Organic Fertilization and Weed Management

Orchard Floor Management – Organic Intensive Workshop
Wenatchee WA, Oct. 11, 2016

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Farm Advisor
UC Cooperative Extension, Sacramento County

http://cesacramento.ucanr.edu
Acknowledgements

Information Provided

• WSU
  – David Granatstein
  – Tianna DuPont
• Univ. of Calif.
  – John Roncoroni
  – Tom Lanini
  – Brad Hanson
• Companies/Individuals
  – GS Long Co.
  – Northwest Wholesale
  – Royal Organic Products
  – True Organic Products
  – Mike Devencenzi
Topics to be Covered

• Organic fertilization (Focus on N)
  ➢ Manures and composts
  ➢ Selected composts, manures, and fertilizers
  ➢ Practices and considerations

• Weed management
  ➢ Pre- and post-plant considerations
  ➢ In-row weed management

• Trial results
Topics to be Covered

• Organic fertilization (Focus on N)
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• Trial results
Manures and Composts

• Typical application rates for both: 2-5 tons/acre
• Best banded, lightly incorporated
• Soil OM content
  – Enhanced by OM additions, destroyed by cultivation
  – Difficult to increase but OM important to add
    • Where in-row tillage used
    • Sandy & clay soils – Water & nutrient retention
    • Clay soils – Aeration & drainage
Manures

• Fresh/dried manure
  – N content and N release generally higher than compost
  – Food safety concerns: Cannot be used within 90 days of harvest
  – Strong odors
  – Salinity concerns
Composts

• Finished compost
  – Thermophilic heating process with turning
  – Temperature low, no ammonia smell

• Chicken compost
  – Partial composting to kill microbes, reduce bulk
  – High N, quick release

• Dairy compost
  – Low N, slow-release

• Salinity concerns
Topics to be Covered

- **Organic fertilization (Focus on N)**
  - Manures and composts
  - **Selected composts, manures, and fertilizers**
  - Practices and considerations

- **Weed management**
  - Pre- and post-plant considerations
  - In-row weed management

- **Trial results**
Supplier and Product Information

• Companies were contacted and several responded
• Mention or omission of companies or products does not imply preference
• Nutrient values are approximate
  – May vary greatly and may change
Selected Compost/Manure/Fertilizer Products

• Dairy compost (1.5% N)
• Chicken manure/compost (3-4% N)
• Dried poultry waste (NW Wholesale) (3-7% N)
• Royal Organic Products
  – Royal Classic (1.4% N), green waste + herbal matter
  – Soil Suplimint (4.2% N), mint biomass
Selected Compost/Manure/Fertilizer Products

• Strutzman Farms
  – Nutri-Rich
    • 4-3-2 (dried poultry waste), pelleted
    • 8-2-4 (DPW + blood, feather, SOP), granular
  – Sup’r Green (3% N), composted chicken manure

• Perfect Blend
  – 4-4-2, 4-4-4, 6-3-3, and 7-2-2
  – Mostly chicken manure + feather meal/raw fish
Selected Specialty Fertilizer Products

• Feather meal (12-13% N)
• True Organic Products
  – Protein meals: Feather, meat, bone (& fish)
  – 12-3-0 (and many other products)
• ProNatural Dry
  – 10-1-0 (feather, crab, and shrimp meals)
  – 6-2-1 (feather, alfalfa, shrimp, fish bone meals)
Liquid Fertilizers for Fertigation

Examples

• True Organic Products
  – 4-0-2 (reduced sugar molasses + fish)
• BioLink
  – 3-0-0 (hydrolized soy protein)
• Injected multiple times through season
Topics to be Covered

• **Organic fertilization (Focus on N)**
  - Manures and composts
  - Selected composts, manures, and fertilizers
  - *Practices and considerations*

• **Weed management**
  - Pre- and post-plant considerations
  - In-row weed management

• **Trial results**
Organic Nitrogen Fertilization

Most Common Practices

• Chicken compost
  – If 30% moisture, approx. 50 lbs. of N applied per wet ton, likely half available over growing season
    • 2 tons might be 50 lbs. avail N
    • 3 tons might be 75 lbs. avail N
• Or dried poultry waste
• Ask to see recent analysis (% N, % moisture)
Organic Nitrogen Fertilization

Most Common Practices

- Difference often made up with feather meal or other product
- For N, chicken compost plus feather meal is usually the least expensive
- Incorporate (or sprinkle?) to reduce ammonia loss
Application Timing
Manure, Compost, and Dry Organic Fertilizers

- Fall applications common, often spring also
- Spring and early summer best; fall too late
- N release temp. dependent, but greatest in 1-2 months following application, even in fall
- Nitrate leaching below root zone
Use In-Row Cover Crop?

- Removes excess N in winter, but:
  - Vole habitat
  - Grass competes with trees for N, water
Synchronize needs with availability

Organic N fertilization 4-6 weeks after bloom optimum, highest need

Cheng and Raba, 2009
Courtesy T. DuPont
User Guide: Organic Fertilizer Calculator

Download Commercial Calculator (per acre calculations)
Download Small Farm/Garden Calculator (square foot calculations)

ORGANIC FERTILIZER CALCULATOR QUICK USER’S GUIDE
http://smallfarms.oregonstate.edu/organic-fertilizer-calculator
Enter your information in yellow cells. Results are in green cells.

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>MATERIAL</th>
<th>FERTILIZER ANALYSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORGANIC FERTILIZERS</td>
<td>ORGANIC FERTILIZERS</td>
<td>ORGANIC FERTILIZERS</td>
</tr>
<tr>
<td>Blood meal (12.5-1.5-0.6)</td>
<td>12.5</td>
<td>91</td>
</tr>
<tr>
<td>Bone meal (3-20-0.5)</td>
<td>3.0</td>
<td>95</td>
</tr>
<tr>
<td>Chicken manure - dried (4-3-2)</td>
<td>4.0</td>
<td>85</td>
</tr>
<tr>
<td>Feather meal (granulated) (13-0-0)</td>
<td>13.0</td>
<td>97</td>
</tr>
<tr>
<td>Fish meal (10-6-2)</td>
<td>10.0</td>
<td>92</td>
</tr>
<tr>
<td>Meat and bone meal (7-8-0)</td>
<td>7.0</td>
<td>93</td>
</tr>
<tr>
<td>Muriate of potash (KCl) (0-0-60)</td>
<td>0.0</td>
<td>100</td>
</tr>
<tr>
<td>Soy meal (6.5-1.5-2.4)</td>
<td>6.5</td>
<td>90</td>
</tr>
<tr>
<td>Sulfate of potash (0-0-50)</td>
<td>0.0</td>
<td>99</td>
</tr>
<tr>
<td>Sulfate of potash magnesia (0-0-22)</td>
<td>0.0</td>
<td>99</td>
</tr>
<tr>
<td>chicken manure 433</td>
<td>4.0</td>
<td>90</td>
</tr>
<tr>
<td>SYNTHETIC FERTILIZERS</td>
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<tr>
<td>Triple super phosphate (0-40-0)</td>
<td>0.0</td>
<td>N/A</td>
</tr>
<tr>
<td>Urea (46-0-0)</td>
<td>46.0</td>
<td>N/A</td>
</tr>
<tr>
<td>COMPOST</td>
<td>COMPOST</td>
<td>COMPOST</td>
</tr>
<tr>
<td>Composted manure (1.5-0.5-0.5)</td>
<td>1.5</td>
<td>60</td>
</tr>
<tr>
<td>HIP compost</td>
<td>2.2</td>
<td>100</td>
</tr>
<tr>
<td>COVER CROPS</td>
<td>COVER CROPS</td>
<td>COVER CROPS</td>
</tr>
<tr>
<td>0</td>
<td>N/A</td>
<td>0</td>
</tr>
</tbody>
</table>
### Guidelines for PAN

<table>
<thead>
<tr>
<th>Nitrogen %</th>
<th>C:N ratio</th>
<th>% N Available</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fresh Material</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>35</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>18</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
<td>45</td>
</tr>
<tr>
<td>5</td>
<td>7</td>
<td>60</td>
</tr>
<tr>
<td>6+</td>
<td>&lt;6</td>
<td>75</td>
</tr>
<tr>
<td><strong>Composts</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>25-35</td>
<td>5</td>
</tr>
<tr>
<td>2-3</td>
<td>10-15</td>
<td>10</td>
</tr>
</tbody>
</table>

- **Year 2 PAN** – 5-10% of total initial N
- **Compost** – 2%/yr N mineralization from Yr 4 on (Cogger et al.)
# PAN of Selected Organic N Fertilizers

<table>
<thead>
<tr>
<th>Amendment</th>
<th>%N</th>
<th>% PAN, Season DW Basis</th>
<th>PAN, Season Lb. N/100 lb. “As Is”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chilean nitrate</td>
<td>16</td>
<td>75</td>
<td>12</td>
</tr>
<tr>
<td>Feather meal</td>
<td>13</td>
<td>75</td>
<td>10</td>
</tr>
<tr>
<td>Blood meal</td>
<td>12</td>
<td>75</td>
<td>9</td>
</tr>
<tr>
<td>True Organic</td>
<td>12</td>
<td>75</td>
<td>9</td>
</tr>
<tr>
<td>Fish meal</td>
<td>10</td>
<td>75</td>
<td>8</td>
</tr>
<tr>
<td>Meat &amp; bone</td>
<td>7</td>
<td>75</td>
<td>5</td>
</tr>
<tr>
<td>Soy meal</td>
<td>7</td>
<td>75</td>
<td>5</td>
</tr>
</tbody>
</table>

Org. Fertilizer Calculator
# PAN of Selected Organic N Fertilizers

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<th>Amendment</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Perfect Blend</td>
<td>7</td>
<td>75</td>
<td>5</td>
</tr>
<tr>
<td>ProNatural</td>
<td>5</td>
<td>67</td>
<td>3.3</td>
</tr>
<tr>
<td>Ch. manure dried</td>
<td>4</td>
<td>56</td>
<td>2.2</td>
</tr>
<tr>
<td>Bone meal</td>
<td>3</td>
<td>32</td>
<td>1.0</td>
</tr>
<tr>
<td>Nutri-Rich</td>
<td>4</td>
<td>10</td>
<td>0.4</td>
</tr>
<tr>
<td>Comp. manure</td>
<td>1.5</td>
<td>10</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Org. Fertilizer Calculator
### Volatilization

<table>
<thead>
<tr>
<th>Application Strategy: Incorporation...</th>
<th>Poultry manure</th>
<th>Other manure</th>
</tr>
</thead>
<tbody>
<tr>
<td>The same day</td>
<td>0.75</td>
<td>0.50</td>
</tr>
<tr>
<td>Within 1 day</td>
<td>0.50</td>
<td>0.40</td>
</tr>
<tr>
<td>Within 2–4 days</td>
<td>0.45</td>
<td>0.35</td>
</tr>
<tr>
<td>Within 5–7 days</td>
<td>0.30</td>
<td>0.30</td>
</tr>
<tr>
<td>After 7 days/none</td>
<td>0.15</td>
<td>0.20</td>
</tr>
</tbody>
</table>

Courtesy T. DuPont

![Diagram of volatilization process](image)
Fertilization Summary

• Compost important to add
  – At least every other year
• Fertilizer choice depends on need and cost
• Price materials based on $/lb. N
• Consider PAN
• Consider N contributions from previous years
• Avoid fall & winter applications
Topics to be Covered

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• Weed management
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  ➢ In-row weed management

• Trial results
Weed Management Before Planting
Chemical approaches before organic certification

- 3-year transition – can certify before the first or second harvest
  - e.g., glyphosate on field bindweed, fumigate for nematodes or replant disease
- Makes weed control by organically-approved means more effective and less expensive later
Weed Management Before Planting

Organic approaches

• Reduce weeds through repeated tillage
  – Irrigate and germinate, then till or flame
  – Mainly annual weeds, not as good on perennials
    • nutsedge, field bindweed, bermudagrass, etc.

• Soil solarization in the planned tree rows
Cultivation

- Best when weeds are small (< 4 in.)
- Do not cultivate wet soil
- Dry conditions after cultivation help to prevent re-rooting
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In-Row Weed Management

- Shallow in-row cultivation/mowing
- Mulches
- Flaming
- Hand hoeing
- Organically acceptable herbicides
- Cross disking
- Cross mowing
- Bio-control (animals)
- Weedeaters – Potential trunk damage
In-Row Mechanical Weed Control

• Cultivators
  – Wonder Weeder
  – Hydraulic arm retraction:
    • Weed Badger, Kimco cultivator, etc.
• Mower
In-Row Cultivation

- Disturbs soil to uproot weeds
- Allows incorporation of amendments, fertilizers
- Disrupts rodent tunnels
- May injure tree roots or root flare/crown
- Drip/microsprinkler lines raised
Wonder Weeder

- Cultivator heads operate by rolling on ground
- 2-3” tillage depth
- Shear bar moves weeds and soil
- Cuts some tree roots
  - May weaken young trees?

Courtesy: D. Granatstein
Wonder Weeder
Shear bar removed for new trees

Courtesy: D. Granatstein
Weed Badger and Kimco Cultivator

- Rotating tines
- Greater depth than WW
  - Rodent tunnels
- Moves into row center
- More moving parts than Wonder Weeder
  - more maintenance?
Mowing

• Avoids soil disturbance
• Weeds remain
  – Compete with trees
  – Vole habitat
Mulches

• Act by blocking light to weeds
• Numerous organic and synthetic materials
• Mostly fabric/plastic or wood chips
Landscape Fabric
Landscape Fabric

• Expensive, but cost spread over...5-10 years?
• Labor intensive to install
• Can pull back annually
  – Remove debris, weeds on top
  – Add compost
• Mower may rip it
• Party time for voles
Voles Thrive Under Fabric
Wood Chip Mulch
Wood Chip Mulch
Good control of annual weeds if thick enough
Wood Chip Mulch

- 2” to 5” depth
- Reapprication every 1-3 years
- Requires front loader and spreader
- Harbors fewer rodents than fabric
- Adds OM, slow-release nutrients
Propane Flamer

• Kills weeds like a contact herbicide
  – Dessicates leaf cells
• Best on young broadleaf weeds
• Avoid young trunks, drip lines
• Worker safety & fire concerns
Propane Flamer

Just prior to flaming

5 min. after flaming

T. Lanini
Propane Flamer

10 min. after flaming

T. Lanini
Organic Herbicides

• Acids
  – Weed Pharm (acetic acid)
  – Suppress EC (caprylic/capric acids)

• Essential Oils
  – Avenger AG (citrus oil)
  – GreenMatch EX (lemon grass)
  – Matran EC (clove)
  – WeedZap (clove & cinnamon)

• Others?
Organic Herbicides

- Nonselective, contact only
- Young weeds only
- Good spray coverage is essential – 70 GPA
- Work better in warm weather (25ºC)
- Organic adjuvants improve weed control
- Repeat applications needed for larger weeds
- May control weed escapes in mulches
Prevention

• Avoid letting weeds go to seed
• Do not let weeds come in on equipment
# Weed Management Summary

<table>
<thead>
<tr>
<th>Method</th>
<th>Advantages</th>
<th>Drawbacks</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-row mowing</td>
<td>Fast, cheap</td>
<td>Weed competition</td>
</tr>
<tr>
<td>Wonder Weeder</td>
<td>Uproots weeds, incorporate amendments</td>
<td>Cuts tree roots</td>
</tr>
<tr>
<td>Weed Badger</td>
<td>Same, but generally deeper</td>
<td>Slower, problem with rocks</td>
</tr>
<tr>
<td>Fabric mulch</td>
<td>Effective, fairly long lasting (5-10 years)</td>
<td>Expensive, weed growth on top, easily ripped, rodents, disposal</td>
</tr>
<tr>
<td>Wood chips</td>
<td>Fairly effective, adds OM</td>
<td>Must re-apply, N tie-up, perennial weeds not controlled</td>
</tr>
<tr>
<td>Flamers</td>
<td>Quick, good on young annual broadleaves</td>
<td>Grasses not controlled, timing critical, safety concerns</td>
</tr>
<tr>
<td>Org. herbicides</td>
<td>Could control weed escapes</td>
<td>Generally ineffective, expensive</td>
</tr>
</tbody>
</table>
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• Trial results
Finding Cost-Effective Weed and Nutrient Management Practices in Organic Pear Orchards

*(Funding: OFRF, Calif. Pear Advisory Board)*

Chuck Ingels, UCCE Sacramento County
Tom Lanini, UCD Plant Sciences Dept.
Karen Klonsky, UCD Ag. & Resource Economics
Ken Shackel, UCD Plant Sciences Dept.
Chris Frieders, Joe Green Ranch (Grower Cooperator)
Experimental Methods

Trial Started Oct. 16, 2008

- Bosc, 18’ x 10’, planted 2001
- RCB design, 7 treatments, 5 reps
- Plot size: 6 trees/rep
# Treatments

1. In-row mowing  no N
2. In-row mowing  manure  2 T/A
3. In-row mowing  manure  4 T/A
4. In-row mowing  feather meal  0.5 T/A
5. Landscape fabric  manure  4 T/A
6. Wood chips  manure  4 T/A
7. Herbicide strip  manure  4 T/A

- No incorporation
Selected Results – 2009-11

Few or no significant differences for these

- Yield (30, 26, 39 T/A)
- Fruit diameters (2.8, 2.7, 2.5 in.)
- Trunk cross-sectional area
- Leaf K, Ca, Mg content
- Soil N
Soil Organic Matter Content

2011

![Bar chart showing Soil Organic Matter Content for different treatments and soil depths.](Image)
Economics
Assumptions Used

- In-row mowing 5 times per yr. (2 passes)
- GreenMatch herbicide applied 5 times
- Wood chips – Year 1: 6 in., Year 2: 3 in.
- Fabric longevity: 8 yrs.
- Chicken manure – 2 vs. 4 T/A
- Feather meal – 0.5 T/A
Economics

Total Costs/Acre/Year

- Mowing
- Fabric
- Chips
- Herbicide
- Manure Lo
- Manure Hi
- Feather

$1,200

$1,000

$800

$600

$400

$200

$0
Thank you! Questions?

cesacramento.ucanr.edu