COMMON ERRORS IN ORCHARD SET UP

Room 308-309 | December 5 2017
CEUs – New Process

Certified Crop Advisor (CCA)
- Sign in and out of each session you attend.
- Pickup verification sheet at conclusion of each session.
- *Repeat this process for each session, and each day you wish to receive credits.*

Pest Control Advisor (PCA), Qualified Applicator (QA), Private Applicator (PA)
- Pickup scantron at the start of the day at first session you attend; complete form.
- Sign in and out of each session you attend.
- Pickup verification sheet at conclusion of each session.
- Turn in your scantron at the end of the day at the last session you attend.

*Sign in sheets and verification sheets are located at the back of each session room.*
AGENDA

- **Spencer Cooper**, Almond Board of California, moderator
- **Mae Culumber**, UCCE-Merced County
- **Franklin Gaudi**, Irrigation Training & Research Center
- **Roger Duncan**, UC Cooperative Extension, Stanislaus County
Pre-plant Almond Orchard Site Evaluation and Modification

Mae Culumber, Ph.D.
Advisor in Cooperative Extension
Fresno County
Site Evaluation: Soil Surveys

• Soil type and distribution
• Drainage
• Flood potential
• Soil salinity levels (Na\(^+\), Cl\(^-\), and B)
SoilWeb Apps

SoilWeb products can be used to access USDA-NCSS detailed soil survey data (SSURGO) for most of the United States. Please choose an interface to SoilWeb:

**Soil Properties App**

Explore soil survey areas using an interactive Google map. View detailed information about map units and their components. This app runs in your web browser and is compatible with desktop computers, tablets, and smartphones.

This app allows users to explore a variety of soil properties in map form.

[https://casoilresource.lawr.ucdavis.edu/soilweb-apps/](https://casoilresource.lawr.ucdavis.edu/soilweb-apps/)
Site Evaluation: Soil Differences

SoilWeb

Explore soil survey areas using an interactive Google map. View detailed information about map units and their components. This app runs in your web browser and is compatible with desktop computers, tablets, and smartphones.

Soil Map: NRCS, Google Earth, etc.
Check with a Backhoe

Start with soil survey
• Dig holes (5’-6’ deep) where maps show differences
• Look for:
  • stratified and compacted layers
  • pull soil samples for analysis and nematodes
Soil Sampling

Soil Analysis

• Objective: Determine suitability for planting
• Sample equal depths down to 5 feet (12” or 18” increments)
• Within CA, labs generally analyze soil-water extract for water soluble salinity, which generally is sufficient

Plant Parasitic Nematodes

• Objective: Determine the presence of plant parasitic nematodes
• Assists in rootstock selection and fumigation requirements
• Sample the top profile of the soil, usually between 6”-12” from multiple sites
## Interpreting a Soil Sample – Typical Soil Profile

<table>
<thead>
<tr>
<th>Depth</th>
<th>pH</th>
<th>EC (dS/m)</th>
<th>Ca (meq/l)</th>
<th>Mg (meq/l)</th>
<th>Na (meq/l)</th>
<th>Cl (meq/l)</th>
<th>SAR</th>
<th>B (mg/l)</th>
<th>Sat %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-12”</td>
<td>6.64</td>
<td>1.10</td>
<td>4.16</td>
<td>3.51</td>
<td>3.91</td>
<td>1.91</td>
<td>2.00</td>
<td>0.30</td>
<td>47.07</td>
</tr>
<tr>
<td>13-24”</td>
<td>6.74</td>
<td>1.11</td>
<td>3.99</td>
<td>3.51</td>
<td>4.27</td>
<td>2.09</td>
<td>2.21</td>
<td>0.45</td>
<td>48.68</td>
</tr>
<tr>
<td>25-36”</td>
<td>7.04</td>
<td>1.01</td>
<td>4.02</td>
<td>3.66</td>
<td>3.17</td>
<td>2.61</td>
<td>1.62</td>
<td>0.80</td>
<td>50.08</td>
</tr>
<tr>
<td>37-48”</td>
<td>6.99</td>
<td>1.18</td>
<td>5.10</td>
<td>4.84</td>
<td>2.47</td>
<td>3.36</td>
<td>1.11</td>
<td>0.30</td>
<td>53.28</td>
</tr>
<tr>
<td>49-60”</td>
<td>7.49</td>
<td>1.38</td>
<td>2.95</td>
<td>3.54</td>
<td>2.42</td>
<td>1.95</td>
<td>1.34</td>
<td>0.69</td>
<td>56.77</td>
</tr>
<tr>
<td>AVG</td>
<td>6.98</td>
<td>1.16</td>
<td></td>
<td></td>
<td></td>
<td>1.66</td>
<td>0.508</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Interpreting a Soil Sample

**Electrical Conductivity (EC):**
- Measure of total salts recorded in deci-Seimens per meter (dS/m)
- Ideally <1.5 for average rootzone, too high reduces growth and production due to osmotic effects

**Saturation Percentage:**
- Measure of soil-water content at saturation
- Helps characterize soil texture

<table>
<thead>
<tr>
<th>SP%</th>
<th>Soil Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;20%</td>
<td>Sandy Soils</td>
</tr>
<tr>
<td>20-35%</td>
<td>Sandy loam to loam</td>
</tr>
<tr>
<td>&gt;35%</td>
<td>Silt or clay loam, clay</td>
</tr>
</tbody>
</table>
Soil Amendments

Soil pH
- Acidic Soils: Lime can raise pH, cheap source of calcium
- Alkaline Soils: Acid, sulfur (slow process)
- Often materials are applied heavily prior to modification to move to deeper depths

Salinity
- Reclaiming ground is challenging and requires a lot of water
- Use calcium containing products to displace Na⁺
- Acidify the soil if dealing with alkaline situations
Interpreting a Soil Sample - Nematodes

Plant Parasitic Nematodes:
- Ring, Lesion, and Rootknot nematodes are of primary concern
- Should be considered when determining soil fumigation needs
- If not listed, the nematode is not found

<table>
<thead>
<tr>
<th>Extraction Method</th>
<th>Plant Parasitic Nematodes</th>
<th>*Soil Ecology</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF</td>
<td>Root Knot</td>
<td>Stubby Root</td>
</tr>
<tr>
<td></td>
<td>109</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>188</td>
<td>15</td>
</tr>
</tbody>
</table>
Water Sampling

• Water should be sampled to determine suitability for almonds
  – Well and surface water

• Water sampling should occur at various times of the year
  – Wells should run 30 minutes prior to sampling
  – Install an EC meter, and resubmit when salinity changes by 20%
Well Water Analysis: Interpretation

Salinity Impacts:
• $EC_w > 1.5 \text{ dS/m}$ – growth can be impacted
• SAR > 3
• Chlorides > 5 meq/L
• Boron > 0.5 ppm

Infiltration Issues:
• $SAR/EC_w < 5.0$
• Ca:Mg <2.0
• Total salts
• pH: indicates if bicarbonate and carbonate ions
Soil Modification

Slip-Plow

Backhoe

Ripper
## Soil Modification - Generalizations

<table>
<thead>
<tr>
<th></th>
<th>Ripping</th>
<th>Slip Plow</th>
<th>Backhoe</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strength</strong></td>
<td>Shattering Hardpan</td>
<td>Mixing Layers</td>
<td>Mixing Layers</td>
</tr>
<tr>
<td><strong>Cons</strong></td>
<td>Doesn’t Mix Layers – tend to reform</td>
<td>Expensive to break hardpans, settling, pulls up “bad stuff”</td>
<td>Expensive, settling</td>
</tr>
<tr>
<td><strong>Areas of Use</strong></td>
<td>Hardpan within the first 4 feet</td>
<td>Extensive fine and coarse layering, heavier soils</td>
<td>Area of layering, compaction, lighter soils</td>
</tr>
</tbody>
</table>
Site Evaluation and Modification

Concluding thoughts:

• Start early

• Best money spent in evaluating sites will prevent costly mistakes

• Soil salinity can reduce yields and kill trees, only sampling will reveal levels

• Any attempts to modify deeper soils should occur prior to planting
Thank you!
COMMON ERRORS IN IRRIGATION DESIGN AND CONSTRUCTION

Dr. Franklin Gaudi
Irrigation Training & Research Center (ITRC)
at Cal Poly
DRIP EVALUATIONS IDENTIFY PROBLEMS

• Student teams Evaluate fields each year
  – over 20 years worth of data
  – Major problem: Plugging and Pressure

<table>
<thead>
<tr>
<th>Microspray and Drip</th>
<th>Pressure Differences - 44.9%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Plugging, Wear, Manufacturing Variation - 51.5%</td>
</tr>
<tr>
<td></td>
<td>Unequal Drainage - 1.1%</td>
</tr>
<tr>
<td></td>
<td>Application Rate - 2.5%</td>
</tr>
</tbody>
</table>

ITRC - Cal Poly
ERROR #1 – HOSE SCREEN WASHERS AT THE HEAD OF EACH HOSE

• THEY PLUG UP AND REDUCE THE PRESSURE TO THE ENTIRE HOSE

• Solution
  • BEST TO REMOVE THEM AND REPLACE WITH REGULAR HOSE SCREEN WASHERS
ERROR #2 – LACK OF FLUSHING AT THE HOSE ENDS

• THIS PLUGS THE EMITTERS AND AFFECTS THE FLOW RATES TO THE TREES

• SOLUTION
  • BEST TO FLUSH AS OFTEN AS POSSIBLE
ERROR #3 – FERTILIZER INJECTION DOWNSTREAM OF FILTERS

• The fertilizers may bond with other nutrients in the water and precipitate out, which plugs the emitters

• Solution
  – Best to inject upstream of the filters
    • Except for strong acids and pesticides
ERROR #4 – DUAL LINE DRIP HOSES INSTALLED TO CLOSE TOGETHER

• This reduces the wetted area,
  which is the purpose of two drip lines

• Solution
  – keep the lines about 5-6 feet apart
ERROR #5 – RUN TIMES OFTEN MISS THE MARK

• IRRIGATING BLOCKS FOR 48-72 HOURS WITH DRIP CAN BE PROBLEMATIC, COMPARED TO MICRO

• SOLUTION
  – BECAUSE THE WETTED AREA IS TYPICALLY SMALLER, IT IS BEST TO ROTATE MORE FREQUENTLY BETWEEN BLOCKS WITH A SHORTER DURATION
ERROR #6 – UNDERSIZED EQUIPMENT

• OFTEN THE PUMPS ARE SIZED TO PROVIDE ADEQUATE FLOW AND PRESSURE, BUT ONLY WHEN NEW

• THE MAINLINES ARE GOING TO BE IN THE GROUND FOR 15-20 YEARS, SO CONSIDER THE ECONOMICS EARLY ON

• SOLUTION
  • INCREASE THE SIZE OF THE PUMP/MOTOR AND ADD A VDF
  • INCREASE PIPE SIZE
ERROR #7 – NOT LEVELING THE PLAYING FIELD

• VARIATIONS IN NUTRIENTS AND SOIL TYPES CAN HAVE BIG IMPACTS ON YIELD

• SOLUTION
  • MAP THE SOILS AND NUTRIENTS IN THE FIELD AND DIFFERENT DEPTHS PRIOR TO PLANTING

\[ y = 52.386x + 514.02 \]
\[ R^2 = 0.2194 \]
GET A RESOURCE

• ITRC WROTE THE BOOK ON DRIP AND MICRO IRRIGATION

• GET IT AT: WWW.ITRC.ORG
Thank you!
Common Errors in Orchard Setup
- Rootstock Consideration

Roger Duncan
UC Cooperative Extension
Stanislaus County
Goal: Orchard that will quickly and uniformly fill in the space and capture maximum sunlight for as long as possible

The best offense is a great defense
Think of the rootstock as your insurance policy

- Protect yourself from nonuniformity & early orchard decline
Lime induced chlorosis on Nemaguard

Much greener trees on Hansen P/A hybrid
Severe zinc deficiency in old corral on Nemaguard
Defoliation and tree decline from excessive chloride – Carmel on Lovell Rootstock
Chloride toxicity on Padre: Lovell Rootstock
Boron toxicity on Carmel: Lovell Rootstock
Bacterial Canker

Nemaguard

Nickels Rootstock

Hansen Rootstock
What is the best rootstock?

Rootstock choice should be site specific and based on the physical, chemical, and biological conditions in your field.
There are now many commercial rootstocks from which to choose

- Peach
- Peach hybrids
- Peach x Almond hybrids
- (Peach x almond) x (Peach x almond)
- Plum
- Peach x Plum
- Almond x Plum
- Complex hybrids (peach, almond, plum, apricot)
Rootstock Influences Many Things

- Nematode tolerance
- Soil-borne disease tolerance
- Soil chemistry tolerance
- Replant disease
- Vigor
- Nutrition
- Bloom time
- Date of maturity
- Drought tolerance
Rootstock Vigor

• Peach / Almond hybrids (Hansen, Bright’s, Nickels, Titan, etc.), Empyrean 1

• Interspecifics (Viking, Atlas)
• Peach (Nemaguard, Lovell)
• Plum (Marianna 26-24)

Most Vigorous (wide spacing)
Least Vigorous (close spacing)
Specific Challenges…

- Alkaline / salty soil or water
  - P/A hybrid (not if heavy, wet soil or if ring nematodes)
    - Hansen, Bright’s 5, Cornerstone, Titan, BB106, F x A
  - Viking
  - Empyrean 1
  - Rootpac R (heavy soil, no ring nemas)
<table>
<thead>
<tr>
<th></th>
<th>Nonpareil</th>
<th></th>
<th>Carmel</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% Sodium</td>
<td>% Chloride</td>
<td>% Sodium</td>
<td>% Chloride</td>
</tr>
<tr>
<td>Nemaguard</td>
<td>0.88 a</td>
<td>0.27 bc</td>
<td>1.19 a</td>
<td>0.26 a</td>
</tr>
<tr>
<td>Guardian</td>
<td>0.66 ab</td>
<td>0.21 cd</td>
<td>0.69 bcd</td>
<td>0.27 a</td>
</tr>
<tr>
<td>Lovell</td>
<td>0.58 bc</td>
<td>0.28 bc</td>
<td>0.75 bc</td>
<td>0.25 a</td>
</tr>
<tr>
<td>Atlas</td>
<td>0.57 bc</td>
<td>0.16 de</td>
<td>0.86 b</td>
<td>0.22 ab</td>
</tr>
<tr>
<td>Krymsk 86</td>
<td>0.55 bc</td>
<td>0.32 b</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cadaman</td>
<td>0.31 cd</td>
<td>0.23 c</td>
<td>0.47 cde</td>
<td>0.24 ab</td>
</tr>
<tr>
<td>Penta</td>
<td>0.24 d</td>
<td>0.50 a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viking</td>
<td>0.21 d</td>
<td>0.12 ef</td>
<td>0.43 de</td>
<td>0.18 bc</td>
</tr>
<tr>
<td>Nickels</td>
<td>0.18 d</td>
<td>0.12 ef</td>
<td>0.35 ef</td>
<td>0.15 cd</td>
</tr>
<tr>
<td>Paramount</td>
<td>0.11 d</td>
<td>0.08 f</td>
<td>0.07 f</td>
<td>0.07 e</td>
</tr>
<tr>
<td>Empyrean 1</td>
<td>0.11 d</td>
<td>0.07 f</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hansen</td>
<td>0.11 d</td>
<td>0.09 ef</td>
<td>0.10 f</td>
<td>0.10 de</td>
</tr>
<tr>
<td>Empyrean 101</td>
<td>0.10 d</td>
<td>0.12 ef</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cornerstone</td>
<td>0.06 d</td>
<td>0.07 f</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Julior</td>
<td></td>
<td></td>
<td>0.37 ef</td>
<td>0.11 de</td>
</tr>
<tr>
<td><strong>Critical Level</strong></td>
<td><strong>0.25</strong></td>
<td><strong>0.3</strong></td>
<td><strong>0.25</strong></td>
<td><strong>0.3</strong></td>
</tr>
</tbody>
</table>
Rootstock Effect on Chloride Accumulation in Leaf Tissue

Cl critical level = 0.3%

<table>
<thead>
<tr>
<th>Rootstock</th>
<th>% Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Krymsk 86</td>
<td>0.89 a*</td>
</tr>
<tr>
<td>Lovell</td>
<td>0.72 b</td>
</tr>
<tr>
<td>Nemaguard</td>
<td>0.57 c</td>
</tr>
<tr>
<td>PAC9908-02</td>
<td>0.45 d</td>
</tr>
<tr>
<td>Atlas</td>
<td>0.42 de</td>
</tr>
<tr>
<td>Cadaman</td>
<td>0.38 def</td>
</tr>
<tr>
<td>Empyrean 1</td>
<td>0.33 ef</td>
</tr>
<tr>
<td>HBOK 50</td>
<td>0.31 ef</td>
</tr>
<tr>
<td>Viking</td>
<td>0.30 f</td>
</tr>
<tr>
<td>F x A</td>
<td>0.19 g</td>
</tr>
<tr>
<td>BB 106</td>
<td>0.19 g</td>
</tr>
<tr>
<td>Brights 5</td>
<td>0.18 g</td>
</tr>
<tr>
<td>GF 677</td>
<td>0.18 g</td>
</tr>
<tr>
<td>Rootpac R</td>
<td>0.17 g</td>
</tr>
<tr>
<td>HM2</td>
<td>0.16 g</td>
</tr>
<tr>
<td>Hansen</td>
<td>0.15 g</td>
</tr>
</tbody>
</table>

*P ≤ 0.05
## Rootstock Effect on Boron Accumulation in Hull Tissue

B critical level = 300 ppm

<table>
<thead>
<tr>
<th>Rootstock</th>
<th>B (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lovell</td>
<td>180 a*</td>
</tr>
<tr>
<td>Cadaman</td>
<td>170 ab</td>
</tr>
<tr>
<td>Atlas</td>
<td>158 ab</td>
</tr>
<tr>
<td>HBOK 50</td>
<td>158 ab</td>
</tr>
<tr>
<td>Nemaguard</td>
<td>153 bc</td>
</tr>
<tr>
<td>Krymsk 86</td>
<td>152 bc</td>
</tr>
<tr>
<td>Empyrean 1</td>
<td>133 cd</td>
</tr>
<tr>
<td>Rootpac R</td>
<td>132 cd</td>
</tr>
<tr>
<td>Hansen</td>
<td>126 de</td>
</tr>
<tr>
<td>GF 677</td>
<td>120 de</td>
</tr>
<tr>
<td>HM2</td>
<td>116 de</td>
</tr>
<tr>
<td>Viking</td>
<td>109 e</td>
</tr>
<tr>
<td>PAC9908-02</td>
<td>108 e</td>
</tr>
<tr>
<td>Brights 5</td>
<td>106 e</td>
</tr>
<tr>
<td>F x A</td>
<td>104 e</td>
</tr>
<tr>
<td>BB 106</td>
<td>102 e</td>
</tr>
</tbody>
</table>

*P ≤ 0.05
Specific Challenges…

• Phytophthora
  – Marianna 26-24
  – Krymsk 86
  – Marianna 40
  – Rootpac R
Specific Challenges…

• Poor drainage / heavy soil
  – Marianna 26-24
  – Krymsk 86
  – Marianna 40?
  – Rootpac R?
Specific Challenges…

• Anchorage / high wind
  – Krymsk 86
  – Viking
  – Hansen
Specific Challenges…

• Armillaria (Oak Root Fungus)
  – Marianna 26-24
  – Krymsk 86
Specific Challenges…

- Bacterial Canker / Ring Nematodes
  - Viking
  - Guardian
  - Lovell
Soil Numbers of Ring Nematodes as Influenced by Almond Rootstock
Escalon, CA.
A Comparison of Almond Rootstocks for Incidence of Bacterial Canker

Escalon, CA (8th leaf)

- Peach / almond hybrid rootstocks are very susceptible to bacterial canker
- Viking, Lovell & Guardian are tolerant
Specific Challenges…

• High Water Table
  
  Often double whammy due to salt build up
  – Rootpac R?
  – Viking, Empyrean 1, P/A hybrid??
  – Krymsk 86 very susceptible to salt injury
  – Corn & oats??
Think about what specific challenges your ground may have and select the appropriate rootstock.

Thank you for your attention
Thank you!
What’s Next

Tuesday, December 5 at 3:00 p.m.

- How to Manage a Young Orchard – Room 308-309
- Come See What’s Happening in D.C.! – Room 306-307
- Research Update: Soil Health, Aerial Almond Mapping and Almond Lifecycle Assessment – Room 312-313
- Technology in the Food Safety World: Tools Such as Whole Genome Sequencing – Friend or Foe? – Room 314
Research Poster Sessions

**Wednesday, December 6**
3:00 p.m. – 5:00 p.m.

Featured topics:
- Irrigation, nutrient management
- Breeding
- Soils, if related to organic matter input
- Sustainability, irrigation improvement continuum, life cycle assessment, dust
- Food quality and safety

**Thursday, December 7**
1:30 p.m. – 2:30 p.m.

Featured topics:
- Insect and disease management
- Fumigation and alternatives
- Biomass (including biochar-related efforts)
- Pollination
- Almond Leadership Program
2017 Research Update Book

• Pickup your copy at the ABC Booth in Hall A+B
• Includes a one-page summary of every current ABC-funded research project