Weed Management in Berry Crops

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Horticulture Dept, OSU
1. Recent research projects
   - Extending weed control in strawberries
   - Raspberry tolerance to Callisto
   - Blackberry tolerance to Matrix

2. What to do about bindweed

3. Weed watch
Extending Weed Control in Strawberries
Objectives

• 1. Refining current use patterns in first year strawberries with sequential applications, and assessing impact on strawberry growth and weed control.
• 2. Screening new products and developing acceptable use patterns.
• 3. Developing long-term solutions for field bindweed.
## Post Transplant

**May 8**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Chateau</td>
<td>3 oz/A</td>
</tr>
<tr>
<td>2</td>
<td>Chateau + Prowl H2O</td>
<td>3 oz/A</td>
</tr>
<tr>
<td>3</td>
<td>Spartan +</td>
<td>8 oz/A</td>
</tr>
<tr>
<td>4</td>
<td>Spartan Prowl H2O</td>
<td>8 oz/A</td>
</tr>
</tbody>
</table>

* Not registered

## Followed by

*(on June 6)*

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Dual Magnum*</td>
<td>1 pt</td>
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<tr>
<td>2</td>
<td>Alion*</td>
<td>2.5 oz</td>
</tr>
<tr>
<td>3</td>
<td>Mission*</td>
<td>2.85 oz/A</td>
</tr>
<tr>
<td>4</td>
<td>Treevix*</td>
<td>2.01</td>
</tr>
<tr>
<td>5</td>
<td>Zidua*</td>
<td>1.00</td>
</tr>
<tr>
<td>6</td>
<td>Reflex*</td>
<td>1 pt</td>
</tr>
<tr>
<td>7</td>
<td>Spin-Aid*</td>
<td>6 pts/A</td>
</tr>
<tr>
<td>8</td>
<td>Upbeet*</td>
<td>1 oz</td>
</tr>
<tr>
<td>9</td>
<td>Python*</td>
<td>1.3 oz</td>
</tr>
</tbody>
</table>

* Not registered
Block I

1. Chateau 3oz/A

2. Chateau + 3oz/A
   Prowl H2O 3pts/A

3. Spartan + 8oz/A

4. Spartan 8oz/A
   Prowl H2O 3pts/A

9 new products + 1 untreated

40 treatments
## Main effects

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Weed control</th>
<th>Crop injury</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Averaged cover all 9 new products</td>
<td>Stand alone</td>
</tr>
<tr>
<td>---------------------</td>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Chateau</td>
<td>97.5 a</td>
<td>97.5 a</td>
</tr>
<tr>
<td>Chateau + Prowl H2O</td>
<td>98.3 a</td>
<td>98.0 a</td>
</tr>
<tr>
<td>Spartan</td>
<td>96.3 b</td>
<td>92.3 b</td>
</tr>
<tr>
<td>Spartan + Prowl H2O</td>
<td>98.2 a</td>
<td>98.3 a</td>
</tr>
</tbody>
</table>
Crop injury

Check

Alion (indaziflam)
Crop injury

Mission (flazasulfuron)

Upbeet (triflusulfuron)
## Weed control

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Averaged over all 9 new products</th>
<th>Stand alone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% control</td>
<td></td>
</tr>
<tr>
<td>Chateau</td>
<td>97.5 a</td>
<td>97.5 a</td>
</tr>
<tr>
<td>Chateau + Prowl H2O</td>
<td>98.3 a</td>
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<td>98.3 a</td>
</tr>
</tbody>
</table>
Overall weed control
Crop safety in blue and caneberries

CALLISTO, MATRIX, AND STINGER
CALLISTO

- Soil residual
- Selective POST
  + Seldom see phyto in blueberries
  + Often in blackberries
- Important to remember injury in caneberries is transient
- Must be balanced with the weed control potential
CALLISTO INJURY
APRIL 11 2 WAT
WEED CONTROL WITH CALLISTO

Annual grasses
- ANNUAL BLUEGRASS
- BARNYARD GRASS
- CRABGRASS
- GREEN FOXTAIL
- ITALIAN (ANNUAL)
- RYEGRASS
- WILD OAT
- WITCHGRASS

Seedling control
- BEDSTRAW
- CHICKWEED
- CLOVER
- DANDELION
- DOCK
- GROUNDSEL
- HORSEWEED/MARESTAIL
- LAMBSQUARTER
- MUSTARD
- NIGHTSHADE
- PIGWEED
- SHEPHERDS-PURSE
- SMARTWEED
- SPEEDWELL
- WILD CARROT
- WILD MUSTARD

Suppression
- KNOTWEED
- MALLOW
- PUNCTURE VINE
WHY USE MATRIX?

- Quackgrass
- Mallow suppression
- Sunflower family
  - Groundsel
  - Dandelion
  - Marestail
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Matrix fb*</td>
<td>Pre</td>
</tr>
<tr>
<td></td>
<td>Goal</td>
<td>4-6&quot;</td>
</tr>
<tr>
<td>2</td>
<td>Matrix fb*</td>
<td>Pre</td>
</tr>
<tr>
<td></td>
<td>Aim</td>
<td>4-6&quot;</td>
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<tr>
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<td>Goal</td>
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</tr>
<tr>
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<td>Aim</td>
<td>4-6&quot;</td>
</tr>
<tr>
<td>5</td>
<td>Matrix</td>
<td>4-6&quot;</td>
</tr>
<tr>
<td>6</td>
<td>Matrix +</td>
<td>4-6&quot;</td>
</tr>
<tr>
<td></td>
<td>Aim</td>
<td>4-6&quot;</td>
</tr>
<tr>
<td>7</td>
<td>Matrix+</td>
<td>4-6&quot;</td>
</tr>
<tr>
<td></td>
<td>Goal</td>
<td>4-6&quot;</td>
</tr>
<tr>
<td>8</td>
<td>Goal fb</td>
<td>4-6&quot;</td>
</tr>
<tr>
<td></td>
<td>Matrix</td>
<td>3 ft directed to bottom 1 ft of cane</td>
</tr>
<tr>
<td>9</td>
<td>Aim fb</td>
<td>4-6&quot;</td>
</tr>
<tr>
<td></td>
<td>Matrix</td>
<td>3 ft directed to bottom 1 ft of cane</td>
</tr>
</tbody>
</table>
AVOIDING INJURY

- Apply Matrix before primocanes emerge
- Apply Matrix after Goal or Aim
- Apply when canes are tall enough to avoid growing points
**Minimum Crop Age for Treatment**

- Raspberries with at least one growing season
- Other caneberry crops, at least two growing seasons

**Application Timing Based on Crop Stage:**

For Every-year Bearing Crops:

- Apply before primocanes emerge in the spring, or wait until primocanes are approximately 3 feet tall or taller and make a directed application.

*Alternate Year Bearing Crops:*

- Apply in the dormant period before canes start new growth or wait until new growth canes are several feet tall so that a directed application can be used.
STINGER

- Ongoing saga
- Dow will not support label
- Despite several years and sites with minimal injury
- Concern of Dow is that consecutive years of use may suppress growth
- Minimizing injury
  - Directed applications
  - Wick applications
  - Alternate years
  - Spot treatments
Raspberry Tolerance to Clopyralid

BERRY YIELD (LBS/A)

HERBICIDE AND APPLICATION DATE

Clopyralid
- Jun '10 + Jun '11
- Aug '10
- Nov '10

Quinclorac
- Jun '10 + Jun '11
- Aug '10
- Nov '10

Check

1 x 2x
What to do about bindweed?
Field Bindweed
Hedge Bindweed
<table>
<thead>
<tr>
<th>Plant Characteristic</th>
<th>Field bindweed</th>
<th>Hedge bindweed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaves</td>
<td>Arrowhead shaped with nearly parallel sides Somewhat rounded leaf tip Single point basal lobe of leaf</td>
<td>Generally triangular shaped Somewhat pointed leaf tip Double point (square) basal lobe of leaf</td>
</tr>
<tr>
<td>Flowers</td>
<td>¾ to 1 inch wide and ¾ to 1 ½ inches long White or pink color Flower stalk has two bracts ½ to 2 inches below flower</td>
<td>1 ½ to 2 inches wide and 1 to 2 inches long White or pinkish color Large bracts at base of petals</td>
</tr>
<tr>
<td>Roots</td>
<td>Deep perennial taproot</td>
<td>Perennial taproot</td>
</tr>
<tr>
<td>Seeds</td>
<td>Dark brownish gray, roughened, 1/3 to 3/16 inch long, with 1 rounded and 2 flattened sides</td>
<td>Reddish brown to black, with one rounded and two flattened sides, about 1/4 inch long</td>
</tr>
</tbody>
</table>

Courtesy of Richard Zollinger, NDSU
Bindweed: Shoots vs Seedlings
Back to the basics

- Prevention
- Cultural controls
- Mechanical
- Chemical
- Biological
Prevention

- Start with a clean field
- Avoid following perennial crops
  - Low or no tillage sites,
  - Poor herbicide selectivity
  - Think mint
- Do not introduce seeds
Is it possible to deplete carbohydrate reserves of bindweed?

- Rely
  - Burning new shoots of blueberries
- Roundup
  - Unintended contact, too late often
- Paraquat
- Multiple times
- Breaking dormancy of shoots
- Carbohydrate exhaustion
Selective Control with Herbicides?

Quinclorac (Quinstar, Albaugh)

• Postemergence
• Selective control!
• Broadleaves
Weeds controlled with Quinstagram

Bindweeds
Canada thistle (suppression)
Clover
Dandelion
Perennial sowthistle

Foxtail (green and yellow)
Barnyard grass
Crabgrass

Bedstraw
Dodder
Lambsquarters
Prickly lettuce
Ragweed
Ragweed
Sunflower
Experiments Testing Caneberry Tolerance to Quinclorac

Blackberries
  2 sites in AY Marion berries near Dayton in 2008, 2009
  1 site in EY Marion's (2008, 2009) OSU Botany Farm
  1st year transplants (tissue culture 2009 OSU Veg Farm)

Raspberries
  1 site at OSU Veg farm (from rooted cuttings, 2009)
  1 site at Lebanon (2010)
  1 site at Dayton (2010)

No sign of impact on crop yield at expected label rates
IR-4 residue field studies should be complete
Raspberry Tolerance to Quinclorac

BERRY YIELD (LBS/A)

HERBICIDE AND APPLICATION DATE

- Clopyralid Jun '10 + Jun '11
- Clopyralid Aug '10
- Clopyralid Nov '10
- Quinclorac Jun '10 + Jun '11
- Quinclorac Aug '10
- Quinclorac Nov '10
- Check

1 x and 2x
Biological control

Eriophyiid mite

*Aceria mahlerbae*
Bindweed moth
Tyta luctuosa
Tyta luctuosa
Tyta luctuosa

- Lep.: Noctuidae
- Distribution in PNW unknown
- Defoliating larvae
- 1-2 generations / year
  - Pupal diapause
  - Daylength, temp cues
- Adults are diurnal
- Monitoring Adult TL
  - 22 larval release sites
  - ♀ Pheromone
  - Presence / Absence
  - Seasonal activity
- Monitoring Adult TL
  - 22 larval release sites
  - Found moths at 9 sites
  - Seasonal activity possible at Basket Slough
Integrating Biocontrol

- Herbicide timing
- Dispersal capacity
- Refuge

Table 1. List of biological control insects, target weed species and herbicides that can be applied without damage to the insect.

<table>
<thead>
<tr>
<th>Insect biocontrol agent</th>
<th>Target weed species</th>
<th>Herbicide</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhinocyllus conicus Froehlich</td>
<td>Cardus spp.</td>
<td>2,4-D</td>
<td>Trumble and Kok, 1980</td>
</tr>
<tr>
<td>Cephalcia chinensis horditius Panzer</td>
<td>Cardus spp.</td>
<td>2,4-D</td>
<td>Trumble and Kok, 1980</td>
</tr>
<tr>
<td>Sphenoptera jugoslavica Obenberger</td>
<td>Centaurea diffusa Lam.</td>
<td>Picloram, Ciproylid</td>
<td>Wilson et al., 2004</td>
</tr>
<tr>
<td>Cyphocoleus achatas Fahrer</td>
<td>Centaurea maculosa Lam.</td>
<td>Picloram</td>
<td>Jacobs et al., 2000</td>
</tr>
<tr>
<td>Urophora affinis Fridd. and U. quadrifasciata Meig.</td>
<td>Centaurea maculosa</td>
<td>2,4-D, Picloram</td>
<td>McCaffrey and Callihan, 1988; Story et al., 1988</td>
</tr>
<tr>
<td>Eustenopus villosus Boheman and Chaetorella succinea Costa</td>
<td>Centaurea solstitialis L.</td>
<td>Ciproylid</td>
<td>DiTomaso et al. 2006</td>
</tr>
<tr>
<td>Hyles euphorbiae L.</td>
<td>Euphorbia esula L.</td>
<td>2,4-D, Picloram</td>
<td>Rees and Fay, 1989</td>
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<tr>
<td>Spurria esulae Gagne</td>
<td>Euphorbia esula</td>
<td>2,4-D, Picloram</td>
<td>Lym and Carlson, 1994</td>
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<tr>
<td>Galerucella calamiensis L.</td>
<td>Lythrum salicaria L.</td>
<td>Glyphosate, Tricopyl</td>
<td>Lindgren et al., 1999</td>
</tr>
</tbody>
</table>
Future research

- Refuge concept
  - Release larvae, adults on field edges
  - Baited live traps to pull females into crop
  - Monitor herbivory on targeted FBW patches

- Evaluate
  - Movement
  - % defoliation
  - Weed fitness
Sharp point fluvellin
(Kickxia elatine)
Horseweed/ Marestail

_Conyza canadensis_

- Not horsetail (Equisteum)
- Asteraceae (sunflower family) _think dandelion_
- Annual, winter, summer
- Glyphosate resistant in many places in E US, CA
History of Glyphosate Resistance
# Testing for Roundup Resistance

<table>
<thead>
<tr>
<th>#</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wilsonville, Nursery</td>
</tr>
<tr>
<td>2</td>
<td>Canby, NWREC</td>
</tr>
<tr>
<td>3</td>
<td>Schultz, Monroe</td>
</tr>
<tr>
<td>4</td>
<td>Old River Rd, Monroe</td>
</tr>
<tr>
<td>5</td>
<td>Bellfountain</td>
</tr>
<tr>
<td>6</td>
<td>Talbot</td>
</tr>
<tr>
<td>7</td>
<td>Dayton</td>
</tr>
<tr>
<td>8</td>
<td>Jefferson I</td>
</tr>
<tr>
<td>9</td>
<td>Lincoln</td>
</tr>
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<td>10</td>
<td>Stayton</td>
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<td>11</td>
<td>Jefferson II</td>
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<td>Aurora</td>
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<td>Boardman I Poplars</td>
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<td>14</td>
<td>Boardman II Poplars</td>
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<td>Patterson, WA, blueberries</td>
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<td>Grandview, WA, vineyard,I</td>
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<tr>
<td>17</td>
<td>Grandview, WA, vineyard, II</td>
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<tr>
<td>18</td>
<td>Sunnyside, WA, mint</td>
</tr>
<tr>
<td>19</td>
<td>Gly susceptible Hanson CA</td>
</tr>
</tbody>
</table>
Not glyphosate resistant
Weed Management
Horticulture Dept
OSU

Hazelnuts, cane and blueberries, Christmas trees, nursery, rhubarb, bindweed control

Research Reports
http://hort.oregonstate.edu/faculty-staff/peachey

Weed Management Handbook
Google: PNW WEED HANDBOOK