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

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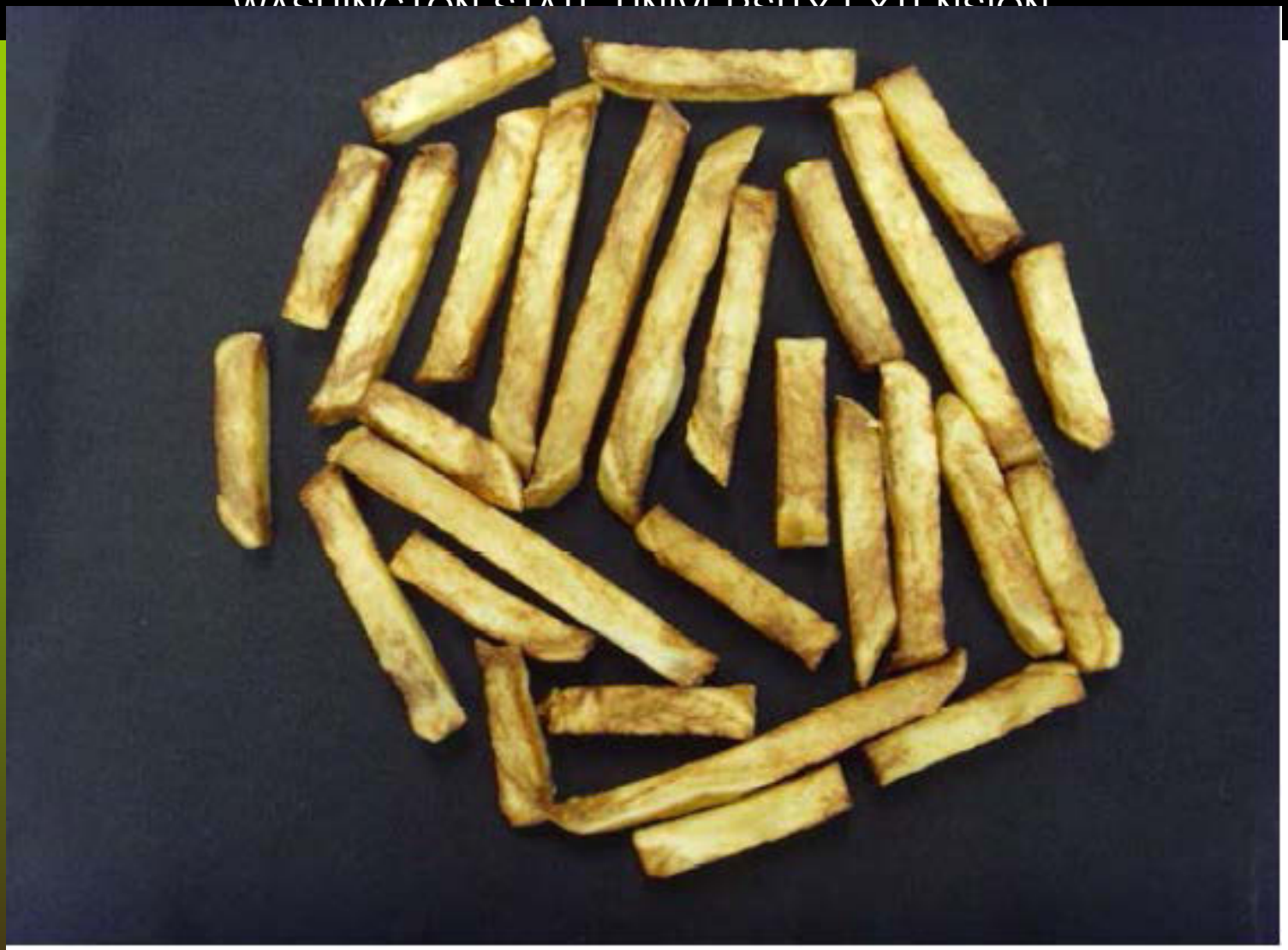
2013 CBCCA Short Course
January 16, 2013

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, Guatamala, Honduras, Nicaragua, and New Zealand.
- First documented to occur in WA, OR, and ID in 2011.

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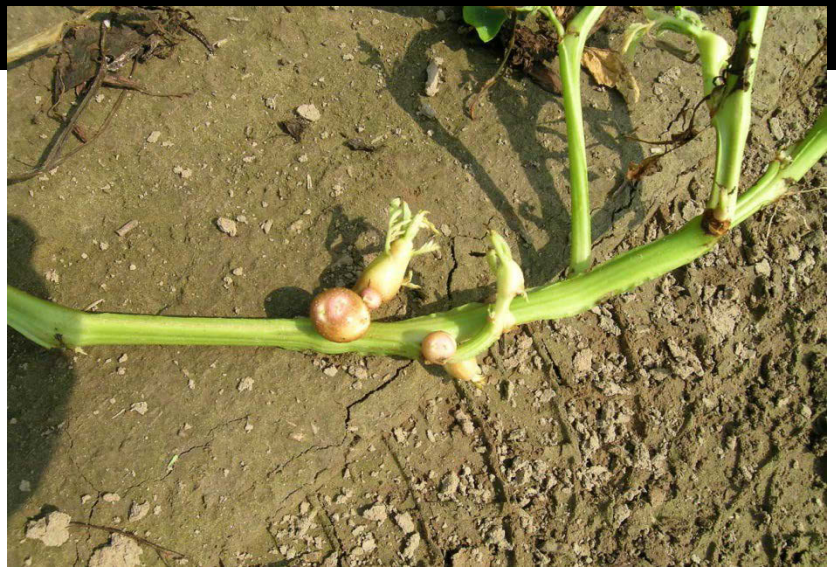

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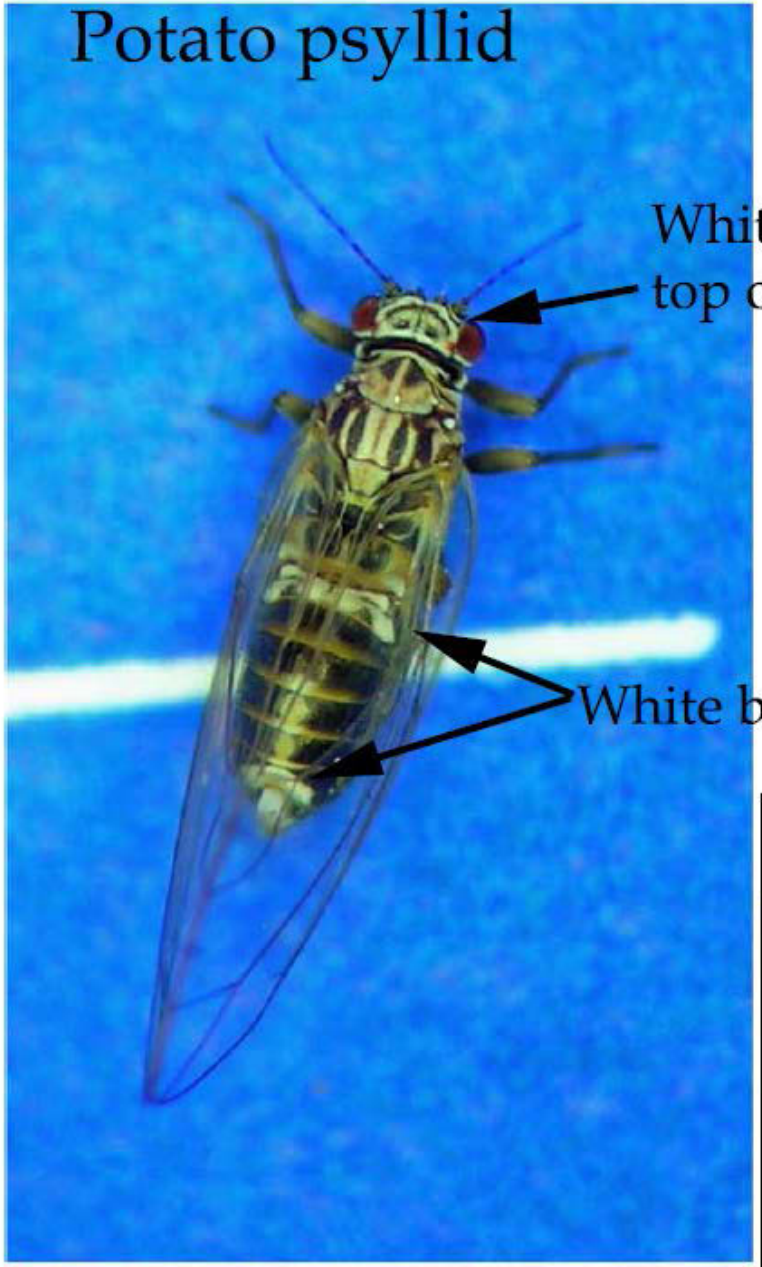
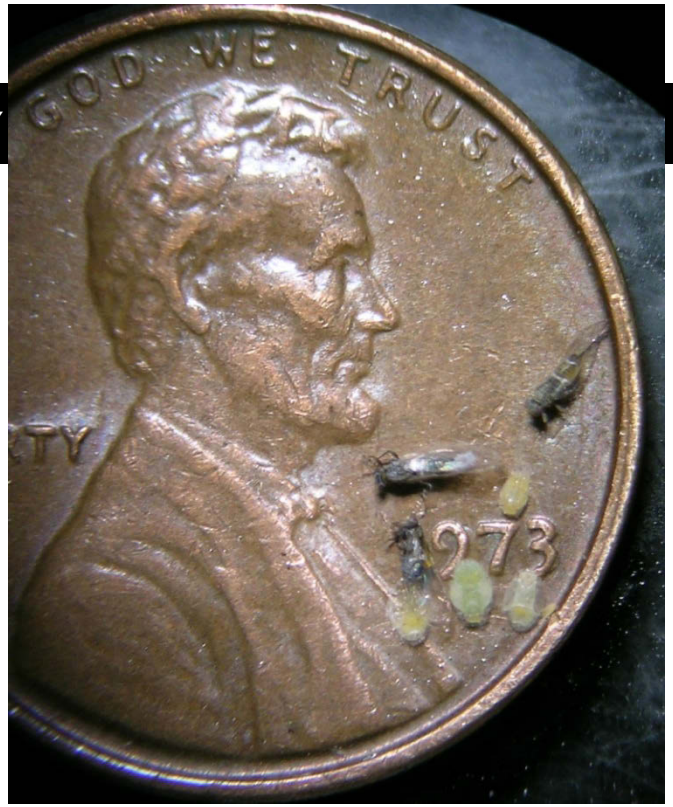


Other psyllids

Colored wings


GOD WE TRUST
1973

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?


Wenatchee
Soap Lake
Ephrata
Odessa
Quincy
Moses Lake North
395
90
Moses Lake
Warden
Lind
Royal City
Othello
Mattawa
Connell
Gap
12
Sunnyside
Richland
Benton City
Grandview
82
West Pasco
Kennewick
Prosser
Finley
Highland
Walla Walla
College Place
Irrigon
395
Boardman
Hermiston
Milton-Freewater
Athena


STIHL

Washington Sentinel Plot Results

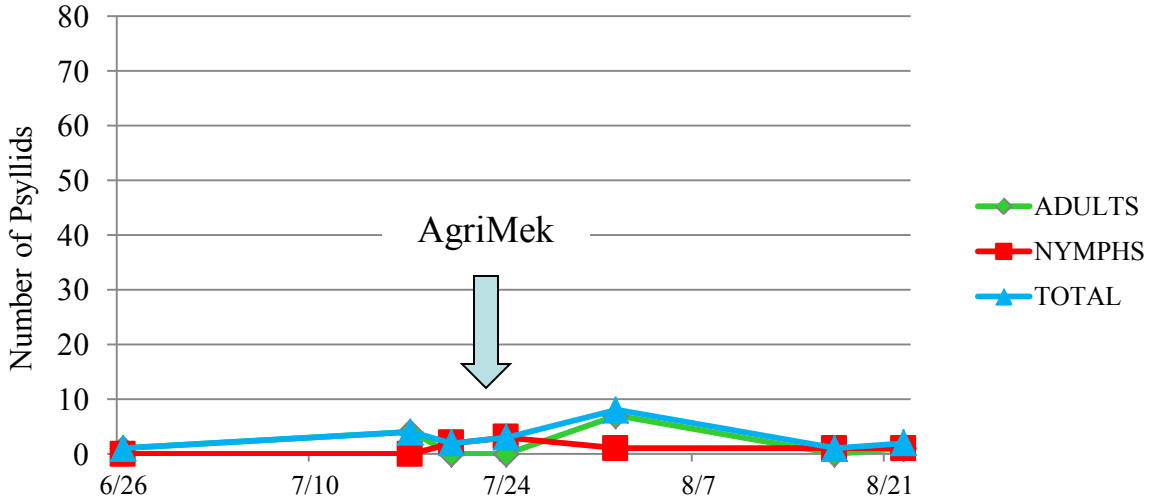
- 6/11/12 1 adult - Irrigon, OR
- 6/12/12 1 adult - Hermiston, OR

- 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

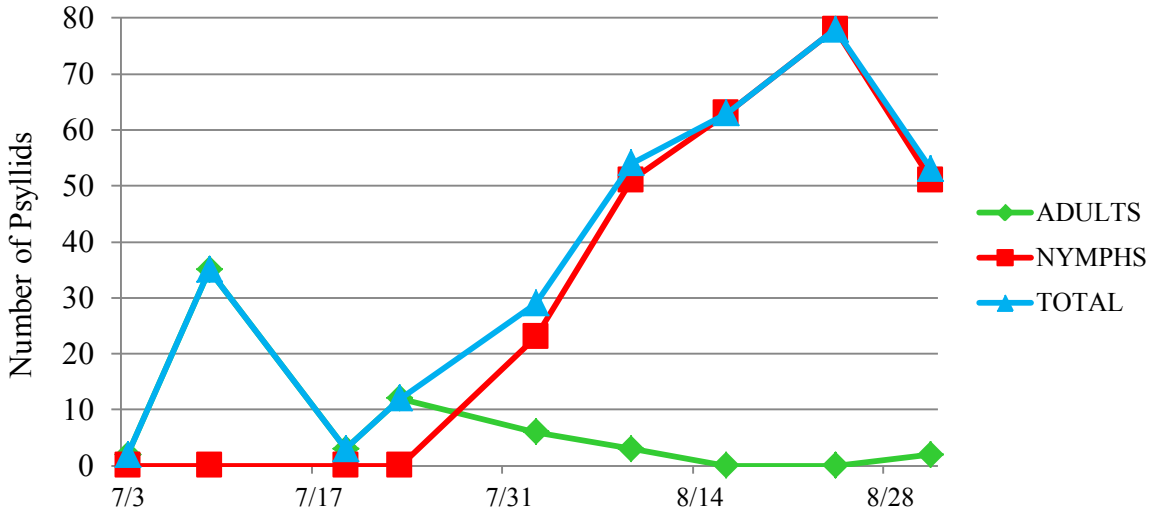
- 7/3/12 6 nymphs - Prosser Sentinel
- 7/30/12 2 nymphs - Paterson Sentinel
- 8/3/12 23 nymphs - Pasco Sentinel
- 9/4/12 2 nymphs - Othello Sentinel

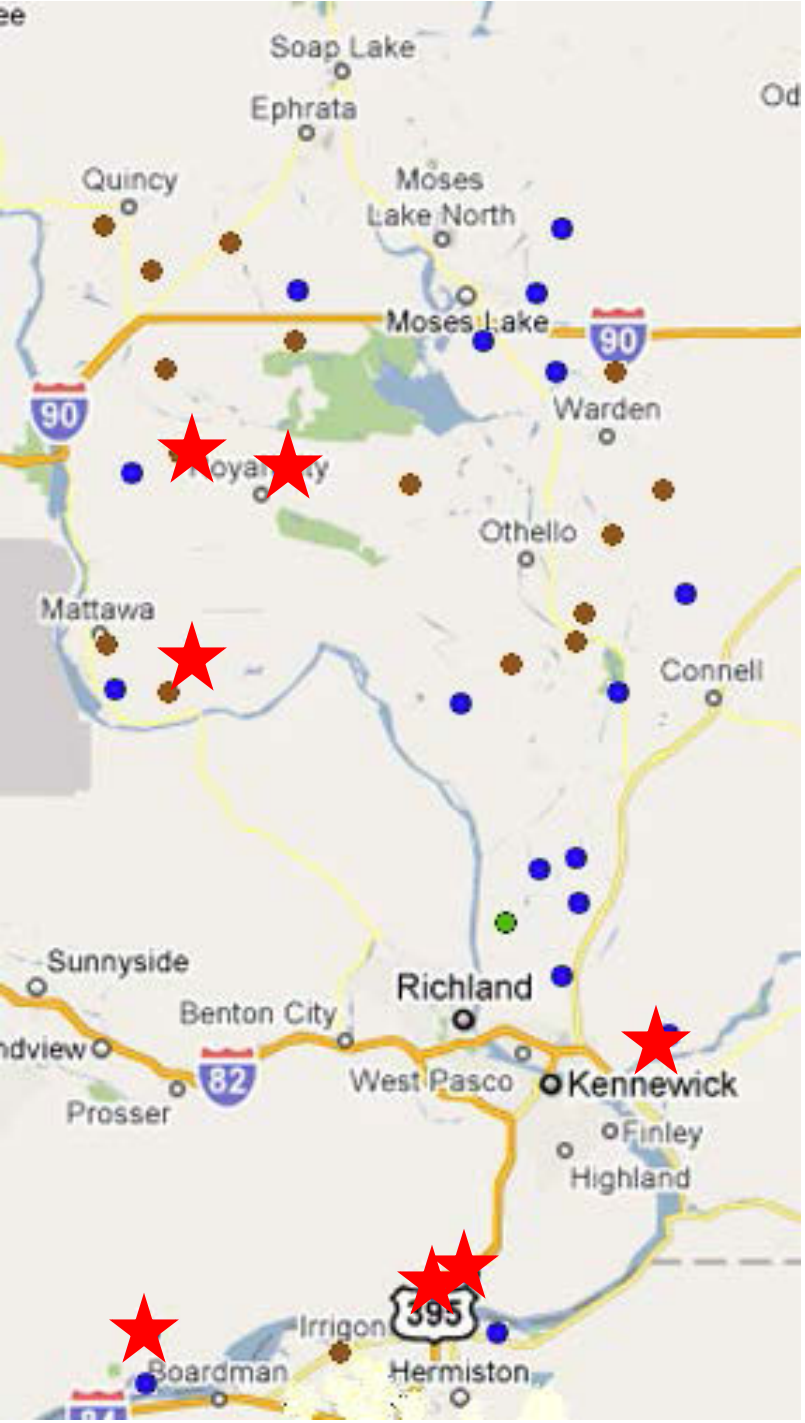
- All tested negative for Lso.

Paterson Sentinel Plot: 2012 Sampling Data



Pasco Sentinel Plot: 2012 Sampling Data

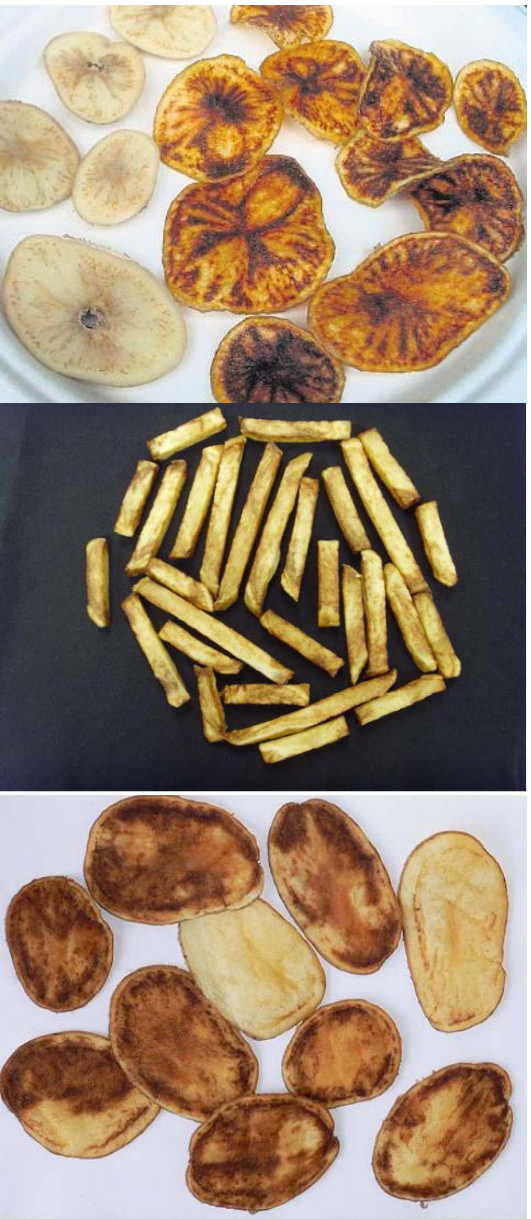




Potato Psyllid Trapping Results with Sticky Cards in 2012

- 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/IPMStuff/PDFs/PotatoPsyllid.pdf

Trade Name	IRAC Group	Colorado Potato Beetle	Beet Leafhopper	Lepidoptera	Psyllid	Aphids	Thrips	Mites
Lannate	1a			x		x	x	
Pyrethroids	3	x	x	x	x			
Actara	4a	x	x		x	x		
Admire	4a	x	x		x	x		
Assail	4a	x	x		x	x		
Belay	4a	x	x		x	x		
Cruiser	4a	x	x		x	x		
Gaucho	4a	x	x		x	x		
Platinum	4a	x	x		x	x		
Provado	4a	x	x		x	x		
Venom	4a		x		x	x		
Radiant	5	x		x	x (n)		x	
Agri-Mek	6			x	x		x	x
Fulfil	9b				x	x		
Beleaf	9c				x	x		
Rimon	15	x		x	x (e,n)			
Movento	23				x (e,n)	x	x	
Oberon	23				x (e,n)			x

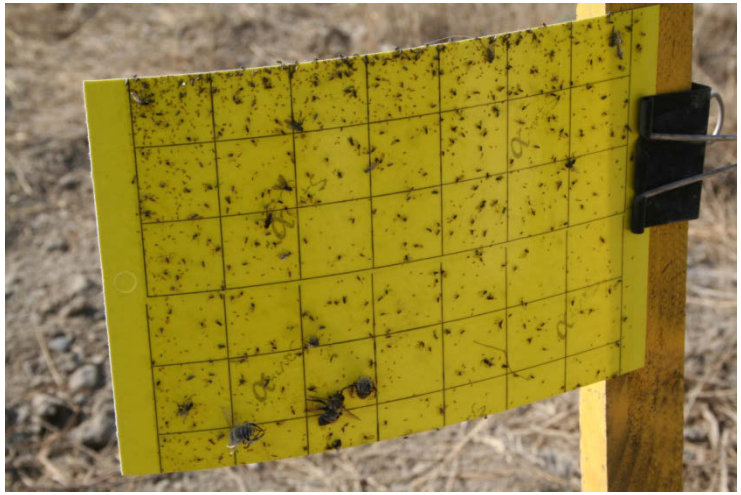
Insecticides labeled for potatoes, x denotes effectiveness of the compound in controlling the pest. In the psyllid column e and n represent efficacy on eggs and nymphs respectively.

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)



At Plant 4/17 All Seed trt Maxim 4FS ST	6/22 6/13 Aphids detected	6/29	7/6	7/13	7/19 7/25 Juv. Psyllid detected	7/26	8/3	8/16	Total Psyllid per plot	Total Aphid per plot
Check	-	-	-	-	-	-	-	-	4 a	4.8 a
Platinum IF	Fulfill	Fulfill	Movento	Movento	Beleaf	Beleaf	Oberon	Oberon	0 b	1.8 b
Cruiser Max ST	AgriMek	AgriMek	Movento	Movento	Fulfill	Fulfill	Rimon	Rimon	0 b	1.3 b
Platinum IF	AgriMek	AgriMek	Movento	Movento	Fulfill	Fulfill	Rimon	Rimon	0 b	0.8 b
Admire Pro IF	Torac	Torac	Movento	Movento	Torac				1 b	0.5 b
Admire Pro IF	Torac	Torac	Torac	Torac	Torac	Torac	Torac	Torac	0 b	1.8 b

Yield and Damage

At Plant 4/17 All Seed trt Maxim 4FS ST	6/22	6/29	7/6	7/13	7/19	7/26	8/3	8/16	Yield ton/A	Necrosis 0-4
Check	-	-	-	-	-	-	-	-	31.9 a	1.6 a
Platinum IF	Fulfill	Fulfill	Movento	Movento	Beleaf	Beleaf	Oberon	Oberon	30.0 a	1.2 a
Cruiser Max ST	AgriMek	AgriMek	Movento	Movento	Fulfill	Fulfill	Rimon	Rimon	31.2 a	0.9 a
Platinum IF	AgriMek	AgriMek	Movento	Movento	Fulfill	Fulfill	Rimon	Rimon	31.4 a	1.0 a
Admire Pro IF	Torac	Torac	Movento	Movento	Torac				28.8 a	1.0 a
Admire Pro IF	Torac	Torac	Torac	Torac	Torac	Torac	Torac	Torac	29.5 a	1.0 a

Summary

- Programs evaluated all worked better than no insecticide under a low pressure situation.
- No differences in yield o necrosis were noted
- Those tubers exhibiting necrosis were tested, ar were negative for ZC as were psyllids collected a 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

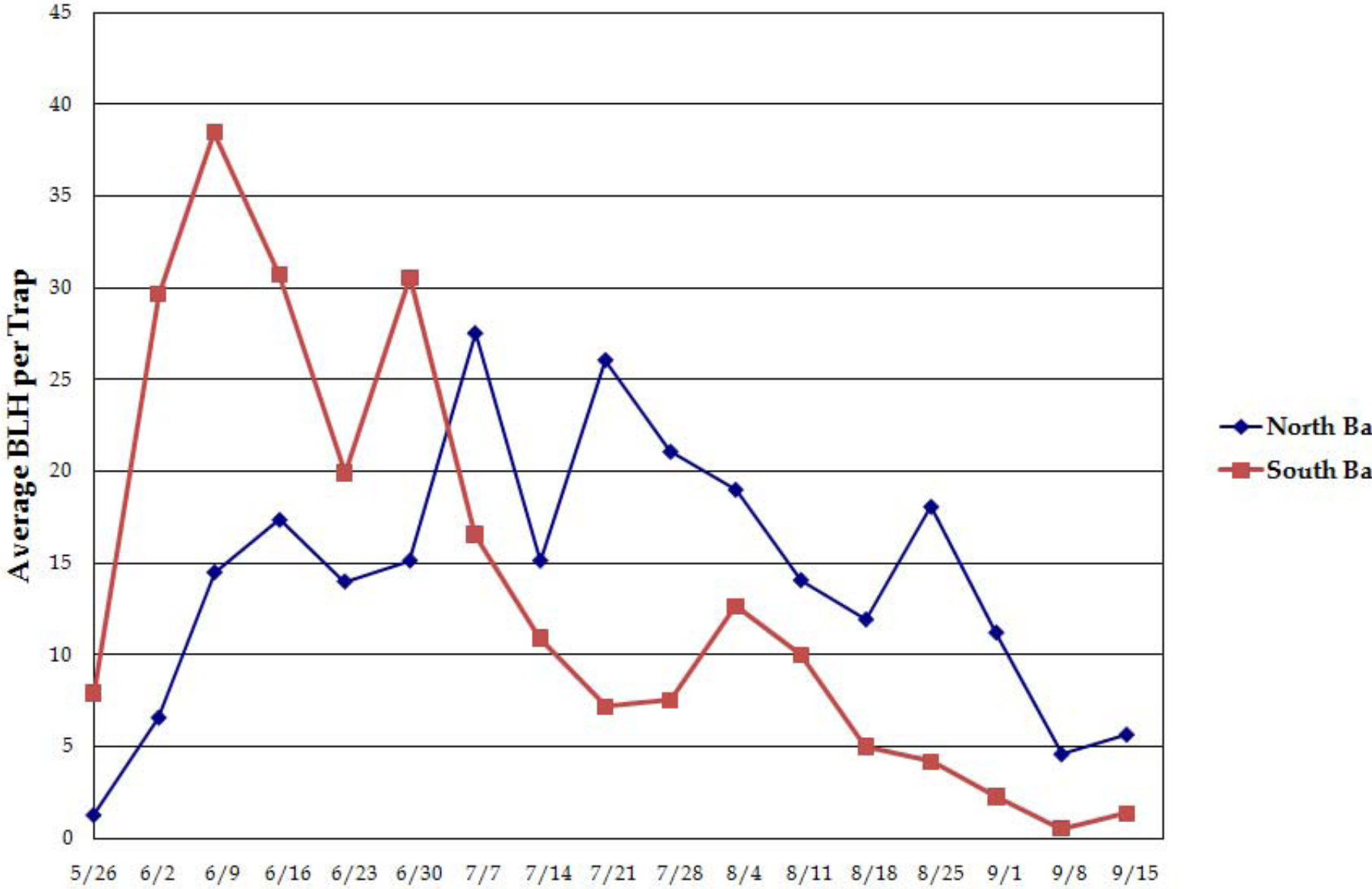
Sometimes beet leafhoppers on sticky traps may be damaged or missing wings.

Beet leafhopper = *Circulifer tenellus*

Leafhopper Sampling

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

2009 Beet Leafhopper Data - Columbia Basin, WA



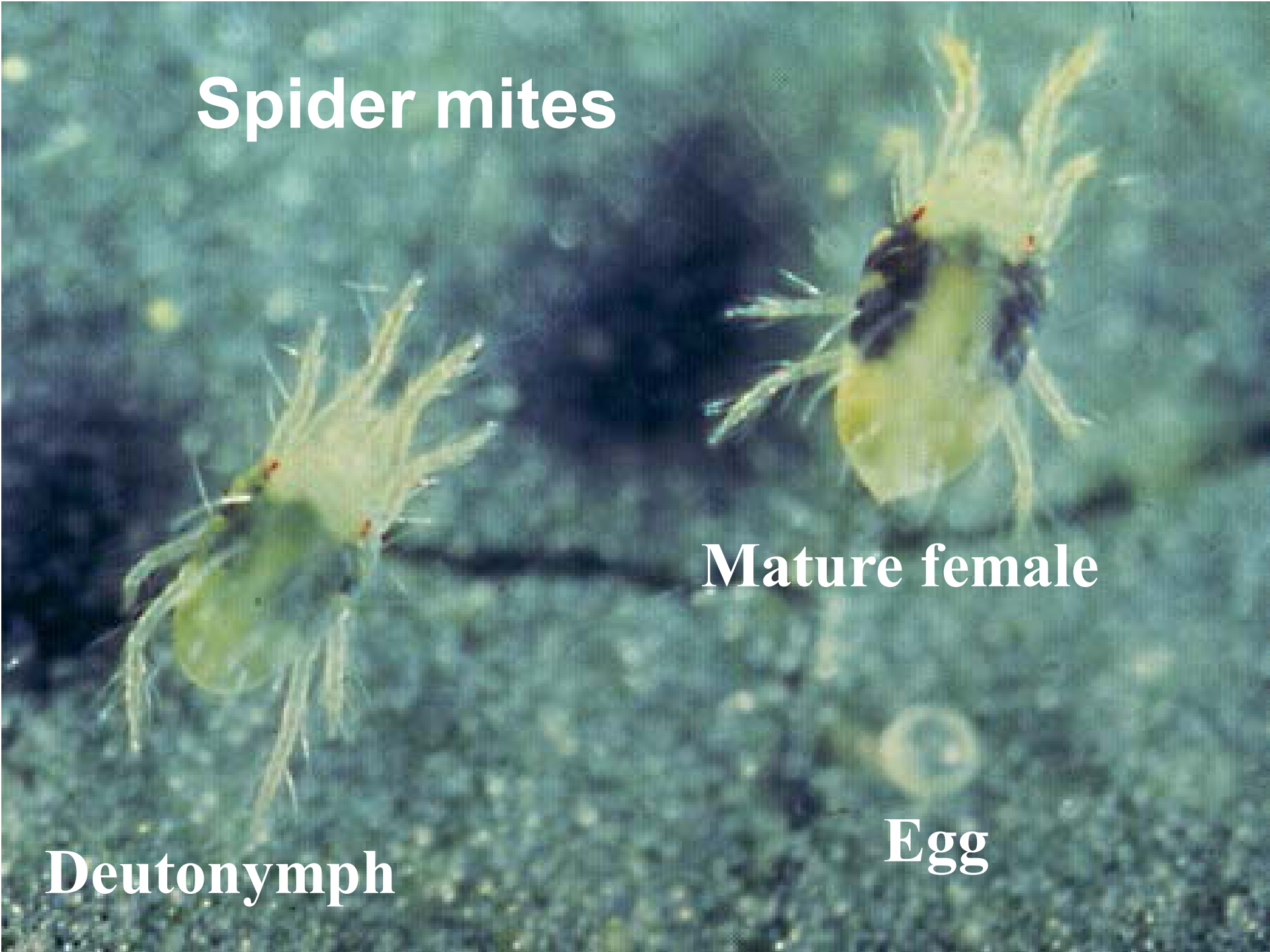
Beet leafhopper control

- 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
Egg
Deutonymph

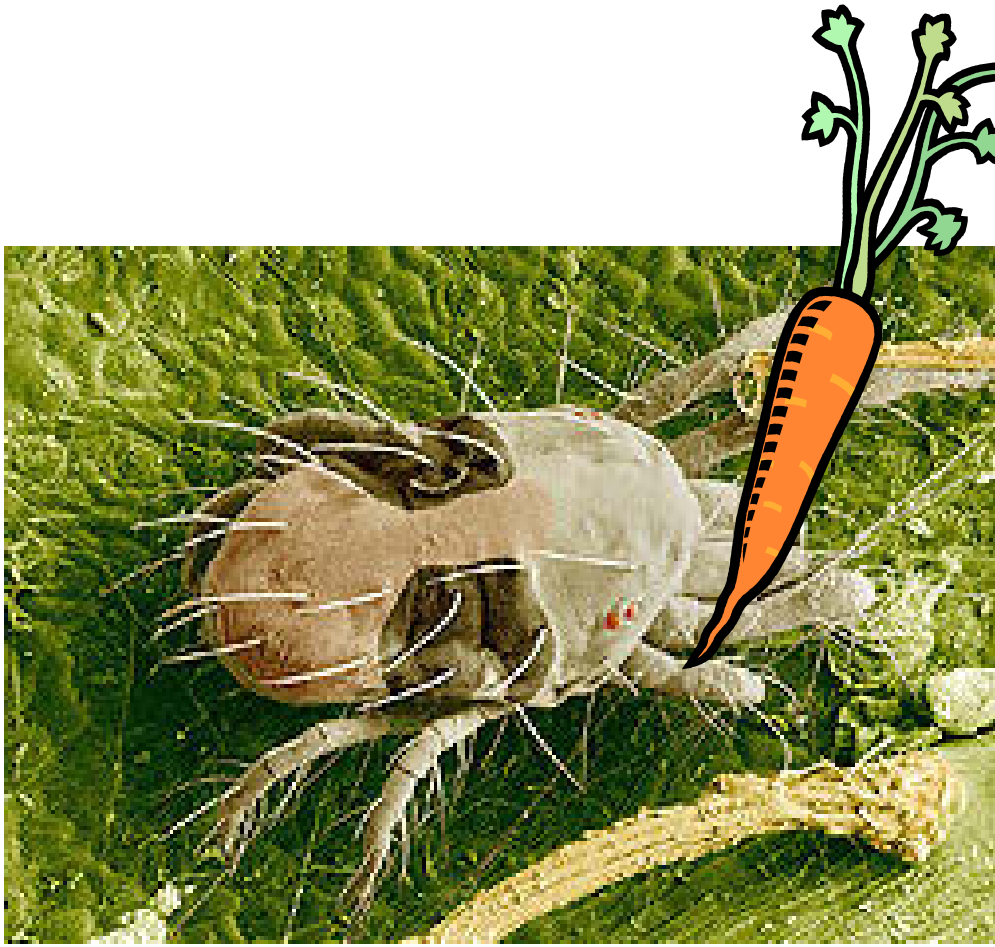

Predator mite egg
Spider
mite egg
6 legged
larva


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*)

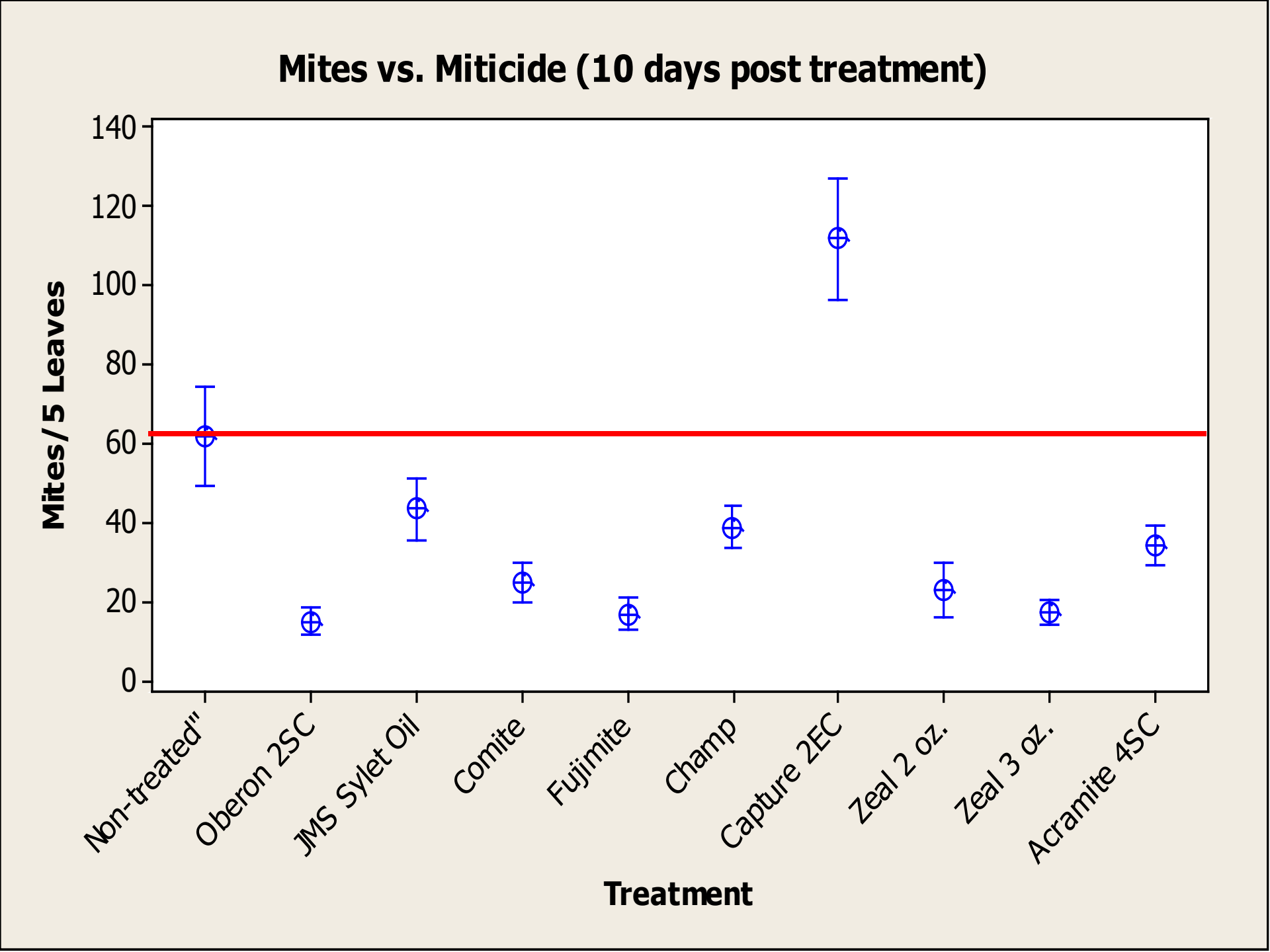
- If leafhoppers are treated regularly, and temperatures are hot and dry, you can flare spider mites. Bad news.
- Pyrethroids are often used because they are inexpensive and effective
- Also, broad spectrum; therefore, the natural enemies that typically keep them (TSSM) in check are eliminated.

- 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

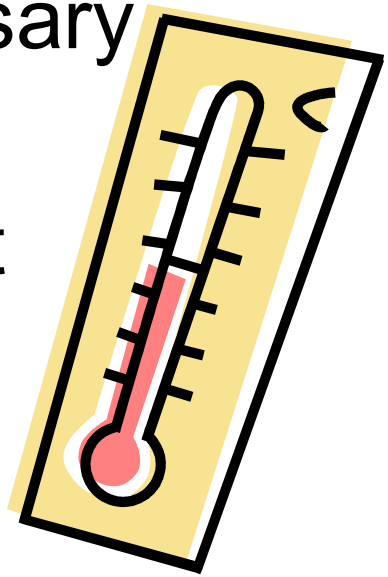
COMMON/TRADE NAME	**Rate lb ai/A**
UTC	------
JMS Stylet Oil	2% sol.
propargite/Comite	1.00
fenpyroximate/Fujimite	0.15
neem/Champ	1.25 L/A
bifenthrin/Capture 2EC	0.1
etoxazole/Zeal	2 oz./A
etoxazole/Zeal	3 oz./A
bifenezate/Acramite	0.75
spiromesifen/ Oberon 2SC	0.25


Mites vs. Miticide (10 days post treatment)
Mites/5 Leaves
140
120
100
80
60
40
20
0
Non-treated"
Oberon 2SC
JMS Sylet Oil
Comite
Fujimite
Champ
Capture 2EC
Zeal 2 oz.
Zeal 3 oz.
Acramite 4SC
Treatment

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

Biology

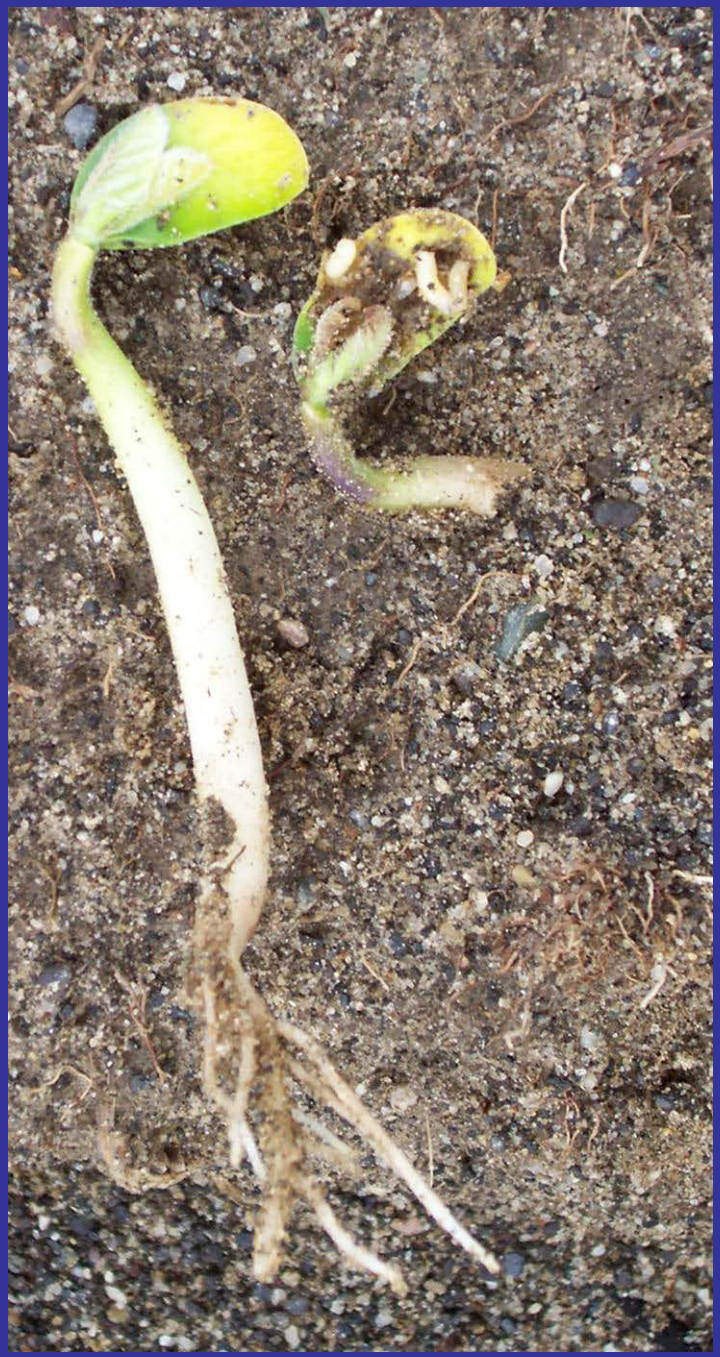
Seed corn maggot, *Delia platura* (Diptera: Anthomyiidae)

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. **

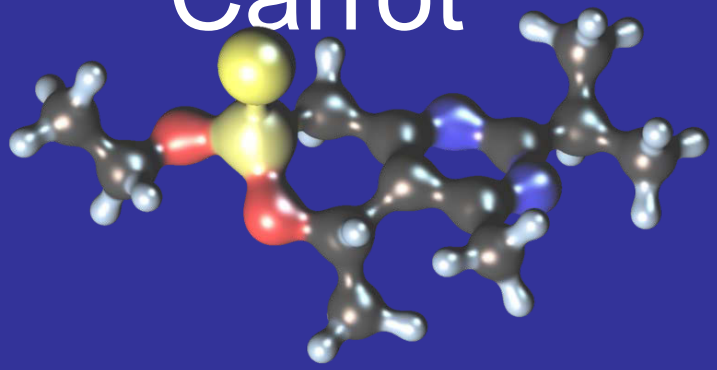
- **Seed corn maggot can infest the germinating seeds and roots of over 47 plant species.**
- **Beans, soybeans, corn and peas are the most seriously damaged hosts.**
- **To a lesser extent, crucifers, cereals, potato seed pieces, cucurbits, tobacco, onions, pepper, buckwheat, and alfalfa are also injured by this pest.**



Damage

- 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.

Maggot Control Carrot

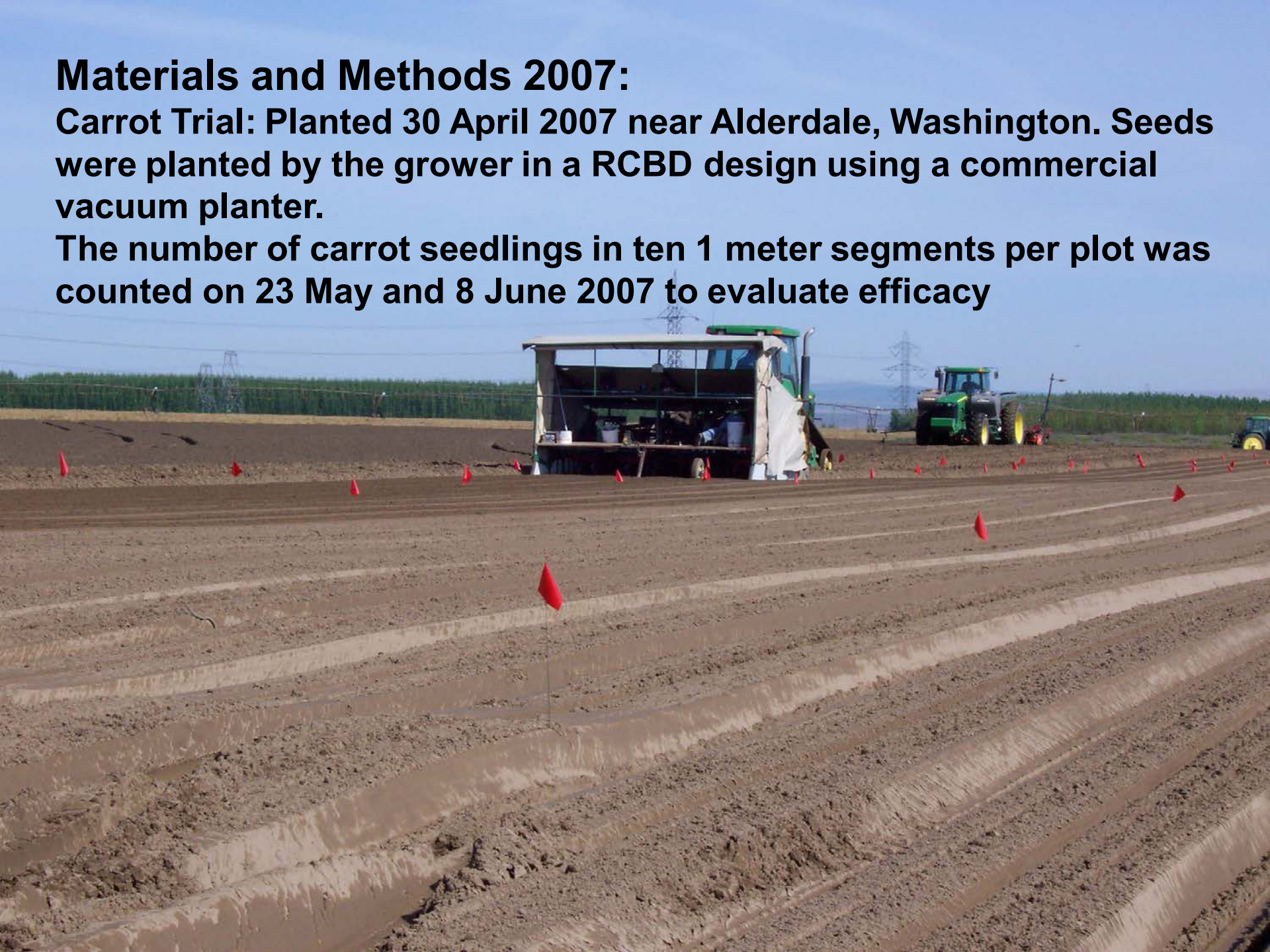


A post-seeding drench chemigation with diazinon or a seed treatment with imidacloprid have been the standard controls in Washington State. The grower has been dissatisfied with these treatments.

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

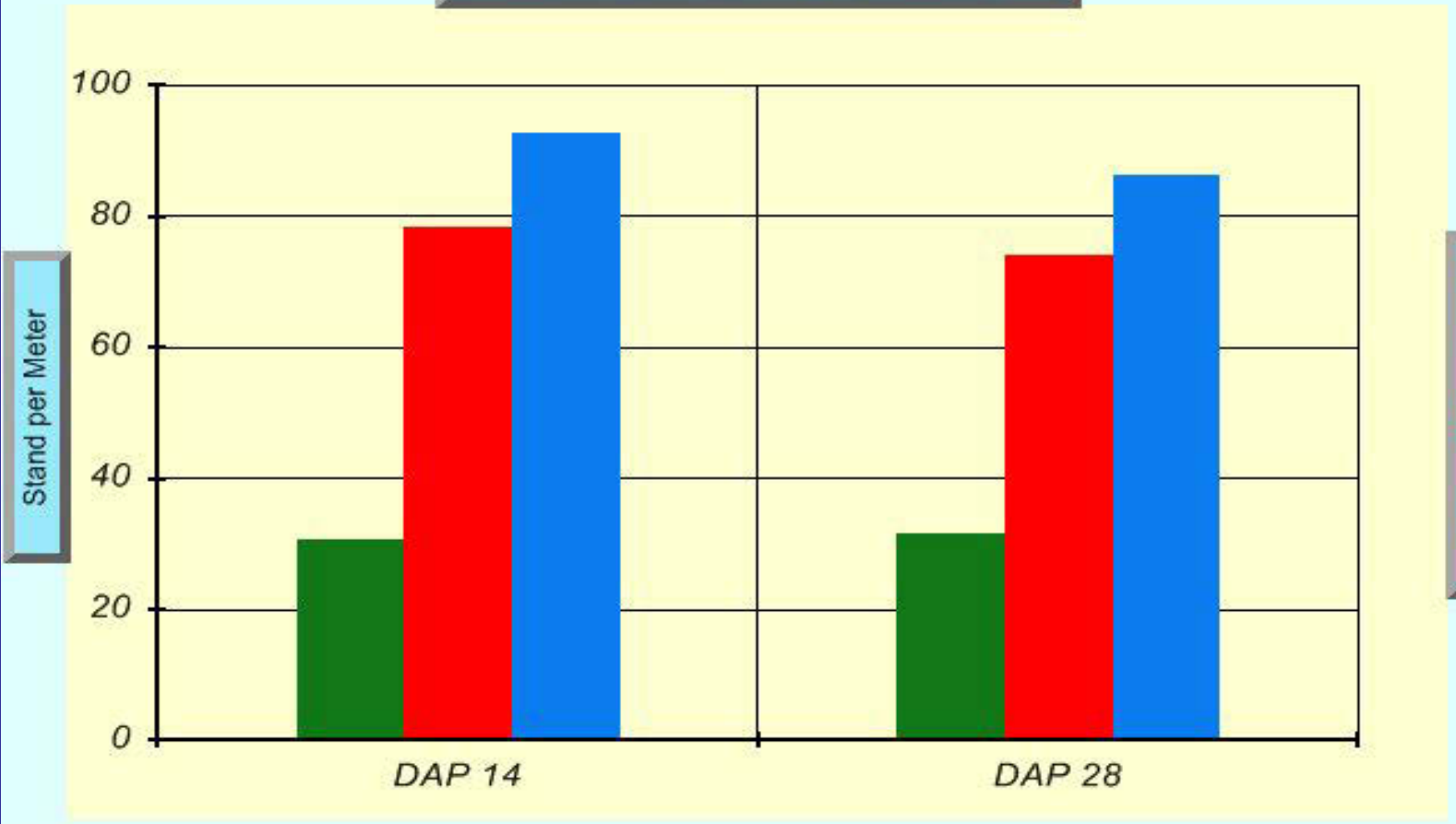


RESULTS 2007 Trial :

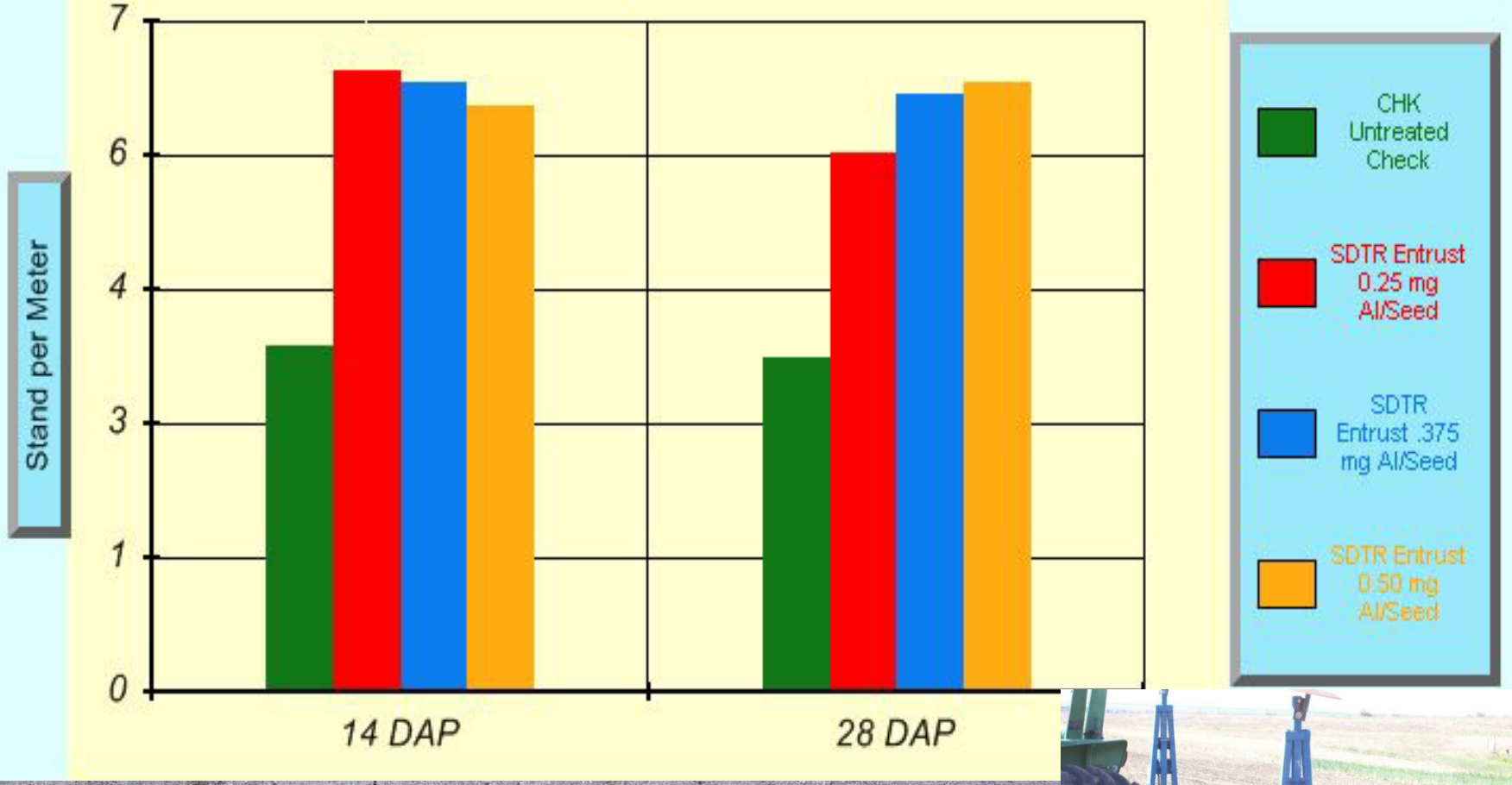
Treatment/ Formulation	Rate or amt/ acre	Seedlings per meter +/- SE	
		24 May	8 June
Entrust	50 g. AI/ acre	61.6 +/- 2.4a	63.3 +/- 1.6a
Diazinon	3 pints/ acre	60.3 +/- 2.8a	65.6 +/- 1.6a
Untreated Check	NA	50.5 +/- 3.9b	50.0 +/- 2.4b

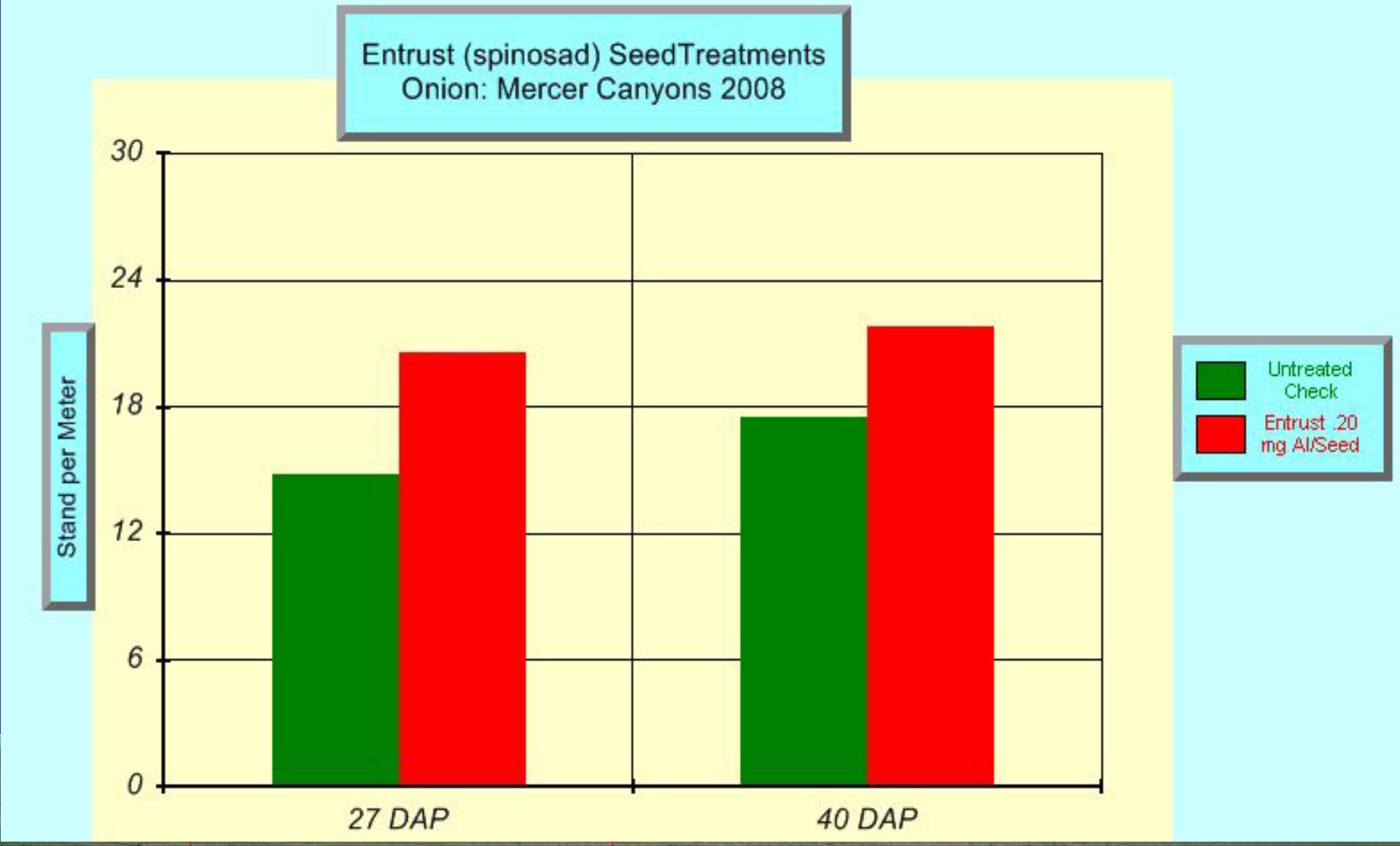
Carrot seed stand establishment with different treatments. Means within columns not followed by the same letter are significantly different from one another. (Fisher's PLSD, $P<0.05$).

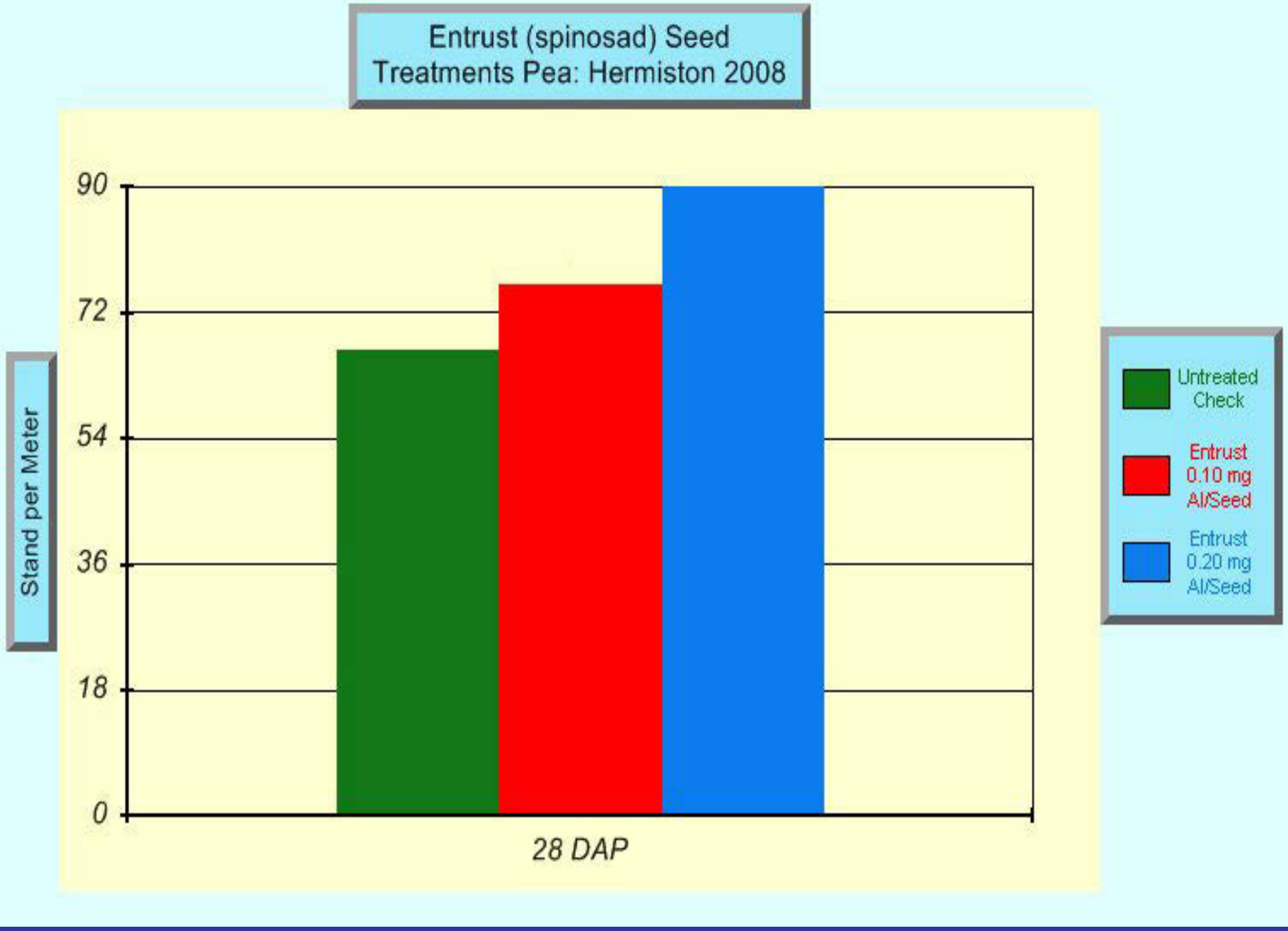
Entrust (spinosad) Seed Treatments
Carrot: Sandpiper Farms 2008

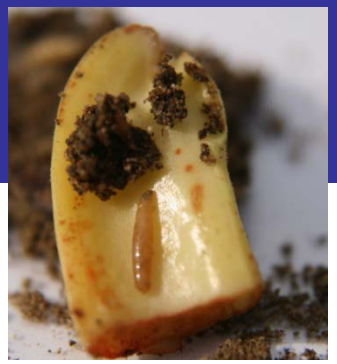


Entrust (spinosad) Seed Treatments
Sweet Corn: Paterson, WA 2008

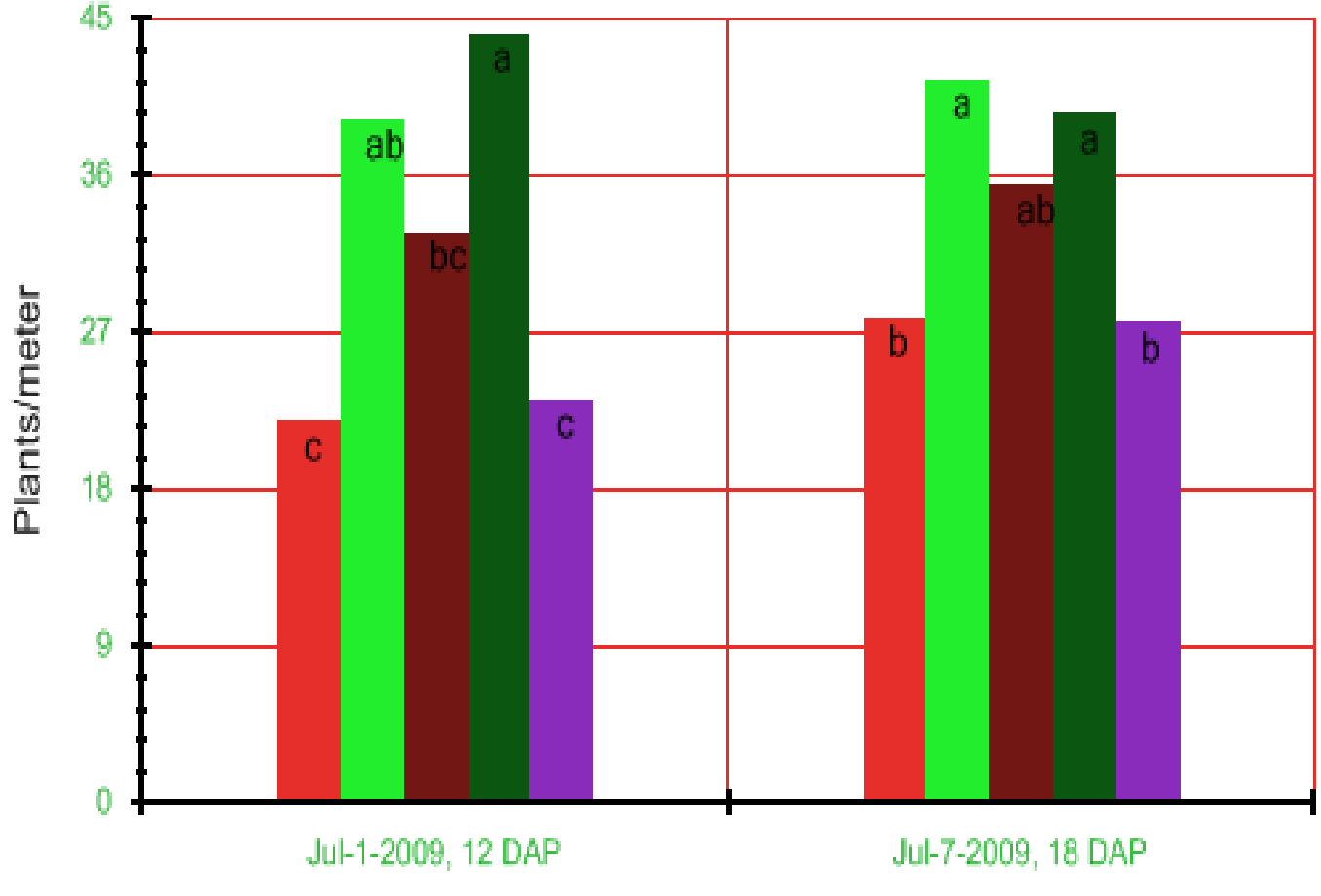



Entrust (spinosad) SeedTreatments
Onion: Mercer Canyons 2008
Stand per Meter
30
24
18
12
6
0
27 DAP
40 DAP
Untreated Check
Entrust .20 mg AI/Seed


Entrust (spinosad) Seed Treatments Pea: Hermiston 2008
Stand per Meter
90
72
54
36
18
0
28 DAP
Untreated Check
Entrust 0.10 mg AI/Seed
Entrust 0.20 mg AI/Seed



Entrust (spinosad) Seed Treatment Dry Bean Mattawa 2009



Untreated Check

Entrust .5 mg AI/Seed

Cruiser 5FS 50 g AE/100 kg

Cruiser 5FS 50 g AE/100 kg
Entrust 0.5 mg AI/Seed
Cruiser 5FS 0.5 mg AI/Seed
Mefenoxam
Captan
Thiram

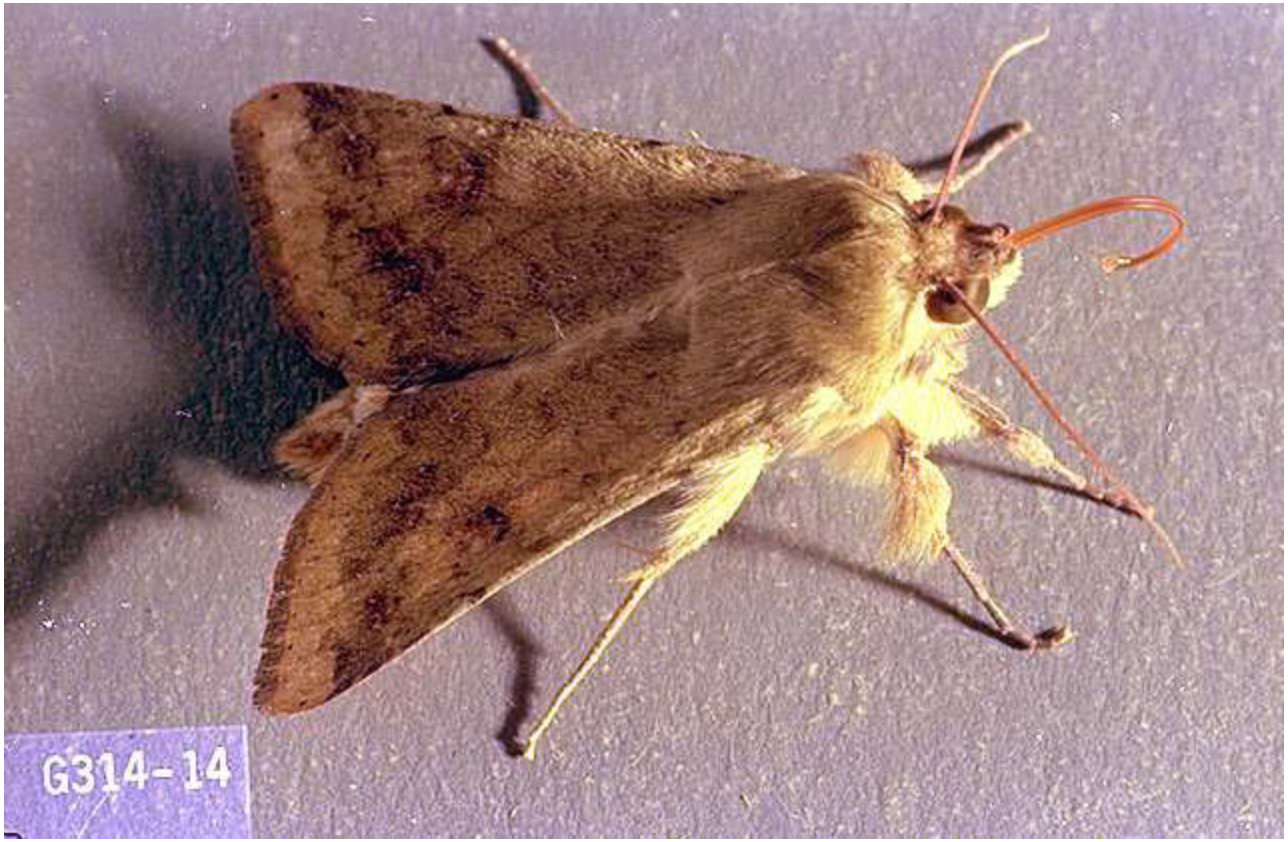
Maggot Summary

- 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 succeptible (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

Pheromone trap

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

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