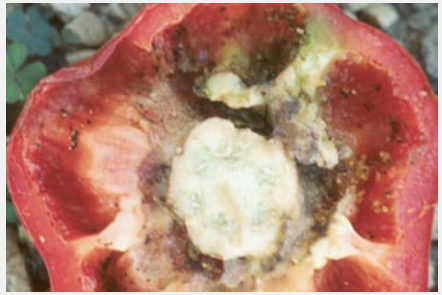
Vegetable Insecticide Update

Celeste Welty
Extension Entomologist
January 2017

THE OHIO STATE UNIVERSITY

Topics

- **Insecticides**
  - New products
  - New uses
  - Cancelled products
- **Pests of concern**
- **Results of recent trials**
- **Information resources**

New product, 2017: **Trident**

- **Biological insecticide**
- **B.t.t. = *Bacillus thuringiensis tenebrionis***
- **Colorado potato beetle, larvae only**
  - **Most effective on 1st instar larvae**
  - **Apply when eggs hatching**
  - **Must be ingested by beetles**
  - **Good coverage needed**

- **a.i. same as ‘M-One’ & ‘Novodor’**
- **Made by Certis**

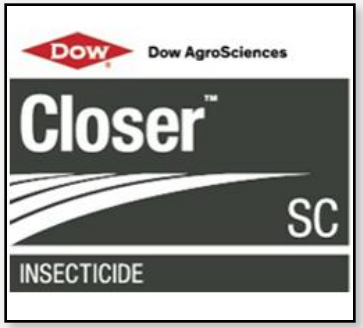
New product, 2016: **BeetleGONE!**

- **Biological insecticide**
- **B.t.g. = *Bacillus thuringiensis galleriae***
- **Targets adults (!) & larvae:**
  - **Japanese beetle**
  - **Asiatic garden beetle**
  - **Pepper weevil**
- **Must be ingested**
- **Cease feeding within hours**
- **Good coverage needed**
- **Made by Phyllom BioProducts**

Coming soon? **Spear**

- **Biological insecticide**
- **Registered: Spear T**
  - **For greenhouse use only**
  - **For thrips control**
- **Not yet registered:**
  - **Spear O**
  - **Spear C**
  - **Spear P**
- **Thrips, caterpillars, beetles, weevils**
- **By Vestaron Corp.**

Closer & Transform



- **Re-established October 2016**
  - registered May 2013
  - suspended Sept. 2015
  - cancelled November 2015
- **A.I.: sulfoxaflor (‘`Isoclast`’)**
- **IRAC group 4C:**
  - **‘cousins’ of neonicotinoids (4A)**
  - **different subgroup than Admire**

sulfoxaflor

Product	Crop	Pest
Closer	brassica leafy veg, ~~cucurbits,~~ fruiting veg, leafy veg, leaves of root/tuber crops	plant bugs aphids leafhoppers whiteflies
Transform	potato root/tuber (radish, beet, carrot) beans (succulent)	plant bugs aphids leafhoppers whiteflies

New uses

- **Agri-Mek SC**
  - **Green onions, for thrips control**
    - **7-day PHI**
    - **On supplemental label**
- **Portal XLO**
  - **Potato, beans, cucumbers**
    - **On main label**
    - **No longer on supplemental label**

Products re-named

- Portal XLO
  - Replaced Portal 0.4EC
  - Same rates
- Sivanto Prime
  - New September 2016
  - Replaced Sivanto 200SL
    - New January 2015
  - Some new uses added
  - Same rates

Sivanto Prime

- **A.I.: flupyradifurone**
- **IRAC group 4D (butenolides)**
  - **‘cousin’ to neonicotinoids (4A)**
- **Systemic action**
- **Liquid: 1.67 lbs a.i./gal**
- **By Bayer**

Sivanto: target pests

- leafhoppers
- aphids
- whiteflies
- squash bug
- Colorado potato beetle

Sivanto Prime

Crop	PHI (days)	
	foliar	soil
Brassica head & leafy	1	21
Cucurbits	1	21
Fruiting veg.	1	45
Leafy veg.	1	21
Legumes	7	-
Root veg.	7	-
Tuber/corm veg.	7	-

Cancellation: flubendiamide

- **Belt SC, made by Bayer**
- **former Synapse WG, made by Bayer**
- **cancelled August 2016**
- **distributors can sell inventory**
- **growers can use product per label**
  - **sweet corn**
  - **Brassica veg**
  - **cucurbits**
  - **fruiting veg**
  - **leafy veg**
  - **legumes**

Cancellation: Calypso 4F

- thiacloprid
- voluntary cancellation announced by Bayer, Dec. 2013
- state registrations being phased out
- still registered in Ohio for 2017
- growers can use product per label
  - peppers

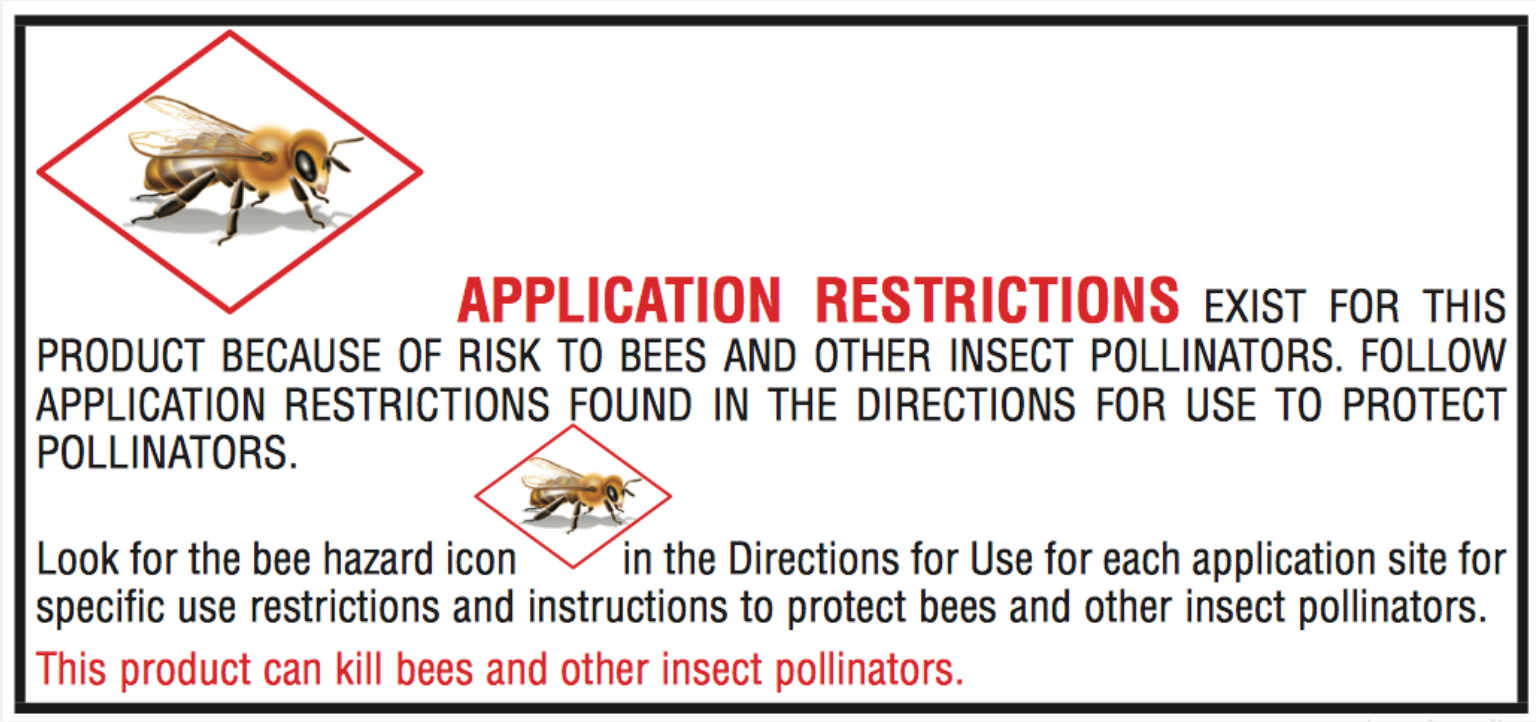
Phase-out of endosulfan (Thionex)

Date for final use	*Crop*
7/31/2012	**cukes, melons, summer squash, eggplant, cabbage+, kale+, lettuce, peach, plum, cherry, strawberry (annual)**
7/31/2013	**pear**
7/31/2015	**pumpkin, winter squash, tomato, pepper, potato, sweet corn, apple, blueberry**
7/31/2016	**strawberry (perennial)**

Deletions from midwest spray guides

- **Courier** (buprofezin)
  - **registered in Ohio but not in most other midwest States**

Pollinator Protection:
new bee advisory box on label



- **Now on labels of neo-nics (Belay, Actara, Admire, Venom) & Exirel**

Pests of current interest

New	**brown marmorated stink bug**
	western bean cutworm
Potential	**Swede midge**
Old	**spider mites**

Brown marmorated stink bug

- **Attacks fruits & seed pods**
- **Invading Ohio since 2007**

Brown marmorated stink bug: injury

corn

pepper

tomato

beans

Monitoring BMSB with traps

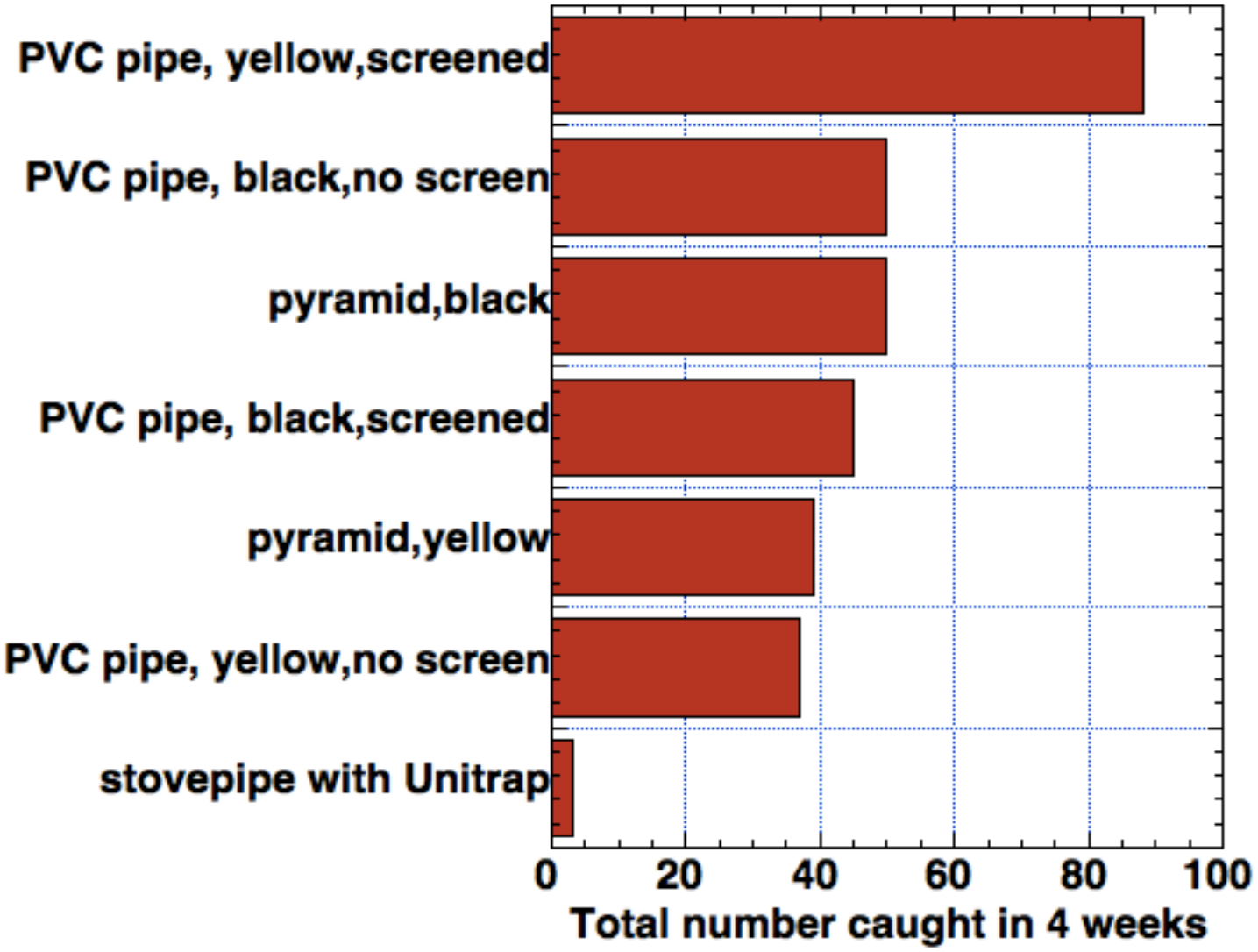
- **Improved lure by USDA-ARS**
- **Double lure for synergy**
  - ARS#20 (10 mg)
  - MDT (66 mg)
- **Available from several companies**
  - AgBio
  - Alpha Scents
  - Rescue
  - Trécé
  - Scentry
  - Bedoukian

Pyramids: black *vs* yellow

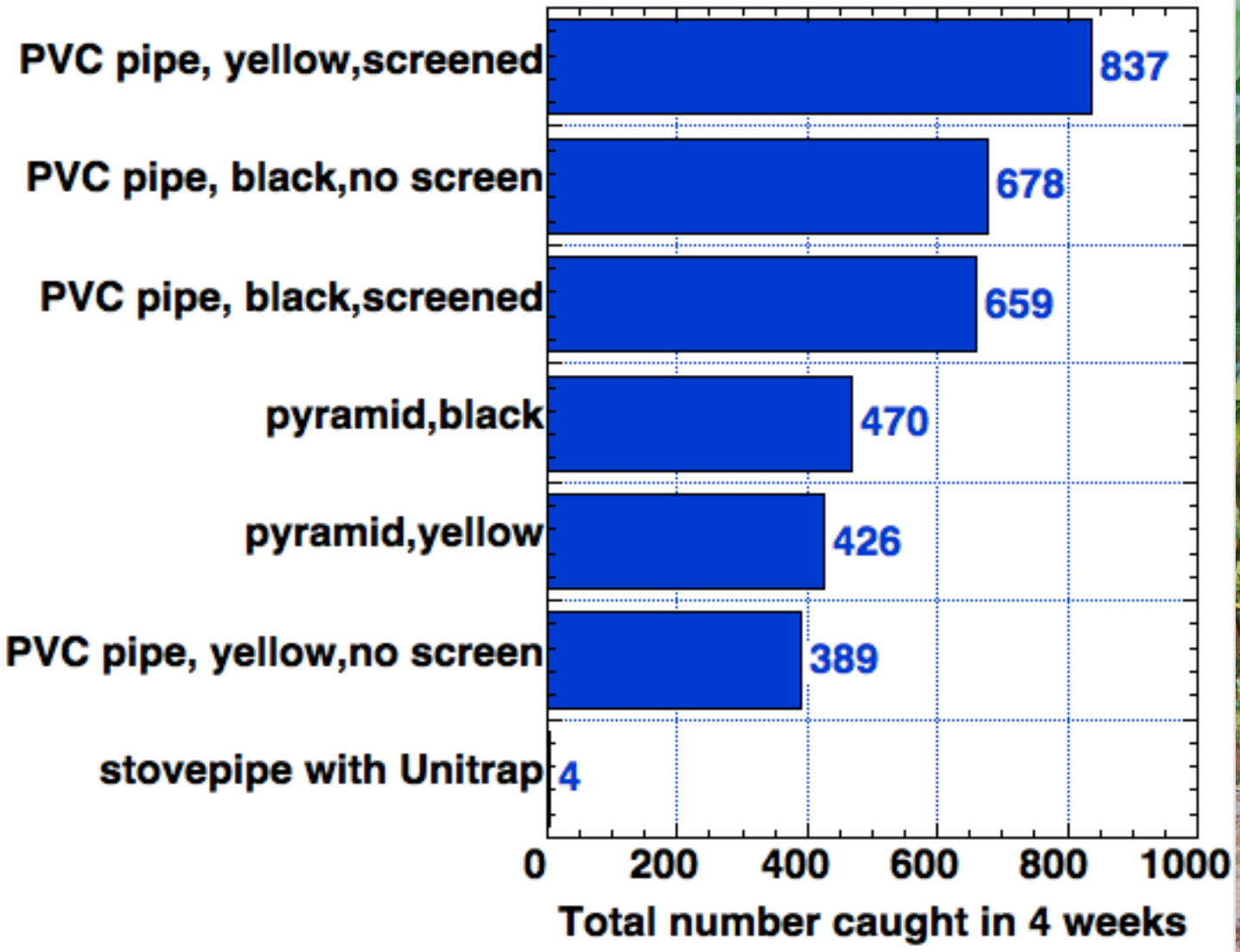
PVC pipe topped by Dead Inn: black *vs* yellow

PVC pipe topped by Dead Inn: black *vs* yellow plain *vs* netted

BMSB adults in traps in corn, August 2013



BMSB nymphs in traps in corn, August 2013



Efficacy ratings for BMSB control in veg crops (Maryland)

Best in field trials:

- Venom/Scorpion
- Leverage (Provado + Baythroid)

Also good:

- Brigade
- Belay
- Orthene
- Hero (Mustang + Brigade)
- Athena (Brigade+ Agri-Mek)
- Endigo (Warrior + Actara)

Fair/Good:

- Baythroid
- Vydate
- Lannate
- Warrior
- Assail

Insecticides for stink bug

Product	*Sweet corn*		*Peppers*	
	PHI	*Limit*	*PHI*	*Limit*
Venom	-	-	1 day	1-2 ap.
Leverage	-	-	0 days	3-4 ap.
Brigade	1 day	2-6 ap.	7 days	2-6 ap.
Belay	-	-	21 days	3-4 ap.
Orthene	-	-	7 days	2 ap.
Hero	3 days	1-2 ap.	7 days	1-2 ap.

Western bean cutworm

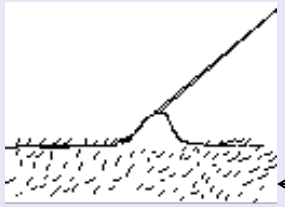
- Long-time pest of corn & dry beans in Colorado & Nebraska
- Moving eastward (Iowa) starting 2000
- Now common in Illinois & Wisconsin
- Pest of sweet corn ears

How to identify it?

	Western bean cutworm	Corn earworm
Number of worms per ear	Many	One

How to identify it?

	Western bean cutworm	Corn earworm
Number of worms per ear	Many	One
Prothorax (segment behind head)	Broad dark stripes	No stripes
Micro-spines on body	None	Many
Net-like marks on head	No	Yes



How to monitor it?

- **Pheromone lure in trap**
  - **Milk jug or unitrap**
  - **One generation per year**
  - **Adults active in July**
  - **Trap mid-June to mid-August**

Monitor by scouting

- Late July & early August
- In plantings with tassels emerging
- Upper 4 leaves of 100 plants/planting
- Look for eggs
- Look for young larvae

How to decide on control?

- **Thresholds (sweet corn):**
  - **4% of plants infested (processing)**
  - **Tentative: 1% of plants (fresh-market)**

What are control options?

- **Insecticide:**
  - **If threshold exceeded**
  - **When eggs are hatching** →

  - **When ~90% of tassels have emerged**
  - **A pyrethroid or Sevin**

What are control options?

- **Insecticide:**
  - **If threshold exceeded**
  - **When eggs are hatching** →

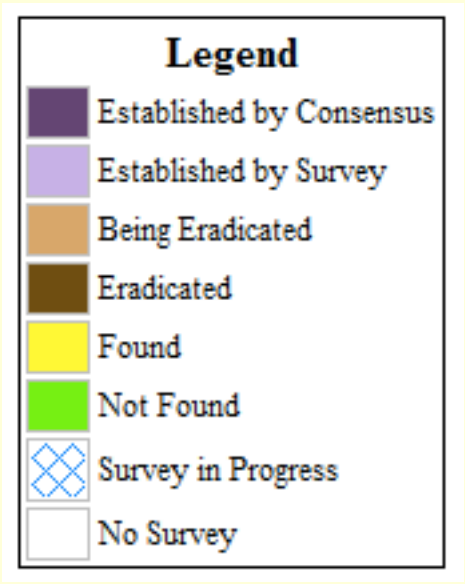
  - **When ~90% of tassels have emerged**
  - **A pyrethroid or Sevin**
- **Transgenic BT hybrid varieties:**
  - **<u>not</u> effective**

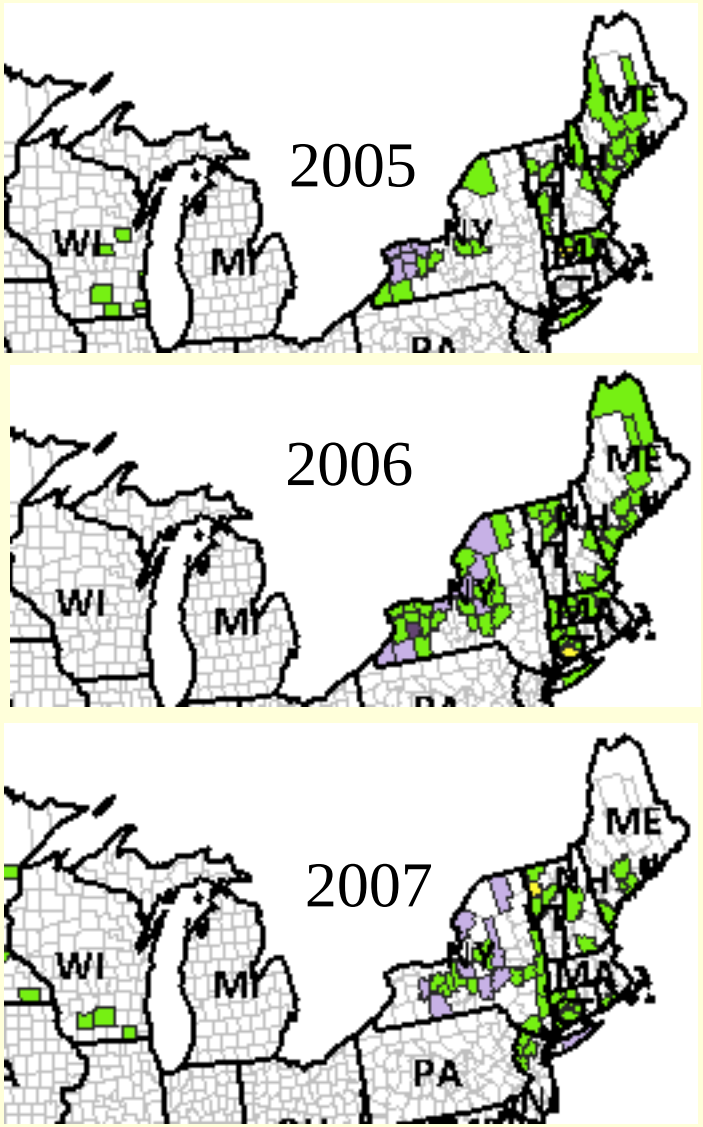
Swede midge

- Attacks cabbage, canola
- Ontario & Quebec, 2000
- Quarantines on plants moving Canada to USA
- USA first in 2004 (NY)

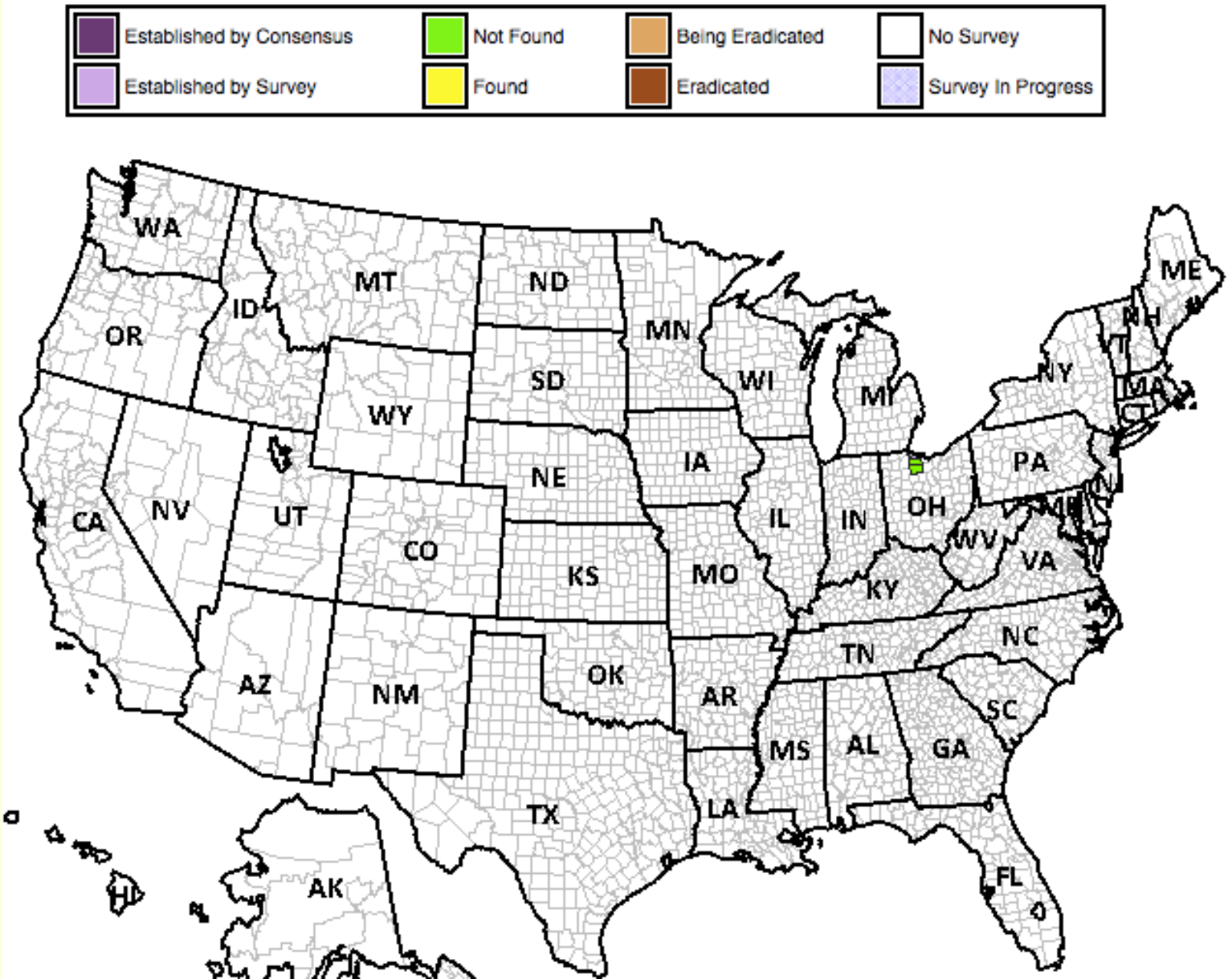
Swede midge: spread

- NY, 2004
- MA, 2005
- CT, 2006
- VT, 2007
- OH, 2009
- NJ

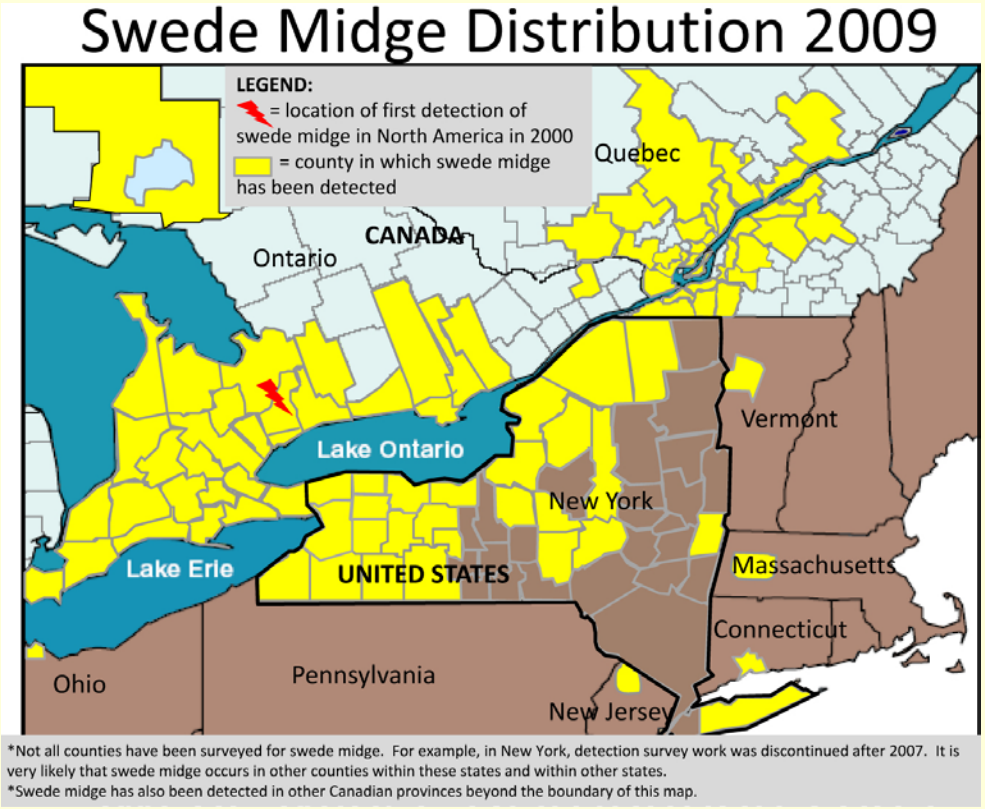




Survey Status of Swede midge - *Contarinia nasturtii*
2009



Swede midge: change in status



LEGEND:
= location of first detection of swede midge in North America in 2000
= county in which swede midge has been detected

- **Removed from quarantine 2009**
  - **Unlikely to be eradicated**
  - **Regulatory action impractical**
  - **Status in USA: present but managed**

Recent problems with an old pest:

Two-spotted spider mite

Two-spotted spider mite

- Often overlooked
- Often mistaken for disease
- Build up in hot dry weather

Two-spotted spider mite: identification

- Tiny (1/60 inch)
- White with 2 black spots
- 8 legs

Two-spotted spider mite: hosts & symptoms

- **Tomato**
  - Yellow blotches
- **Bean**
  - White stippling

Two-spotted spider mite: hosts & symptoms

- **Watermelon**
  - –Yellow blotches
  - –Brown lesions

Two-spotted spider mite: hosts & symptoms

- **Sweet corn**
  - **Flag leaf**

Two-spotted spider mite: diagnosis

- Fine webbing on leaf underside
- Scout by tapping leaf over paper, look for moving specks
- Early diagnosis for good control

Spider mite management

- Tolerable at low density
- Conserve natural predators
- Overhead irrigation can help
- Soft control:
  - Insecticidal soap
  - Horticultural Oil
- Chemical control:
  - Agri-Mek or others

Insecticides for spider mites

- **Organophosphates**
  - Dimethoate
  - MSR (Metasystox-R) RUP
- **Miticides (newer)**
  - Agri-Mek RUP
  - Acramite
  - Oberon
  - Zeal
  - Portal
- **Miticides (older)**
  - Dicofol, Kelthane
  - Vydate RUP

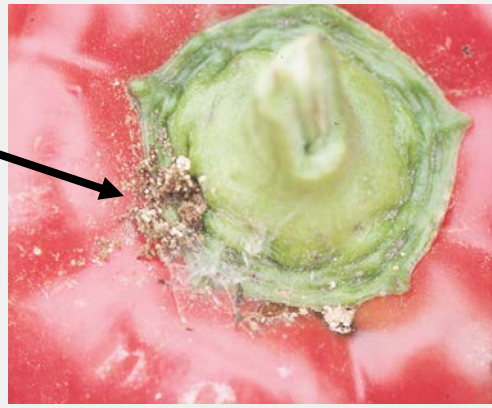
Insecticide efficacy trials

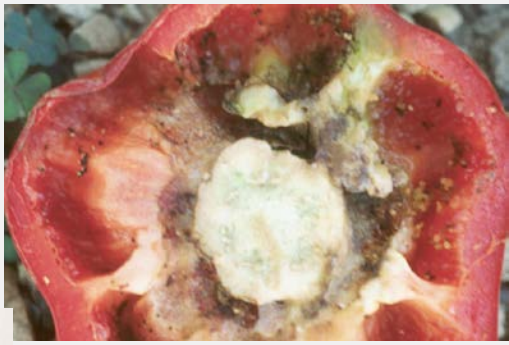
- bell peppers
- sweet corn
- cabbage

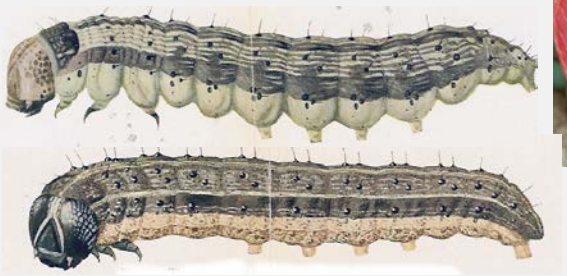
Worms in Peppers

Caterpillar pests of peppers

- **Key : European corn borer**
  - Bore into fruit
  - Quality loss
  - Yield loss
- **Occasional pests:**
  - Corn earworm
  - Fall armyworm
  - Beet armyworm







Challenge: good control

- 100% control of ECB is rare
- Due to canopy:
  - Dense
  - Hard to cover thoroughly

- Due to borer location:
  - Entry on stem often oriented down
  - Protected inside fruit
- Processors demand <3% damage

Insecticide timing for borer control in pepper

- **First spray:**
  - within 1 week of surge in trap catch
  - when >1 moth/night in trap
  - usually late July
- **Spray schedule:**
  - spray every 7 days (range 5 - 14 days)
  - during time moths active, 4 - 6 weeks
- **Stop spraying:**
  - once trap catch falls (usually early Sept.)
  - or until harvest if other pests active

Insecticides for borer on peppers

Insecticide	*PHI*	*efficacy*
Coragen	1	E
Orthene	7	E
Mustang Maxx	1	G
Pounce/Ambush	3	G
Warrior	5	G
Baythroid	7	G
Brigade	7	G
Radiant	1	G
Intrepid	1	G
Confirm	7	G
Asana	7	F
Sevin	3	F
Lannate	3	F
B.t.	0	F

European Corn Borer on Peppers

- **Years with average temperature:**
  - **Only 2 generations likely**
  - **Need 4 to 6 sprays total**
- **Years with very hot temperature:**
  - **3 generations likely**
  - **Need 8 to 10 sprays total**

Bell pepper insecticide trials 2013, 2014, 2016

- **Target:**
  - **European corn borer ***
  - **Fall armyworm**
  - **Corn earworm**
- **Uncertainty**
  - **ECB population size**
- **Spray interval**
  - **10-day in 2013**
  - **7-day in 2014 & 2016**

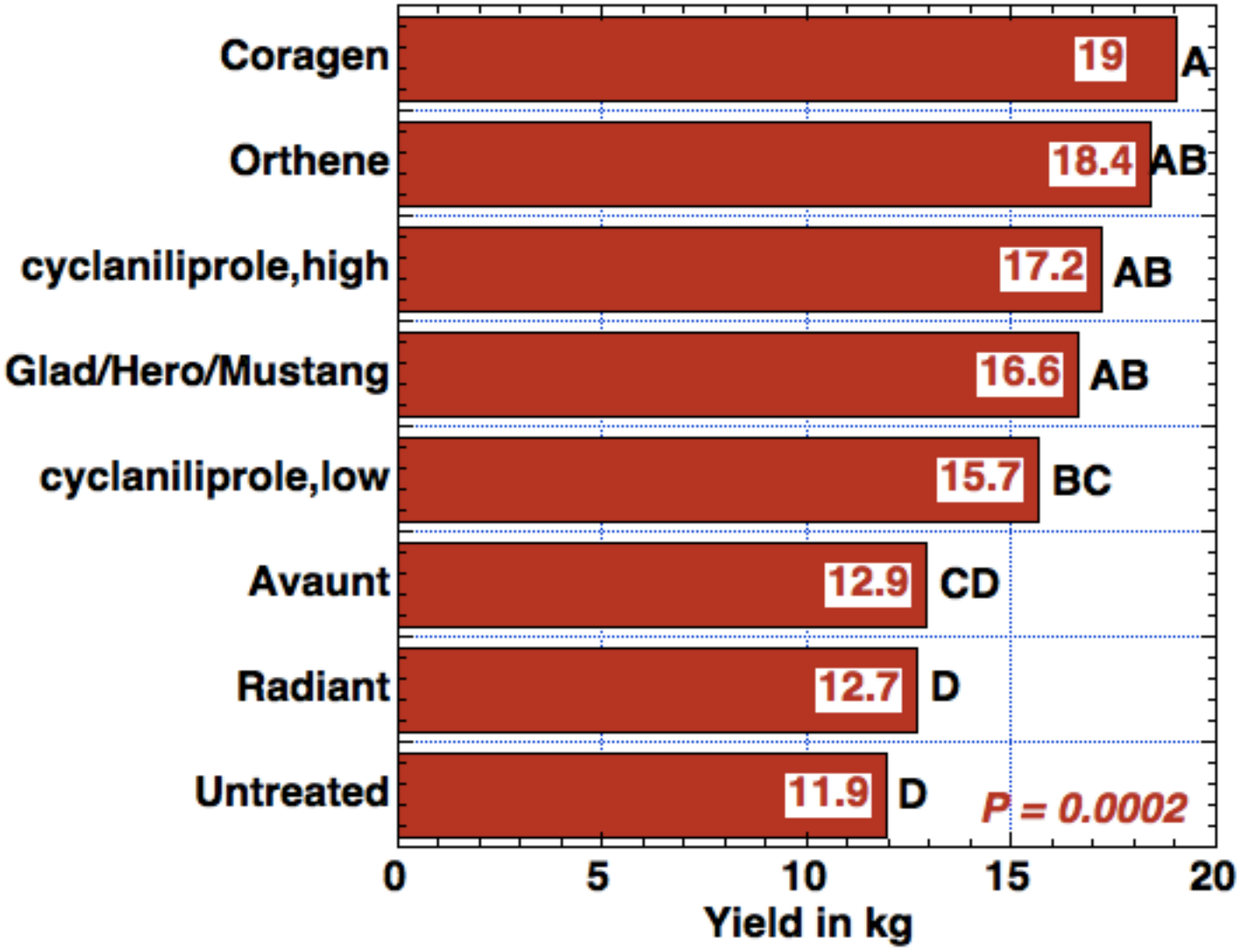
Bell pepper insecticide trials 2013, 2014, 2016

- **Registered insecticides**
  - Orthene
  - Coragen
  - Avaunt
  - Radiant
  - Mustang Maxx
  - Hero
  - Gladiator
- **Experimental insecticides**
  - Harvanta (cyclaniliprole)
  - Intrepid Edge (Intrepid + Radiant)
  - RDS-63 (dicloromezotiaz)

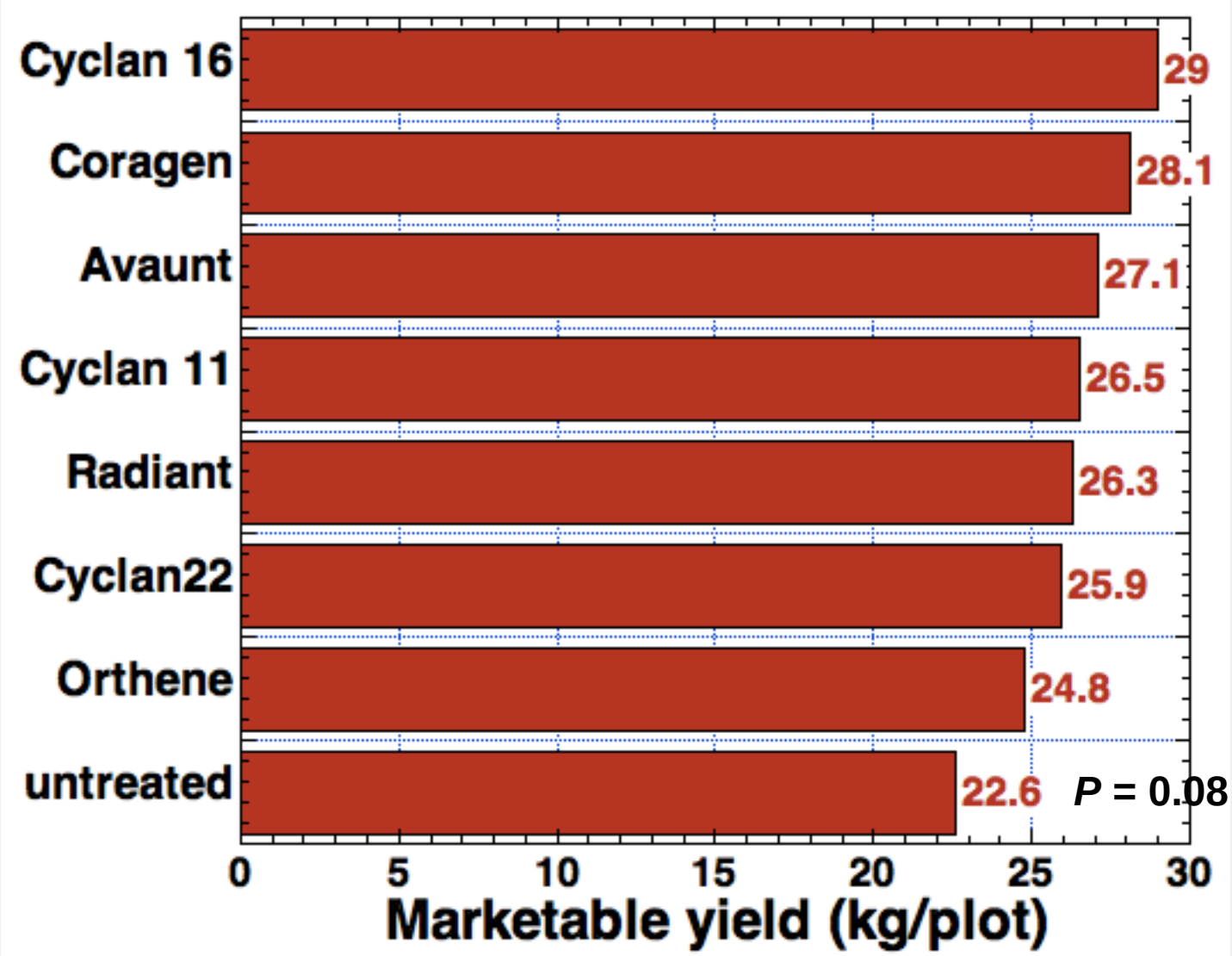
Worm pressure varies year to year

	% of pepper fruit damaged by caterpillars in untreated plots		
Year >>	2013	2014	2016
Harvest #1	0%	3%	2%
Harvest #2	34%	12%	1%
Harvest #3	41%	18%	0%
Harvest #4	10%	9%	2%
Cumulative	*25%*	*12%*	*1%*

Marketable yield of red bell peppers in 4 harvests (cumulative) after 5 insecticide applications at 10-day spray interval, Fremont, Ohio, 2013



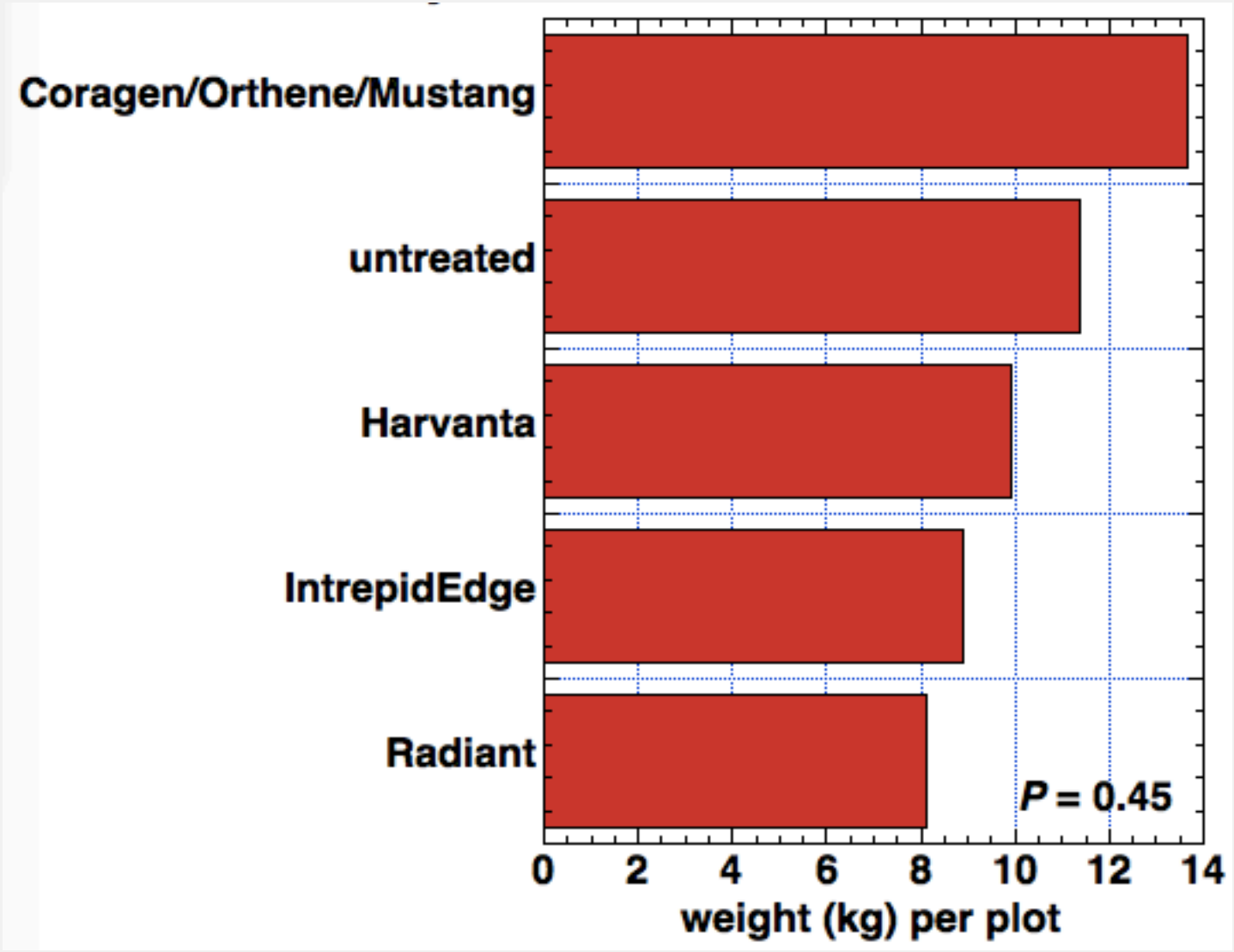
Red bell pepper insecticide trial, 2014
Marketable yield in 4 cumulative harvests
After 7 sprays at 7-day intervals



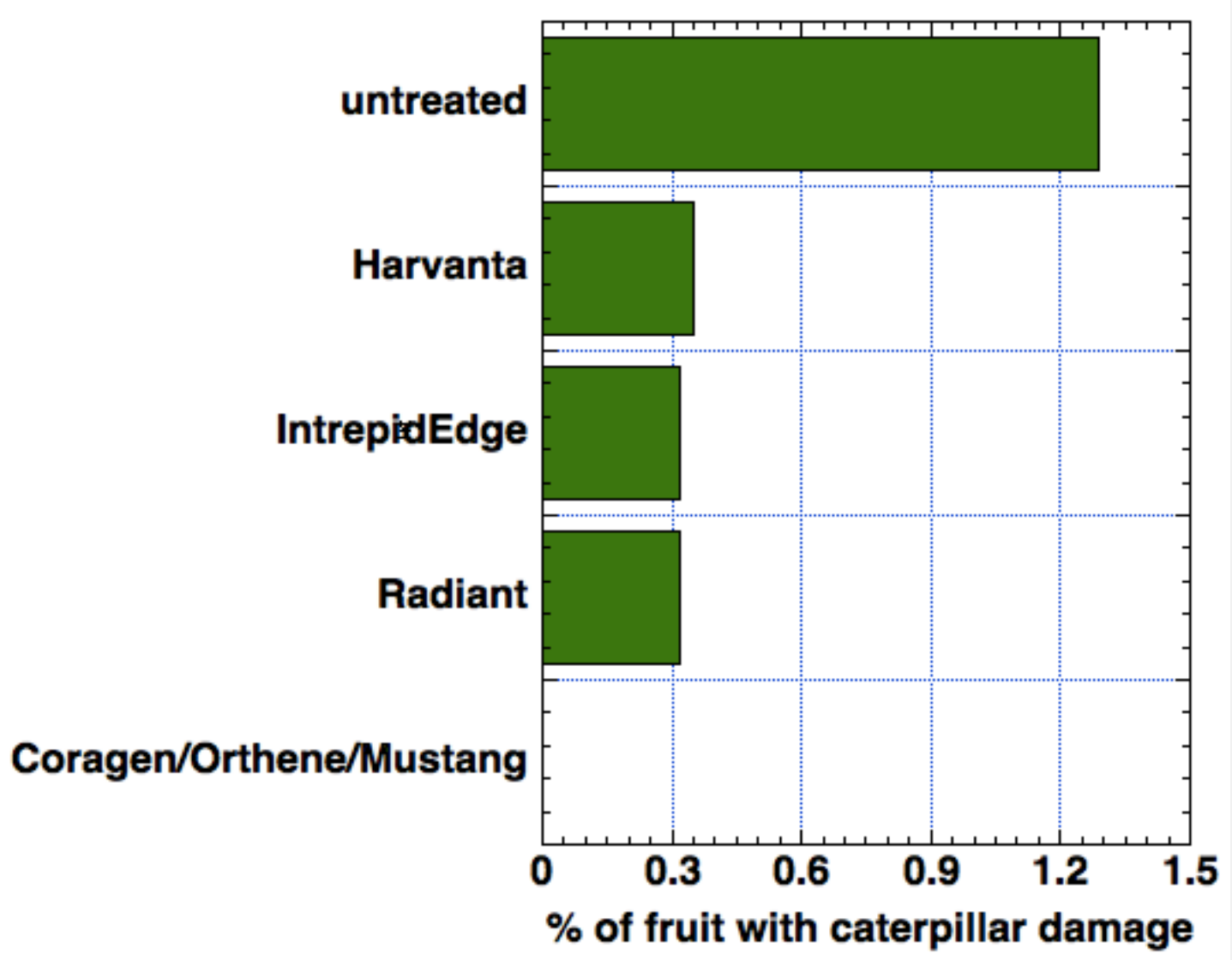
‘Standard’ program for bell peppers, 2016

spray	product
1	Coragen SC 5 fl oz/A
2	Orthene 97SP, 1 lb/A
3	Coragen SC 5 fl oz/A
4	Orthene 97SP, 1 lb/A
5	Coragen SC 5 fl oz/A
6	Mustang Maxx, 4 fl oz/A
7	Mustang Maxx, 4 fl oz/A
8	Mustang Maxx, 4 fl oz/A

Red bell pepper insecticide trial, 2016
Marketable yield in 4 cumulative harvests
After 8 sprays at 7-day intervals



Red bell pepper insecticide trial, 2016
% of total fruit damaged by caterpillars
After 8 sprays at 7-day intervals



P = 0.20

Corn earworm control, sweet corn field trials 2007-2015

Jim Jasinski & Celeste Welty

- **Concern about pyrethroid resistance**
- **Start spray program at 1st silk**
- **6 sprays at 3- to 4-day intervals**

Target pests

- **Primary:**
  - Corn earworm

- **Other caterpillars:**
  - European corn borer
  - Fall armyworm

- **Other pests**
  - Silk-clipping beetles
  - Corn leaf aphid (in husks)

Treatments

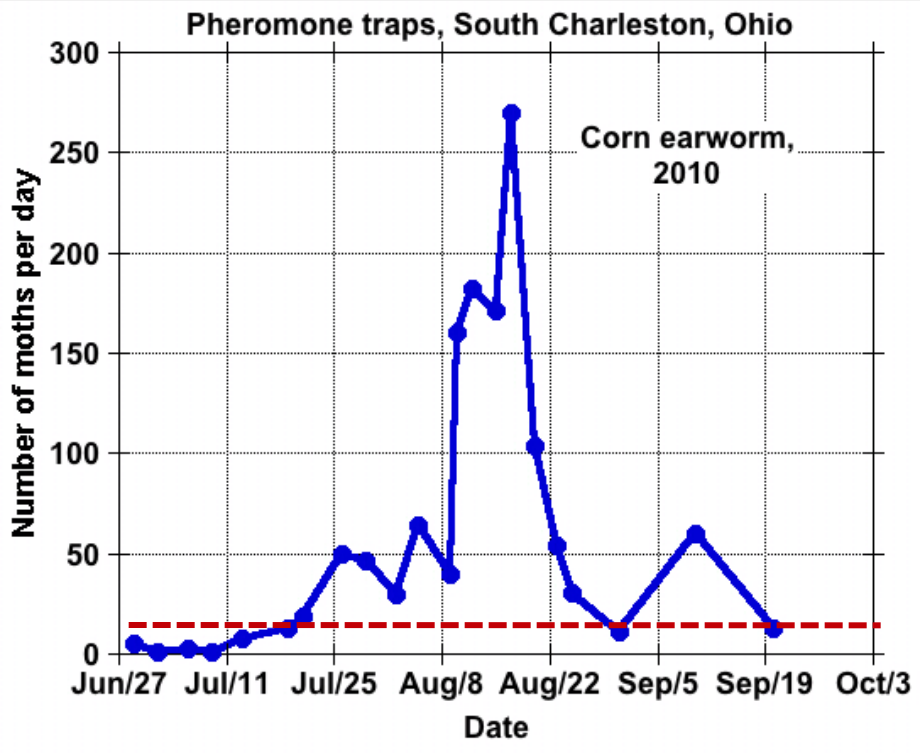
- **Older a.i.s:**
  - **Pyrethroids: Brigade (= Capture), Warrior, Hero, Asana, MustangMax**
  - **Carbamates: Lannate, Larvin**
- **Newer a.i.s:**
  - **Radiant**
  - **Coragen**
  - **Belt**
  - **Blackhawk**
  - **virus: Gemstar**
- **Pre-mix:**
  - **Voliam Xpress**
- **Hybrids**
  - **BT corn ‘Attribute BC 0805’**
  - **‘Providence’ isoline**

Worm species in field trial

Year	# larvae per ear in untreated plots		
	Corn earworm	Eur. corn borer	Fall armyworm
2007	2.7	0.9	0.01
2008	0.1	0.6	0.01
2009	1.3	0.1	0.10
2010	0.8	0.9	0.1
2011	0.1	0.04	0.01
2012	0.2	0.1	0
2013	0.1	1.1	0.05
2014	1.8	0.9	0
2015	1.0	1.1	0.02

Corn earworm seasonal activity

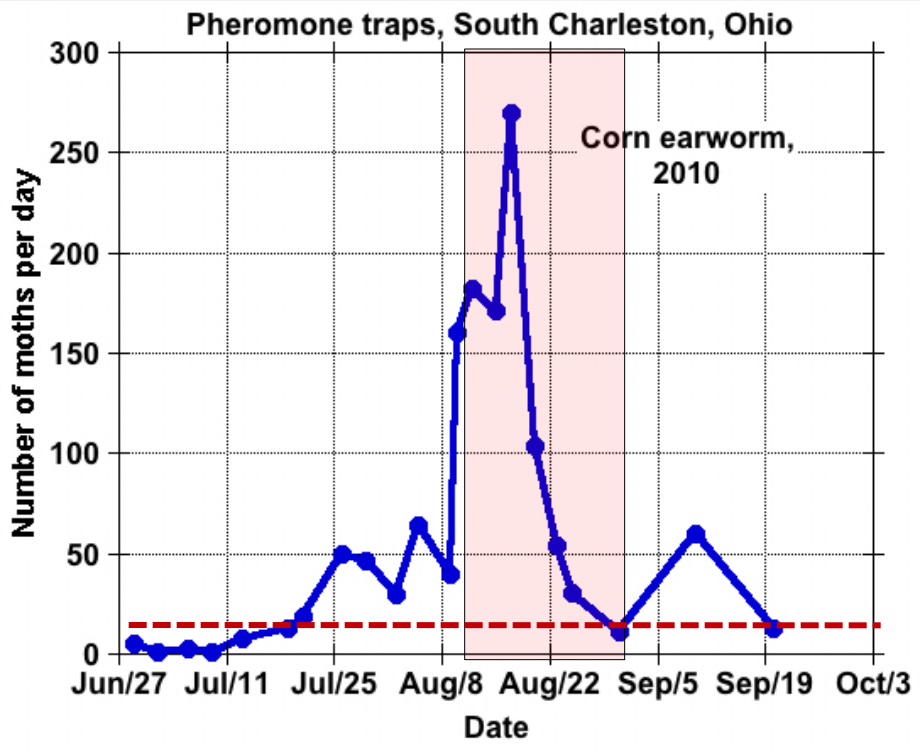
- red dashed line = “high” moth density, 13 moths/day in trap



2010

Corn earworm seasonal activity

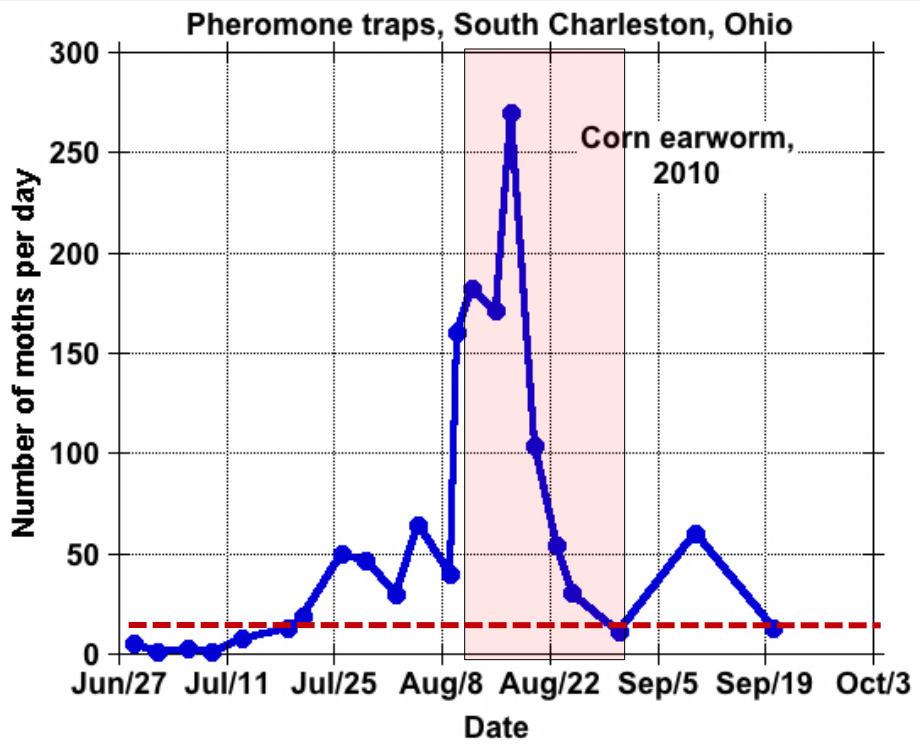
- red dashed line = “high” moth density, 13 moths/day in trap
- red shading = silking = spray period



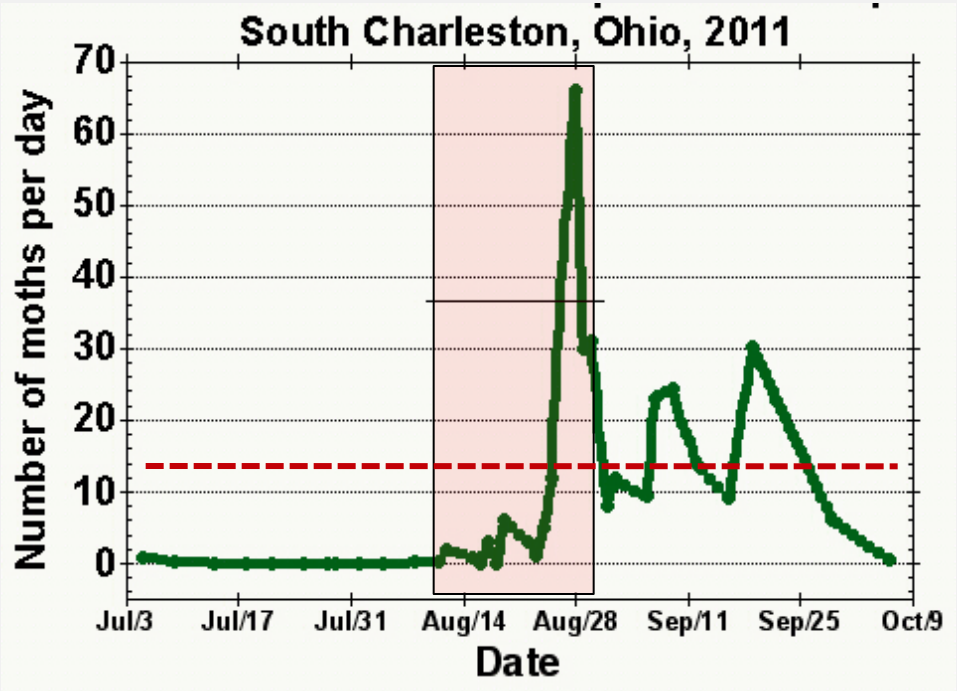
2010

Corn earworm seasonal activity

- red dashed line = “high” moth density, 13 moths/day in trap
- red shading = silking = spray period



2010



2011

Corn earworm in field trials

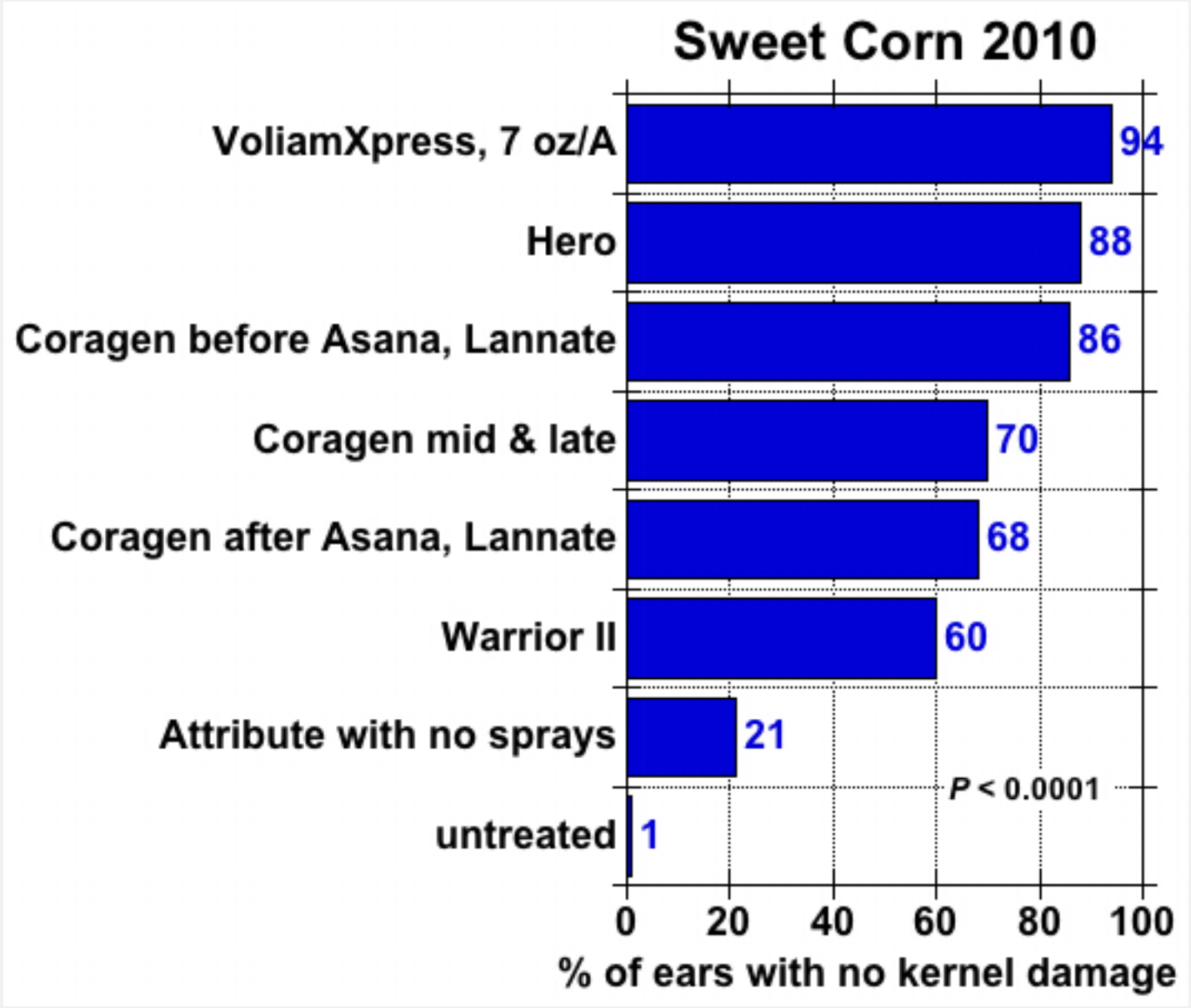
Year	Corn earworm pressure	# moths/day at peak
2007	Very high, prolonged	388
2008	Low	5
2009	High but quick	63
2010	Very high	270
2011	High but late	66
2012	Moderate	37
2013	Low	5
2014	Moderate but late	15
2015	Moderate	53

Year-to-year differences in damage

Year	CEW pressure	% of ears with no kernel damage	
		Untreated	
2007	Very high	3%	
2008	Low	59%	
2009	High	9%	
2010	Very high	1%	
2011	High, late	82%	
2012	Moderate	61%	
2013	Low	51%	
2014	Mod., late	0%	
2015	Moderate	2%	

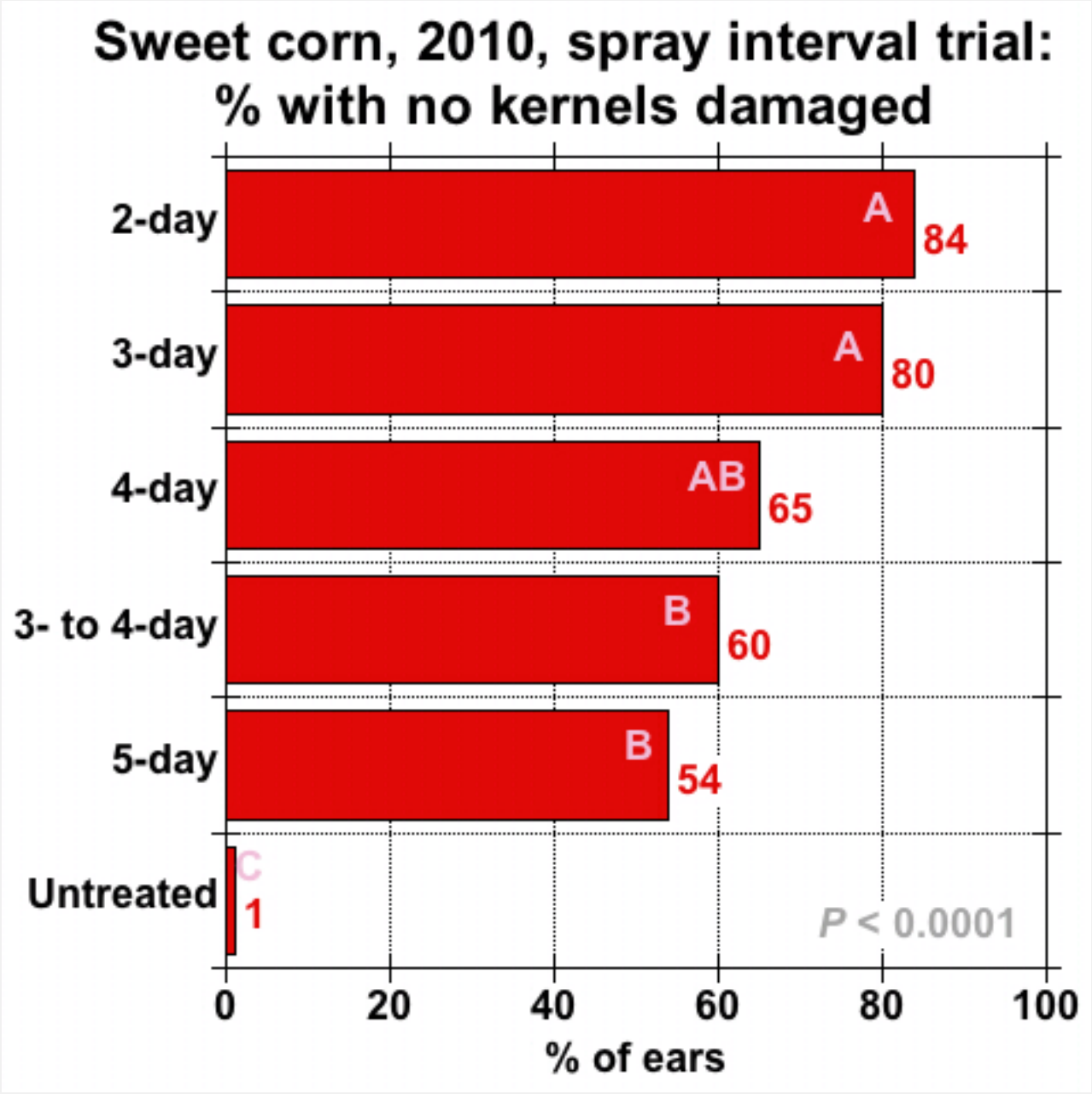
Year-to-year differences in damage

Year	CEW pressure	% of ears with no kernel damage	
		Untreated	Warrior (max rate)
2007	Very high	3%	49%
2008	Low	59%	96%
2009	High	9%	94%
2010	Very high	1%	60%
2011	High, late	82%	99%
2012	Moderate	61%	96%
2013	Low	51%	99%
2014	Mod., late	0%	18%
2015	Moderate	2%	8%


Sweet Corn 2010
VoliamXpress, 7 oz/A
94
Hero
88
Coragen before Asana, Lannate
86
Coragen mid & late
70
Coragen after Asana, Lannate
68
Warrior II
60
Attribute with no sprays
21
untreated
1
P < 0.0001
0
20
40
60
80
100
% of ears with no kernel damage

Comparison of spray schedule intensity, 2010

- One product: Warrior, at max rate
- Treatments (during silking):
  - Spray every 2 days (11 times)
  - Spray every 3 days (7 times)
  - Spray every 4 days (6 times)
  - Spray every 5 days (5 times)
  - Usual: start 3-day, then 4-day (6 times)


Sweet corn, 2010, spray interval trial:
% with no kernels damaged
2-day
3-day
4-day
3- to 4-day
5-day
Untreated
A
84
A
80
AB
65
B
60
B
54
C
1
P < 0.0001
0
20
40
60
80
100
% of ears

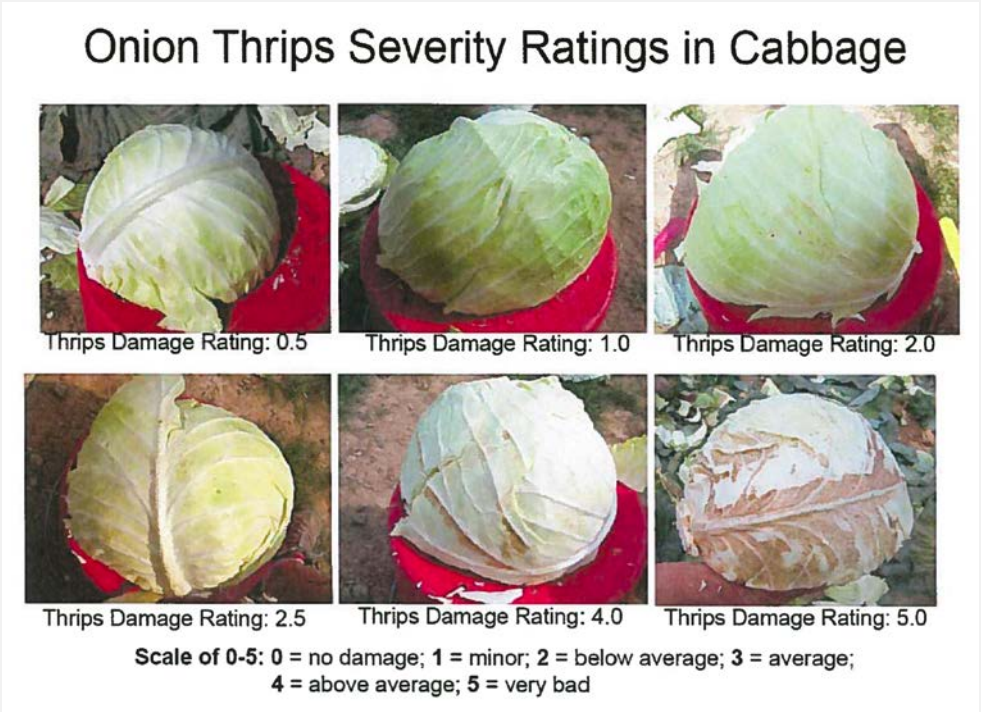
Conclusions from 9 years of field trial data

- **Relief that pyrethoids still ok**
  - **when CEW low**
  - **but max rates needed**
- **Relief that new a.i.s now available**
  - **diamides**
  - **spinosyns**
- **Worry about whether efficacy of pyrethroids will suddenly drop**

Thrips trials on cabbage

2012, 2013, 2015

- **Evaluate Exirel (cyazypyr)**
- **Damage rating: scale 1 to 5**
- **Rate each of outer 10 head leaves**
- **Use sum of 10 ratings per head**



Thrips treatments in 2012:

Sequence of 3 products @ 2 sprays, spray every 2 weeks

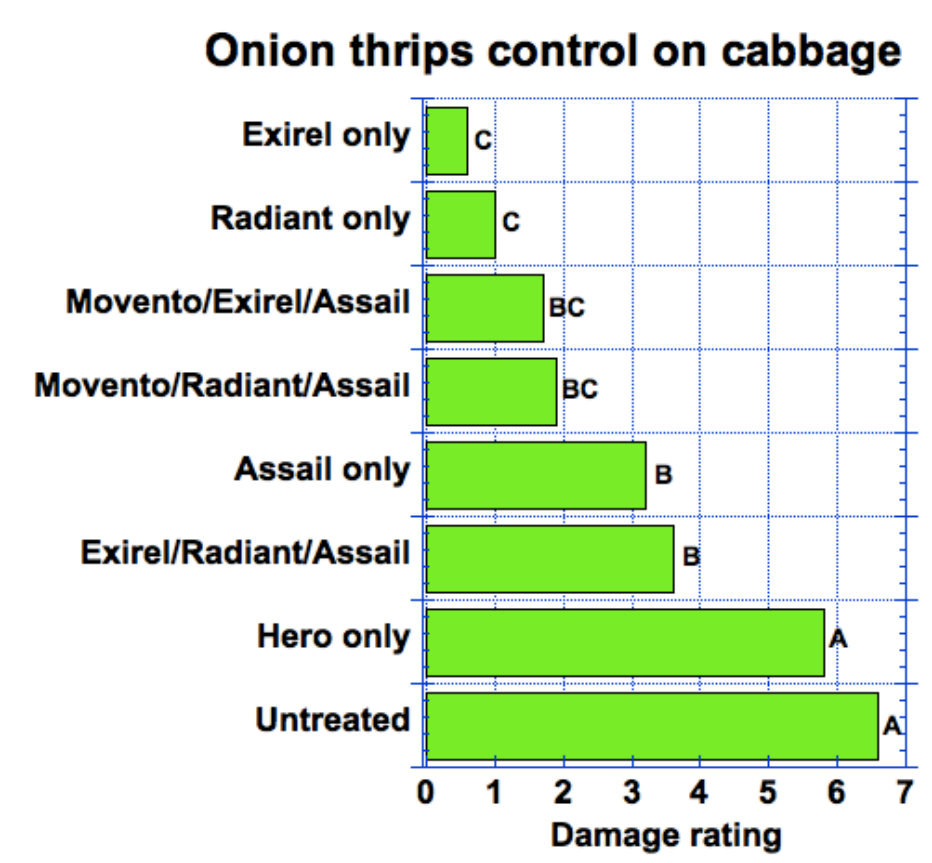
Treat-ment	Spray 1 (& 2)	Spray 3	Spray 4	Spray 5	Spray 6
1 (stan-dard)	Movento + Dipel	Radiant	Radiant	Assail	Assail

Thrips treatments in 2012:

Sequence of 3 products @ 2 sprays, spray every 2 weeks

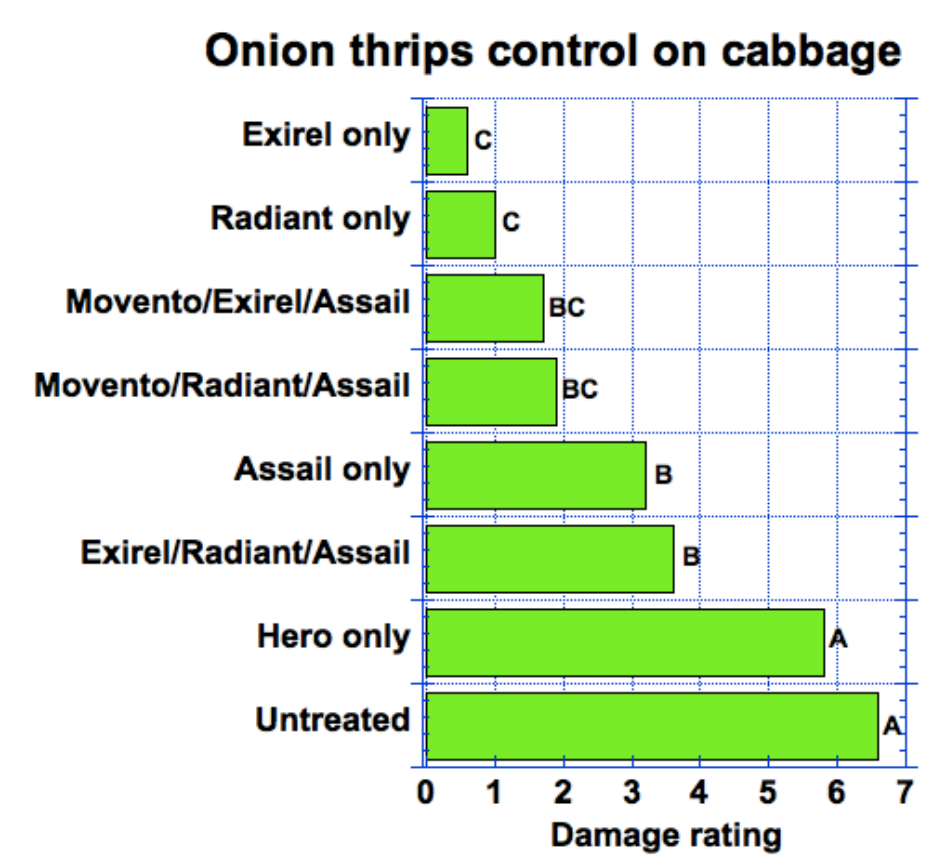
Treat-ment	Spray 1 (& 2)	Spray 3	Spray 4	Spray 5	Spray 6
1 (stan-dard)	Movento + Dipel	Radiant	Radiant	Assail	Assail
2	Movento + Dipel	Exirel	Exirel	Assail	Assail
3	Exirel	Radiant	Radiant	Assail	Assail
4	Exirel	Exirel	Exirel	Exirel	Exirel
5	Radiant	Radiant	Radiant	Radiant	Radiant
6	Hero	Hero	Hero	Hero	Hero
7	Assail	Assail	Assail	Assail	Assail
8 (untrt)	-	-	-	-	-

Thrips on cabbage, Fremont, 2012



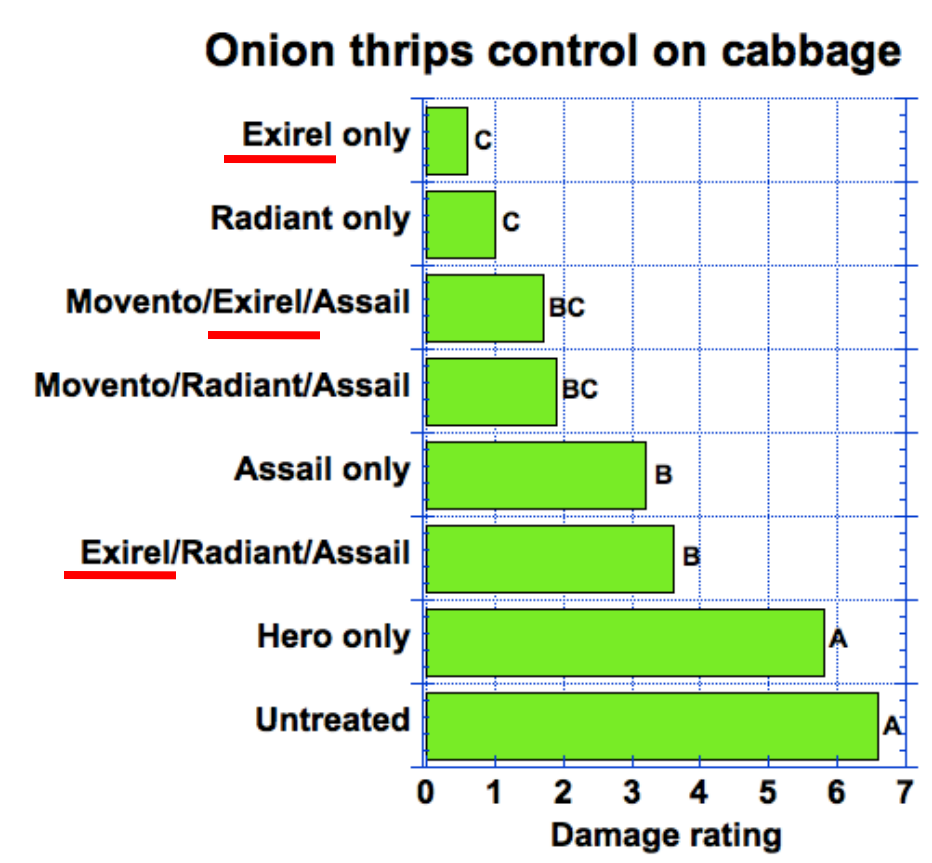
Thrips on cabbage, Fremont, 2012

‘standard’ →



Thrips on cabbage, Fremont, 2012

‘standard’ →



Thrips treatments in 2013:

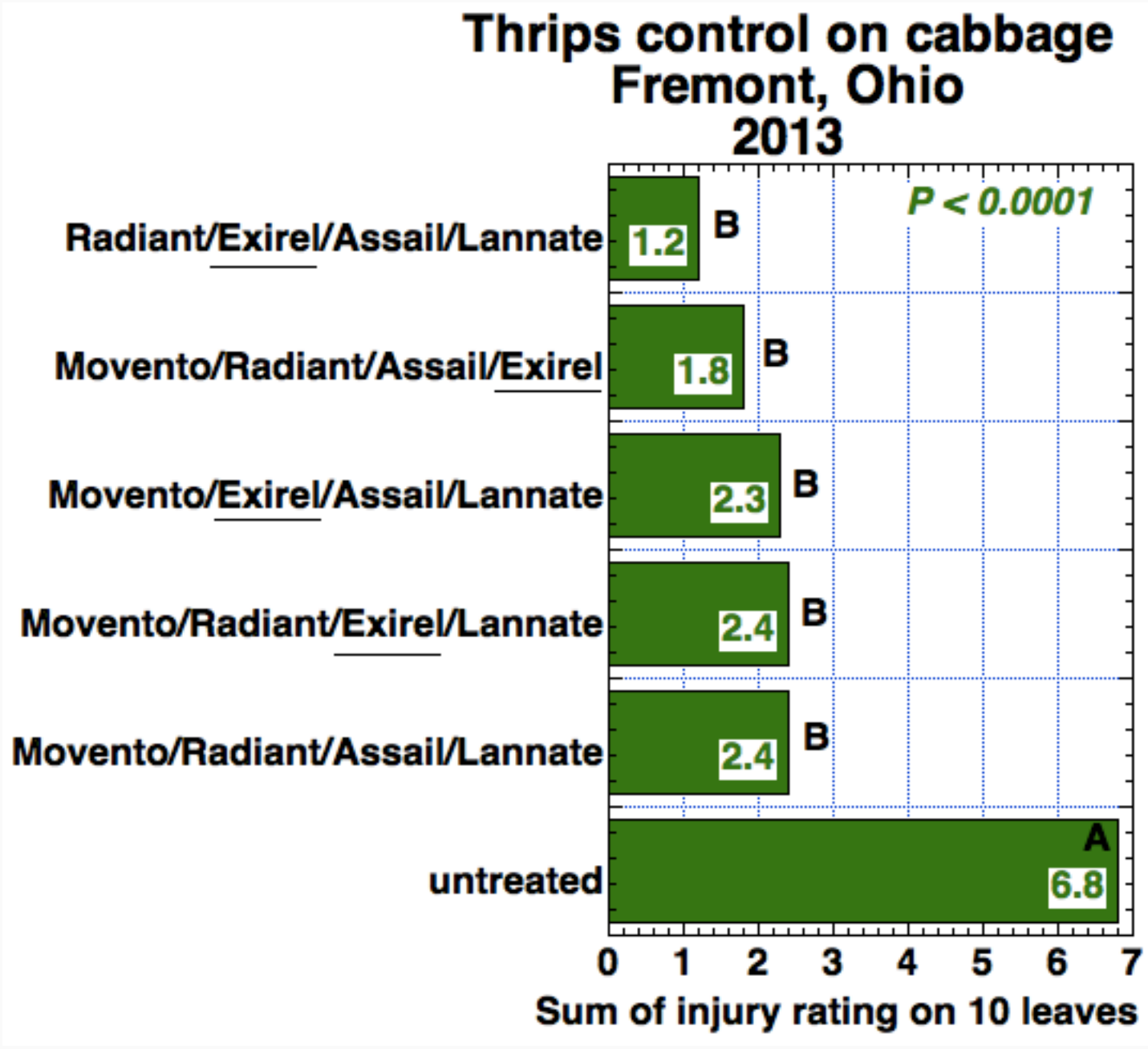
Sequence of 4+ products @ 2 sprays, spray every 10 days

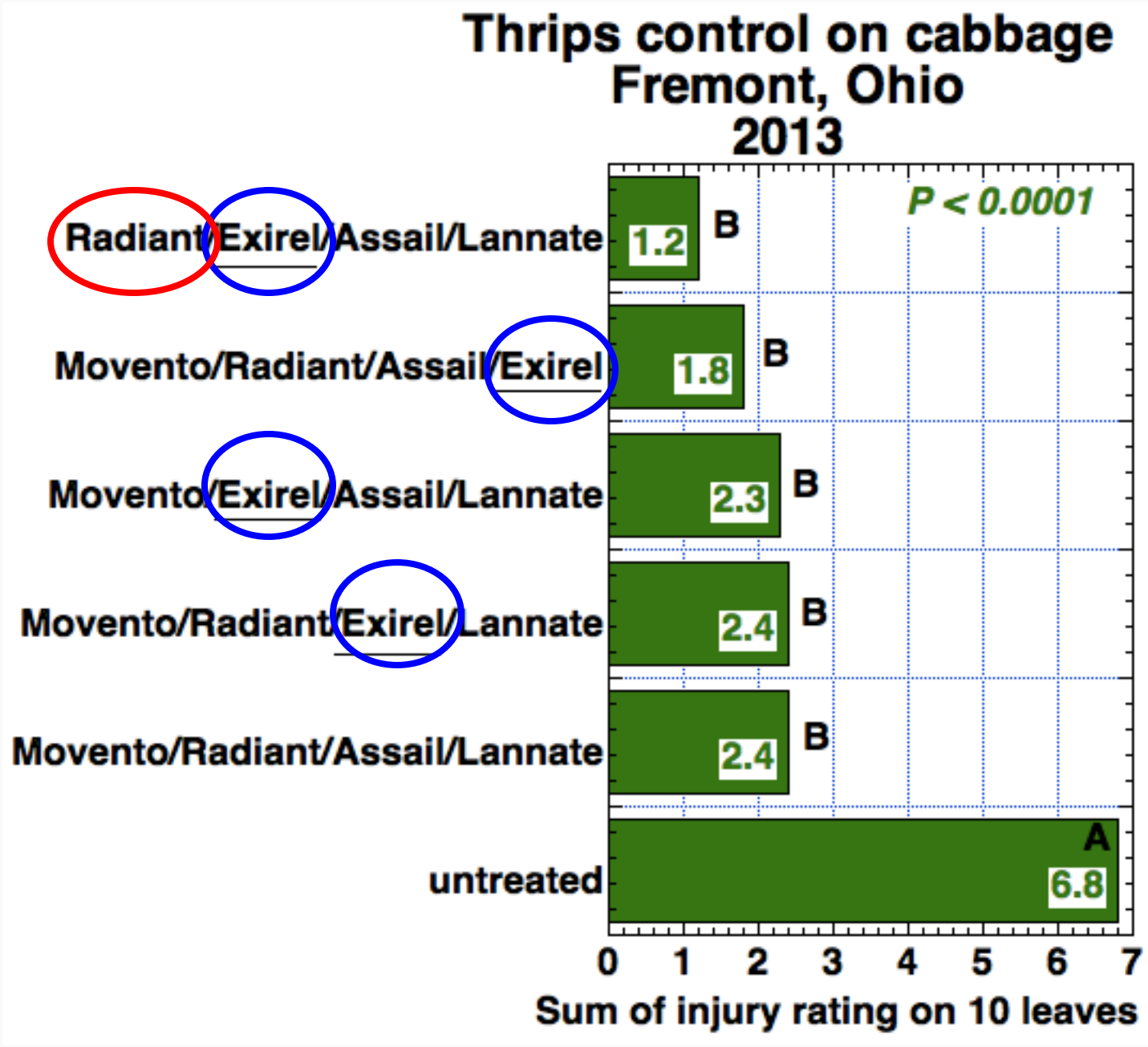
Treatment	Sprays 1 & 2	Sprays 3 & 4	Sprays 5 & 6	Sprays 7 & 8	Spray 9
1 (standard)	Movento + Dipel	Radiant	Assail	Lannate	Baythroid

Thrips treatments in 2013:

Sequence of 4+ products @ 2 sprays, spray every 10 days

Treatment	Sprays 1 & 2	Sprays 3 & 4	Sprays 5 & 6	Sprays 7 & 8	Spray 9
1 (standard)	Movento + Dipel	Radiant	Assail	Lannate	Baythroid
2	Movento + Dipel	Exirel	Assail	Lannate	Baythroid
3	Movento + Dipel	Radiant	Exirel	Lannate	Baythroid
4	Movento + Dipel	Radiant	Assail	Exirel	Baythroid
5	Radiant	Exirel	Assail	Lannate	Baythroid
6 (untrt)	-	-	-	-	


Thrips control on cabbage
Fremont, Ohio
2013
P < 0.0001
Radiant/Exirel/Assail/Lannate
1.2
B
Movento/Radiant/Assail/Exirel
1.8
B
Movento/Exirel/Assail/Lannate
2.3
B
Movento/Radiant/Exirel/Lannate
2.4
B
Movento/Radiant/Assail/Lannate
2.4
B
untreated
6.8
A
0
1
2
3
4
5
6
7
Sum of injury rating on 10 leaves


Thrips control on cabbage
Fremont, Ohio
2013
P < 0.0001
Radiant/Exirel/Assail/Lannate
1.2
B
Movento/Radiant/Assail/Exirel
1.8
B
Movento/Exirel/Assail/Lannate
2.3
B
Movento/Radiant/Exirel/Lannate
2.4
B
Movento/Radiant/Assail/Lannate
2.4
B
untreated
6.8
A
0 1 2 3 4 5 6 7
Sum of injury rating on 10 leaves

'standard'

Thrips treatments in 2015:

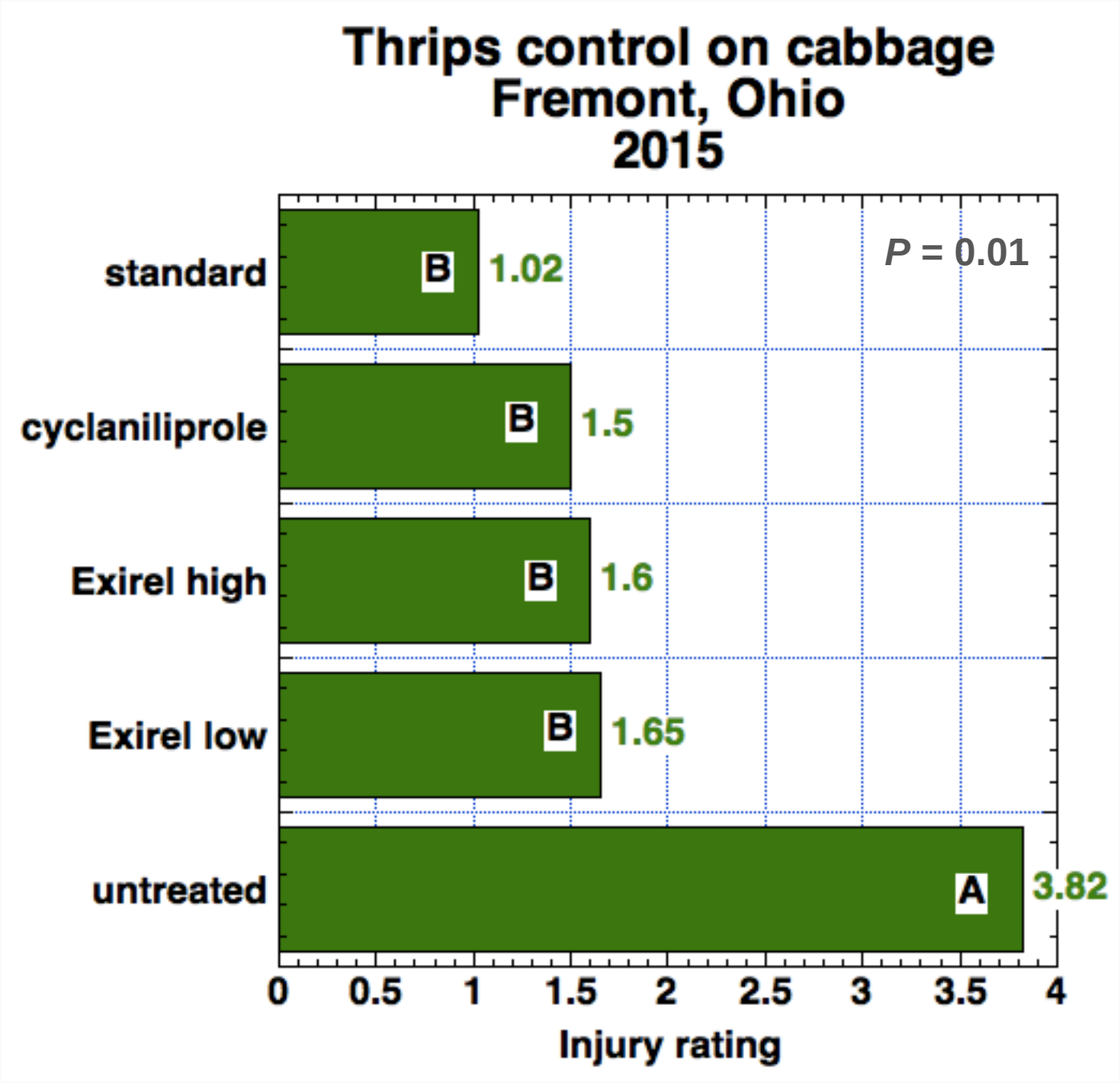
Sequence of 4 products @ 2 sprays, spray every 10 days

Treatment	Sprays 1 & 2	Sprays 3 & 4	Sprays 5 & 6	Sprays 7 & 8
1 (standard)	Radiant	Movento + Dipel	Assail	Lannate

Thrips treatments in 2015:

Sequence of 4 products @ 2 sprays, spray every 10 days

Treatment	Sprays 1 & 2	Sprays 3 & 4	Sprays 5 & 6	Sprays 7 & 8
1 (standard)	Radiant	Movento + Dipel	Assail	Lannate
2	Radiant	Exirel (13.5 oz/A)	Assail	Lannate
3	Radiant	Exirel (16.9 oz/A)	Assail	Lannate
4	cyclaniliprole	cyclaniliprole	cyclaniliprole	cyclaniliprole
5 (untrt)	-	-	-	-


Thrips control on cabbage
Fremont, Ohio
2015
P = 0.01
standard
B
1.02
cyclaniliprole
B
1.5
Exirel high
B
1.6
Exirel low
B
1.65
untreated
A
3.82
0
0.5
1
1.5
2
2.5
3
3.5
4
Injury rating

Conclusions: thrips on cabbage

- Intensive schedule gives good control
  - 10-day interval
  - 2 sprays Radiant
  - 2 sprays Movento + Dipel
  - 2 sprays Assail
  - 2 sprays Lannate
- Exirel fits well early or late
- Exirel lower rate is acceptable
- cyclaniliprole (Harvanta) will fit well

Resources on website

u.osu.edu/pestmanagement/

- Reports on Ohio insecticide trials
  - Bell pepper
  - Cabbage
  - Sweet corn
  - Apples
- IPM guidelines
  - Sweet corn
  - Apples
- Trap reports from Ohio locations
- Pictures of pests

the end

Info on fruit & veg. pests
u.osu.edu/pestmanagement/

Questions?
e-mail: welty.1@osu.edu
office phone: 614 292 2803