Apple IPM Intensive Workshop

Weed Control in Apple Orchards

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Weeds in Orchard Systems

• Competition for water, light, nutrients
  • *New plantings*
  • *Dwarf rootstocks with shallow root systems in high density arrangements*
• Large vegetation can impact the deposition of crop protection chemicals
  • *Facilitate potential for herbicide drift and crop injury*
• Habitat for invertebrate and vertebrate pests
• Alter crop microclimates to influence disease development
• Interference with harvest operations
New Findings in Weed Control in Young Apple Orchards

Deborah Breth and Elizabeth Tee
Cornell Cooperative Extension, Lake Ontario Fruit Program

Abbots, NY

Take home messages...

Start clean (first two years) and start early (May and June) with weed control

New high-density orchards depend on good tree growth in the first 2 years to develop the canopy for high crops in years 2-5. Our research shows that poor weed control in the first 2 years can result in less tree growth that is estimated to reduce production in the third year by half and a several year delay in break-even payback of the initial investment. We estimate that management practice in new orchards is worth thousands of dollars in long-term profitability.

Critical Weed Control Requirements in High Density Apple Orchards

Deborah Breth
Cornell Cooperative Extension, Lake Ontario Fruit Program

Abbots, NY

Take home messages...

Start clean (first two years) and start early (May and June) with weed control

Weed control is a necessary component of high density apple production systems to prevent competition for nutrients and water, and remove habitat for pests. Previous work done by Ian Merwin (1994) indicated that a weed-free strip of trees was needed to maintain a reduced crop load. Our work shows that good weed control is a necessary component in new high-density orchards to minimize growth and early cropping. If weeds are allowed to establish early, they can significantly reduce the potential for high density orchards. This work was done on semi-dwarfing rootstocks.

Figure 2. 2014 soil test results, Wayne Co., NY using Gala trees on M.9 rootstock planted May 3, 2014.

Figure 3. A third rootstock was established.
Weed Size and Herbicide Injury to Trees

As weeds get taller, spray boom comes up and more opportunity to have herbicides contact foliage...
As a side note...Be sure you aren’t applying an herbicide to your canopy
Weed Control – Herbicides

• Activity
  • Contact vs. systemic (translocated)

• Selectivity
  • Broadleaf specific vs. grass specific vs. non-selective

• Timing (relative to weed emergence)
  • Before (soil-applied, residual) vs. after (foliar applied) weed emergence

• Timing (relative to crop age)
  • Establishment phase vs. mature tree

• Timing (relative to crop stage)
  • In-season vs. dormant applications
### Pre-emergence (soil-applied)

<table>
<thead>
<tr>
<th>Active ingredient</th>
<th>Primary selectivity</th>
<th>Min. tree age</th>
</tr>
</thead>
<tbody>
<tr>
<td>dichlobenil</td>
<td>AG, PG, ABL, PBL</td>
<td>Depends on form/rate</td>
</tr>
<tr>
<td>diuron</td>
<td>AG, ABL</td>
<td>1 yr</td>
</tr>
<tr>
<td>flumioxazin</td>
<td>AG, ABL</td>
<td>Depends on protect.</td>
</tr>
<tr>
<td>halosulfuron</td>
<td>ABL, nutsedge</td>
<td>1 yr</td>
</tr>
<tr>
<td>indaziflam*Res Use</td>
<td>AG, ABL</td>
<td>3 yr</td>
</tr>
<tr>
<td>norflurazon</td>
<td>AG, nutsedge</td>
<td>none</td>
</tr>
<tr>
<td>oryzalin</td>
<td>AG</td>
<td>none</td>
</tr>
</tbody>
</table>

### Pre-emergence (soil-applied)

<table>
<thead>
<tr>
<th>Active ingredient</th>
<th>Primary selectivity</th>
<th>Min. tree age</th>
</tr>
</thead>
<tbody>
<tr>
<td>oxyfluorfen</td>
<td>ABL</td>
<td>1 yr</td>
</tr>
<tr>
<td>pendimethalin</td>
<td>AG</td>
<td>none</td>
</tr>
<tr>
<td>pronamide*Res Use</td>
<td>AG, PG</td>
<td>0.5-1 yr</td>
</tr>
<tr>
<td>rimsulfuron</td>
<td>AG, ABL</td>
<td>1 yr</td>
</tr>
<tr>
<td>simazine*Res Use</td>
<td>ABL</td>
<td>1 yr</td>
</tr>
<tr>
<td>terbacil*Res Use</td>
<td>AG, ABL</td>
<td>Depends on rate/NB</td>
</tr>
</tbody>
</table>

AG, ABL – annual grasses and broadleaves
PG, PBL – Perennial grasses and broadleaves

Always read the label before using products. Not all a.i.s are suitable for all rootstocks or labeled for use in all NY counties.
### Post-emergence (foliar-applied)

<table>
<thead>
<tr>
<th>Active ingredient</th>
<th>Primary selectivity</th>
<th>Min. tree age</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,4-D*Res Use</td>
<td>ABL, PBL</td>
<td>1 yr</td>
</tr>
<tr>
<td>carfentrazone</td>
<td>ABL</td>
<td>none</td>
</tr>
<tr>
<td>clopyralid*Res Use</td>
<td>ABL, PBL</td>
<td>1 yr</td>
</tr>
<tr>
<td>glufosinate</td>
<td>AG, ABL</td>
<td>none</td>
</tr>
<tr>
<td>glyphosate</td>
<td>AG, ABL, PB, PBL</td>
<td>none</td>
</tr>
</tbody>
</table>

### Post-emergence (foliar-applied)

<table>
<thead>
<tr>
<th>Active ingredient</th>
<th>Primary selectivity</th>
<th>Min. tree age</th>
</tr>
</thead>
<tbody>
<tr>
<td>paraquat*Res Use</td>
<td>AG, ABL</td>
<td>1 yr</td>
</tr>
<tr>
<td>pyraflufen</td>
<td>ABL</td>
<td>none</td>
</tr>
<tr>
<td>saflufenacil*Res Use</td>
<td>ABL</td>
<td>1 yr</td>
</tr>
<tr>
<td>sethoxydim</td>
<td>AG, PG</td>
<td>none</td>
</tr>
</tbody>
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AG, ABL – annual grasses and broadleaves, PG, PBL – Perennial grasses and broadleaves

Always read the label before using products. Not all a.i.s are labeled for use in all NY counties
**Glyphosate**

- Roundup
- EPSPS synthase inhibitor
- Very good translocation
- Coverage – less critical
- Non-selective
- Good perennial “control”
- Good annual BL weeds
- Good annual grass control

**Glufosinate**

- Rely
- Glutamine synthase inhibitor
- Limited translocation
- Coverage – critical
- Non-selective
- Poor perennial “control”
- Good annual BL weeds (small)
- Variable annual grass control (small)
## Growth – inhibiting herbicides

<table>
<thead>
<tr>
<th>WSSA Group</th>
<th>Details (mode of action, active ingredient, timing of application relative to weed emergence)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WSSA 1</td>
<td>ACCase inhibitor, prevents fatty acid synthesis/membrane development, sethoxydim, POST</td>
</tr>
<tr>
<td>WSSA 2</td>
<td>ALS inhibitor, inhibits branch chain amino acid/protein synthesis, halosulfuron, rimsulfuron, PRE (POST)</td>
</tr>
<tr>
<td>WSSA 3</td>
<td>Microtubule inhibitor, inhibits cell division, oryzalin, pendimethalin, pronamide, PRE</td>
</tr>
<tr>
<td>WSSA 4</td>
<td>Synthetic auxins, growth regulators, 2,4-D, clopyralid, POST</td>
</tr>
<tr>
<td>WSSA 9</td>
<td>EPSPS inhibitor, inhibits aromatic amino acid/protein synthesis, glyphosate, POST</td>
</tr>
<tr>
<td>WSSA 20, 29</td>
<td>Cellulose inhibitors, inhibits cell wall biosynthesis, dichlobenil, indaziflam, PRE</td>
</tr>
</tbody>
</table>
# Tissue – destroying herbicides

<table>
<thead>
<tr>
<th>WSSA Group</th>
<th>Details (mode of action, active ingredient, timing of application relative to weed emergence)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WSSA 5, 7</td>
<td>PSII inhibitors, generates reactive molecules, diuron, simazine, terbacil, <em>PRE</em></td>
</tr>
<tr>
<td>WSSA 10</td>
<td>Glutamine synthase inhibitor, ammonia buildup, glufosinate, <em>POST</em></td>
</tr>
<tr>
<td>WSSA 12</td>
<td>Carotenoid biosynthesis inhibitor, generates reactive molecules, norflurazon, <em>PRE</em></td>
</tr>
<tr>
<td>WSSA 14</td>
<td>PPO inhibitors, generates reactive molecules, flumioxazin, oxyfluorfen, <em>PRE (POST)</em>, pyraflufen, saflufenacil, <em>POST</em></td>
</tr>
<tr>
<td>WSSA 22</td>
<td>PS I electron diverter, generates reactive molecules, paraquat, <em>POST</em></td>
</tr>
</tbody>
</table>
Resistant Weeds in US by WSSA Groups listed for Apples in NY

(listed herbicide may not be representative of all reported resistances)
• Herbicide resistance that has likely developed in trees and vine systems

• 144 confirmed cases worldwide
• 24 confirmed cases in the US (CA, MI, NM, OR, WA)
  • *Glyphosate* – 13
  • *PSII inhibitors* – 8
  • *PSI diverters, ACCase inhibitors, ALS inhibitors, glufosinate* – 2 or fewer

• Palmer and Powell amaranths, Italian and rigid ryegrass, Eastern black nightshade, velvetleaf, ladysthumb, hairy fleabane, horseweed, common lambsquarters
• Perennial weeds in orchards

• *Convolvulus arvensis* – Field bindweed

• *Cyperus esculentus* – yellow nutsedge
• Field Bindweed – *Convolvulus arvensis*
  
  • Broadleaf, perennial vine
  
  • Extensive root system (taproots to 30’)
  
  • Spreading, regenerative rhizomes
  
  • Prostrate vines that become climbing
  
  • Flowering occurs summer until frost
  
  • Seed production up to millions/A
  
  • Seed are long-lived in soil (decades)
• Yellow nutsedge – *Cyperus esculentus*

• Grass-like perennial
• Stiff leaves, V-shaped in cross section
• Pointed at tip
• Yellow-gold flowers in clusters
• Seed are small and football-shaped
• Tubers (nutlets) produced singly on rhizomes
• Tubers persist for 3-5 years in the soil
Sedges have edges

Rushes are round

Grasses have nodes from tips to the ground

*Cyperus esculentus*  
*Juncus effusus*  
*Elymus repens*
Perennial Weed Control

- **Bindweed**
  - Eradicate before planting
  - Prevent establishment
  - Frequent (2-3 wk) cultivation
  - Shading

- **Nutsedge**
  - Eradicate before planting
  - Prevent establishment
  - Eliminate wet conditions
  - Shading
Perennial Weed Control

• Bindweed
  • Dichlobenil
  • Rimsulfuron (PRE?)
  • Glyphosate
  • Auxinic herbicides

• Nutsedge
  • Dichlobenil
  • Rimsulfuron (PRE, EPOST)
  • Halosulfuron (PRE, EPOST)
  • Glyphosate
• Dichlobenil
  • Volatilizes quickly at warmer temperatures (apply late fall or early spring)
  • Higher rates needed for perennials

• Rimsulfuron, halosulfuron
  • Rimsulfuron PRE for field bindweed in California, POST not effective
  • Halosulfuron PRE or POST (3-5 leaf) for nutsedge

• Glyphosate
  • Flowering bindweed
  • 3-5 leaf nutsedge
  • Do not let come into contact with foliage, green bark

• Auxinic
  • Timing with respect to bloom, avoid contact with sensitive tree tissue
  • Broadleaf selective
  • Clopyralid not available on long Island
What do you want to learn more about with respect to weeds and weed control (please rank)

Herbicides and modes of action
Timing of herbicides to maximize control
How to manage perennial species
Diagnosing herbicide injury in trees
Herbicide resistance detection and management
Herbicide impacts on soil health
Adjuvant impact on herbicide efficacy
Non-chemical/organic weed control
Climate change impacts on weeds/weed control
Were there any topics of interest in that you want more information about that WERE NOT mentioned in the previous slide?