Herbicide Selection and Management in Pome and Stone Fruit

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Herbicide Mode of Action

Herbicides target a specific plant enzyme, biochemical pathway, or reproductive function. This is called the **Mode of Action (MOA)**. The active place in the biochemical or reproductive pathway is called the **Target Site**.
MOA and Target Site for herbicides in the same chemical family are similar. Using the same or related compounds may lead to crop injury or weed resistance. The more active a herbicide is, the greater the risk of weed resistance.
# Chemical Families and Representative Herbicides (1)

<table>
<thead>
<tr>
<th>Family</th>
<th>Herbicide</th>
<th>MOA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substituted Urea</td>
<td>Karmex, Lorox</td>
<td>Photosystem II Inhibitor</td>
</tr>
<tr>
<td>Substituted Uracil</td>
<td>Sinbar, Hyvar X</td>
<td>Photosystem II Inhibitor</td>
</tr>
<tr>
<td>Triazine</td>
<td>Princep, Aatrex</td>
<td>Photosystem II Inhibitor</td>
</tr>
</tbody>
</table>
## Chemical Families and Representative Herbicides (2)

<table>
<thead>
<tr>
<th>Family</th>
<th>Herbicide</th>
<th>MOA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfonylurea</td>
<td>Matrix, Sandea</td>
<td>Acetolactase Synthase Inhibitor</td>
</tr>
<tr>
<td>Dinitroaniline</td>
<td>Prowl, Surflan</td>
<td>Mitosis Inhibitor</td>
</tr>
<tr>
<td>Diphenylether</td>
<td>Goal, Blazer</td>
<td>Protoporphyrinogen Oxidase Inhibitor</td>
</tr>
</tbody>
</table>
## Chemical Families and Representative Herbicides (3)

<table>
<thead>
<tr>
<th>Family</th>
<th>Herbicide</th>
<th>MOA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triazolinone</td>
<td>Aim, Spartan</td>
<td>PPO Inhibitor</td>
</tr>
<tr>
<td>Phenyl-Phthalimide</td>
<td>Chateau</td>
<td>PPO Inhibitor</td>
</tr>
<tr>
<td>Pyrimidinedione</td>
<td>Treevix (Kixor)</td>
<td>PPO Inhibitor</td>
</tr>
<tr>
<td>Family</td>
<td>Herbicide</td>
<td>MOA</td>
</tr>
<tr>
<td>---------------</td>
<td>---------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Nitrile</td>
<td>Gallery, Casoron</td>
<td>Cellulose Synthesis Inhibitor</td>
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<tr>
<td>Pyridazinone</td>
<td>Solicam</td>
<td>Pigment Inhibitor</td>
</tr>
<tr>
<td>Triketone</td>
<td>Callisto</td>
<td>Carotenoid Synthesis Inhibitor</td>
</tr>
</tbody>
</table>
Methods of Selectivity

- Metabolism of the herbicide
- Placement in time or space
- Plant anatomical differences
- Resistance at site of action
- Differences in stage of growth
Fruit Tree Selectivity

New Planting

Established Tree

Soil

Herbicide
Directed Application
Broadcast Application

Plot of Trees
Leaching Potential

• The more soluble a herbicide is the greater the potential for leaching into the root zone and for crop injury.

• Sandy soil with less than 1% organic matter is very porous and herbicides may leach into tree root zone. Observe label precautions about soil type and herbicide rates.
## Residual Herbicides for Tree Fruit (1)

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>MOA</th>
<th>Solubility (ppm)</th>
<th>Half Life (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surflan</td>
<td>Mitosis Inhibitor</td>
<td>3.0</td>
<td>20</td>
</tr>
<tr>
<td>Prowl H2O</td>
<td>Mitosis Inhibitor</td>
<td>0.3</td>
<td>44</td>
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<tr>
<td>Devrinol</td>
<td>Mitosis Inhibitor</td>
<td>73</td>
<td>70</td>
</tr>
<tr>
<td>Kerb</td>
<td>Mitosis Inhibitor</td>
<td>15</td>
<td>60</td>
</tr>
<tr>
<td>Herbicide</td>
<td>MOA</td>
<td>Solubility (ppm)</td>
<td>Half Life (days)</td>
</tr>
<tr>
<td>-----------------</td>
<td>----------------------------------</td>
<td>------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Trellis (Gallery)</td>
<td>Cellulose Synthesis Inhibitor</td>
<td>1.0</td>
<td>120</td>
</tr>
<tr>
<td>Casoron</td>
<td>Cellulose Synthesis Inhibitor</td>
<td>21</td>
<td>60</td>
</tr>
<tr>
<td>Alion</td>
<td>Cellulose Synthesis Inhibitor</td>
<td>3</td>
<td>?</td>
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## Residual Herbicides for Tree Fruit (3)

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>MOA</th>
<th>Solubility (ppm)</th>
<th>Half Life (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chateau</td>
<td>PPO Inhibitor</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>Goal</td>
<td>PPO Inhibitor</td>
<td>0.1</td>
<td>35</td>
</tr>
<tr>
<td>Treevix</td>
<td>PPO Inhibitor</td>
<td>2100</td>
<td>17</td>
</tr>
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</table>
## Residual Herbicides for Tree Fruit (4)

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>MOA</th>
<th>Solubility (ppm)</th>
<th>Half Life (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matrix</td>
<td>ALS Inhibitor</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Sandea</td>
<td>ALS Inhibitor</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>Mission</td>
<td>ALS Inhibitor</td>
<td>2100</td>
<td>16</td>
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## Residual Herbicides for Tree Fruit (5)

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>MOA</th>
<th>Solubility (ppm)</th>
<th>Half Life (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karmex</td>
<td>PSII Inhibitor</td>
<td>42</td>
<td>90</td>
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<tr>
<td>Princep</td>
<td>PSII Inhibitor</td>
<td>2</td>
<td>60</td>
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<tr>
<td>Sinbar</td>
<td>PSII Inhibitor</td>
<td>710</td>
<td>120</td>
</tr>
<tr>
<td>Herbicide</td>
<td>MOA</td>
<td>Solubility (ppm)</td>
<td>Half Life (days)</td>
</tr>
<tr>
<td>-----------------</td>
<td>----------------------</td>
<td>------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Roundup</td>
<td>EPSPS Inhibitor</td>
<td>15K</td>
<td>45</td>
</tr>
<tr>
<td>Gramoxone</td>
<td>PSI Inhibitor</td>
<td>620K</td>
<td>1000</td>
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<tr>
<td>Fusilade DX</td>
<td>ACCase Inhibitor</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>Poast</td>
<td>ACCase Inhibitor</td>
<td>4400</td>
<td>5</td>
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<tr>
<td>Select</td>
<td>ACCase Inhibitor</td>
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<td>3</td>
</tr>
<tr>
<td>Herbicide</td>
<td>MOA</td>
<td>Solubility (ppm)</td>
<td>Half Life (days)</td>
</tr>
<tr>
<td>-----------</td>
<td>-----------------------</td>
<td>------------------</td>
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</tr>
<tr>
<td>Rely 280</td>
<td>Glutamine Inhibitor</td>
<td>1370K</td>
<td>7</td>
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<tr>
<td>Aim</td>
<td>PPO Inhibitor</td>
<td>12K</td>
<td>0</td>
</tr>
<tr>
<td>Venue</td>
<td>PPO Inhibitor</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Treevix</td>
<td>PPO Inhibitor</td>
<td>2100</td>
<td>17</td>
</tr>
<tr>
<td>Sandea</td>
<td>ALS Inhibitor</td>
<td>15</td>
<td>30</td>
</tr>
</tbody>
</table>
Adjuvants

- Material added to the spray mixture that helps overcome spray barriers and disruptors.
Spray Barriers

• Natural plant characteristics that reduce herbicide contact or in other ways reduce effectiveness of herbicides.
• Eg: Leaf angle, cuticle wax, leaf hairs, growth habit, plant size, reproductive stage, level of dormancy.
Spray Disruptors

• Factors other than plant physiology and morphology that cause reduced effectiveness of herbicides.
• Eg: Hard water, high pH water, tank mix components, wind, rain.
Types of Adjuvants

2. Spray Modifier Agents – modify physical and mechanical barriers.
Activator Agents


2. **Crop Oil Concentrate (COC)** – 80% petroleum oil and 20% surfactant.

3. **Methylated Seed Oil (MSO)** – Oil concentrate from soybean oil; usually 100% oil.
Effects of Adjuvants on Spray Droplets

http://pubs.cas.psu.edu/freepubs/pdfs/uo221.pdf
Spray Modifier Agents

1. Acidifiers – eg LI700
2. N Fertilizer – urea, ammonium nitrate
3. Compatibility Agents
4. Anti-Foam
5. Sticker
6. Drift Control
7. Silicone Surfactants – Silwet L-77, Sylgard 309
Adjuvant Selection

1. Nonionic Surfactant (NIS) for most postemergence herbicide application.
2. Crop Oil Concentrate (COC) for herbicides that recommend it on the label.
3. Methylated Soybean Oil (MSO) for some ALS inhibitors.
5. Sticker spreader for insecticide and fungicide application.
6. Drift retardant for blast sprayers.
Optimum Weed Control

1. Know your weeds.
2. Know your herbicides.
3. Know your crop.
Weeds

1. Identify weeds to family and genus if possible.
2. It is normally easier to control weeds preemergence than postemergence.
3. For perennials, attack them at several stages during the year.
Weed Identification

Websites

• Weed Science Society of America Weed ID:
  – http://www.wssa.net/Weeds/ID/index.htm
• Identifying Weeds in Field Crops:
  – http://www.ipm.msu.edu/weeds-field.htm
• MSU Turf Weeds:
  – http://msuturfweeds.net/
• Midwestern Turfgrass Weed Identification and Control:
  – http://www.turf.uiuc.edu/weed_web/index.htm
• University of Illinois Weed Science:
  – http://weeds.cropsci.illinois.edu/weedid.htm
Weed Identification
Publications (1)

“More Turfgrass and Related Weeds: Beyond the Color Atlas”
-L.B. McCarthy & D.W. Hall

“Weeds of the Northeast”
-R. Uva, J. Neal, and J. DiTomaso

“Weeds of the West”
-R. Uva, J. Neal, & J. DiTomaso
Weed Identification

Publications (2)

“Weeds of the South”
-Charles T. Bryson & Michael S. DeFelice

“Weeds of the Midwestern United States & Central Canada”
-Charles T. Bryson & Michael S. DeFelice
Herbicides

1. Know the Mode of Action (MOA). Use at least 2 MOA preemergence. Apply preemergence herbicides in fall and spring. Rotate MOA each year.

2. Include glyphosate in fall and spring, preemergence applications to kill biennials and winter annuals.

3. Use postemergence herbicides during the growing season to kill emerged weeds. Some weeds can be killed only postemergence. Observe PHI’s.

4. Be aware of potential crop injury.
Crop

1. Each crop has specific herbicide registrations. Do not assume all trees are the same.
2. Young trees are more susceptible; roots are shallow and bark is thinner.
3. Watch for crop injury symptoms.
4. Maintain good pesticide records.
A Weed Control Program
For Apple (1)

Year 0
Fall: **Chateau** 8-10 oz + glyphosate 1 qt

Year 1
Spring: **Sinbar** 1 lb or **Karmex** 3 lb
June: glyphosate 1 qt + **Venue** 2 oz
Fall: **Alion** 5 oz + glyphosate
A Weed Control Program
For Apple (2)

Year 2
Spring: **Matrix** 4 oz + **Karmex** 3 lb + glyphosate
June: **Treevix** 1 oz + **Venue** 1 oz
Fall: **Solicam** 4 lb + **Casoron** CS 1.4 gal + glyphosate

Year 3
Spring: **Princep** 4 lb + **Surflan** or **Prowl** 4 qt
June: **Rely 280** 3 pt + **Venue** 1 oz
Fall: **Chateau** 8-10 oz + glyphosate
A Cherry Weed Control Program (1)

Year 0

Fall: **Chateau** 6-10 oz + glyphosate 1 qt

Year 1

Spring: **Prowl** 4 qt + **Matrix** 4 oz

June: glyphosate 1 qt or **Aim** 2 oz + **Venue** 2 oz

Fall: **Alion** 5 oz + glyphosate
A Cherry Weed Control Program (2)

Year 2

Spring: **Goal Tender** 2 qt + **Surflan** 2 qt
June: **Gramoxone** 2 qt (28 day PHI) + **Venue** 2 oz
Fall: **Chateau** 0-1 oz + glyphosate 1 qt

Year 3

Spring: **Prowl** 4 qt + **Matrix**
June: **Gramoxone** 2 qt + **Venue** 2 oz
Fall: **Alion** 5 oz + glyphosate
New Labels Coming for Tree Fruit

- **Mission** (flazasulfuron) – Long residual
- **Trellis** (isoxaben) – Long residual
- **Spartan** (sulfentrazone) – Composite + pigweed control
- **Stinger** (clopyralid) – Post composite, legume, nightshade
Special Weed Problems

Yellow Nutsedge – Sandea – Post
Quackgrass – Kerb – Fall
Annual Bluegrass – Select Max
The End