How Hop Herbicides Work

Jed Colquhoun
University of Wisconsin-Madison
How Hop Herbicides Work

• Hop herbicides (example trade names):
  – norflurazon (Solicam)
  – trifluralin (Treflan)
  – flumioxazin (Chateau)
  – carfentrazone (Aim)
  – glyphosate (Roundup)
  – 2,4-D
  – clethodim (Select)

Pesticide labels change often and vary regionally. As always, read and follow the pesticide label prior to use. The information in this presentation is not a substitute for the label – the label is the law!
How Hop Herbicides Work

• Hop herbicides:
  – What they’re used for in hops
  – How they work, not in a textbook way but so that they work best
  – Any issues to keep an eye out for
How Hop Herbicides Work

1. Herbicide application
2. Plant uptake
   - Metabolism - activation
   - Metabolism - deactivation
3. Translocation
   - Contact herbicides
4. Target site
5. Toxicity or herbicidal activity
norflurazon (Solicam)

- PRE herbicide: apply to clean soil after tillage in fall or early spring
- Controls several broadleaves and grasses
- Apply as a directed spray to the soil on each side of the row
- Apply 6 months or more after crop planting
- 60 day pre-harvest interval
norflurazon (Solicam)

• Uptake: primarily roots
• Translocation: to the growing points
• Plant system affected:
  – Blocks pigment formation
  – Toxic byproducts build up in plant
  – Cell membranes are destroyed
• Selectivity: tolerant plants have less uptake and more metabolism
norflurazon (Solicam)
trifluralin (ex: Treflan)

- Controls several annual grasses and a few broadleaf weeds
- PRE control only – emerged weeds not touched
- Needs to be incorporated 1 to 2 inches deep, but don’t damage the hop crowns
- Don’t spray or drag treated soil over hop crowns – emergence will be delayed
trifluralin (ex: Treflan)

- **Uptake**: roots of nearby germinating weeds
- **Translocation**: to root growing points
- **Plant system affected**: 
  - Cell division in root tips is disrupted
- **Selectivity**: tolerant plants have less uptake, less translocation and more metabolism
trifluralin (ex: Treflan)
trifluralin (ex: Treflan)
carfentrazone (Aim EC)

• Available in WI on a Special Local Needs label
• For sucker control and for young broadleaf emerged weeds
  – Suckers: apply to the bottom 1.5 ft and to sucker mat. See label for adjuvant requirements
  – Newly-emerged broadleaf weeds: Apply using a shielded or hooded sprayer
    • Avoid newly trained hop bines until sufficient barking and until they are tall enough to avoid the apical bud
flumioxazin (Chateau SW)

• For sucker control and for PRE weed control
  – Suckers: Apply as a directed spray after the hop bines are at least 6 ft tall
    • Spray the lower 2 ft of hops
  – PRE weed control: Apply to dormant hops as a band 1 to 1.5 ft from the row
    • Controls several broadleaves and some grasses
    • Don’t use with an adjuvant
    • Avoid contact with hops
flumioxazin (Chateau SW) and carfentrazone (Aim EC)

• Uptake: roots and shoots for Chateau; shoots for Aim
• Translocation: some with Chateau; almost none with Aim
• Plant system affected:
  – Cell membranes are destroyed and cells collapse
• Selectivity: tolerant plants metabolize the herbicides
carfentrazone (Aim EC)
glyphosate (ex: Roundup)

- Non-selective: what you spray will be injured or killed, including the hops!
- Post-emergent – no soil residual
- Can be applied as a row middle, shielded, wiper, directed or spot treatment
  - Don’t let it contact the hops – remove suckers in the area prior to application if needed
  - 14 day pre-harvest interval
glyphosate (ex: Roundup)

• Uptake: only by shoots, not by roots
• Translocation: to the active sink in the plant
• Plant system affected:
  – Amino acid production
• Selectivity: Non-selective! Roundup injures or kills most plants that it touches!
glyphosate (ex: Roundup)
Susceptible: 1 pint/Acre (21 DAT)
Oregon: 1 pint/Acre
Oregon: 4 pints/Acre
Oregon: 8 pints/Acre
Glyphosate resistance update

- Common waterhemp:
  - Eau Claire County: 10x resistance
  - Pierce County: 13x resistance
- Palmer amaranth:
  - Dane County
- Previously identified:
  - Giant ragweed
  - Horseweed

Figure 1. Comparison of ten susceptible plants versus ten Dane County Palmer amaranth plants. Pictures taken at 21 days after application.

Figure 1. Comparison of ten Eau Claire County common waterhemp versus seven susceptible plants. Pictures taken at 14 days after application.
Herbicide-Resistant Palmer Amaranth Cases in Wisconsin

Confirmed Glyphosate Resistance
Suspected Glyphosate Resistance
No Confirmed Resistance

* Tested by a molecular assay from UIUC

(Map by T. R. Butts, slide by D. Hammer)
Herbicide-Resistant Common Waterhemp Cases in Wisconsin

- Confirmed Glyphosate Resistance
- Suspected Glyphosate Resistance
- No Confirmed Resistance

* Tested by a molecular assay from UIUC

(Map by T. R. Butts, slide by D. Hammer)
<table>
<thead>
<tr>
<th>Seedling Shape</th>
<th>Common Waterhemp</th>
<th>Redroot Pigweed</th>
<th>Smooth Pigweed</th>
<th>Powell Amaranth</th>
<th>Palmer Amaranth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
</tr>
<tr>
<td>Stem Hairs</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
</tr>
<tr>
<td>Leaf Shapes</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
</tr>
<tr>
<td>Separate Male and Female Plants</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Seedhead Shape</td>
<td>smooth, long, slender</td>
<td>prickly, short, stout</td>
<td>slightly prickly, long, slender</td>
<td>prickly, very long, thick</td>
<td>very prickly, very long, thick</td>
</tr>
</tbody>
</table>

Source: Pratt et al., Iowa State University, 1999
2,4-D (several trade names)

• Post-emergent broadleaf weed control
• Make directed applications to row middles
• Can make up to 3 applications, but with at least 30 days between applications
• 28 day pre-harvest interval
• Don’t contact green hop stems or foliage
2,4-D (several trade names)

• Uptake: shoots and foliage
• Translocation: to the growing points
• Plant system affected:
  – Plant hormones: unbalanced and overloaded
• Selectivity: grasses uptake and transport 2,4-D less effectively and metabolize it quickly; differences in broadleaf control based on metabolism rate
2,4-D (several trade names)
2,4-D

2,4-D on Tomato
Postemergence
Did you catch my drift?
clethodim (ex: Select)

- Post-emergent grass control
  - Controls most annuals and some perennials
  - No broadleaf weed control
- Apply to actively growing grasses
- Include an adjuvant as directed by the label
- 21 day pre-harvest interval
clethodim (ex: Select)

- Uptake: shoots and foliage
- Translocation: to the growing points
- Plant system affected:
  - ACCase enzyme is blocked
- Selectivity: grasses have an active ACCase enzyme; broadleaf plants don’t
clethodim (ex: Select)
clethodim (ex: Select)