Welcome to the webinar!

- The webinar will start at the top of the hour.
- If you'd like to type in a question, use the question box on your control panel and we will read the questions aloud after the c. 45 minute presentation
- The webinar is being recorded and you can find it in our archive at http://www.extension.org/pages/70279

Organic Blackberry Production: Tips Learned from an Ongoing Research Study

Dr. Bernadine Strik and Dr. Luis Valenzuela, Oregon State University
Dr. David Bryla, USDA-ARS

March 13, 2014

Bernadine Strik       David Bryla       Luis Valenzuela
Organic Blackberry Production –
Tips Learned From an Ongoing Research Study

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Dr. David Bryla, Research Horticulturist, HCRU, USDA-ARS
Dr. Luis Valenzuela, Postdoctoral Research Associate, OSU

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2010-01940; OREI02409; NCSFR

Graduate Students Working on the Project
Department of Horticulture, Oregon State University
Renee Harkins, Masters of Science, 2011-2013 (completed)
Javier Fernandez-Salvador, Masters of Science, 2011-2014
Emily Dixon, Masters of Science, 2012-2015

Topics to be covered

- Project outline
- Planting establishment
- Trailing blackberry growth & management
- Cultivar & weed management effects
- Impacts on soil & plant nutrition
- Drip irrigation & fertigation
- Impacts on soil moisture & root growth
- Summary of successes & some challenges
Objectives
1. Impact of weed management on plant growth, weed pressure, yield & ...
2. Nutrient accumulation and losses

Objectives
3. Effect of post harvest irrigation & …
4. Impact of training time (August or February) on plant growth and yield

Study site
OSU’s North Willamette Research and Extension Center, Aurora, OR

Certified Organic, 2012

Treatments
Cultivar
- ‘Black Diamond’
- ‘Marion’

Weed management
- ‘Non-weeded’
- ‘Hand weed’
- ‘Weed mat’

Irrigation
- With or without post-harvest irrigation

Training time
- August
- February

- 1 acre planting
- TC planted May 2010 (5’ x 10’)
- A cereal rye/common vetch cover crop between rows
- Single lateral drip tube either suspended on trellis or under weed mat (landscape fabric)
July 2010 – "year 1"

February 2011 – beginning of year 2

Primocanes that grew in the planting year were cut off in late winter

July 2011 – year 2

Primocanes were trained as they grew
April 2012 – year 3

Planting, May 17, 2012 – year 3; first year of production

July 3, 2012 – year 3, first year of production

'Non-weeded'  'Hand weed'  'Weed mat'
Pruning & Training
After fruit harvest is done (mid-late August)

Cut dying floricanes and remove from the trellis wires (weigh)

Pruning & Training – August training
Loop primocane bundles around the two upper training wires

Emily Dixon, August primocane training
Training time

August trained

Before training in Feb.

OR

Fertilizers Applied

- 2 lb/a boron in 2013 and 2014 (Solubor)
- 500 lb/a dolomite lime (Pro-Pelli-it) in 2013
- 1 ton/a fine lime (Pro-Pelli-it) in 2013
Cultivar effects on yield

‘Black Diamond’  ‘Marion’

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Yield (kg/ha)</th>
<th>2012 Machine Harvested Yield by Cultivar, 2012 and 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Diamond</td>
<td>8,888 (4 tons/a)</td>
<td>13,333 (6 tons/a)</td>
</tr>
<tr>
<td>Marion</td>
<td>7,333 (3 tons/a)</td>
<td>11,555 (5 tons/a)</td>
</tr>
</tbody>
</table>

Machine harvesting ‘Marion’ – canopy size related to every-year production
Weed management effects on yield

<table>
<thead>
<tr>
<th>Weed Management Treatments</th>
<th>June 26, 2013 – year 4; second year of production</th>
</tr>
</thead>
<tbody>
<tr>
<td>'Non-weeded'</td>
<td>'Hand weed'</td>
</tr>
<tr>
<td>'Weed mat'</td>
<td></td>
</tr>
</tbody>
</table>

Yield as Affected by Weed Management, 2012 and 2013

<table>
<thead>
<tr>
<th>Weed Management</th>
<th>Yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-weeded</td>
<td>8,000</td>
</tr>
<tr>
<td>Hand weeded</td>
<td>13,333</td>
</tr>
<tr>
<td>Weed Mat</td>
<td>16,000</td>
</tr>
</tbody>
</table>

2012 Mean yield by weed management

2013 Mean yield by weed management

<table>
<thead>
<tr>
<th>Weed Management</th>
<th>Yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-weeded</td>
<td>5,999</td>
</tr>
<tr>
<td>Hand weeded</td>
<td>8,666</td>
</tr>
<tr>
<td>Weed Mat</td>
<td>9,777</td>
</tr>
</tbody>
</table>
Floricanes, 2013

- Weeds in 2012 reduced primocane number in 2012/floricane number in 2013.
- Floricane weight (at pruning in August) was reduced in non-weeded plots and was greater in weed mat than in hand-weeded.
- Berry weight was reduced in non-weeded plots.

Weeds do compete in blackberry

Commercial trailing blackberry field

Commercial, organic, 'Chester Thornless' semi-erect blackberry field
Commercial, organic blackberry field
Red clover, mow and blow

Commercial 'Chester Thornless' organic blackberry field

Commercial, organic, 'Triple Crown', semi-erect blackberry field
### Economics

#### Costs of the three weed management strategies during establishment (3 years) ($/acre)

<table>
<thead>
<tr>
<th>Weed management strategy</th>
<th>Hand weeding cost</th>
<th>Weed mat cost</th>
<th>Total Cost</th>
<th>Gross returns (fruit sales/acre)</th>
<th>Net income ($/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-weeded</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6831</td>
<td>6819</td>
</tr>
<tr>
<td>Hand weeded</td>
<td>55</td>
<td>962</td>
<td>11384</td>
<td>11384</td>
<td>11384</td>
</tr>
<tr>
<td>Weed mat (amortized for 5-year life)</td>
<td>962</td>
<td>12699</td>
<td>13661</td>
<td>13661</td>
<td>13661</td>
</tr>
</tbody>
</table>

Note: this is gross income minus weed management costs = net income NOT including other management costs (assumed to be equivalent among treatments for other cultural practices)

Adapted from: Harkins et al., 2014

### Soil Nutrients

- Soil pH was significantly higher in weed mat plots in 2013
- Soil organic matter has increased over time; this may reflect core sampling including fine blackberry or weed (in non-weeded) roots

- Soil K has been greater under weed mat and has declined over the 3 years of the study
- Soil Ca was greater under weed mat in 2013 and levels increased after lime application (2012-13)
- Soil nitrate was less in 2012 than in 2011 & 2013, but was low each year in general
Nutrients removed in machine-harvested fruit of 'Marion' and 'Black Diamond', 2012-13

(Harkins et al., 2014; Dixon et al, work in progress)

<table>
<thead>
<tr>
<th>Nutrients (lb/ton)</th>
<th>N</th>
<th>P</th>
<th>K</th>
<th>Mg</th>
<th>Ca</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Diamond</td>
<td>2.9 - 4.5</td>
<td>0.5</td>
<td>3.0</td>
<td>0.3</td>
<td>0.5</td>
<td>0.20</td>
</tr>
<tr>
<td>Marion</td>
<td>2.9 - 3.9</td>
<td>0.6</td>
<td>3.0 - 3.3</td>
<td>0.4</td>
<td>0.7 - 0.8</td>
<td>0.19</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Micronutrients (oz./ton)</th>
<th>B</th>
<th>Fe</th>
<th>Mn</th>
<th>Cu</th>
<th>Zn</th>
<th>Al</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Diamond</td>
<td>0.10</td>
<td>0.20</td>
<td>0.2 - 0.3</td>
<td>0.02</td>
<td>0.08</td>
<td>0.2 - 0.4</td>
</tr>
<tr>
<td>Marion</td>
<td>0.10</td>
<td>0.20</td>
<td>0.2 - 0.3</td>
<td>0.03</td>
<td>0.08</td>
<td>0.2 - 0.4</td>
</tr>
</tbody>
</table>

Fruit Nutrients, 2013

- Cultivars differed in many fruit nutrients
- Berries from non-weeded plots had lower %N, K, Mg, Fe, B, Cu, and Zn than hand-weeded or weed mat plots
- Berries from weed mat plots had lower %Ca than other treatments

Fruit Water Content & Brix

- Cultivars differed in fruit moisture content and Brix (% soluble solids)
- Weed control increased fruit moisture content and decreased Brix relative to non-weeded plots
Irrigation Management

- Why is irrigation important?
- What is the best method to apply irrigation?
- Where, when, and how much?

Photo from http://www.stahlbush.com

Irrigation System Design & Layout

Drip system
- One line/row
- 2 ft. emitter spacing (adjust for soil type)
- 0.5 gph emitters (self-cleaning, pressure-compensating)

Hand weeded or non-weeded (hanging drip)

Weed mat (surface drip)

Establishment

Irrigate young plants in short, frequent pulses (15-30 min x 4 times/day)

Weed mat (water permeable)
### Application of fertilizer
- By hand (year 1)
- Fertigation (years 2+)

### Fertilizer
- Fish emulsion + fish hydrolysate
- Mix tank
- Water-driven injector (no electricity)

### Irrigation of Established Plantings

**Bud break/flowering** (May – early June)
- 1-6 in. rain
- 50/70°F
- 2-5 gal/plant (daily)
- Irrigate as needed

**Fruit flowering** (late June – early July)
- 1.5-3 in. rain
- 65/75°F
- 5-6 gal/plant (daily)
- Irrigate 3-4 days/week

**Harvest** (early July – early Aug.)
- No rain
- 70/85°F
- 6-8 gal/plant (daily)
- Irrigate daily

**Post-harvest** (Aug. – Sept.)
- <1 in. rain
- 70/85°F
- 4-6 gal/plant (daily)
- Irrigate 3-4 days/week

### Weed mat increases plant water use
- Larger plant canopy
- Warmer air temperature
- 10-20% more irrigation than hand-weeded plots
Do we need to irrigate after harvest?

**No post-harvest irrigation**

**Advantages**
- Saves water
- Reduces weed growth
- “Hardens the plants off”?

**Disadvantages**
- Less primocane growth?
- Fewer flower buds?
- Less yield?

**Treatments**
- Post-harvest irrigation
- No post-harvest irrigation (August – September)

---

### Post-Harvest Irrigation

#### Floricane traits:

<table>
<thead>
<tr>
<th>Irrigation treatment</th>
<th>Avg. length (ft)</th>
<th>No. of nodes</th>
<th>Bud break (%)</th>
<th>Flowers per lateral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-harvest</td>
<td>18</td>
<td>99</td>
<td>58</td>
<td>9</td>
</tr>
<tr>
<td>No post-harvest</td>
<td>16</td>
<td>82</td>
<td>62</td>
<td>9</td>
</tr>
<tr>
<td>Significant</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

#### Fruit production:

<table>
<thead>
<tr>
<th>Irrigation treatment</th>
<th>Total yield (ton/acre)</th>
<th>Berry wt (g)</th>
<th>Brix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-harvest</td>
<td>3.6</td>
<td>5.5</td>
<td>11.6</td>
</tr>
<tr>
<td>No post-harvest</td>
<td>3.6</td>
<td>5.6</td>
<td>11.8</td>
</tr>
<tr>
<td>Significant</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

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### How much water did we save?

67,000 gallons/acre!

Can we do it every year?
Plant water uptake

Plant water use starts belowground

Water and nutrient uptake occurs predominantly by the fine roots
Plant water uptake

The location of fine roots in the soil is important for understanding plant water uptake.

Root system is flexible

Less soil water & nutrients  More soil water & nutrients

Effects of irrigation & weed management on soil moisture

Hand weeding with post-harvest irrigation Sep. 21, 2012
Irrigation continued until October 2, 2012

Hand weeding with no post-harvest irrigation Sep. 21, 2012
Irrigation stopped on August 8, 2012
Effects of irrigation & weed management on soil moisture

- Weed mat with post-harvest irrigation
  - Sep. 21, 2012
  - Irrigation continued until October 2, 2012

- Weed mat with no post-harvest irrigation
  - Sep. 21, 2012
  - Irrigation stopped on August 8, 2012

Effects of irrigation & weed management on root distribution

- Root observation tubes (weed mat & hand-weeded)
Effects of irrigation & weed management on root distribution

Total number of root images collected from the tubes in 2010-2013: 181,760!

Effects of irrigation & weed management on soil water availability

Neutron probe

Soil water availability within soil profile and root presence
Soil water availability within soil profile and root presence

Soil moisture availability within soil profile and root presence

12-24" soil depth

Black Diamond effects on water availability were 2 weeks earlier than Marion.

There was 1 month difference between Black Diamond and Marion.

Jul  Aug  Sep  Oct  Jul  Aug  Sep  Oct
0   10   20   30   40
0   10   20   30   40
No post-harvest irrigation
Post-harvest irrigation

Marion

Black Diamond
Soil moisture availability within soil profile and root presence

12-24" soil depth

Black Diamond effects on water availability were 2 weeks earlier than Marion

24-36" soil depth

There was 1 month difference between Black Diamond and Marion

Soil moisture availability within soil profile and root presence

12-24" soil depth

Black Diamond effects on water availability were 2 weeks earlier than Marion

24-36" soil depth

There was 1 month difference between Black Diamond and Marion

Soil moisture availability within soil profile and root presence

12-24" soil depth

Black Diamond effects on water availability were 2 weeks earlier than Marion

24-36" soil depth

There was 1 month difference between Black Diamond and Marion

Soil moisture availability within soil profile and root presence

36-48" soil depth

48-60" soil depth

60-72" soil depth

Time

P=0.0006

Irrigation

P<0.0001

Irrigation

P<0.0001
Summary

• Black Diamond appears to be using water faster than Marion
• Large differences in soil water uptake occurred at 12-36"
• No big differences at 36-48" (both cultivars are using water at the same locations in the soil?)
• Shutting off irrigation after harvest reduced roots in Black Diamond
• Marion seems more adapted to dry soil conditions
• How does this impact irrigation?

Keys to Successful Irrigation of Organic Blackberries

➢ Use drip irrigation
  • One line/row
  • Use self-cleaning, pressure-compensating emitters
  • Establish the planting with drip (not sprinklers)
  • Increase irrigation during fruit ripening
  • Add extra water with weed mat (10-20%)

➢ Inject organic fertilizers through the drip system
  • Use an electric dosing pump
  • Flush out the lines at least once a year

➢ Irrigate after harvest???

Challenges

• Insect management may be more difficult
Raspberry Crown Borer
Pennisetia marginata
Plots with larvae found or with recognizable damage were counted during August training.

Plots with Raspberry Crown Borer
2013

Spotted Wing Drosophila
Drosophila suzukii
Female with serrated ovipositor
Male with spotted wings
Actual size 2-3 mm

From OSU Extension Publication, EM8991

Spotted Wing Drosophila

Courtesy, WSU
Summary & Future Directions

• Weeds compete with establishing and mature blackberries reducing growth and yield
• Weed mat has been a cost-effective strategy with yield greater than hand-weeded during establishment
• We are learning more about treatment effects on nutrient removal and how this may be used to develop nutrient management programs
• While yields have been similar to conventional systems and use of weed mat looks promising, we need to look at the long-term effect of weed mat on soil properties and nutrient management

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  – Amber Shireman, USDA-ARS
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  – Emily Dixon
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  – Joe Bennett, Pacifica Organic Advisors, WA
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  – NCSER
  – Ore. Organic Cropping Grant

Quick Poll Questions
Questions?

• Find all upcoming and archived webinars at http://www.extension.org/pages/25242

• Find the recording of this webinar at http://www.extension.org/pages/70279

• Have an organic farming question? Use the eXtension Ask an Expert service at https://ask.extension.org/groups/1668/ask

• We need your feedback! Please respond to an email survey about this webinar which you’ll receive later.

• Thank you for coming!