Alfalfa Weevil Pyrethroid Resistance and a Kansas Update

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- Native to Eurasia and North Africa
- Three strains were introduced into the U.S.
  - Western (Salt Lake City, Utah, in 1904)
  - Egyptian (Yuma, Arizona, in 1939)
  - Eastern (Maryland in 1952)

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Western</th>
<th>Egyptian</th>
<th>Eastern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate during aestivation</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Migrate out of fields</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Pupate</td>
<td>In soil</td>
<td>On plant</td>
<td>On plant</td>
</tr>
<tr>
<td>Climatic preference</td>
<td>Cold</td>
<td>Hot, dry</td>
<td>Early moist</td>
</tr>
<tr>
<td>Population peak</td>
<td>1-3 weeks later</td>
<td>1-3 weeks earlier</td>
<td>1-3 weeks earlier</td>
</tr>
</tbody>
</table>

Stubble de-barking prevents regrowth
Widespread Resistance

2015-Canada

Resistance in CO started in 2017

Note: COC helps get better results with Steward

Did not use COC

To summarize...

**lambda-cyhalothrin (pyr)**
- poor residual control, larval survival

Oklahoma, Colorado, California, Montana, New Mexico, Utah

**cobalt (chlorpyrifos +lambda-cyhalothrin)**
- poor residual control, larval survival

Washington, Wyoming(suspected)
Add Kansas to the List

Vials obtained from Colorado pre-dosed with lambda-cyhalothrin 0.0393 mg ai/2 ml acetone

Wild 2nd-3rd instar weevil larvae collected in May from 2 counties (FL, Graham/Rooks line) and exposed for 48 hours

% Weevil Mortality

- Finney: 23%
- Graham: 25%

Insecticide use patterns and short-range dispersal of weevils result in highly localized areas of resistance

Knowledge Base: Life

What is driving resistance and control difficulties?

1. Repeated use of the same insecticide or mode of action, poor coverage

2. Increase in mild winters/lack of extreme cold temperatures

3. Adult beetle longevity

4. Behavioral differences between weevil strains

Only 4 modes of action!

<table>
<thead>
<tr>
<th>Insecticide</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha-cypermethrin (Fasac CS)</td>
<td>0.014 to 0.025 lb. a.i./acre (2.2 to 3.8 fl. oz./acre)</td>
</tr>
<tr>
<td>Beta-cyfluthrin (Baythroid XL)</td>
<td>0.025 to 0.022 lb. a.i./acre (1.6 to 2.8 fl. oz.) Data indicates that rates of 0.015 to 0.02 should provide the longest protection against larval damage.</td>
</tr>
<tr>
<td>Chlorpyrifos (numeros products)</td>
<td>Check label, but generally 1 to 2 pints/acre</td>
</tr>
<tr>
<td>Chlorpyrifos plus lambda-cyhalothrin* (Cobalt Advanced)</td>
<td>19 to 38 fl. oz./acre</td>
</tr>
<tr>
<td>Chlorpyrifos plus zeta-cypermethrin (Stallion)</td>
<td>9.25 to 11.75 fl. oz./acre</td>
</tr>
<tr>
<td>Cyfluthrin (Tombstone)</td>
<td>0.025 to 0.044 lb. a.i./acre (1.6 to 2.8 fl. oz.)</td>
</tr>
<tr>
<td>Gamma-cyhalothrin (Pygaxis, Declare)</td>
<td>0.01 to 0.035 lb. a.i./acre (2.56 to 3.84 fl. oz.) (Declare: 1.02 to 1.54 fl. oz./acre) A higher rate should provide the longest protection against larval damage.</td>
</tr>
<tr>
<td>Indoxacarb (Steward)</td>
<td>22</td>
</tr>
<tr>
<td>Lambda-cyhalothrin (numeros products)</td>
<td>0.02 to 0.03 lb. a.i./acre. Data reviewed so far indicates that the higher rate should provide the longest protection against larval damage.</td>
</tr>
<tr>
<td>Lambda-cyhalothrin plus chromgranilaxide (Volicam Xpress)</td>
<td>6.0 to 9.0 fl. oz./acre</td>
</tr>
<tr>
<td>Methomyl (Lannate)</td>
<td>1X 3 pints/acre, SP 1 lb/acre</td>
</tr>
<tr>
<td>Phosmite* (Ismidai)</td>
<td>1X 3 pints/acre, SP 1 lb/acre</td>
</tr>
<tr>
<td>Permethrin (multiple products)</td>
<td>0.2 lb. a.i./acre. Results in Kansas research trials have been variable.</td>
</tr>
<tr>
<td>Lambda-cyhalothrin plus chromgranilaxide (Besiege)</td>
<td>5.0 to 10.0 fl. oz./acre</td>
</tr>
<tr>
<td>Zeta-cypermethrin (Mustang MAXX, etc.)</td>
<td>0.014 to 0.025 lb. a.i./acre (2.24 to 4.0 fl. oz./acre). Data are limited, but the higher rate should provide the longest protection against larval damage.</td>
</tr>
</tbody>
</table>

* Treatments listed are mainly used for treating alfalfa weevil larvae; products with an asterisk are also recommended for adult alfalfa weevil control.

Knowledge Base: Life

What is driving resistance and control difficulties?

- Weevil survival
- Egg laying

400-1000 eggs/female (1500/female in other countries)

3. Adult beetle longevity

Resistant individuals can pass on genetics for 2 or more years

4. Behavioral differences between weevil strains

A topic that needs more regional observations
• Rotate to new Mode of Action
• Indoxacarb (Steward) currently providing control, but being evaluated to confirm continued effectiveness
• Monitor results, report problems
• Regional resistance monitoring will be ongoing
• Non-chemical controls

What now?

Spray gallonage for ground equipment:
- 7 inch alfalfa 10-12 gpa
- 8-15 inch 15-20 gpa
- >15 inches 20 gpa minimum
- Use 30 psi and hollow cone nozzles, adjust spray pattern as suggested by the nozzle manufacturer to overlap near the top of the canopy

Spray gallonage for aerial equipment:
- Less than 2 gallons of spray per acre has frequently resulted in unsatisfactory control.
- Overall efficacy frequently increases as even more carrier is used.

Coverage for sprays

Early season management

<table>
<thead>
<tr>
<th>Stage</th>
<th>Degree Days</th>
<th>Feeding Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>8&quot;-14&quot;</td>
<td>70-100</td>
<td>feeding damage to top 1&quot;-2&quot; inches growth on 30% to 50% of terminals</td>
</tr>
<tr>
<td>3&quot;-7&quot;</td>
<td>30-60</td>
<td>feeding evident on top 1&quot;-2&quot; of growth</td>
</tr>
<tr>
<td>0&quot;</td>
<td>0-30</td>
<td>1-2 larvae per stem</td>
</tr>
</tbody>
</table>

Note: once a week scouting may not be enough during high pressure! Young alfalfa can be defoliated in 3-4 days!

Late season management

<table>
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<tr>
<th>Stage</th>
<th>Degree Days</th>
<th>Feeding Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>3&quot;-7&quot;</td>
<td>100-150</td>
<td>feeding evident on top 1&quot;-2&quot; of growth</td>
</tr>
<tr>
<td>0&quot;</td>
<td>0-30</td>
<td>1-2 larvae per stem</td>
</tr>
</tbody>
</table>

Note: additional stubble sprays may be necessary after cutting

Stubble sprays: 8+ larvae/sqft (4+ if drought stressed) prevent regrowth

OPTION a: Early cutting if within 10-14 days of cutting, the hay is expected to dry quickly, and windrows will be rapidly removed from the field so the relatively delicate larvae are exposed to bright sunlight and drying winds.

OPTION b: Spraying before cutting is advisable if the top 2"-3" injured and harvest cannot be done immediately, or if weather conditions favor larval survivorship and other stresses make rapid regrowth following cutting unlikely.
Damage adds up...

- Consider other little known weevils in our alfalfa

Foliar pests

- Clover root curculio
- White fringed weevil

Root pests

Unseen root damage—often blamed on environmental or nutrient stress

Clover root curculio

Unseen root damage—often blamed on environmental or nutrient stress

Trochanter mealybug

Recurring and spontaneous?

Feeds on soybeans, corn, sorghum, alfalfa & more

White fringe beetle

All white-fringed beetles are highly fertile females; no males have been found

Knowledge + Life
Questions?
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