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Monitoring and Management of Fruit Pests - Update

as a component of Integrated Pest Management (IPM) methods to control insect pests

Greg Krawczyk, Ph. D.

Penn State University
Department of Entomology
Fruit Research and Extension Center
Biglerville, PA
e-mail:gxk13@psu.edu

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Insect Pest Management Tools

(e.g., insecticides)

New names
but not new active ingredients:

Bexar®, Voliam® flexi, Besiege®, Cormoran®, Leverage®, Admire Pro®, Ultor®, and more…

New products for 2019:

Versys® - afidopyrofen

PQZ® - pyrifluquinazon

Conventional insecticides

Mating disruption products

Grandevo

Surround

Venerate

Entrust

Bacillus thuringiensis

CM Virus

Horticultural oils and soap

Bio-rational and organically approved insecticides

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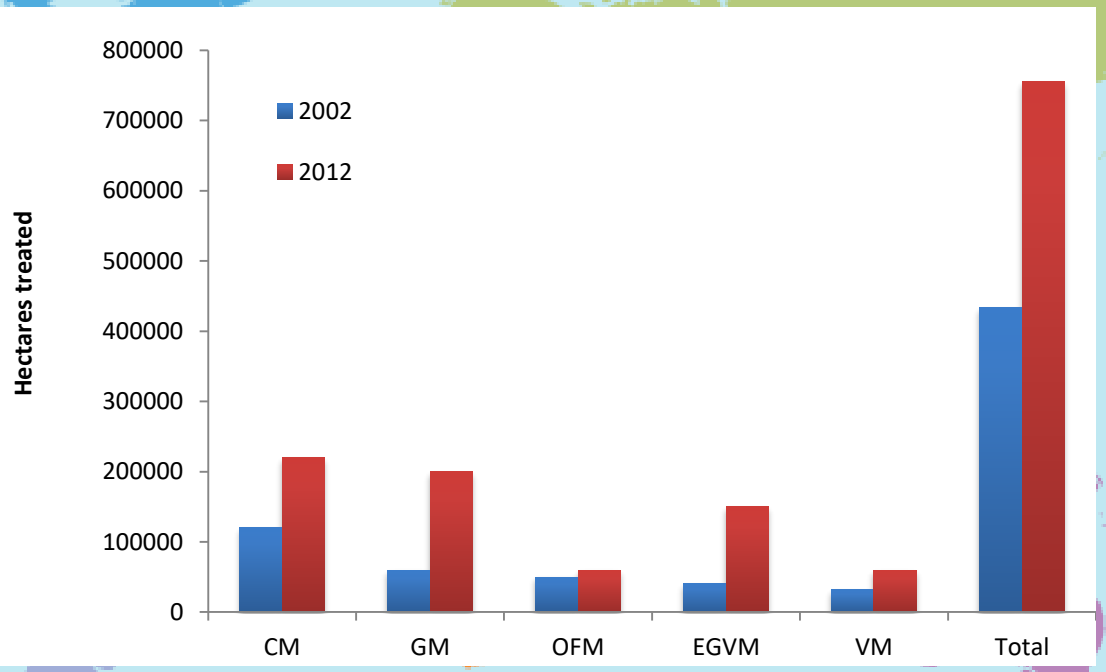
Worldwide use of MD

756,000 ha ≈ 1,867,320 acres

GM-

CM– 220,000 ha



OFM– 60,000 ha

Source: Larry Gut. MSU 2014

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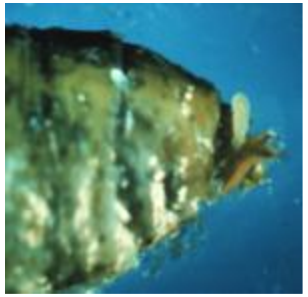
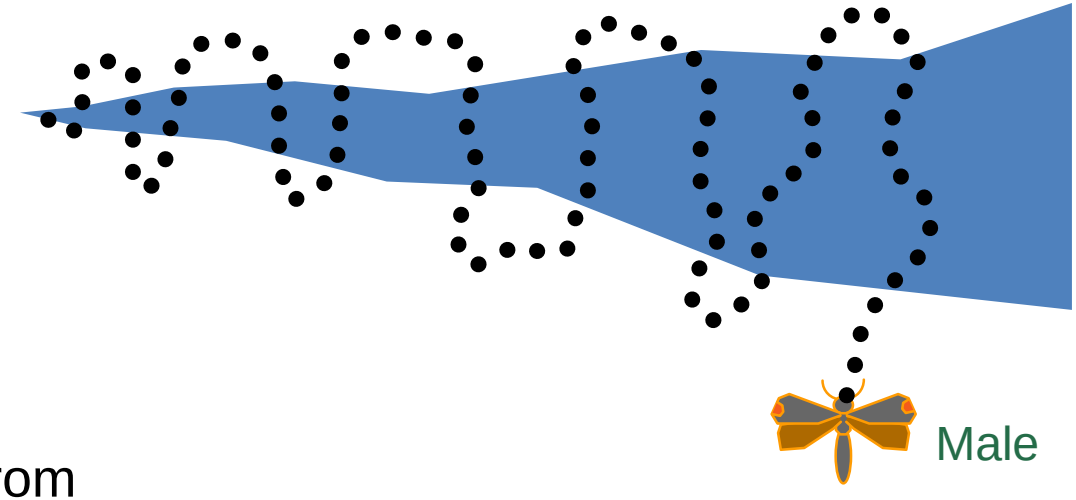
How do insect pheromones function?

Wind



Female

Pheromone Plume



Male

Female release pheromone from specialized gland;
Straight chain of ca. 12-14 carbon alcohols, acetate, aldehydes;
Typical pheromone is a blend of 3-4 compounds.

Male antennal sensilla detect and sift pheromone molecules from air;
Odorant stimulates receptor cells within antenna;
Males become able to find female moths.

Each insect species has unique, species specific sex pheromome

Slide courtesy of Dr. Larry Gut, MSU

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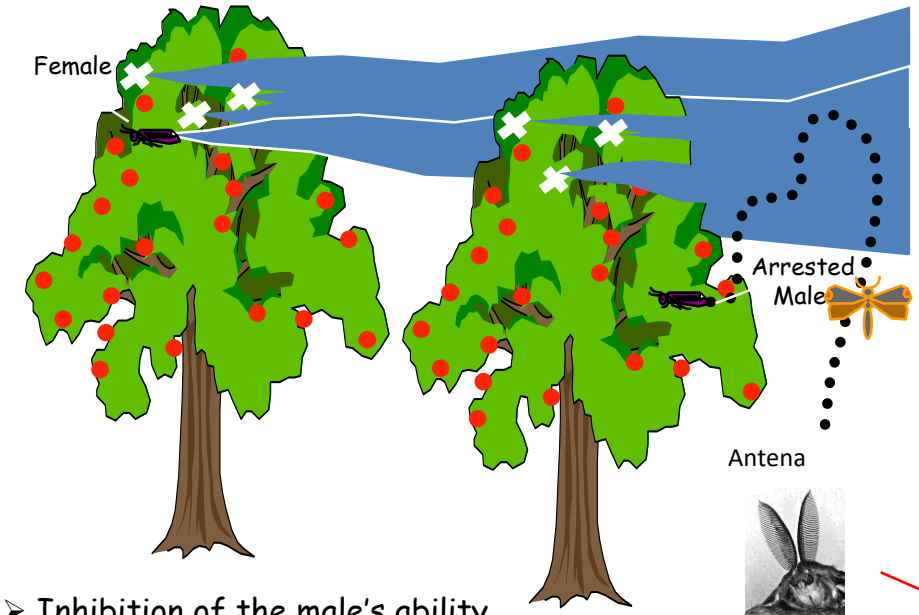
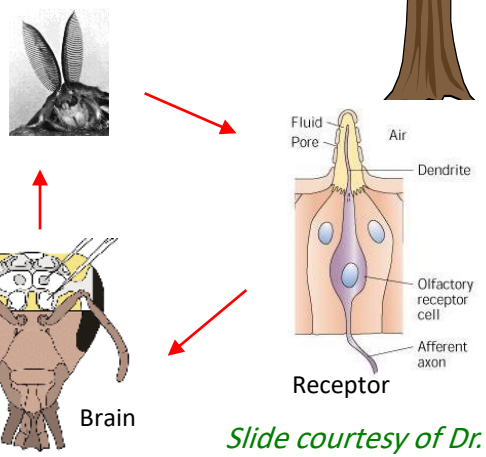
Moth SEX 101
"mechanisms of mating disruption"

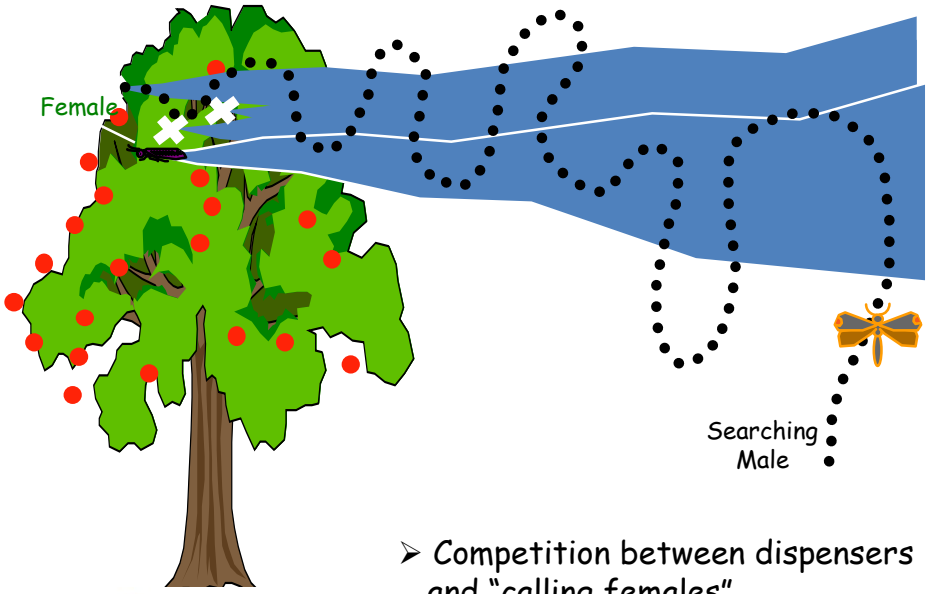
Adaptation - Habituation



- Inhibition of the male's ability to respond to pheromone
- Searching limited or absent
- May not need attractive blend
- Density independent



"False trails"



- Competition between dispensers and "calling females"
- Male moths actively search
- Relies on attractive blend
- Density-dependent

Slide courtesy of Dr. Larry Gut, MSU

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Use of insect sex pheromones in pest management…

- Mating disruption does not kill anything: influences insect behavior – *"Birth Control for Bugs".*

Mating disruption

Sex pheromone is the main MD pest management tool

Insects are "Confused!"

No death with MD, population reproductive effect only

Very selective, only target pest is affected, beneficial insects are not affected

Delayed mating effect

Insecticides

Corrective, fast acting, approach, good for immediate response

Possible negative environmental effect

Broad spectrum activity, pests and beneficial insects are killed (non-target impact).

Each species has a different, species specific sex pheromone

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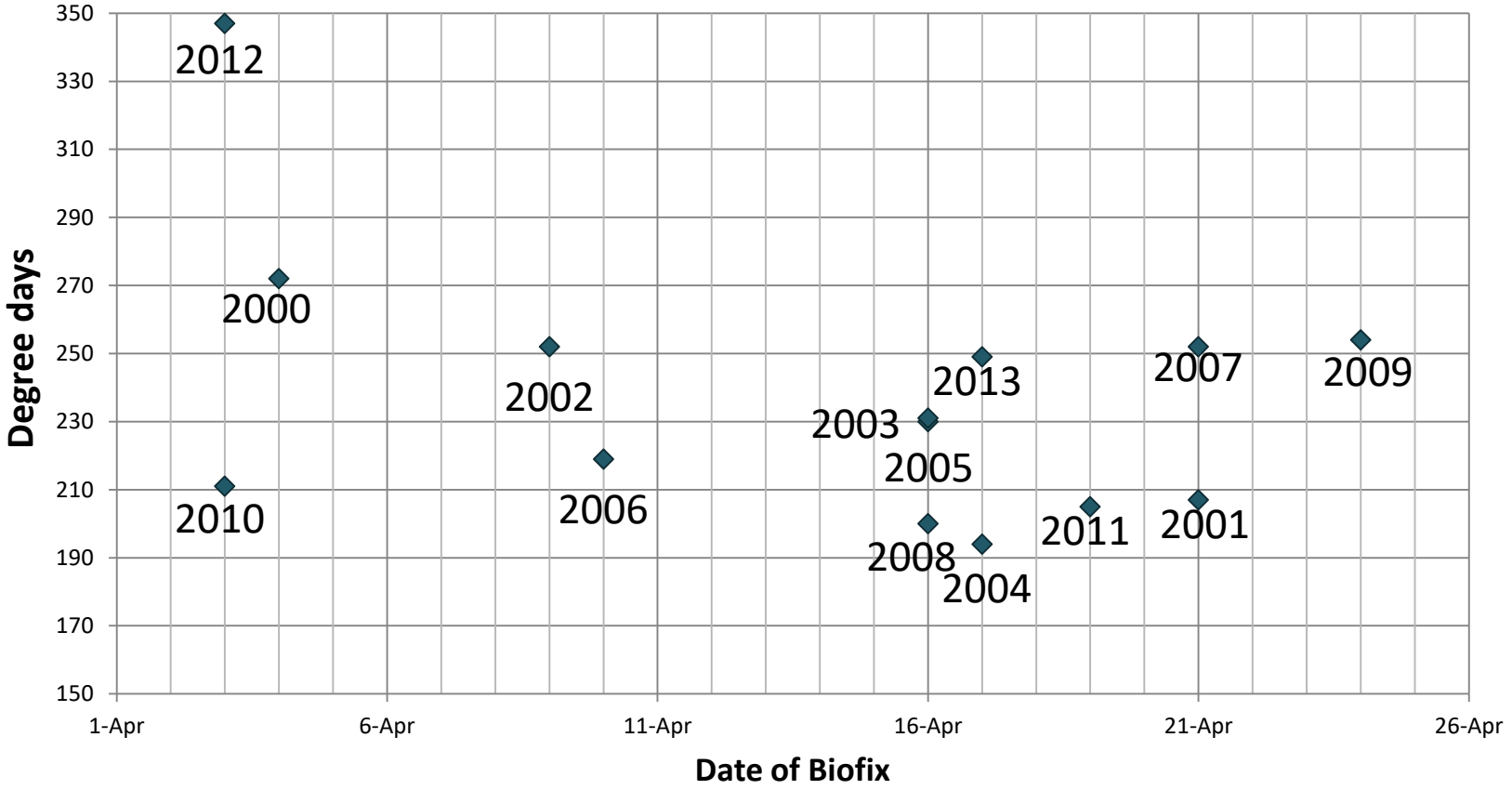
Oriental Fruit Moth

Degree days (DD) accumulated from **Jan 1 to Biofix**



OFM biofixes from 2000 to 2013 season (base 45°F)

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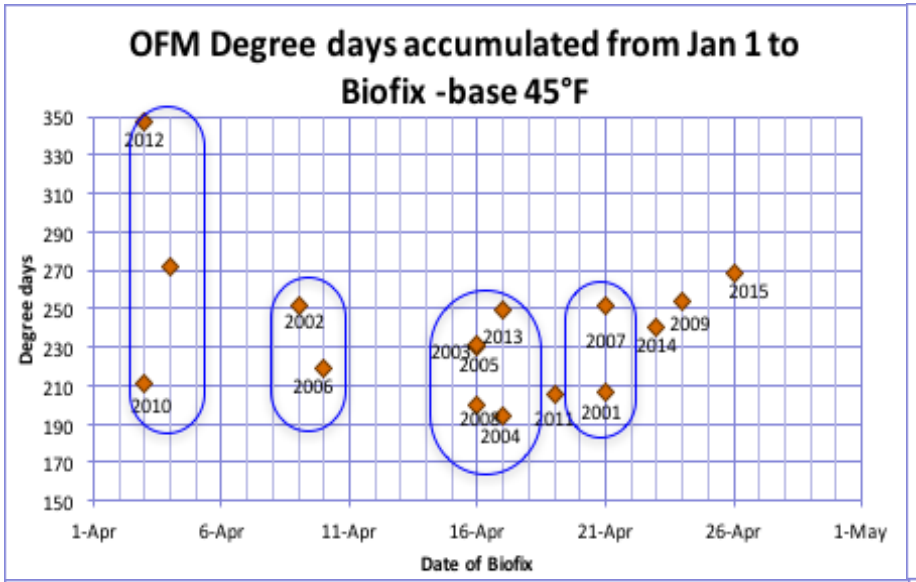
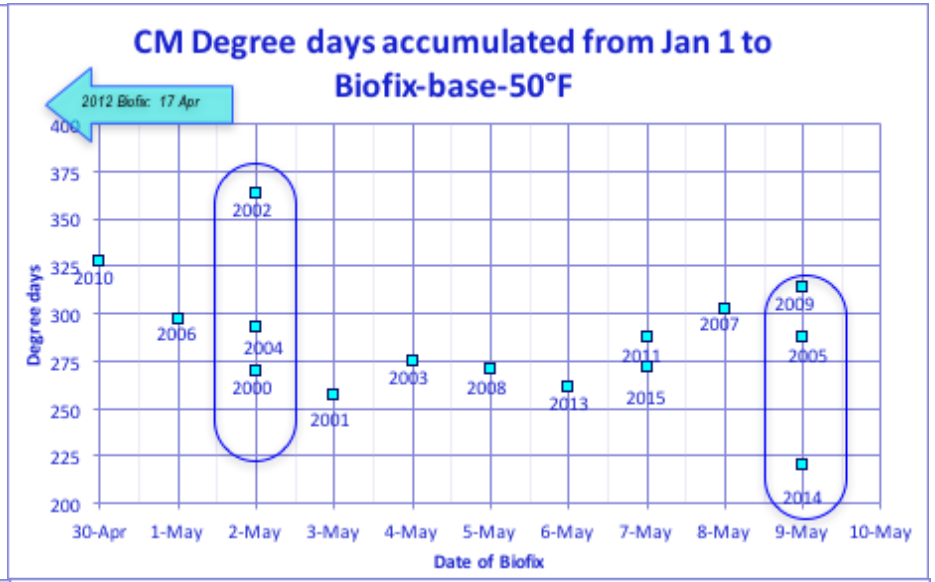
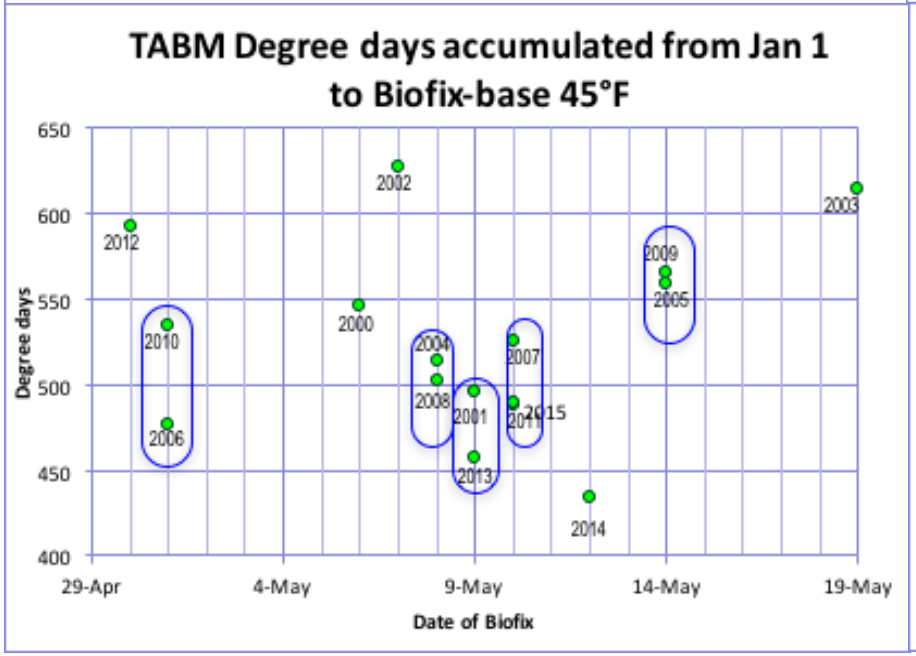
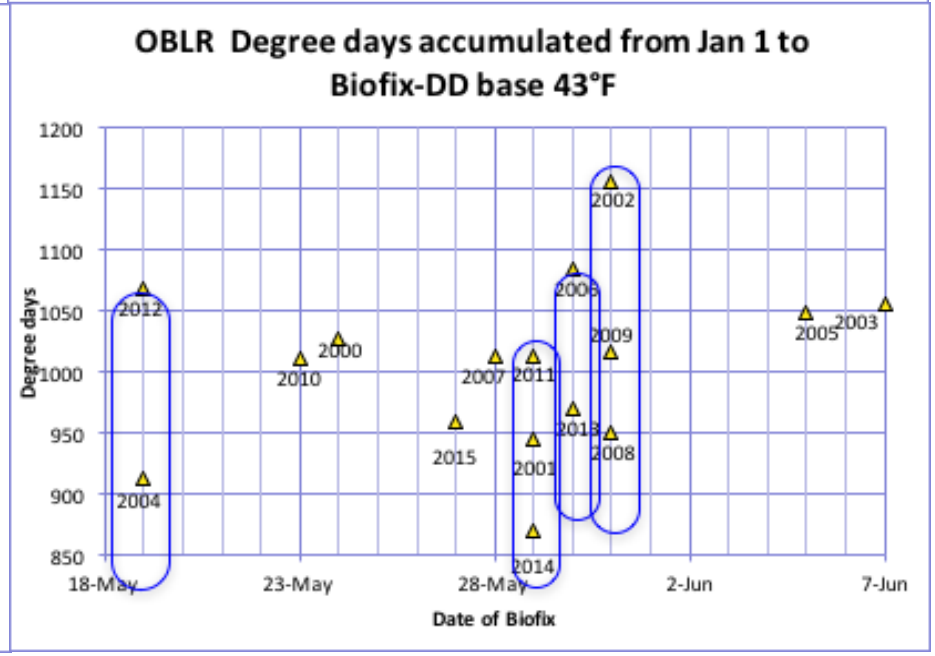
Biofix dates for fruit pests - comparison









The same location – PSU FREC Orchards

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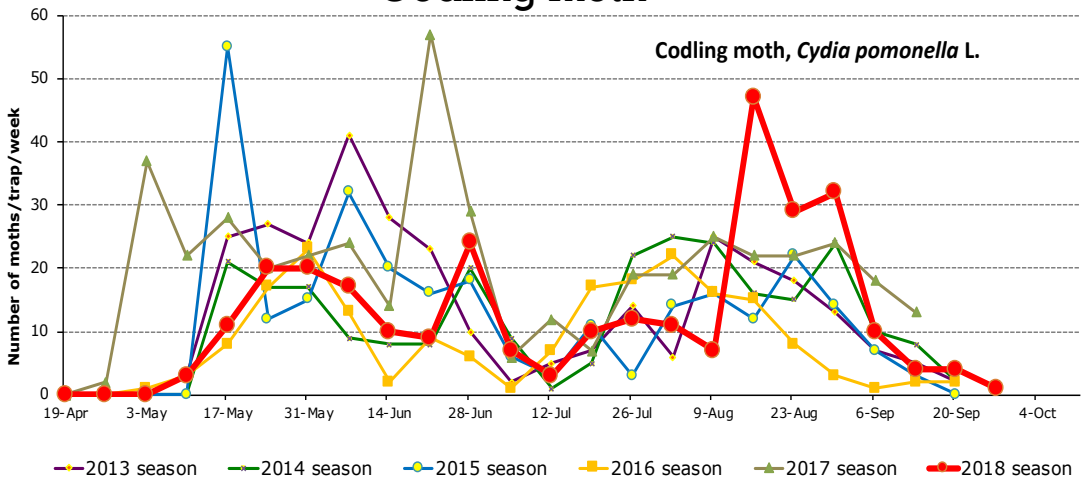
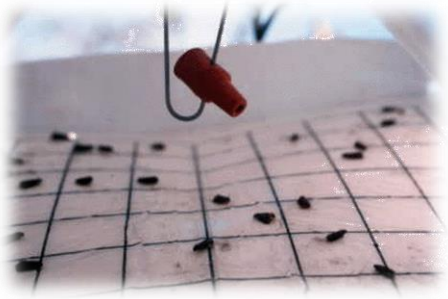
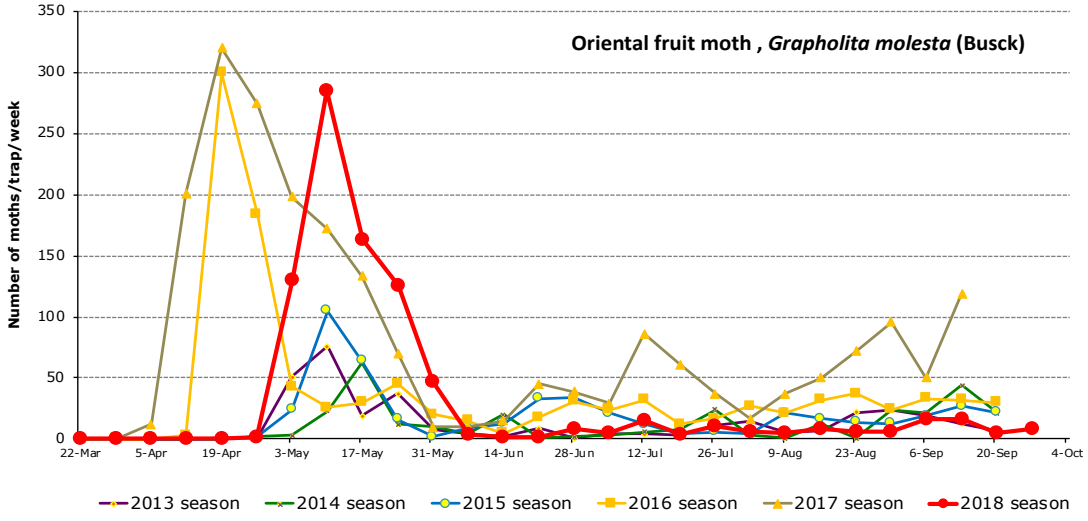
Seasonal activity of CM and OFM

Codling moth





Oriental fruit moth



Moth capture data collected from the the same PSU FREC Biglerville orchards

Moth capture information at the PSU FREC web site available during the season

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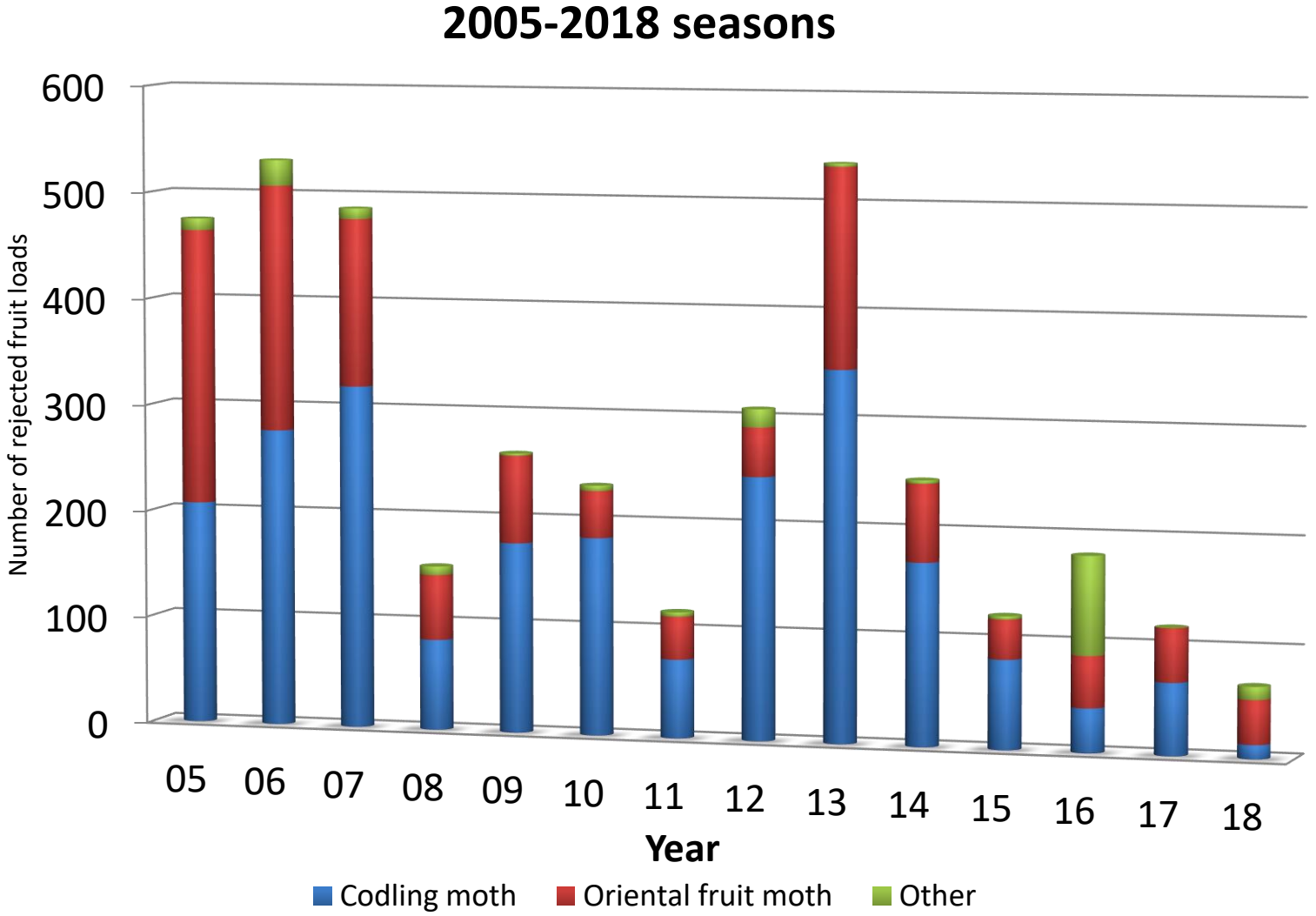
Fruit loads rejected by PA fruit processors



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Mating disruption: products

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Mating disruption products in fruit (2019)

Suterra®

CheckMate® OFM Dispenser

CheckMate® CM-XL 2.0 Dispenser

CheckMate® Puffer® OFM-O

CheckMate® Puffer® CM-OFM Pro

CheckMate® Puffer® CM-O

CheckMate® CM 2.0 Flowable

CIDETRAK® DA MEC

CIDETRAK® CMDA COMBO™ MESO-A

CIDETRAK® CMDA + LR Dual MESO™

CIDETRAK® CMDA + OFM MESO™

CIDETRAK® CM-OFM COMBO

CIDETRAK® OFM-L MESO™

TRÉCÉ® INCORPORATED

ISOMATE® DWB

ISOMATE® OFM TT

ISOMATE® CM/OFM MIST PLUS

ISOMATE® PTB DUAL

ISOMATE® CM/OFM TT

PACIFIC BIOCONTROL CORPORATION
The Market Leaders in Pheromone Mating Disruption

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Mating disruption products in fruit Borers, 2019

Dogwood **B**orer

Dogwood borer, 150-100 disp.

ISOMATE® DWB

Peach **T**ree **B**orer

Lesser **P**each **T**ree **B**orer

Lesser peachtree borer, Peachtree borer, 150 disp.

ISOMATE® PTB DUAL

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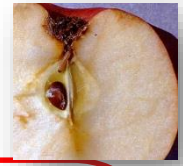
Mating disruption products in fruit

Oriental fruit moth, 2019



CIDETRAK CMDA + OFM MESO — 30-32 /ac

CIDETRAK CM-OFM COMBO — 18-32 /ac

CIDETRAK OFM-L MESO — 18-35 /ac

CheckMate Puffer OFM-O — 1-2 /ac

CheckMate Puffer CM-OFM Pro — 1-2 /ac

ISOMATE® CM/OFM MIST PLUS — 1 /ac

CheckMate OFM Dispenser — 100-200 /ac

ISOMATE® OFM TT — 50-100 /ac

ISOMATE® CM/OFM TT — 200 /ac

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Mating disruption products in fruit
Codling moth, 2019

2.4-4.8 fl oz/ac

CheckMate CM 2.0 Flowable

1-2 /ac

CheckMate Puffer CM-O

1-2 /ac

CheckMate Puffer CM-OFM Pro

1 /ac

ISOMATE® CM/OFM MIST PLUS

18A+18B /ac

CIDETRAK CMDA+LR Dual MESO

120-200 /ac

CheckMate CM-XL 2.0 Dispenser

18-36 /ac

CIDETRAK CMDA COMBO MESO-A

30-38 /ac

CIDETRAK CMDA+OFM MESO

200 /ac

CIDETRAK CM-OFM COMBO

200 /ac

ISOMATE® CM/OFM TT

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Why to use mating disruption on fruit pests?

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PA Area –Wide Mating Disruption Project Design

2006 – 2010 seasons

Program Size:

15 growers in 5 sites totaling about 1100 acres,
115 total blocks of apple, peach, pear, apricot, cherry (Adams County, PA)
Mating disruption applied on the entire farm, on all crops grown.
20 growers totaling about 1000 acres with their whole farms under mating disruption outside of Adams County

Pheromone Dispensers:

Apple/Pear blocks -- **Isomate CM/OFM TT** @ 200 disp./ac – 2006,

150-200 disp./ac – 2007 and 100-175 disp./ac – 2008

CheckMate CM/OFM Duels 2007-2008 (1 grower/year @ 150 disp.

Isomate M100 @ 100 disp./ac – 2007-2008 (mid-June)

Grant supplied 50% (2006), 30% (2007) and 20% (2008) of cost of materials

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College of Agricultural Sciences

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Changes in insecticide usage during the AWMD project

★ 3 years in WFMD program

★ Maintained low insect populations

★ Reduced insecticide output by half

Grower 2

MAY			JUNE				JULY		AUG/SEPT		
5-5	5-13	5-16	6-2	6-7	6-17	6-28*	7-6	7-15	8-8	9-9	2006: 6 complete
azinphos-methyl 561 g	azinphos-methyl 561 g	azinphos-methyl 561 g	diazinon 1121 g	methoxy fenozide 351 g phosmet 1121 g	methoxy fenozide 351 g Phosmet 1121 g	phosmet 2242 g	diazinon 561 g	phosmet 1121 g	methoxyfenozide 449 g	phosmet 1121 g	
5-5	5-13		6-7		6-17				8-8	8-13	2007: 3 complete
diazinon 50W 561 g	diazinon 50W 1121 g		methoxyfenozide 210 g		methoxyfenozide 261 g				methoxy fenozide 351 g	methoxy fenozide 351 g	
5-5			6-7		6-17				8-8	8-22	2008: 2.5 complete
acetamiprid 175 g			methoxyfenozide 561 g		methoxyfenozide 561 g/ha				rynaxypyr 68 g	rynaxypyr 68 g	
5-5	5-16		6-7		6-17		7-15				2009: 2.5 complete
acetamiprid 210 g	acetamiprid 210 g		spinetoram 158 g		spinetoram 158 g		rynaxypyr 68 g				

*Rates of formulated products are the actually applied rate in g/ha, all sprays ARM unless noted with * for complete application*

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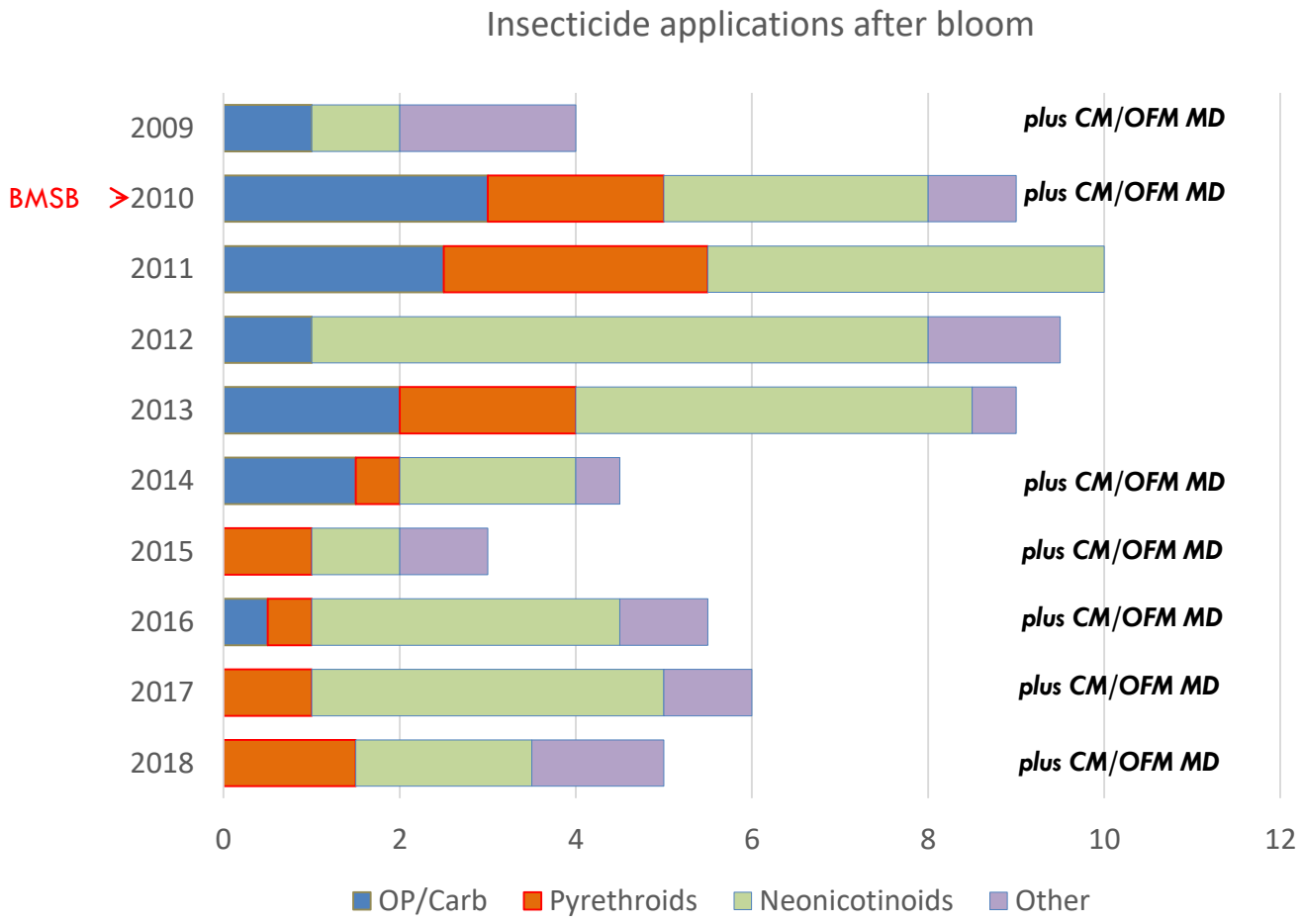
Changes in seasonal insecticide applications - apples

2009-2018 seasons

(Commercial orchard, PA)



Potential other controlled pests:

- *Codling moth*
- *Oriental fruit moth*
- *Plum curculio*
- *Japanese beetle*
- *Tufted apple budmoth*
- *Spirea aphids*
- *European apple sawfly*
- *Scales*
- *……*

Insecticides:
Carbamates (IRAC Group 1A) – methomyl,
Organophosphates (IRAC Group 1B) – phosmet,
Pyrethroids (IRAC Group 3A) – fenpropathrin, lambda cyhalothrin, bifenthrin,
Neonicotinoids (IRAC Group 4A) – acetamiprid, clothianidin, thiamethoxam, dinotefuran, thiacloprid,
Other (IRAC Groups 5, 18, 28) – methoxyfenozide, spinetoram, rynaxypyr.

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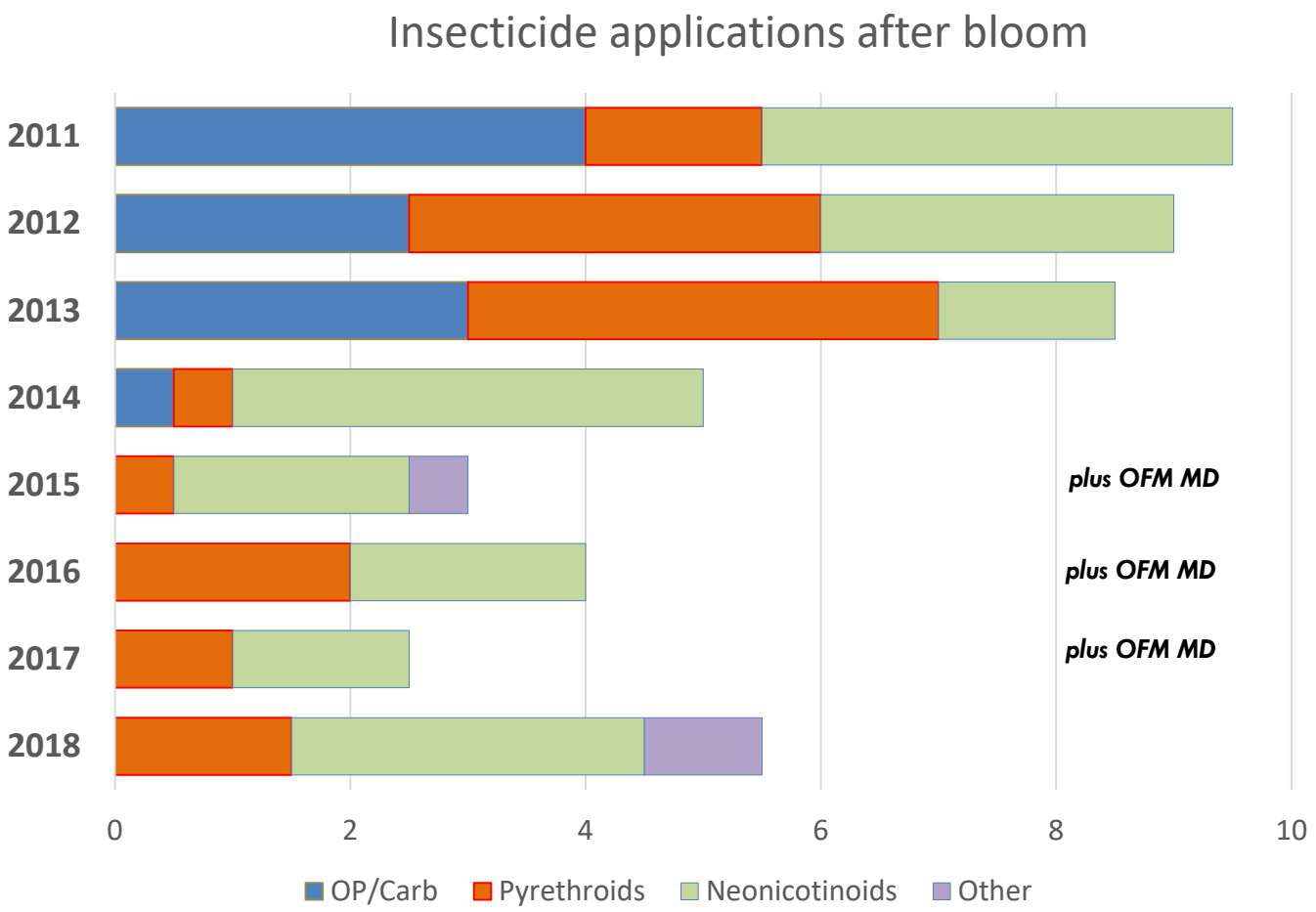
Changes in seasonal insecticide applications - peaches

2011-2018 seasons

(Commercial orchard, PA)



Potential other controlled pests:

- *Oriental fruit moth*
- *Plum curculio*
- *Japanese beetle*
- *Tufted apple budmoth*
- *Green peach aphid*
- ……

Insecticides:
Carbamates (IRAC Group 1A) – methomyl,
Organophosphates (IRAC Group 1B) – phosmet,
Pyrethroids (IRAC Group 3A) – fenpropathrin, lambda cyhalothrin, bifenthrin,
Neonicotinoids (IRAC Group 4A) – acetamiprid, clothianidin, thiamethoxam, dinotefuran, thiacloprid,
Other (IRAC Groups 5, 18, 28) – methoxyfenozide, spinetoram, rynaxypyr.

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Recent trials with codling moth and Oriental fruit moth mating disruption

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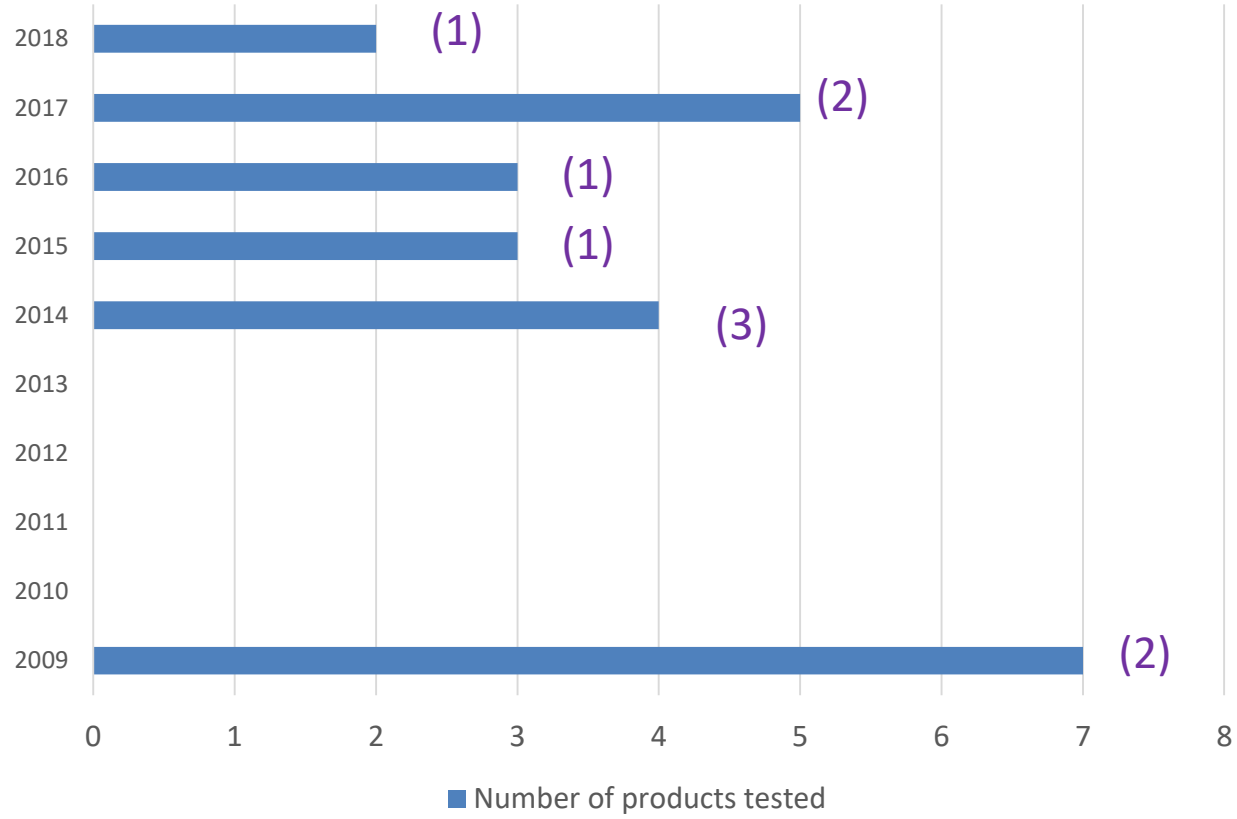
Mating disruption projects at PSU

Data from 2009-2018 seasons



Companies with MD products:

Hercon
Pacific Biocontrol/CBC America
Suterra
Trece

(x) – number of pheromone companies with products included for testing per season

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Mating disruption trials

2014 CM/OFM mating disruption trials

Sites and activities:
Three commercial orchards plus PSU FREC
Pheromone traps monitored weekly
In season and harvest fruit evaluations

Suterra LLC MD products:
Puffer CM-OFM – standard, 1 dispenser/acre
Puffer SPX-PM1 - experimental (0.5x pheromone load rate)

TRECE Inc. MD products:
CIDETRAK CM/OFM Meso, 32 dispensers/acre, apples (experimental)
CIDETRAK CM/OFM – 150 dispensers/acre, apples
CIDETRAK OFM Meso, 30 dispensers/acre, peach (experimental)
CIDETRAK OFM only, 150 dispensers/acre, peach

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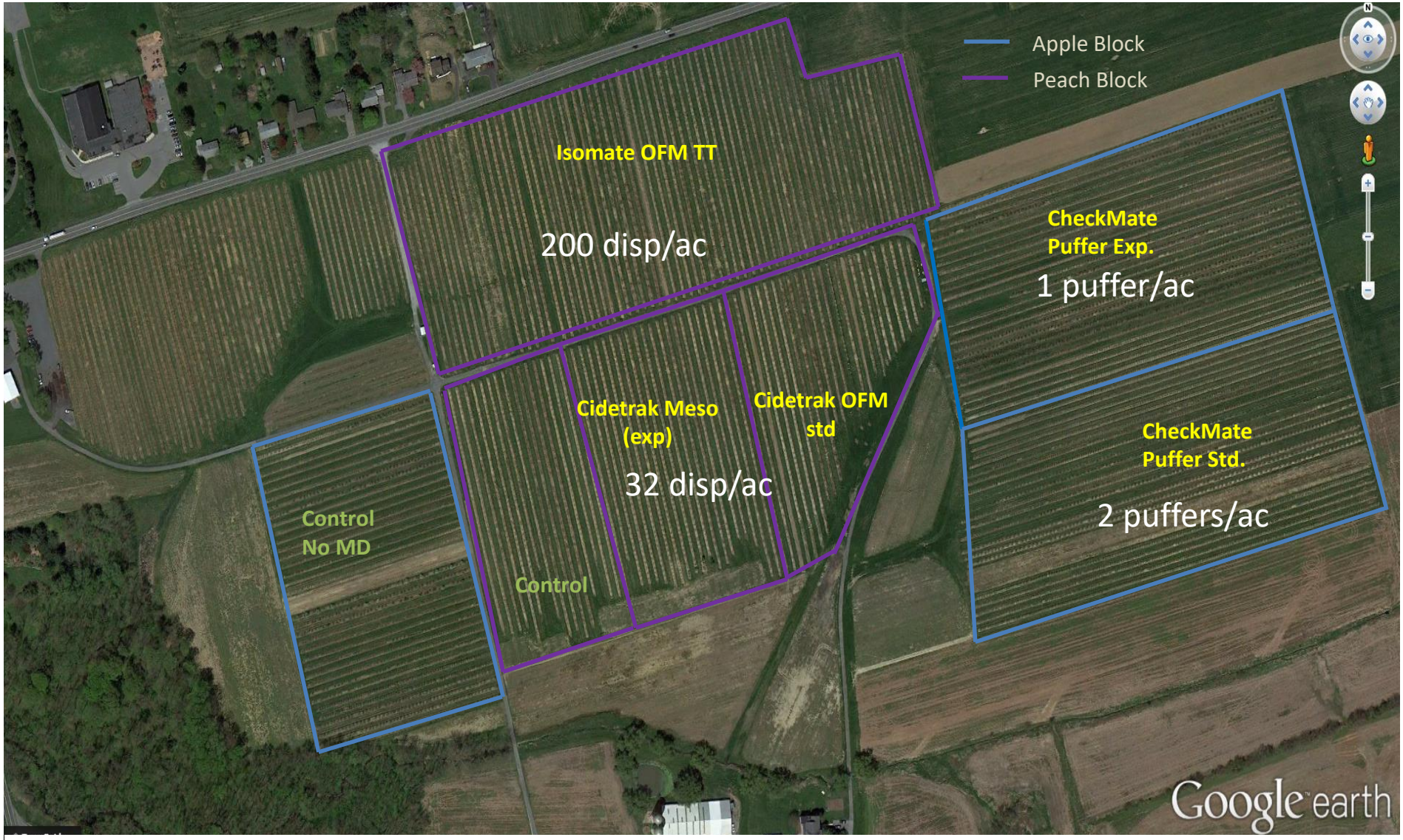
Mating Disruption Project

Adams County, 2014



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2014 Mating disruption trials apples

Treatment	Percent injured fruit at harvest (apples only)	
	CM	OFM
Puffer CM/OFM (exp)	0.0 a	0.0 a
Puffer CM/OFM	0.0 a	0.0 a
Cidetrak Meso (exp)	0.0 a	0.0 a
Cidetrak CM/OFM	0.0 a	0.0 a
Isomate CM/OFM TT	**0.0 a**	**0.0 a**

Harvest fruit evaluations, averages from 3 commercial orchards




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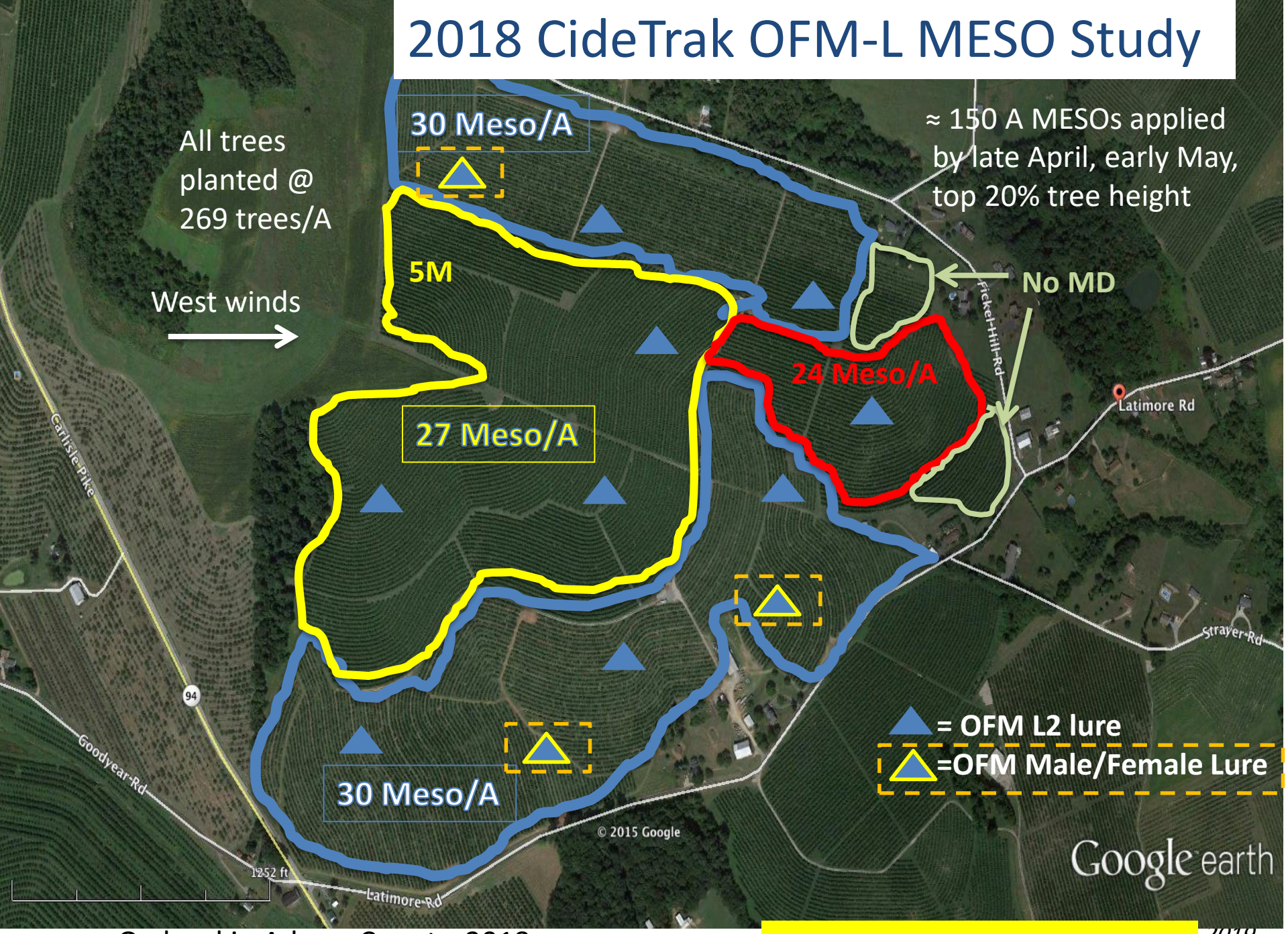
2018 CideTrak OFM-L MESO Study



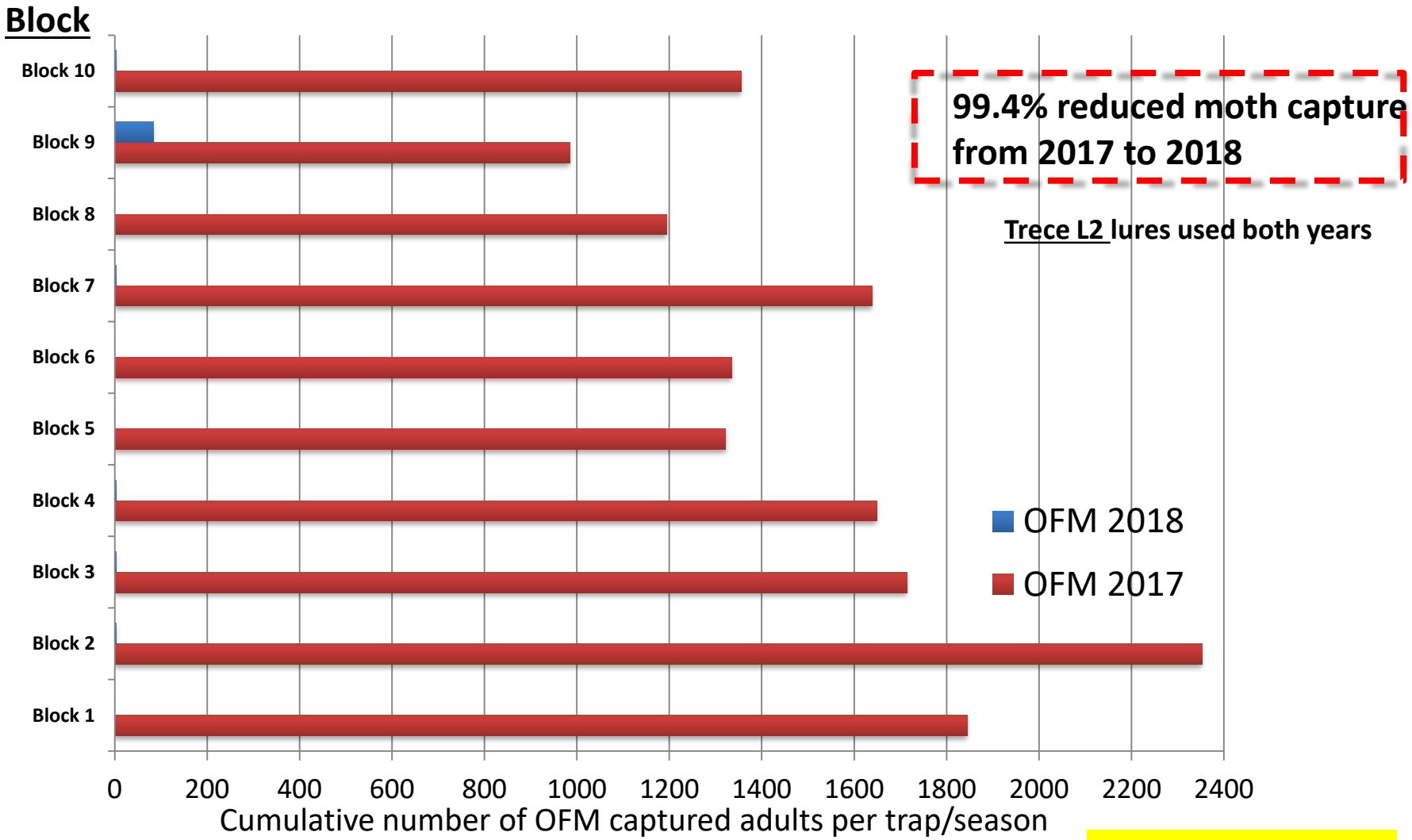
Orchard in Adams County, 2018

Data from Hull Pest Management Services

2019

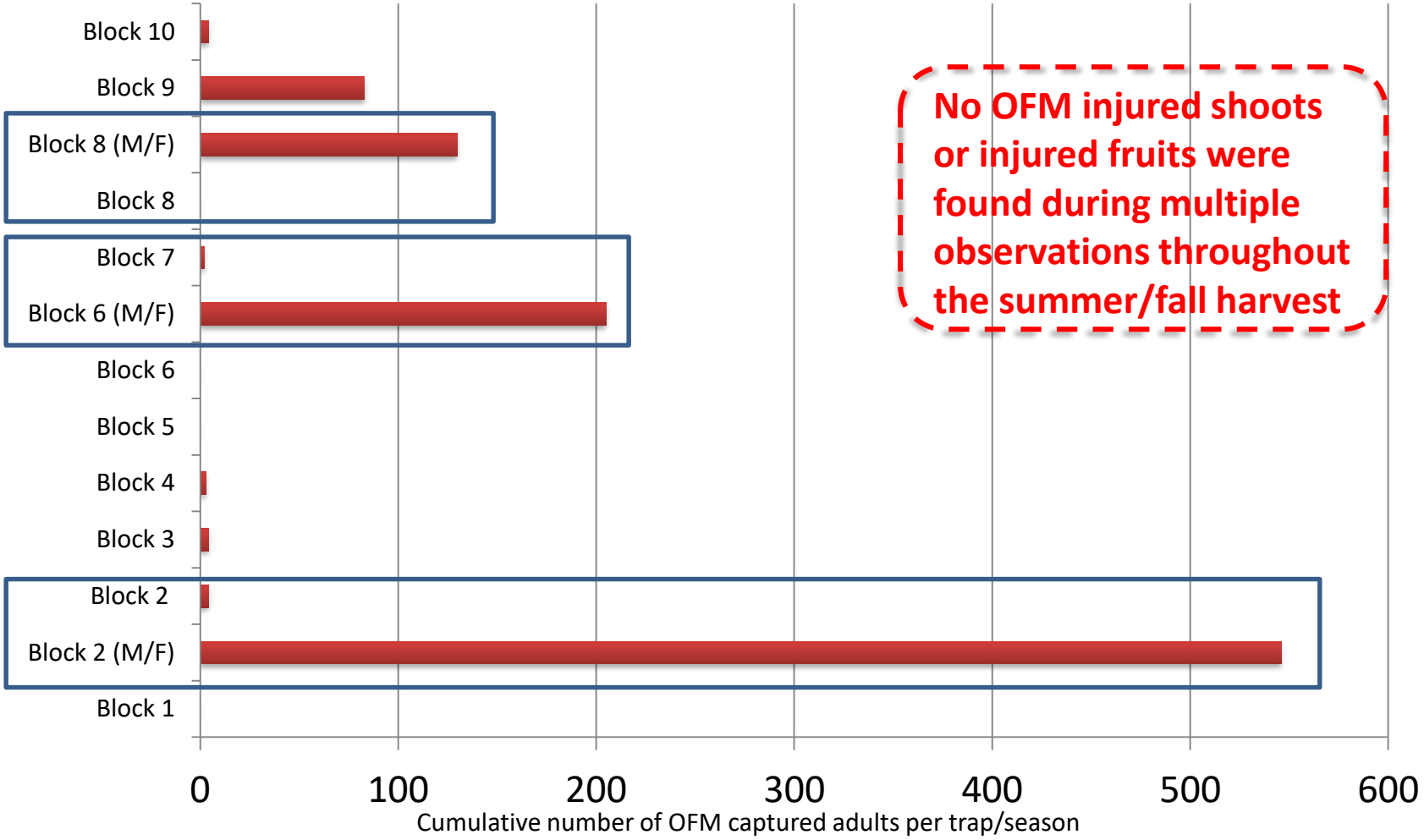
OFM Moth Capture –

Orchard with No MD (2017) vs CideTrak OFM-L MESO (2018)



OFM Total Moth Capture

CideTrak OFM-L Meso Study – OFM capture in L2 and M/F traps



M/F = OFM Male/Female Lure Trap

***Moth capture from 5/2 to 9/19**

Data from Hull Pest Management Services

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OFM Pheromone Trap Catch Thresholds for Apple and Peach in Pennsylvania

Orchard without OFM mating disruption

No. adult males/trap/week			
Brood 1*		Broods 2-4*	
Apple	Peach	Apple & Peach	Recommended action
0 – 15	0 – 5	0 - 5	Not a problem
16 – 30	6 – 15	6 – 10	Potential problem
31 – 60	16 – 30	11 – 25	Treatment required
>60	>30	>25	Severe problem

**average moth captures from a minimum of 2 traps per 5-7 ha*
(Recommendations from the 2018-2019 PSU Tree Fruit Production Guide)

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Monitoring lures

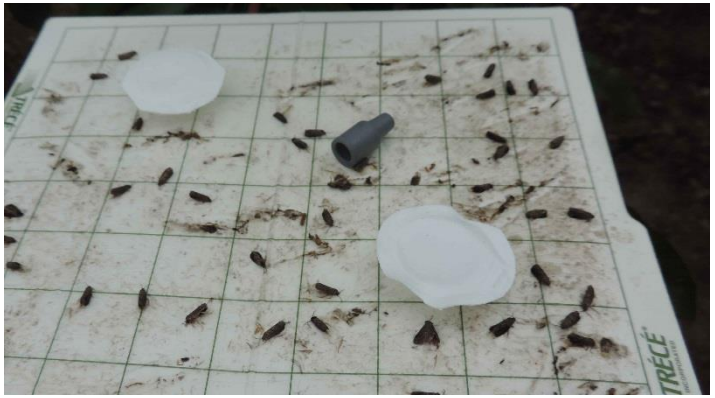
- **Codling moth** monitoring lures:

  Pherocon ® CM DA Combo (8 week lure)

  Pherocon ® CM DA Combo + AA (8 week lure)

  Pherocon ® CM LL (12 week lure)

  Pherocon ® CM lure (4 week lure)



- **Oriental fruit moth** monitoring lures:

  Pherocon ® OFM Combo Dual (6-8 weeks lure)

  Pherocon ® OFM LL (12 week lure)

  Pherocon ® OFM (4 week lure)

Plus various lures from AlphaScent ®, Suterra ®, Scentry ® , AgBio® and others…..

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OFM Pheromone Trap Catch Thresholds for Apple and Peach in Pennsylvania

With MD treatments ???

No. adult males/trap/week			
Brood 1*		Broods 2-4*	
Apple	Peach	Apple & Peach	Recommended action

?

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CM and OFM available **mating disruption** products

2019 season (based on information provided by manufacturers)

Codling moth

- CheckMate® CM-XL 2.0
- Cidetrak ® CMDA Combo Meso-A
- Cidetrak® DA MEC
- CheckMate® CM 2.0 F
- CheckMate® Puffer CM

Oriental fruit moth

- CheckMate® OFM
- Cidetrak® OFM-L MESO
- Isomate® OFM TT
- CheckMate® OFM-F
- CheckMate® Puffer OFM

CM and OFM

- Cidetrak® CM-OFM Combo
- Cidetrak® CMDA +OFM MESO
- Isomate® CM/OFM TT
- CheckMate® Puffer CM/OFM Pro
- Isomate® CM/OFM Mist Plus

Hand applied dispensers;
30-200 dispensers/acre;

Aerosol dispensers;
1-3 dispensers/ac;

Sprayable;
aiblast applications.







“Ghost trap “ for BMSB

2013-2018 seasons

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BMSB captures in “ghost traps”

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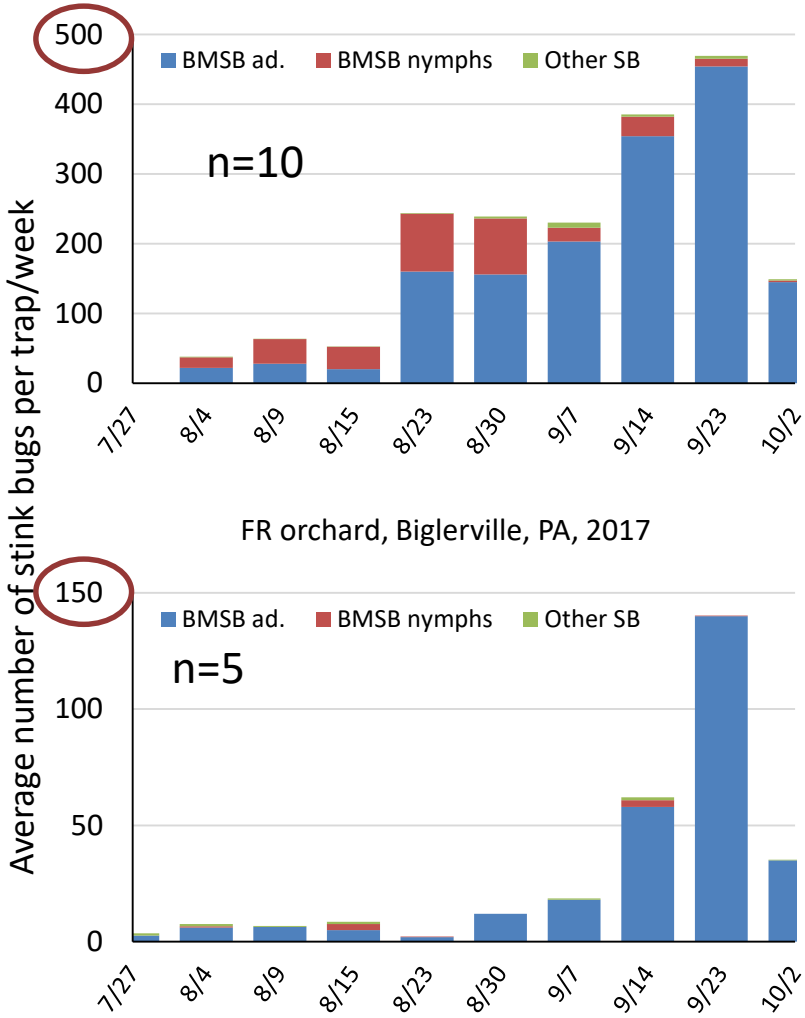
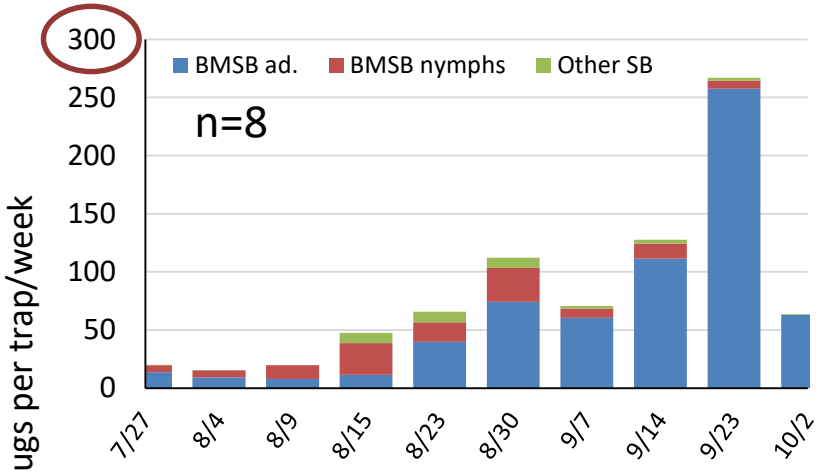
Average SB captures in "ghost traps"

2017 season

JL orchard, York Spring, PA, 2017

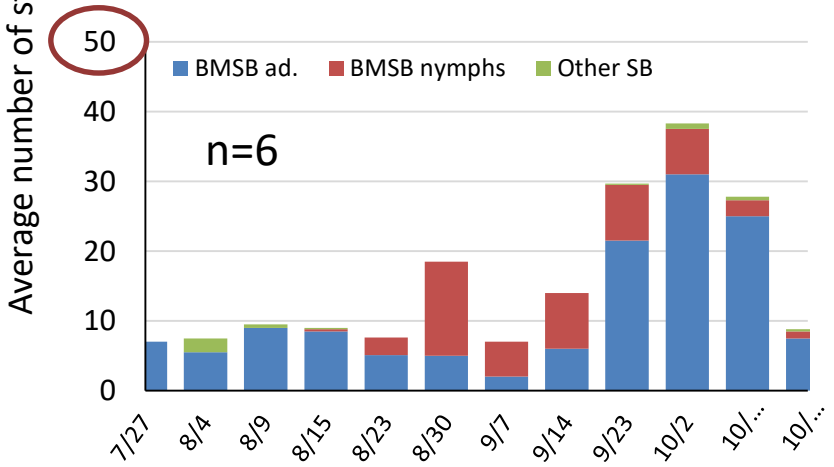


BH orchard, Biglerville, PA, 2017



FR orchard, Biglerville, PA, 2017

CH orchard, Lancaster, PA, 2017



n- number of ghost traps per site

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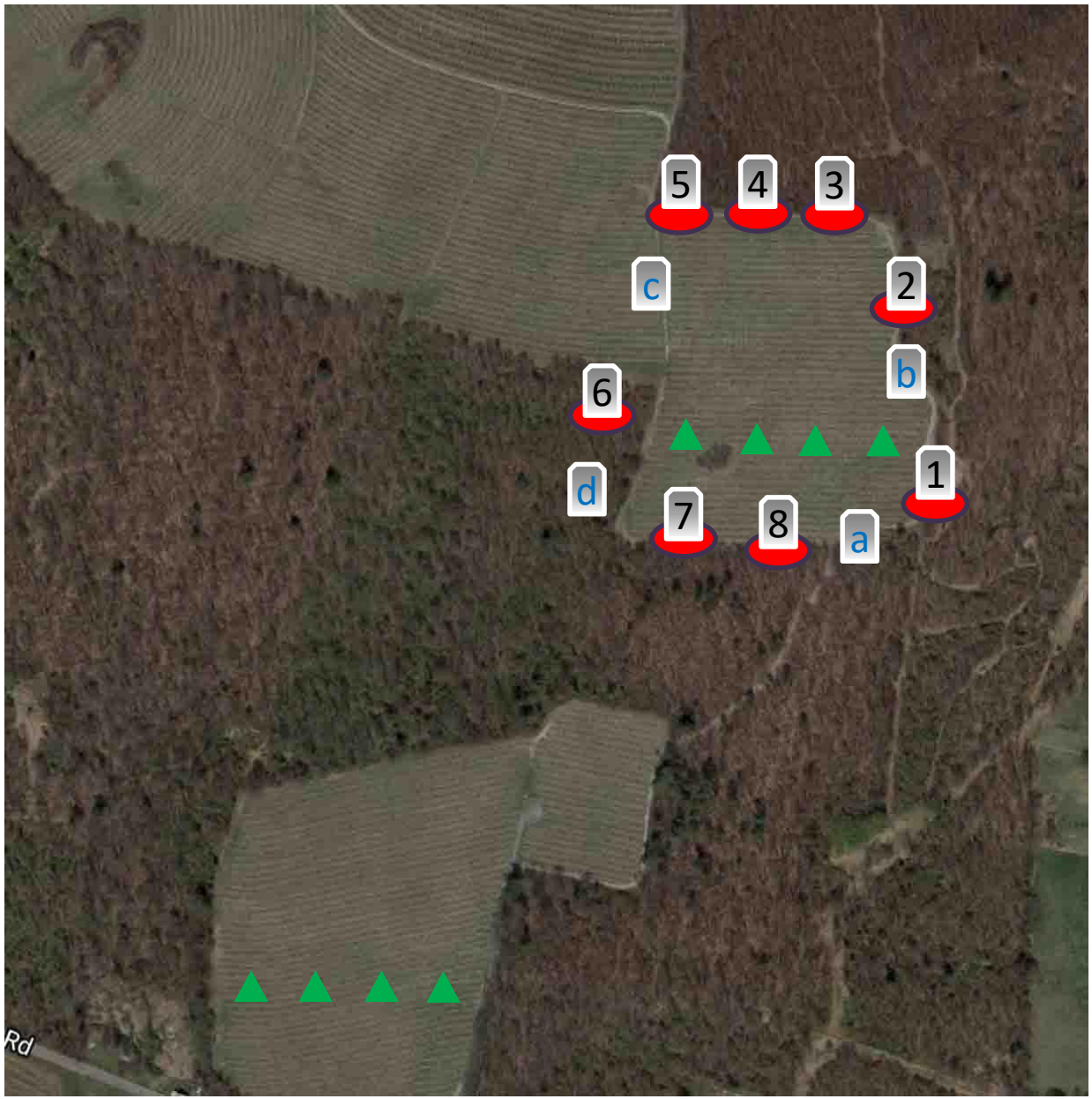
BMSB captures in monitoring traps

BL Orchard, 2017

BMSB	Ghost traps	Control
Adults	**0.58 a**	**2.86 b**
Nymphs	**0.31 a**	**1.28 b**

Average BMSB captures per trap/week. Rescue traps baited with Ag Bio lures. Four traps per treatment

Each block had 20 plus acres



a Ghost trap

1 Ghost trap with tarp

Monitoring trap

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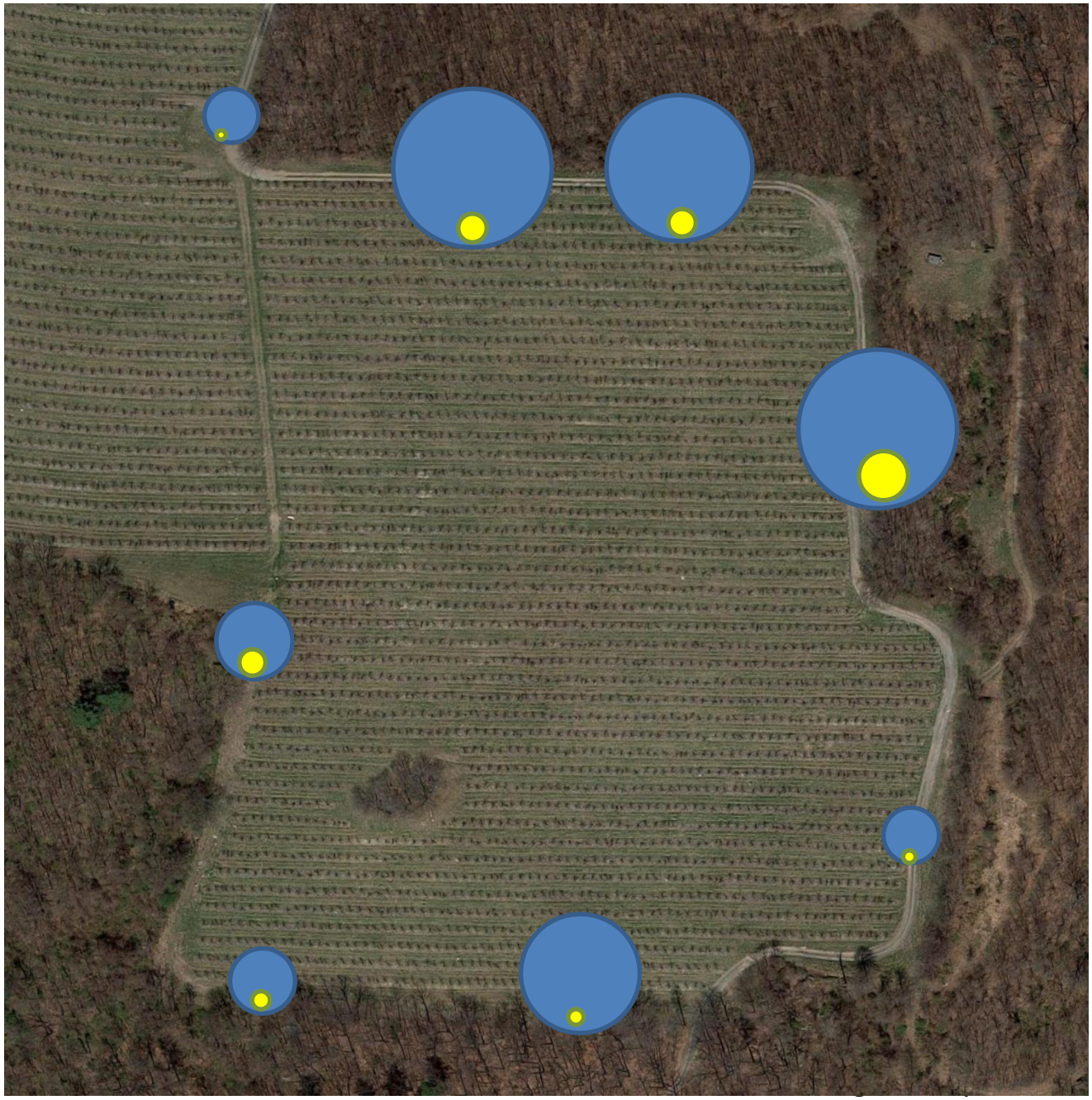
BMSB captures in ghost traps

BL Orchard, 2017

2351 BMSB adults

2351 BMSB nymphs

*Size equivalent of **2351** dead SB*



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BMSB ghost traps, lure load comparison

Adams County, 2018

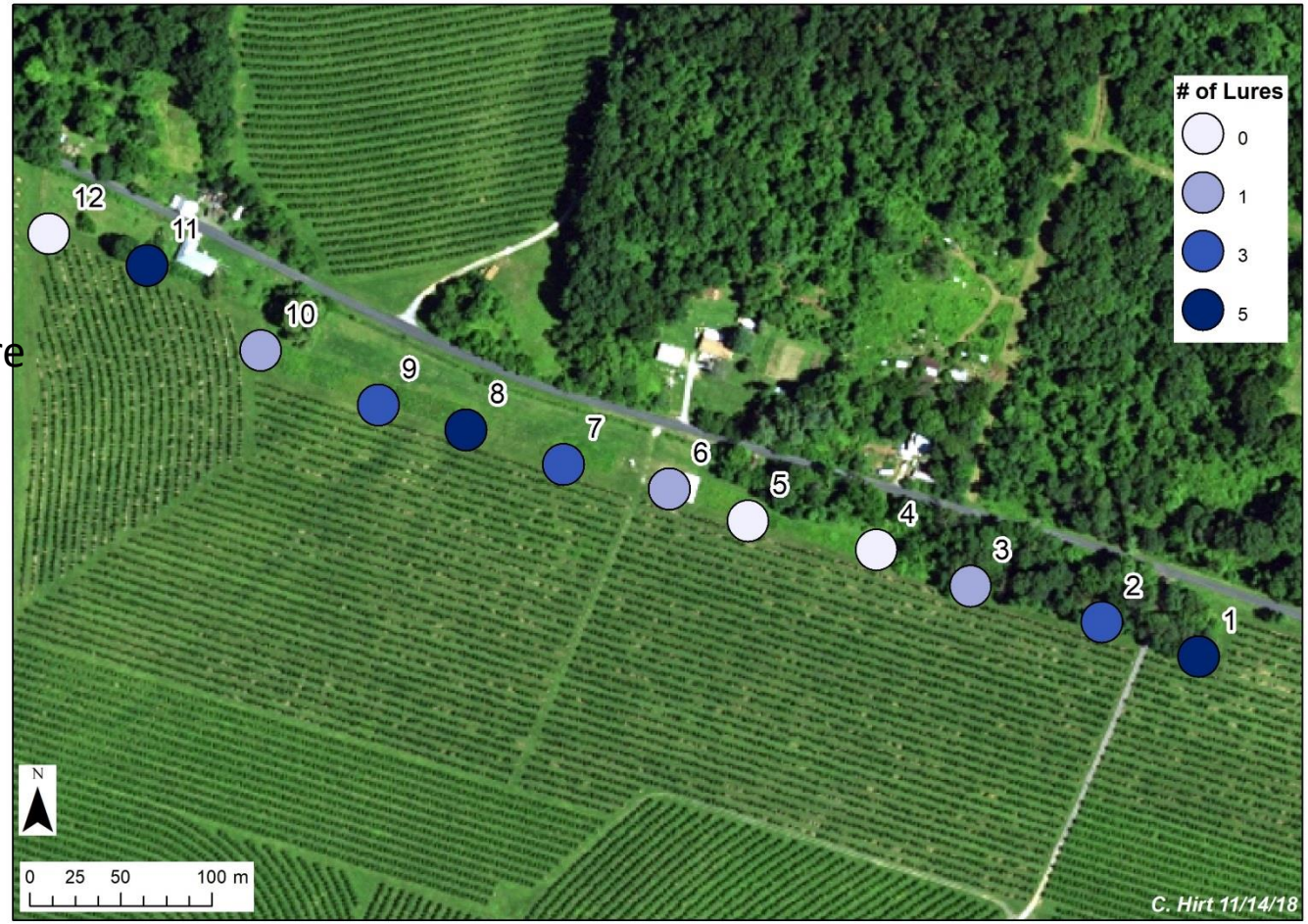
Trap:
8 ft tall ghost traps
with D-Terence® net;
(Vestergard Frandsen)

Lure:
Pherocon® BMSB Dual lure
(Trece, Inc)

Dose:
1x, 3x, 5x and 0 (control)

Duration:
Aug 01 - Oct 15, 2018

Traps checked weekly
Traps spaced 150 ft apart



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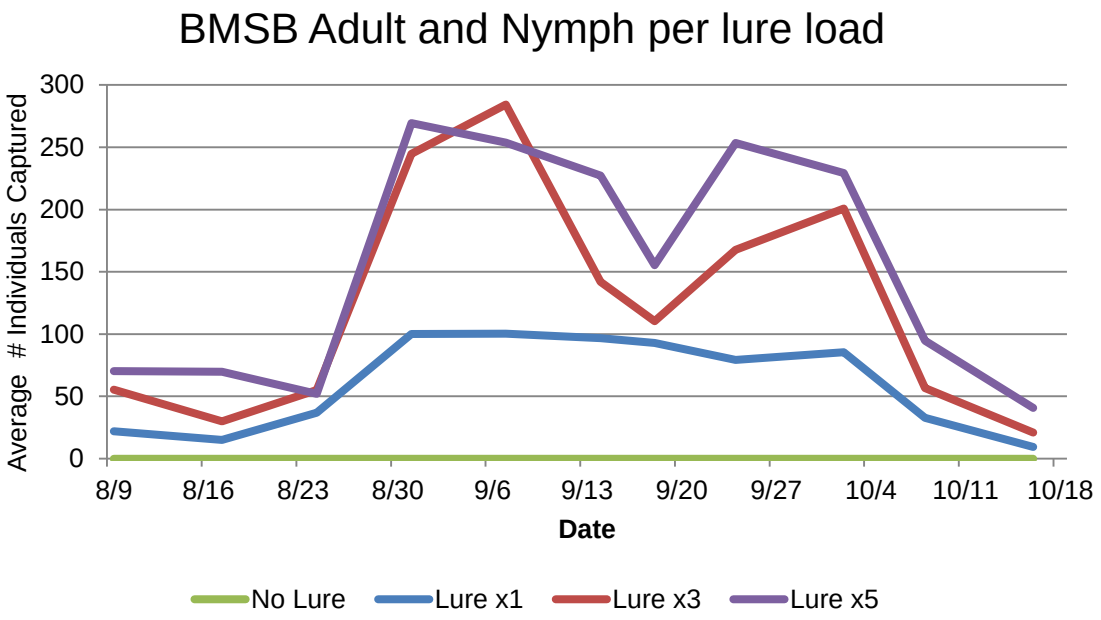
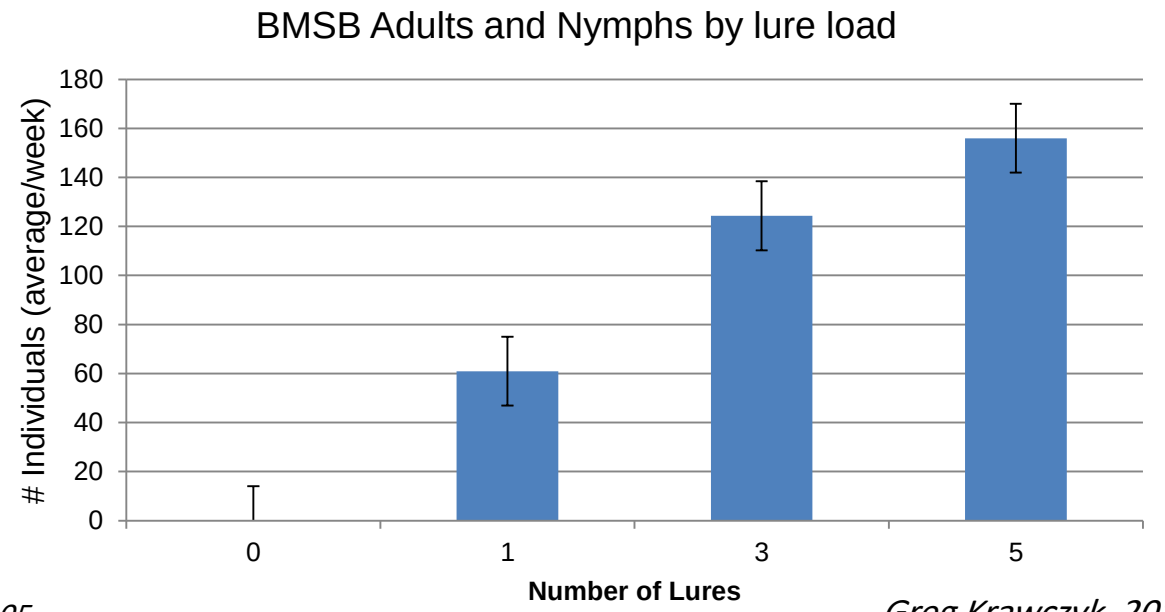
Lure load comparison, 2018

Orchard LB, Adams County, PA





ANOVA, LSD test, sqrt x transformation, p≤ 0.05

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BMSB ghost traps, net age comparison

Lancaster County, 2018

Trap:
8 ft tall ghost traps
with D-Terence® net;
(Vestergard Frandsen)

Lure:
Pherocon® BMSB Dual lure
(Trece, Inc), 3 lures/trap

Treatments:
Year 1 net
Year 2 net,
Legacy net (2plus)
Pyramid trap

Duration:
Aug 01- Oct 15, 2018

Traps checked weekly
Traps spaced 150 ft apart

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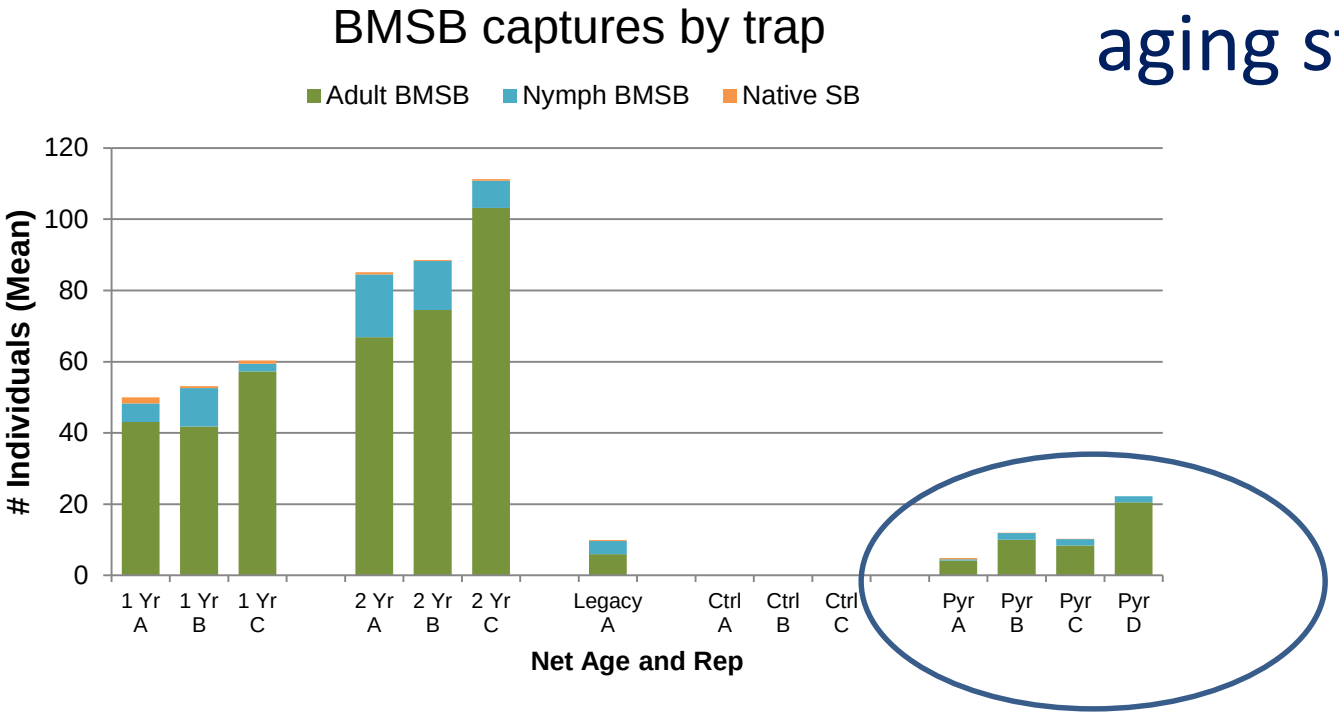
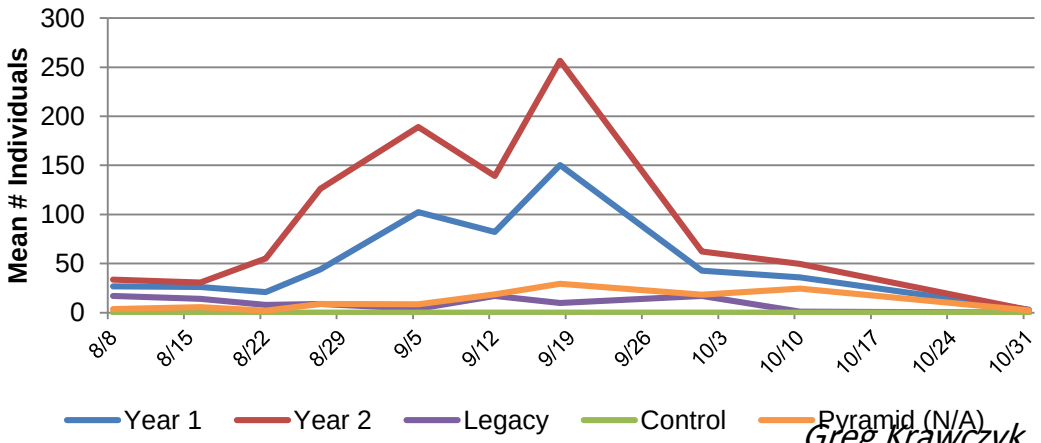
CH orchard, ghost traps aging study, 2018





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Summary

Monitoring of insect pests in orchards constitute the basis for effective and economical pest management practices;

Combination of mating disruption products with effective insecticides products provides excellent control of codling moth and Oriental fruit moth;

Traditional high density materials (e.g., Isomate, Checkmate or Cidetrak hand applied dispensers) and newly registered low labor mating disruption products (e.g., CheckMate puffers, Isomate Mist or Cidetrak Meso product) provided excellent control of internal fruit feeders;

Combinations of BMSB targeted treatments with available soft and selective management tools for the control of internal feeders will help to revive practical long term benefits from effective integrated pest management (IPM).

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Thank you

- Projects supported by funding from the State Horticultural Association of Pennsylvania
- Mating disruption products and monitoring materials provided by Hercon®, Suterra®, and Trece ®.

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