>
<td>Potassium</td>
<td>48.60</td>
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<tr>
<td>Calcium</td>
<td>1.90</td>
<td>25.8</td>
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<tr>
<td>Magnesium</td>
<td>2.14</td>
<td>8.8</td>
</tr>
<tr>
<td>Micronutrients</td>
<td>1.14</td>
<td></td>
</tr>
</tbody>
</table>
Excessive potassium

- Mint mulch may oversupply K and Mg when used at rates required for N fertilization
- Wood chips or municipal compost may supply fewer Nutrients
Very active soil

Compost 1 to 2 inches deep
Frequent Calcium applications
Frequent foliar calcium

- Early season pro natural calcium. A complexed calcium
- Mid June Calcium Chloride 94% ,  5 pounds per acre
- 7 or 8 applications on varieties less prone to bitter pit
- 10 to 12 applications on young trees, Goldens
- 15 to 20 on Honeycrisp, Watch overspray and Temps
Foliar Micronutrients

- Tree shield. Contains a lot of Phosphate like Alliote
- Pro Natural Zinc
- Pro natural Iron
- Mora leaf P&K
- Weak trees get a little urea mixed in
Deficit irrigation

- Sets terminals
- Improves fruit color
- Helps control effect of excessive vigor
- Improves spur density
- Improves sugar levels
- Reduces harvest bruising
- May reduce fruit size if done incorrectly
Quincy partial root zone drying

Deficit

Deficit + Mulch
Minimize tillage

- Bark damage to trunk
- Damage to the roots in the most productive soil horizon on a regular basis
- Soil compaction from frequent travel
- Reduces soil OM
Rodent Damage
Organic no till mouse control

- 50 traps per acre
- $.30 each
- Traps last 3 years
- Check 5 times at 1 hour per acre
- Round labor cost to $50 per year
- Traps are $5 per acre per year
- Organic peanut butter for bait $$$$$$
I can describe the tail, do I understand the Elephant?