Management of Foliar Insect Pests in Vegetables

Tim Waters
WSU Regional Vegetable Specialist Franklin & Benton Co.

Malheur Entomology Short Course 45 min
Potato Pests?

- Wireworm
- CPB
- BLH
- Aphids
- Mites
- Psyllids
- Thrips
- Tuberworm
Potato Psyllids and Zebra Chip Update for the Columbia Basin

Carrie H. Wohleb
Regional Extension Specialist for Potato and Vegetable Crops
WSU Grant-Adams Extension

2013 CBCCA Short Course
January 16, 2013
Zebra Chip Disease of Potato

- The causal agent of Zebra Chip (ZC) is a bacterium, *Candidatus Liberibacter solanacearum* (Lso).

- Transmitted to potatoes by the potato-tomato psyllid (*Bactericera cockerelli*).
  - Psyllids can acquire Lso after 8-24 hrs of feeding on infected plants, and can transmit it after a 2-wk latent period.
  - Once infected, they transmit Lso rapidly.

- ZC reduces yields by causing premature plant senescence.

- ZC causes an internal tuber defect.
  - Discoloration of vascular ring and medullary ray tissues in tubers.
History of Zebra Chip Disease in the U.S.A.

- ZC was first documented in potato fields in Saltillo, Mexico in 1994.
- ZC reported in southern Texas in 2000.
- ZC spread to other parts of TX, KS, and NE by the mid-2000’s.
- ZC has now been reported in twelve states, and also in Mexico, Guatemala, Honduras, Nicaragua, and New Zealand.
- First documented to occur in WA, OR, and ID in 2011.
Potato psyllid

White rim on top of head

3-way branch in wing veins

Wings clear, without spots or color

Other psyllids

Colored wings
Where do the Potato Psyllids Come From?

- Potato psyllids were once thought to migrate to the PNW each year from other areas, but new information suggests they can overwinter in some areas of the PNW.

- They have been found on bittersweet nightshade in ID, OR, and WA throughout the year (including winter).

- Do some psyllids migrate to the PNW, while others overwinter here?

- Does the bacterium overwinter in infected psyllids and/or on bittersweet nightshade?
Washington Sentinel Plot Results

- 6/11/12 1 adult - Irrigon, OR
- 6/12/12 1 adult - Hermiston, OR
- 6/12/12 2 adults - Prosser Sentinel
- 6/26/12 1 adult - Paterson Sentinel
- 7/2/12 1 adult - Yakima Sentinel
- 7/3/12 2 adults - Pasco Sentinel
- 8/28/12 4 adults - Othello Sentinel
- 7/3/12 6 nymphs - Prosser Sentinel
- 7/30/12 2 nymphs - Paterson Sentinel
- 8/3/12 23 nymphs - Pasco Sentinel
- 9/4/12 2 nymphs - Othello Sentinel

- All tested negative for Lso.
Potato Psyllid Trapping Results with Sticky Cards in 2012

• Only found at 7 of 39 sites.

• Each had only 1-3 psyllids total for the season.

• Hundreds of cards were deployed, only 12 psyllids were collected.

• All tested negative for Lso.

• Is there a better way to do this?
Predicting Zebra Chip in the PNW

• It can be difficult to assess the risk of ZC occurring in potato crops in the Columbia Basin.

• Potato psyllid monitoring efforts can help assess risk, but psyllids can be very difficult to monitor.

• Only a few psyllids tested positive for Lso in the PNW in 2012, but…
  • Only a tiny fraction of the psyllid population is tested.
  • It only takes a few hours for an infected psyllid to transmit the disease.
  • Zebra chip losses can be significant.
Chemical Control Recommendations

- Most experts agree that insecticide treatments should be initiated once you find a psyllid. Continue monitoring the field, and apply follow-up insecticides as needed.

- Some are suggesting a more aggressive approach.

- “Biology and Management of Potato Psyllid in PNW Potatoes” by Schreiber, Rondon, and Jensen
Prior to 2012 Season

Biology and Management of Potato Psyllid in Pacific Northwest Potatoes. Schreiber, Jensen, and Rondon

http://www.nwpotatoresearch.com/IPMStuf f/PDFs/PotatoPsyllid.pdf
<table>
<thead>
<tr>
<th>Trade Name</th>
<th>IRAC Group</th>
<th>Colorado Potato Beetle</th>
<th>Beet Leafhopper</th>
<th>Lepidoptera</th>
<th>Psyllid</th>
<th>Aphids</th>
<th>Thrips</th>
<th>Mites</th>
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<td></td>
<td>x</td>
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<td>x</td>
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<td>(e,n)</td>
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<td>x (e,n)</td>
<td></td>
<td></td>
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<td>x</td>
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Insecticides labeled for potatoes, x denotes effectiveness of the compound in controlling the pest. In the psyllid column e and n represent efficacy on eggs and nymphs respectively.
Methods Efficacy Plots

- USDA ARS Paterson, OSU HAREC Hermiston
- 4 Rows by 25-30 foot plots, 4 reps RCBD
- At plant IF, ST, Foliar, and Chemigation
- Evaluate efficacy with several methods…
Evaluation of Treatments

Vacuum, Leaf samples (10-30 per plot), Sticky cards (0)
<table>
<thead>
<tr>
<th>At Plant</th>
<th>4/17 All Seed trt Maxim 4FS ST</th>
<th>6/22</th>
<th>6/29</th>
<th>7/6</th>
<th>7/13</th>
<th>7/19</th>
<th>7/26</th>
<th>8/3</th>
<th>8/16</th>
<th>Total Psyllid per plot</th>
<th>Total Aphid per plot</th>
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<tr>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>4 a</td>
<td>4.8 a</td>
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<td>Movento</td>
<td>Beleaf</td>
<td>Beleaf</td>
<td>Oberon</td>
<td>Oberon</td>
<td>0 b</td>
<td>1.8 b</td>
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<tr>
<td>Cruiser Max ST</td>
<td>AgriMek</td>
<td>AgriMek</td>
<td>Movento</td>
<td>Movento</td>
<td>Fulfill</td>
<td>Fulfill</td>
<td>Rimon</td>
<td>Rimon</td>
<td>0 b</td>
<td>1.3 b</td>
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<td>AgriMek</td>
<td>Movento</td>
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<td>Fulfill</td>
<td>Fulfill</td>
<td>Rimon</td>
<td>Rimon</td>
<td>0 b</td>
<td>0.8 b</td>
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<td>Torac</td>
<td>Torac</td>
<td>Movento</td>
<td>Movento</td>
<td>Torac</td>
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<td>1 b</td>
<td>0.5 b</td>
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<td>Torac</td>
<td>Torac</td>
<td>Torac</td>
<td>Torac</td>
<td>Torac</td>
<td>0 b</td>
<td>1.8 b</td>
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# Yield and Damage

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<th>6/22</th>
<th>6/29</th>
<th>7/6</th>
<th>7/13</th>
<th>7/19</th>
<th>7/26</th>
<th>8/3</th>
<th>8/16</th>
<th>Yield ton/A</th>
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<td>31.9 a</td>
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<td>Movento</td>
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<td>Beleaf</td>
<td>Oberon</td>
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<td>30.0 a</td>
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<td>Movento</td>
<td>Fulfill</td>
<td>Fulfill</td>
<td>Rimon</td>
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<td>0.9 a</td>
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<td>Movento</td>
<td>Movento</td>
<td>Torac</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>28.8 a</td>
<td>1.0 a</td>
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<td>Torac</td>
<td>Torac</td>
<td>Torac</td>
<td>Torac</td>
<td>Torac</td>
<td>Torac</td>
<td>Torac</td>
<td>29.5 a</td>
<td>1.0 a</td>
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</tbody>
</table>
Summary

- Programs evaluated all worked better than no insecticide under a low pressure situation.
- No differences in yield or necrosis were noted.
- Those tubers exhibiting necrosis were tested, and were negative for ZC as were psyllids collected at the USDA Paterson site in 2012.
Carrot

- Wireworm
- Seedcorn Maggot
- Aphid
- Rust Fly
- Cutworm
- Armyworm
- Leafhopper
- Spider mites
Beet leafhopper *Circulifer tenellus*

- Overwinters as adult females in weedy areas
- Eggs laid in stem of host plants
- May to June first generation begins migrating
- 2-3 generations/yr
- Weed hosts include Russian thistle, kochia, and mustards
Beet leafhopper

- Very common in Columbia Basin
- Vector of Aster yellows, BLTVA.
- Feeding itself causes little damage
- Causes leaf stunting and proliferation of roots

http://potatoes.wsu.edu/survey/PotatoInsectSurvey.html
Leafhopper Identification on Yellow Sticky Traps

Beet Leafhopper Comes in Two Color Forms

Light-colored form of beet leafhopper

Darker form of beet leafhopper

Total length about 1/8”

No dark spots on head. Head rounded in front.

Beet leafhopper, dark form

Sometimes beet leafhoppers on sticky traps may be damaged or missing wings.

Beet leafhopper = *Circulifer tenellus*
Leafhopper Sampling

• Done with yellow sticky cards
• Outside of field
• Non-irrigated weeds
• Low to the ground
Beet leafhopper control

• Doesn’t take long to vector
• Control weeds to help control LH

• Pyrethroids
• Carbaryl
• Admire
• Provado
• Lannate
• Actara
Spider mites

- Two-spotted Spider Mite (*Tetranychus urticae*)
- Can be a problem in all vegetable crops
Spider mites

Mature female

Deutonymph

Egg
Spider mite egg

Predator mite egg

6 legged larva
A female will typically produce over 100 to 200 eggs in her lifetime.

This can vary with temperature, host plant species, host plant quality, relative humidity, exposure to pesticides, etc.
Two-spotted Spider Mite (*Tetranychus urticae*)

- If leafhoppers are treated regularly, and temperatures are hot and dry, you can flare spider mites. Bad news.
- Pyrethroids are often used because they are inexpensive and effective.
- Also, broad spectrum; therefore, the natural enemies that typically keep them (TSSM) in check are eliminated.
• Carefully monitor leafhopper populations and be careful to only treat when necessary to avoid mite flares
• Mite feeding will reduce plant productivity and can cause significant economic loss if outbreaks occur during bulking phase of carrot growth
## 2007 Trial Treatment List

<table>
<thead>
<tr>
<th>COMMON/TRADE NAME</th>
<th>Rate lb ai/A</th>
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<tr>
<td>UTC</td>
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<tr>
<td>JMS Stylet Oil</td>
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<td>propargite/Comite</td>
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<tr>
<td>fenpyroximate/Fujimite</td>
<td>0.15</td>
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<tr>
<td>neem/Champ</td>
<td>1.25 L/A</td>
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<td>bifenthrin/Capture 2EC</td>
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<tr>
<td>etoxazole/Zeal</td>
<td>2 oz./A</td>
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<td>etoxazole/Zeal</td>
<td>3 oz./A</td>
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<td>bifenezate/Acramite</td>
<td>0.75</td>
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<tr>
<td>spiromesifien/ Oberon 2SC</td>
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</table>
Mites vs. Miticide (10 days post treatment)

Treatment: Non-treated, Oberon 2SC, JMS Syet Oil, Comite, Fujimite, Champ, Capture 2EC, Zeal 2 oz., Zeal 3 oz., Acrobat 4SC

Y-axis: Mites/5 Leaves

X-axis: Treatment

The graph compares the number of mites per 5 leaves after various treatments, with a red line indicating the non-treated control.
Summary

• Only treat leafhoppers when necessary
• Avoid using pyrethroids (especially repeatedly) when the weather is hot
• Capture can and will flare mites in carrot
• During hot weather, scout for mites in dry, dusty, or otherwise stressed sections of the fields in order to avoid outbreaks.
Beans

- Aphid
- Armyworm
- Cutworm
- Cucumber Beetle
- Wireworm
- Grasshopper
- Lygus
- Pea Leaf Weevil
- Seedcorn Maggot
- Spider mite
- Stinkbug
The seed corn maggot was identified in North America in 1855. It has been identified in all arable portions of North America from southern Canada into Mexico.
• Seed corn maggot overwinter in the soil as pupae. The adult flies emerge from puparia at night or early in the morning and push themselves up to the soil surface. Adults benefit from a sugar source (flowering weeds/honeydew).
• Seedcorn maggots are pests of various seeds at germination.
• Stand loss and damage is greatest during the cool, (and wet) springs period.
• Decaying plant material attracts the adult flies where the females lay eggs. **
• Seed corn maggot can infest the germinating seeds and roots of over 47 plant species.
• Beans, soybeans, corn and peas are the most seriously damaged hosts.
• To a lesser extent, crucifers, cereals, potato seed pieces, cucurbits, tobacco, onions, pepper, buckwheat, and alfalfa are also injured by this pest.
• Maggots make their way to the sprouting seeds where they bore into, feed on, and often destroy the cotyledons and growing point of the seed of young plants. The eggs hatch readily at temperatures as low as 50° F. Larval and pupal development may continue at temperatures from the mid-50s on up.
A post-seeding drench chemigation with diazinon or a seed treatment with imidacloprid have been the standard controls in Washington State. The grower has been dissatisfied with these treatments.
Materials and Methods 2007:
Carrot Trial: Planted 30 April 2007 near Alderdale, Washington. Seeds were planted by the grower in a RCBD design using a commercial vacuum planter.
The number of carrot seedlings in ten 1 meter segments per plot was counted on 23 May and 8 June 2007 to evaluate efficacy.
## RESULTS 2007 Trial:

<table>
<thead>
<tr>
<th>Treatment/Formulation</th>
<th>Rate or amt/ acre</th>
<th>Seedlings per meter +/- SE</th>
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<tr>
<td></td>
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<tr>
<td>Entrust 50 g. AI/ acre</td>
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<td>61.6 +/- 2.4a</td>
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<tr>
<td>Diazinon 3 pints/ acre</td>
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<td>60.3 +/- 2.8a</td>
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<tr>
<td>Untreated Check NA</td>
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<td>50.5 +/- 3.9b</td>
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Carrot seed stand establishment with different treatments. Means within columns not followed by the same letter are significantly different from one another. (Fisher’s PLSD, $P<0.05$).
Entrust (spinosad) Seed Treatments
Onion: Mercer Canyons 2008

Stand per Meter

27 DAP

40 DAP
Entrust (spinosad) Seed Treatment Dry Bean Mattawa 2009

Plants/meter

Jul-1-2009, 12 DAP
Jul-7-2009, 18 DAP
Maggot Summary

- Diazinon and Lorsban can be effective at controlling SCM where labeled.
- Seed treatments (Cruiser and Entrust) are probably the best control.
- Double Crop Fields, high organic matter, near rivers tend to be most susceptible.
- Slower germination allows pest to attack.
- Pay attention to field history
Sweet Corn

- Wireworm
- Seedcorn maggot
- Corn earworm
- Aphid
- Armyworm

- Corn Rootworm
- Spider Mites
- Thrips
- Cutworm
Corn Earworm *Helicoverpa zea*

- Adult vary a bit in size and color
- Photos OSU Ken Gray Collection
Corn Earworm *Helicoverpa zea*

- Overwinter as pupa in soil
- Adults emerge in June
- Moths active in evening and night
- Corn silk is preferred for egg laying
- Eggs hatch in 5-7 days
Corn Earworm *Helicoverpa zea*

- Larva feed for 2-3 weeks
- Then they pupate in soil
- 2 weeks later adults emerge
- 2-3 generations/year
Corn Earworm *Helicoverpa zea*

- Begin sampling prior to first silk
- Begin control when eggs start hatching
- Early plantings may escape heavy pressure
- Some varieties are less susceptible (tight husks)
- Pheremone or inverted cone traps
  - Threshold?? 5-10 moths/trap/night
Corn Earworm *Helicoverpa zea*

- Control
- Pyrethroids
  - Capture, Bathroid, Asana, Warrior, Pounce, Mustang
- Others
  - Lannate, Gemstar, Belt Radiant, Lorsban, Sevin
- Clothespins
- Start at or a few days prior to first silk
Hartstack corn earworm pheromone trap
[ Picture by R. Foster ]
Disclaimer

• Not all compounds tested are currently registered for use on Onions in Washington State.
• Do not use unregistered compounds
• Consult your local Extension office and read and follow label directions.
• Oregon and Washington labels (PICOL): http://cru66.cahe.wsu.edu/LabelTolerance.html
Tim Waters  
Regional Vegetable Specialist,  
Washington State University  
404 W. Clark Ave.  
Pasco, WA 99301  
509 545-3511 Phone  
509 545-2130 Fax  
twaters@wsu.edu

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