High Tunnel Raspberry Production in Grow Bags

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Special thanks to Shelia Long, Randy Stout, Jeremy Emery and our hourly employees for work on this project.
Raspberries

• Rubus idaeus
• Red and yellow raspberries
• (Black raspberries)
• Perennial crowns with biennial canes
• Primocane bearers and floricane bearers
Management of primocane and floricane bearing raspberries

Floricane bearing

Canes do not bear fruit in the first season. The canes overwinter and produce fruit in the second season and then die. Fluctuating winter temperatures in Missouri may injure overwintering raspberry canes.

Primocane bearing

No overwintering canes, no problem with winter injury.
Field grown floricane bearing raspberries in Missouri

- Difficult to overwinter canes to become floricanes due to fluctuating winter temperature.
- Difficult to grow in heavy soils – need excellent internal water drainage
- Not a common crop in southern Missouri like Blackberries
- Prelude and Nova
Field grown primocane bearing raspberries in Missouri

- Not a viable commercial crop in Missouri
- Most cultivars bear in August when heat is an issue
- Sunburn
- Diseases due to high humidity and rainfall
- Sensitive to heavy soils and wet soils
- Late bearing cultivars harvest period cut short by frost
- Hertitage, Caroline, Josephine
Raspberries in High Tunnels!!

- Superior to field grown
- More reliable production
- Higher yields (even year 1 for primocane bearers)
- Larger berries
- Better quality – less disease
- Improved shelf life
- Extended growing season
- Protection from frost
- Protection from heat (shade cloth)
Raspberry observational trial Mtn. Grove

- Caroline, Heritage and Josephine in ground in high tunnel and in an adjacent field planting.
- Harvested every other day
- Marketable yield and average berry weight data collected
- Cull fruit discarded and not weighed
- Weighed dormant cane prunings
Table 1. Three year annual average (2011 – 2013) weight of marketable yield, weighted average berry weight and weight of dormant canes for three primocane raspberry cultivars grown in a high tunnel (HT) and in the field (F) at Mountain Grove, MO

<table>
<thead>
<tr>
<th>Cultivar/Location</th>
<th>Marketable Yield Lbs./30 feet</th>
<th>Average Berry Weight grams</th>
<th>Dormant Canes Lbs./30 feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caroline HT</td>
<td>30.9</td>
<td>2.8</td>
<td>22.5</td>
</tr>
<tr>
<td>Caroline F</td>
<td>13.9</td>
<td>2.3</td>
<td>12.8</td>
</tr>
<tr>
<td>Heritage HT</td>
<td>36.5</td>
<td>2.2</td>
<td>24.2</td>
</tr>
<tr>
<td>Heritage F</td>
<td>9.7</td>
<td>1.4</td>
<td>9.1</td>
</tr>
<tr>
<td>Josephine HT</td>
<td>32.5</td>
<td>3.9</td>
<td>24.3</td>
</tr>
<tr>
<td>Josephine F</td>
<td>5.8</td>
<td>2.8</td>
<td>6.9</td>
</tr>
</tbody>
</table>
### Table 2. Marketable yield per cultivar/location for three primocane raspberry cultivars grown in a high tunnel (HT) and in the field (F) at Mountain Grove, MO

<table>
<thead>
<tr>
<th>Cultivar/Location</th>
<th>2011 yield lbs/30’ (establishment year)</th>
<th>2012 yield lbs/30’</th>
<th>2013 yield lbs/30’ (significant loss of yield to SWD)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caroline HT</td>
<td>19</td>
<td>50</td>
<td>26</td>
</tr>
<tr>
<td>Caroline Field</td>
<td>27</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Heritage HT</td>
<td>24</td>
<td>50</td>
<td>35</td>
</tr>
<tr>
<td>Heritage Field</td>
<td>21</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Josephine HT</td>
<td>19</td>
<td>51</td>
<td>29</td>
</tr>
<tr>
<td>Josephine Field</td>
<td>13</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

*Spotted Wine Drosophila discovered at Mountain Grove in 2013

@ $5/pint (12 ounces) Josephine in the high tunnel in 2012 would realize $1.42 gross revenue per square foot. Compare with tomatoes (slicers) at $7.25; Cucumbers at $2.50; Lettuce at $8.05 and Green Peppers at $3.20 (ISU Vegetable Production Budgets for a High Tunnel).

Problem is that the raspberries are perennial and planted in ground.
Raspberry liqueur @ Missouri State
Spotted Wing Drosophila

• Was discovered at our station in 2013
• Active after strawberries
SWD Management

• Spray weekly at night
• Test berries for larvae (1c salt/gallon water) weekly
Table 3. Pesticides used on raspberries at the SFES

<table>
<thead>
<tr>
<th>Insecticide</th>
<th>Class*</th>
<th>PHI Days</th>
<th>Max # of Applications Per season</th>
<th>Application interval</th>
<th>Probably SWD Efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delegate</td>
<td>5</td>
<td>1</td>
<td>6</td>
<td>4 days</td>
<td>Excellent</td>
</tr>
<tr>
<td>Mustang Maxx</td>
<td>3A</td>
<td>1</td>
<td>6</td>
<td>7 days</td>
<td>Excellent</td>
</tr>
<tr>
<td>Assail 30 SG</td>
<td>4A</td>
<td>1</td>
<td>5</td>
<td>7 days</td>
<td>Good</td>
</tr>
<tr>
<td>Danitol 2.4 EC</td>
<td>3A</td>
<td>3</td>
<td>3</td>
<td>14 days</td>
<td>Excellent</td>
</tr>
<tr>
<td>Malathion 5 EC</td>
<td>1B</td>
<td>1</td>
<td>3</td>
<td>7 days</td>
<td>Good</td>
</tr>
</tbody>
</table>

*5 Spinosyns; 3A Pyrethroids and Pyrethrins; 4A Neonicotinoids and 1B Organophosphates
A Fixed-Spray System for SWD Management in High Tunnel Raspberries

Arthur Agnello, Andrew Landers, and Greg Loeb
Department of Enomology, NYSAES, Cornell University, Geneva NY

Figure 6. 1/4-inch dropline inserted into spray supply line

Figure 7. Droplines along sides of rows from spray supply lines

Figure 8. Microsprinkler nozzle spraying

An observation

• In 2015, we discontinued pesticide application on September 28.
• No larvae were detected in October or November to early December in the high tunnel.
• Early or late HT production may avoid some SWD pressure.
  – Early floricane producers – Prelude?
  – Late primocane producers – Crimson Giant?
How to produce raspberries in a high tunnel sustainably?

• Minimize SWD damage?
  – Manage hedgerow density
  – Harvest daily
  – Rotate pesticides

• Pricing, market and cost of production

• New Research looking at moving plants in and out of the high tunnel to allow space for other crops to maximize profit per square foot.
Research Project

- Initial Data
  April 2014 to December 2015

- 2 Years Additional Funding
  – Specialty Crop Block Grant

- 30 x 96 High Tunnel

- Mountain Grove, Missouri
Goals

- Evaluate best cultivars for high tunnel production in grow bags
- Develop crop rotation cycle with vegetables and raspberries to maximize high tunnel space
Joan J

- Great Britain
- Early Season
- Firm, Dark Red Fruit
- Vigorous and upright
- Spineless
Himbo Top

- Switzerland
- Mid Season
- Large, bright red fruit
- Vigorous and upright
Polka

- Poland
- Mid-Season
- Red, shiny fruit
- Good sucker production
- Susceptible to Potato Leaf Hopper
- Observed Leaf Symptom
Josephine

- University of Maryland
- Late Season
- Large, dark red fruit
- Resistant to leaf hopper
- Baseline/Control
Crimson Giant

- Cornell University
- Late Season
- Large, bright red fruit
- Cone shape
- Firm and flavorful
- Developed for November Market

Photo Credit: Dr. Courtney A. Weber, Cornell University
Planted Early Season Vegetables
Raspberry Planting

Bare Root

Plug
Grow Bags
Smart Pot by High Caliper

- 5 Gallon (12 x 10.15”)
- Aerates
- Air Prunes Roots
- Reduces tipping over
- Maximize Space
Experimental Design

• Randomized Complete Block
  – 5 Treatments (Cultivars)
  – 4 Replications (Blocks)
Data Collected

• Marketable Fruit Weight
• 25 Berry Weight
• Weight of dormant canes
2014 Raspberry Total Yield

Yield estimation based on unharvested green berries on October 31, 2014.
2014 Number of Unharvested Berries

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joan J</td>
<td>414</td>
</tr>
<tr>
<td>Polka</td>
<td>222</td>
</tr>
<tr>
<td>Himbo Top</td>
<td>275</td>
</tr>
<tr>
<td>Josephine</td>
<td>545</td>
</tr>
<tr>
<td>Crimson Giant</td>
<td>2786</td>
</tr>
</tbody>
</table>
2015 Raspberry Total Yield

Cultivar

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Pounds per 20 ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joan J</td>
<td>64.95</td>
</tr>
<tr>
<td>Polka</td>
<td>56.76</td>
</tr>
<tr>
<td>Himbo Top</td>
<td>55.08</td>
</tr>
<tr>
<td>Josephine</td>
<td>44.31</td>
</tr>
<tr>
<td>Crimson Giant</td>
<td>42.30</td>
</tr>
</tbody>
</table>
2014 Average Berry Weight

<table>
<thead>
<tr>
<th>Variety</th>
<th>Grams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joan J</td>
<td>3.25</td>
</tr>
<tr>
<td>Polka</td>
<td>3.56</td>
</tr>
<tr>
<td>Himbo Top Cultivar</td>
<td>3.17</td>
</tr>
<tr>
<td>Josephine</td>
<td>3.79</td>
</tr>
<tr>
<td>Crimson Giant</td>
<td>4.50</td>
</tr>
</tbody>
</table>
2015 Average Berry Weight

<table>
<thead>
<tr>
<th>Cultivars</th>
<th>Grams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joan J</td>
<td>3.38</td>
</tr>
<tr>
<td>Polka</td>
<td>3.20</td>
</tr>
<tr>
<td>Himbo Top</td>
<td>3.06</td>
</tr>
<tr>
<td>Josephine</td>
<td>3.30</td>
</tr>
<tr>
<td>Crimson Giant</td>
<td>4.31</td>
</tr>
</tbody>
</table>
Future Plans

• Continue Evaluation of Lettuce/Raspberry Rotation
• Monitor SWD Pressure
• Add a Demonstration Trial of Prelude
  – To observe early Floricane Berry Production
• Compile a Cost Analysis
University of Arkansas Interactive Budget

• Developed by Center for Agriculture and Rural Sustainability

• Apple, Blackberry, Blueberry, Raspberry, Strawberry

Interactive Budgets for Fruit Crops

Interactive budgets can help producers in estimating the costs of production and in conducting what-if analyses around costs, revenues and production levels.

Interactive Sustainable Apple Budget User Guide

Apple Budget User Guides

Interactive Apple Budget

Interactive Sustainable Strawberry Budget User Guide

Strawberry Budget User Guides

Interactive Strawberry Budget

Interactive Blackberry and Raspberry Budget User Guides

Interactive Blackberry Budget

Interactive Raspberry Budget
Raspberries Overwintered
Questions?