New Materials vs. Old Pests
New Monitoring for New Pests

Maine State Pomological Society
Preseason Tree Fruit Meeting
March 6, 2019
Lewiston Auburn College, Lewiston ME

Cornell University

Hudson Valley Research Laboratory

THE JENTSCH LAB

INSECT BIOLOGY, ECOLOGY, AND MANAGEMENT IN HUDSON VALLEY AGRICULTURAL COMMODITIES

WELCOME ENTOMOLOGY BROWN MARMORATED STINK BUG INVASIVES ORGANIC AG. RESEARCH TREE FRUIT THE HEIRLOOM ORCHARD VEGETABLE SWEET CORN SMALL FRUIT GRAPE IN THE NEWS

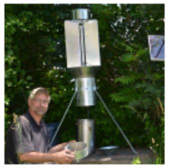
Welcome to the Jentsch Lab

HVRL ENTOMOLOGY STAFF

Research Our research and extension outreach program is directed by Cornell University's Department of Entomology and located at the Hudson Valley Research Laboratory (now FARM), in Highland, NY. We are a part of the New York State Agricultural Experiment Station in Geneva, NY, with the laboratory building owned by a non-profit cooperative tree fruit grower organization (HVRL Inc.).

Partnership This cooperative partnership with the College of Agriculture and Life Science (CALS), Cornell Cooperative Extension (CCE) and the Eastern New York Commercial Horticultural Program (ENYCHP) providing continuous agricultural Research and Extension to the agricultural community on Tree Fruits and Vegetables in the Hudson Valley since 1923.

Education Research-based extension outreach continues to provide valuable problem solving solutions to New York farmers through educational programs organized by Cornell Cooperative Extension and participating associations. Horticultural plant protection programs at the Hudson Valley Lab are especially important to sustaining the viability of agriculture in the Hudson Valley and Northeast as agricultural production is ultimately the best way to preserve open space and economic stability in the rapidly developing corridor between Albany and New York City.



Search

2017 BLOG PAGES

- Workshop Announcement: 'Pre-Bloom Decision Making for Your Orchard' Friday March 8th 2019, 2-5PM; HVRL February 22, 2019
- Entomology presentations available on-demand: 2019 ENYCHP Winter Fruit Schools Desmond Hotel & Conf Ctr., Albany, NY February 20, 2019
- Workshop Announcement: March 8th 2019 'Pre-Bloom Decision Making for Your Orchard' January 25, 2019
- Celebrating the Life of a Tree Fruit Grower and Dear Friend: Remembering Leonard Clarke January 16, 2019
- Last Chance To Sign Up: The Heirloom Orchard: A Three-Day Series on Estate Orchard

blogs.cornell.edu/jentsch/

Cornell University Hudson Valley Research Laboratory

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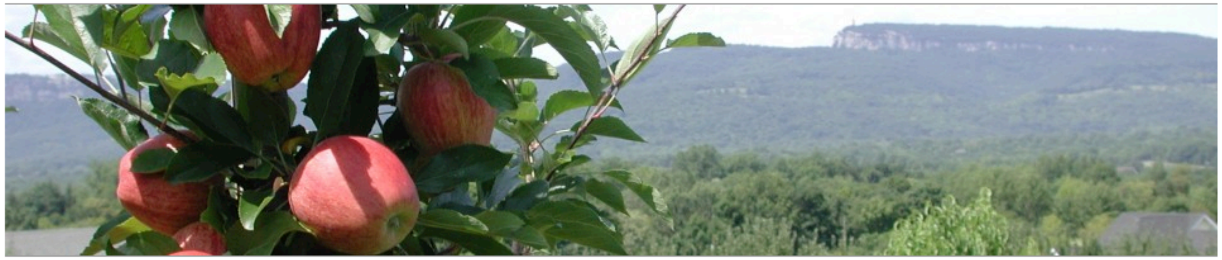

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Extension Publications

Plant Protection Presentations

On-Farm Research

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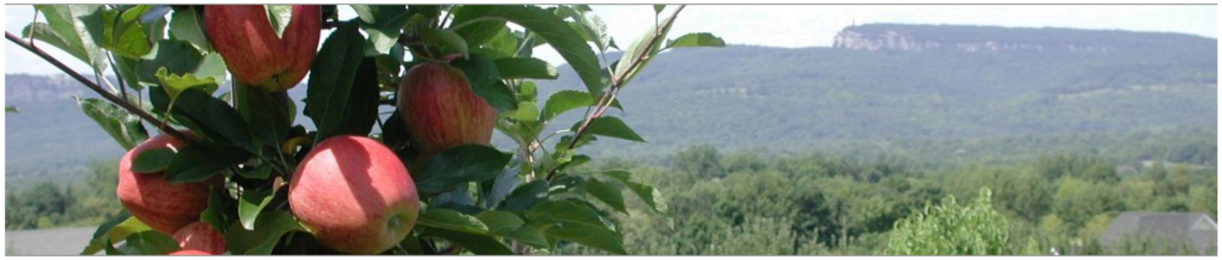

WELCOME | ENTOMOLOGY | BROWN MARMORATED STINK BUG | INVASIVES | ORGANIC AG. RESEARCH | TREE FRUIT | THE HEIRLOOM ORCHARD | VEGETABLE | SWEET CORN | SMALL FRUIT | GRAPE | IN THE NEWS

Plant Protection Presentations

Fruit Production IPM Presentations:

2018

New Materials vs. Old Pests New Monitoring for New Pests

Biological Control of Brown Marmorated Stink Bug, Halyomorpha halys Stål (Hemiptera: Pentatomidae) in NYS, Red Tomato Annual Growers Meeting, March 1, 2019, Henry A. Wallace Center, Hyde Park, NY

Invasive Insect Tsunami: Managing BMSB in NYS Orchards.

Developing Exclusion and Attract-and-kill Strategies To Manage Spotted Wing Drosophila In Raspberry PYO Production. 2019 ENYCHP Winter Fruit Schools Desmond Hotel & Conf Ctr., Albany, NY

Managing Brown Marmorated Stink Bug and Spotted Wing Drosophila in NYS. 2019 Lake Ontario Winter Fruit SchoolsMonday & Tuesday, February 4-5th, 2019

Insecticide Efficacy for Insect Management of Tree Fruit In Eastern NY, Long Island Agricultural Forum, Riverhead, NY January 9th, 2019

The Heirloom Orchard: A Three-Day Series on Estate Orchard Management. Saturday Dec 8th, 15th, 22nd 2018 @ HVRL

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New Materials vs. Old Pests

New & Old Insecticide Updates

Bio-Pesticides

Tree Fruit Insecticide Efficacy Studies

New Monitoring Methods and Trials

Insecticides for NYS

Over the past 25 - >50 Years (Prior to FQPA)

Organophosphates

Chlorpyrifos (Lorsban)
Diazinon
Malathion
Phosmet (*Imidan)

- Broad Spectrum / Contact Activity
- Neurotoxins, targeting nicotinic acetylcholine receptors (nAChR)
- Harmful to mammals & humans

Carbamates

Carbaryl (Sevin)
Methomyl (*Lannate)
Oxamyl (*†Vydate)

- Pome fruit crop load reduction / thinning agent
- ERM / TSSM / ARM flare-ups likely
- Reduced biological control (increase of STLM/Aphid)

Pyrethroids

Bifenthrin (*Brigade)
Esfenvalerate (*Asana XL)
Fenpropathrin (*Danitol)
Lambda-cyhalothrin (*Warrior)
Permethrin (*Pounce)

- 'Usre Friendly' – low mamalian toxicity
- Relatively low rates compared to OP's
- Reduced biological control (increase of WAA)
- Suppression of ERM / TSSM / ARM
- Yet, mite flare-ups likely after use ends

Insecticides for NYS

Over the past 10 - 20 Years (Post FQPA*)

Organophosphates

Chlorpyrifos (Lorsban)
Diazinon
Malathion
Phosmet (*Imidan)

Carbamates

Carbaryl (Sevin)
Methomyl (*Lannate)
Oxamyl (*†Vydate)

Pyrethroids

Bifenthrin (*Brigade)
Esfenvalerate (*Asana XL)
Fenpropathrin (*Danitol)
Lambda-cyhalothrin (*Warrior)
Permethrin (*Pounce)

Avermectin *(penetrant required)*
Abamectin **(Agri-Mek, Agri-Flex, Abba)**

Bacillus thuringiensis (Bt, Dipel, Deliver) *(short UV field life)*

Spinosyns
Spinosad **(Spintor - Organic)**
Spinetoram **(Delegate)**

IGR's *(Excellent Soft SJS, CM (egg), Lep materials)*
Buprofezin **(Centaur)**
Novaluron **(Rimon)**, Pyriproxyfen **(Esteem)**
Methoxyfenozide **(Intrepid)**

***Neonicotinoids** – *Translaminar (penetrant)* contact & locally systemic
Neurotoxins, targeting nicotinic acetylcholine receptors (nAChR), OP replacement

Acetamiprid **(Assail)**
Imidacloprid **(*Admire Pro)**
Thiamethoxam **(*†Actara)**

Insecticides for NYS

Over the past 5 - 10 Years

Pyridinecarboxamide (*systemic, supression of feeding*)

Flonicamid **(Beleaf) – WAA Mgt.**

Oxadiazine *(Soft, broad spectrum)*

Indoxacarb (**Avaunt) – Alt. for OP's - PF-2C - PC, EAS, Lep. Complex (OW OBLR, GFW, OFM)**

Anthranilic Diamide *(Soft, excellent for the lepidopteran complex)*
Chlorantraniliprole **(Altacor)** (*narrow spectrum)*
Cyazypyr **or** Cyantraniliprole **(Exirel)** *(Broad spectrum) –* ***PC Mgt.***

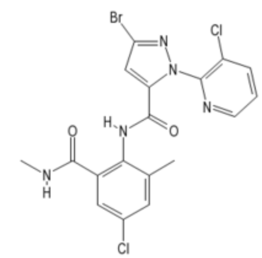
Pre-Mixes *(many not equivelant to high rate of each active ingredient, broad spectrum)*

- Chlorantraniliprole/Lambda-cyhalothrin **(Voliam Xpress,** now named **Besiege)**
- Chlorantraniliprole/Thiamethoxam **(Voliam Flexi)**
- Cyfluthrin/Imidacloprid **(Leverage)**
- **L**ambda-cyhalothrin/Thiamethoxam **(Endigo)**
- Thiamethoxam/Abamectin **(Agri-Flex)**
- Zeta-Cypermethrin/Avermectin B1 **(Gladiator)**

Insecticides for the Northeast
New / Novel

Biological Insecticides
Burkholderia spp. strain A396 (**Venerate**) *Marrone Bio Innovations*
Chromobacterium subtsugae (**Grandevo**) *Marrone Bio Innovations*
Granulosis Virus (**Carpovirusine, Cyd-X, Madex**) Codling Moth only

Neonicotinoid
Sulfoxaflor (**Closer**) – Feeding Suppression (BMSB)
Flupyradifurone **(Sivanto 250SC; Prime)** nicotinic acetylcholine inhibitor, SJS suppression, aphids



Anthranilic Diamides (Ryanodine – disrupts calcium pathway release)
Cyazypyr **or** Cyantraniliprole **(*†Exirel)** Broad spectrum, Lep & PC activity
Cyclaniliprole (†**Harvanta 50SL** (ISK Corp.)) Broad spectrum

---

Pre-mix
Cyantraniliprole (Exirel)/ Abamectin (AgriMek) **(Minecto Pro)**
Novaluron (Rimon IGR) / Acetamiprid (Assail) **(Cormoran)**

2019 Insecticide Registrations Updates

Grandevo (Chromobacterium subtsugae) Marrone Bio Innovations

- EPA Reg. No. 84059-17
- A microbial containing fermentation solids from a bacterium, labeled against **internal feeding leps** and **leafrollers** in pome and stone fruit.
- stomach poison, impacting feeding, fecundity and oviposition
- OMRI-approved
- Low toxicity to bees and most beneficials.

2019 Insecticide Registrations Updates

Sivanto Prime (flupyradifurone)

EPA Reg. No. 264-1141

- In the butenolide class (IRAC 4D)
- Registered in pome fruits against aphids (except WAA), leafhoppers, San Jose scale, and pear psylla.
- EPA Reduced-Risk, low bee toxicity and safe to beneficials.

Not yet available in Suffolk & Nassau Counties except under FIFRA Section 24 (C), special needs label.

2019 Miticide Registrations Updates

Banter SC (bifenazate)

EPA Reg. No. 70506-322

- Acaricide registered in pome and stone fruit
- Same a.i. as *Acramite*, WDG & SC formulations

Onager Optek (hexythiazox)

EPA Reg. No. 10163-337

- Liquid (emulsion) formulation same a.i. as *Savey*
- Acaricide registered in pome and stone fruit

2019 Insecticide Registrations Updates

Cidetrak CMDA Combo Meso-A

Codling moth pheromone mating disruption

EPA Reg. No. 51934-16

- Dispenser registered in pome fruits
- "Meso" formulation releases for 120-150 days
- **Hand-applied at 18-36 dispensers per acre**.
- Monitor CM using high release lures
- Apply insecticides 1st yr; along boarders 2nd yr.
- Very effective combined with CM granulosis virus

2019 Insecticide Updates: On The Horizon

Versys Inscalis: BASF Corporation

Active ingredient – Afidopyropen

EPA Reg. No. 7969-389

TRP Ion channel feeding inhibitors (IRAC 9D)

- Novel mode of action: **disrupts behavior** including feeding in target insects
- Green & Rosy apple aphid at 1.5 oz./A
- Woolly apple aphid suppression at 3.5 oz./A

Not yet available in Suffolk & Nassau Counties

2019 Insecticide Updates: On The Horizon

Harvanta: Active ingredient cyclaniliprole

SummitAgro USA

- EPA Reg. No. 71512-26-88783
- Diamide class (IRAC 28)
- Same mode of action as Altacor and Exirel
- Activates ryanodine receptors preventing muscle contraction.
- **Plum curculio and Leps in apples and peach**
- Small fruit uses for spotted wing Drosophila
- Low toxicity to bees

2019 Insecticide Updates: On The Horizon

NICHINO AMERICA®

PQZ: Nichino America

Active ingredient – Pyrifluquinazon

EPA Reg. No. 7969-389

TRP Ion channel feeding inhibitors (IRAC 9B)

- Novel mode of action: disrupts behavior
- Translaminar foliar insecticide
- Apple aphid complex

Not yet available in Suffolk & Nassau Counties

New Materials vs. Old Pests

New & Old Insecticide Updates

Bio-Pesticides, New & Novel Tools

Tree Fruit Insecticide Efficacy Studies

New Monitoring Methods and Trials

Biological Pesticides (Insecticides)

I. **Biological control organisms.**

II. **Biopesticides:** Microbial organisms such as bacteria, fungi, viruses, protozoa, or oomycetes or the toxins produced by organisms, laboratory reared and manufactured.

III. **Plant-Incorporated Protectants (PIPs)**: chemicals produced by plants after genetic modification (GMO or through breeding) to produce compounds resistant to insect or disease pests. Genes alter the manufacture of proteins increase plant defense mechanisms to improve resistance to pests. Ex. Bt Corn and Round-up Ready Corn

IV. **Natural products** such as hort. oils, fatty acid soaps, repellents

V. **Attractants**: Synthetic or natural products to lure and trap pests.

VI. **Barrier Film:** Inert coating to reduce attractiveness of host plant

Biological Insecticides

I. Biological control organisms:

- **Predators:** feed directly on host pest life stages
  egg, larva, nymph and adult
- Predators are **immature or adult forms**
- Use host finding chemical cues 'footprints' such as host pheromones, plant host of pest, visual - color, sounds
- Predatory populations rise and fall based on prey populations, environmental conditions and agrochemical applications and residue

Biological Insecticides

I. Living organisms such as **biological control organisms**.
Predatory organisms of pests

a. Aphids

- Lacewing adults and larva
- Ladybird beetle adult and larva
- Cecidomyiidae larve (fly − gall midge)
- Syrphid larva (fly)

b. European Red Mite

- Phytoseiid Mite
  T. pyri, A. fallacius
- Stigmaid Mite
  Z. mali

Do They work: YES, Through Conservation

Insecticides (Pyrethroids) and fungicides (Manzate) significantly reduce predatory beneficials.
'Soft' programs and reduced rates of pesticides allow for higher field populations of predators

Biological Insecticides

I. Living organisms such as **biological control organisms**.
Predatory organisms of pests

Aphids can build near apple harvest with fall rains and new growth.

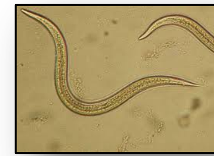
Multicolored Asian Ladybird Beetle will also increase and feed on aphid, yet may begin to pupate on fruit, causing fruit injury.

MALB Pupa Case

Fruit puncture

MALB mouth parts

Biological Insecticides



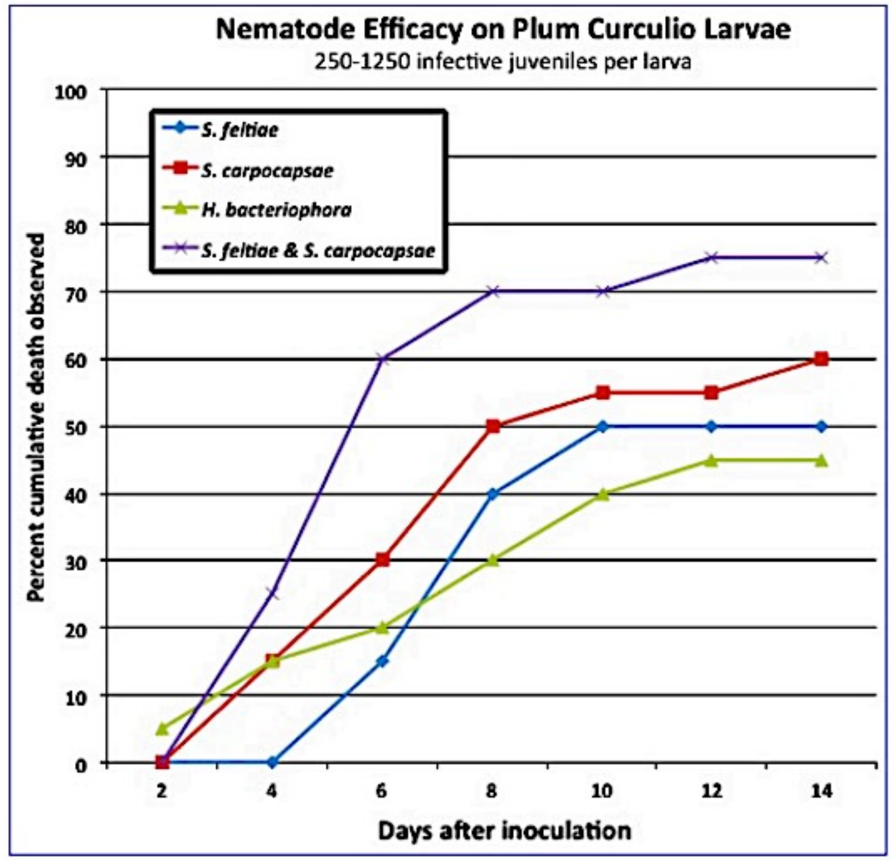
I. Living organisms such as **biological control organisms**.
Predatory organisms of pests

c. Nematodes: 'Persistent' complex for managing plum curculio the Northeast

- Steinernema feltiae,
- S. Carpocapsae
- Heterorhabditis bacteriophora

Applied to the soil.
CO_2 gradient to detect and infest white grub larva

Reduces oplum curculio larva in orchard floor
Do not impact migrating PC adults
Best use in organic orchards



Elson Shields, Art Agnello NYFQ Spring 2014

Biological Insecticides

I. Biological control organisms:

- **Parasitoids:** (Hymenopteran − wasps) lay their eggs in pest life stages including egg, larva, nymph
- Parasitoids are adult forms. Immature develop within host.
- Use host finding chemical cues 'footprints' such as host pheromones, plant hosts of the pest, visual - color, sounds
- Parasitoid populations often have multiple hosts, 'follow' prey populations as they , environmental conditions and agrochemical applications and residue
- Many reside outside of the Ag. crop; less risk from crop mgt.

Biological Insecticides

I. Biological Control organisms.

Parasitic organisms of pests (parasitoids)

a. Micro hymenoptera

- Samurai wasp, Trissolcus japonicus

- Adult wasps lay their eggs into eggs of a pest such as a stink bug
- Wasp larva feed on developing stink bug nymph
- Wasp adult emerges from egg
- BMSB held in check In Asia
- significantly reduce crop injury.
- Insecticide drift to wooded edge may reduce the parasitoid pop.

2 mm

T. japonicus

Biological Insecticides

II. **Biopesticides:** Infection from the organism and or toxins produced by organisms can develop; spores and toxins are laboratory reared and manufactured for use in pest management.

These include strains of **Viruses, Fungi and Bacteria.**

Products for use as insecticides come in many forms including spores, released toxins derived from fermentation processes and biproducts.

Insects exposed by viroid fragments, fungal spores or bacteria transmission through feces or direct contact will become infected, leading to a decline or mortality of the insect.

Applied at first hatch of each generation through complete hatch using multiple applications at 5-7d intervals.

Biological Insecticides

II. **Biopesticides:** Viruses (Granulosis virus)

Advantages in using microbial viruses

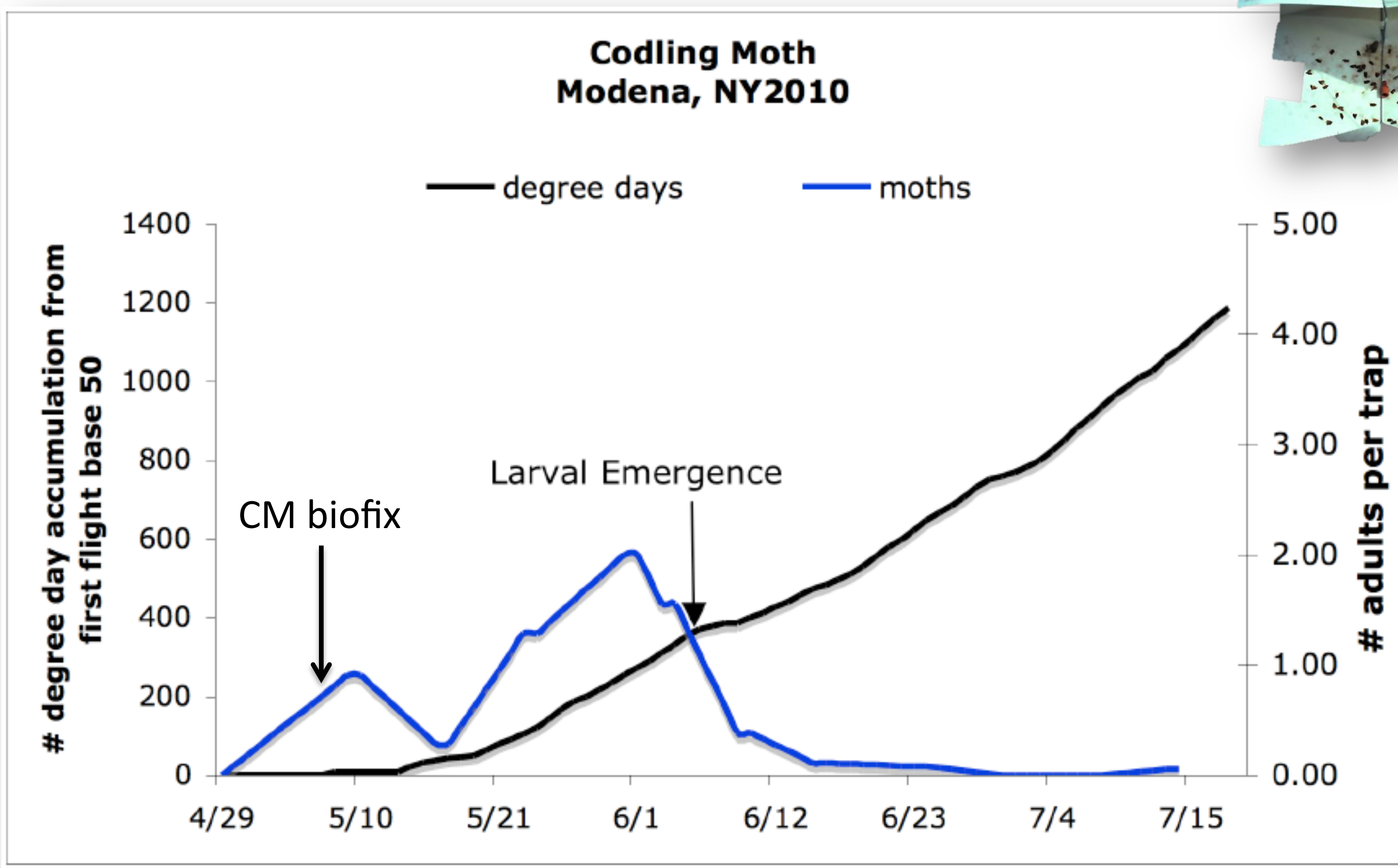
- Safety for humans and other nontarget organisms
- Reduction of pesticide residues
- No secondary pest outbreak and no preharvest interval is required
- Many are OMRI approved

Disadvantages

- Host specificity or narrow spectrum of a single species
- Long period of lethal infection is required
- Inactivated by environmental factors (ultraviolet light, high temp.)
- Often more expensive then conventional pesticides
- Resistance by codling moth: Madex, Carpovirusine, Cyd-X
- New strains: **Virosoft CP4** (BioTEPP), **Carpovirusine Evo 2** (NPP/ Arysta LifeScience) **Madex Max and Madex Plus** (Andermatt Biocontrol AG) to inhibit resistance.

Biological Insecticides

Granulosis virus when used with mating disruption (OFM / CM twin ties) applied at first trap capture of adult CM over successive years have found to be very effective



Biological Insecticides

Incidence of insect damage on disease resistant varieties at harvested fruit 9 Aug. 2010

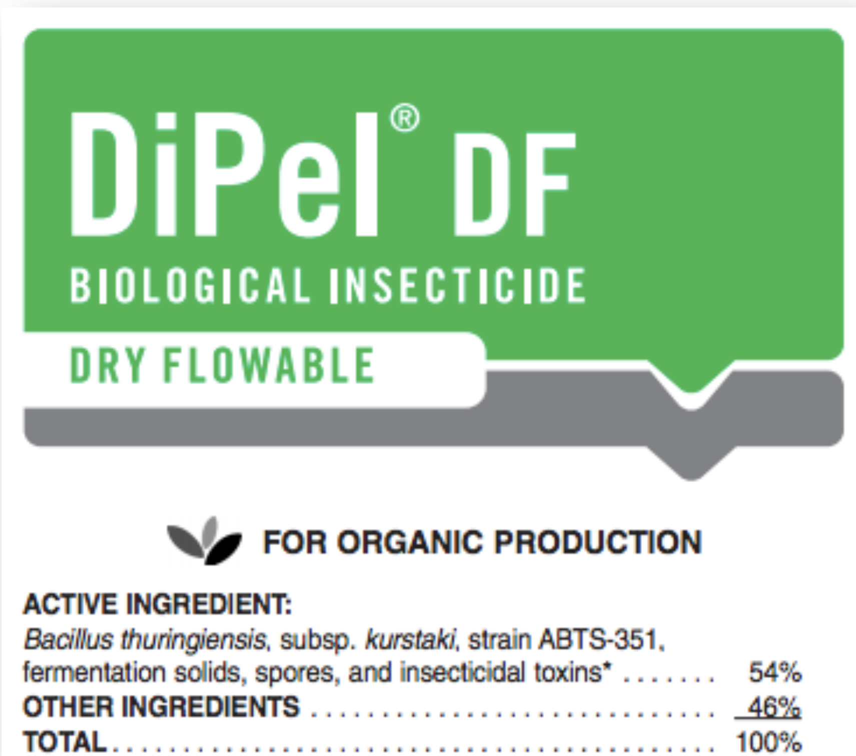
Material and rate of formulated product per A		Plum curc.	Tarnish plant bug	Stink bug complex	Internal lep OFM/CM	European apple sawfly	Apple maggot tunnel	No insect damage
Edge	Clark: CB..................	0.0	0.0	0.0	0.0	0.0	2.0	91.3
Interior	Clark: CB..................	2.0	0.5	0.5	0.0	0.0	2.0	86.7
Edge	Clark: Et + GF120.....	5.2	1.3	3.3	0.0	0.7	0.0	85.0
Interior	Clark: Et + GF120.....	3.2	0.7	6.4	0.4	0.1	0.0	84.9
Combined	Clark Block................	3.7	0.9	4.4	0.4	0.3	0.3	85.5
Edge	Grower Standard.........	0.0	8.0	0.0	0.0	0.0	0.0	92.0
Interior	Grower Standard.........	0.0	4.0	0.0	0.0	0.0	0.0	96.0
Combined	WestWind................	77.0	4.0	0.3	68.0	14.0	47	14.0
Untreated	Clark Block..............	64.3	3.3	5.3	23.0	0.0	17.7	13.7

Clark block received 4 trmts. Of Surround WP at 50 lbs./A, 200 Isomate twin ties for CM & OFM mating disruption and Cyd-X @ 4.0 oz./A. Split block East received CB= 'Curve Ball' at 1 per tree; Split block west received Et = Entrust 80WP @ 4.0 oz./A and GF120 at 64 oz./A.

Biological Insecticides

II. Biopesticides: Toxins produced by organisms, laboratory reared and manufactured.

Bacteria: *Bacillus thuringiensis*/B.t. is a fermented toxin used at low rates using 5 day intervals is an excellent materials for OBLR, and can be used during bloom.



- Immature larval stages
- UV sensitive
  Best use during overcast sky
- **Low rates using short re-application intervals**
- Can be used during bloom
- Pollinator safe

Biological Insecticides

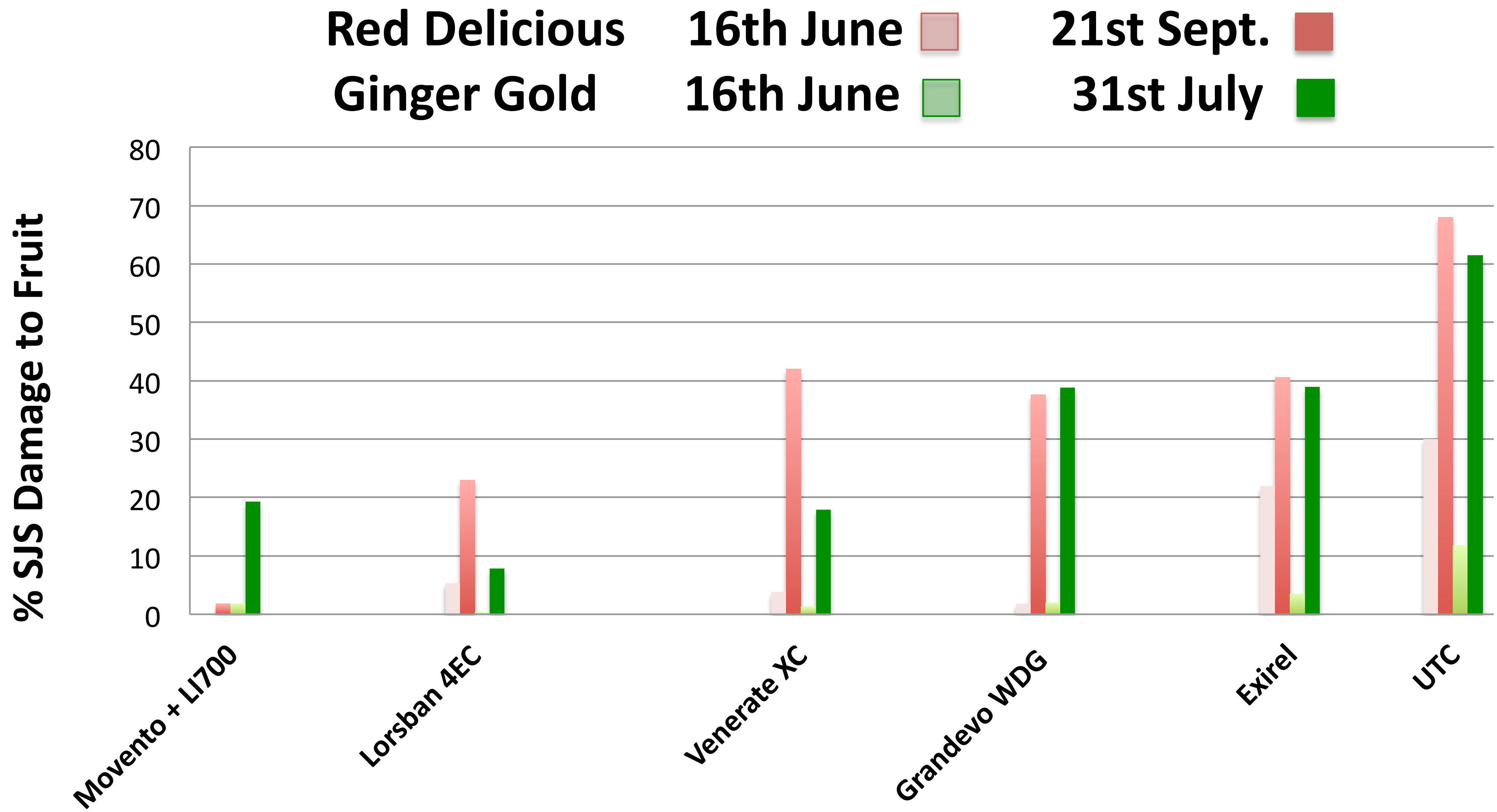
II. Biopesticides: Toxins produced by organisms, laboratory reared and manufactured.

Bacteria: Venerate, *Burkholderia* spp. strain A396, a genus of Proteobacteria manufactured by Marrone Bioscience

Venerate acts as an anti-feedent against San Jose Scale (SJS) and Brown Marmorated Stink Bug (BMSB).

- Target the crawler stage of San Jose scale according to scouting using two applications at 7-day intervals, using minimum of 75 gal,.A to achieve full coverage of foliage and fruit.
- Use of a nonpenetrating spreader-sticker to improve coverage and rain fastness.

% San Jose Scale Fruit Injury
1st & 2nd Gen. HVRL, 2017



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IV. **Natural products** such as oils, fatty acids or soaps, repellents

- **Horticultural oils** during pre-bloom on tree fruit
    a. Pear psylla as ovipositional deterrent, significant reduces 1^{st} generation nymphs.
    b. Season long control of psylla using 1% every 14d in 'dilute applications' (100GPA) will significantly reduce injury from psylla & reduce leaf drop from fabraea.
    c. A 1% application will significantly reduce San Jose Scale in pear and apple with complete coverage of the canopy
    d. Summer use of oil* at 1% will manage European and Two Spotted Spider Mite

* Do not use 14d on either side of Captan fungicide application. Phytotoxicity can occur

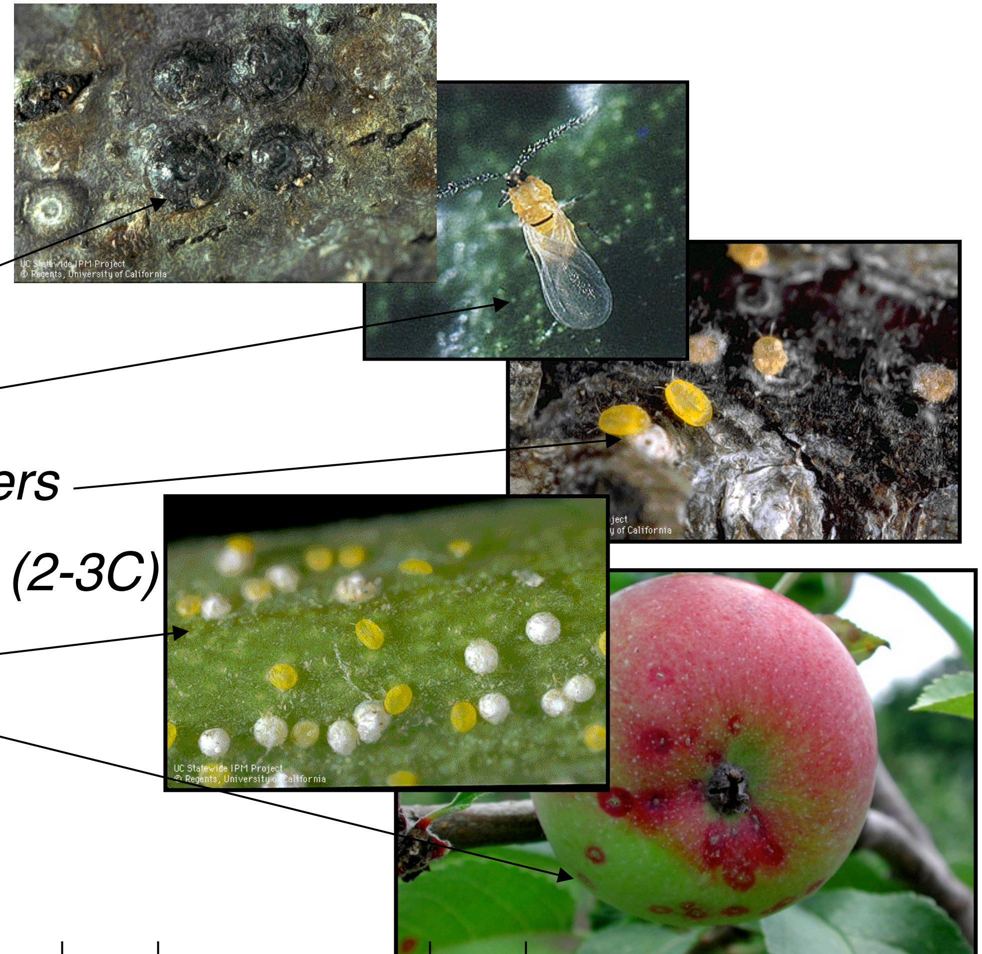
Table 12 **Evaluations of Insecticide Schedules for Controlling Pear Psylla on Pear [a]**
Hudson Valley Research Laboratory, Highland, NY - 2018

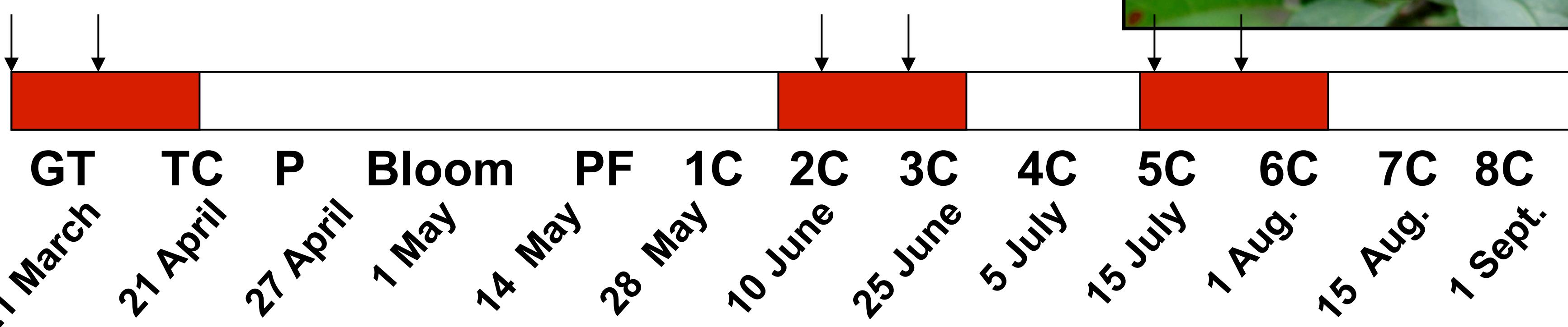
		Honeydew Phytotoxicity to Bosc Pear Foliage			
		%	% severity		
Treatment / Formulation	Rate	/ shoot	Interior-tree	Mid-Tree	Outer-Tree
1. BioCover Oil	128.0 fl.oz./100	23.3 b	13.1 c	8.8 b	6.8
2. BioCover Oil	128.0 fl.oz./100	19.9 b	30.0 abc	28.8 ab	23.8
+ Surround	12.5 lbs./100				
3. Surround	12.5 lbs./100	26.7 b	19.9 bc	16.3 b	9.8
BioCover Oil	128.0 fl.oz./100				
4. BioCover Oil	128.0 fl.oz./100	41.2 ab	26.7 abc	23.8 ab	25.0
Venerate XC + oil	1.0 qt./A				
5. BioCover Oil	128.0 fl.oz./100	48.3 ab	29.6 abc	32.5 ab	18.8
Venerate XC + oil	2.0 qt./A				
6. BioCover Oil	256.0 fl.oz./100	57.1 ab	42.9 b	40.0 ab	33.8
Grandevo WDG	2.0 lb./A				
7. BioCover Oil	256.0 fl.oz./100	59.6 ab	32.5 abc	33.8 ab	23.8
BotaniGard	2.0 qt./100				
Certis CX-10282	2.0 qt./100				
8. UTC		71.4 a	50.4 a	56.3 a	38.8
P value for transformed data		0.0051	0.0011	0.0066	0.644

[a] Seasonal evaluations made on 'Bartlett'.

San Jose Scale (SJS)

- *OW on bark as 'black-cap'*
- *Adult males emerge and mate*
- *Do not lay eggs - produce live crawlers*
- *Crawlers appear 4-6 wk. post bloom (2-3C)*
- *'White cap' → 'Black cap'*





Pre-bloom - San Jose scale

Evaluation of insecticides for controlling San Jose scale on apple, N.Y.S.A.E.S., Hudson Valley Lab., Highland, N.Y.-2005

% mortality of 'Black Cap' adults

Treatment	Quantity	Timing	Removing the scale covering from day 7 to day 45
1. Damoil	3.0 gal. / 100	GT	Brown and shriveled →
2. Damoil	2.0 gal. / 100	HIG	Brown and shriveled →
3. Lorsban 4E	1.0 pt. / 100	HIG	Brown and shriveled →
4. Esteem	1.25 oz./ 100	HIG	Bright yellow →
5. Assail	1.25 oz./ 100	HIG	Yellow → Browning → Brown and shriveled
9. Untreated	-	-	

GT on 4 April
HIG on 7 April

Pre-bloom - San Jose scale

Evaluation of insecticides for controlling San Jose scale on apple, N.Y.S.A.E.S., Hudson Valley Lab., Highland, N.Y.-2005

Treatment	Quantity	Timing	% mortality per # of days post application: 7 d	14 d	21 d	28 d	45 d
1. Damoil	3.0 gal. / 100	GT	100.0 c	100.0 c	100.0 c	100.0 c	100.0 c
2. Damoil	2.0 gal. / 100	HIG	100.0 c	100.0 c	100.0 c	100.0 c	100.0 c
3. Lorsban 4E	1.0 pt. / 100	HIG	100.0 c	100.0 c	100.0 c	100.0 c	100.0 c
4. Esteem	1.25 oz./ 100	HIG	48.5 b	41.3 b	37.5 a	51.4 b	59.4 b
5. Assail	1.25 oz./ 100	HIG	51.6 b	44.6 b	78.4 b	94.1 c	99.9 c
9. Untreated	-		2.7 a	23.0 a	37.5 a	36.0 a	34.9 a

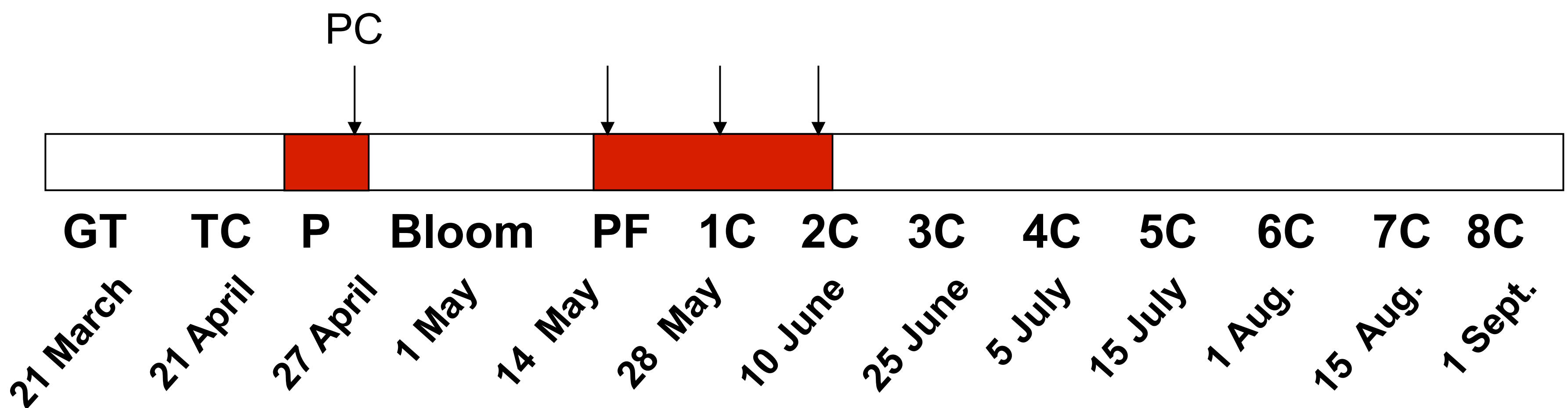
GT on 4 April
HIG on 7 April

Pre-bloom - San Jose scale

Evaluation of insecticides for controlling San Jose scale on apple, N.Y.S.A.E.S., Hudson Valley Lab., Highland, N.Y.-2005

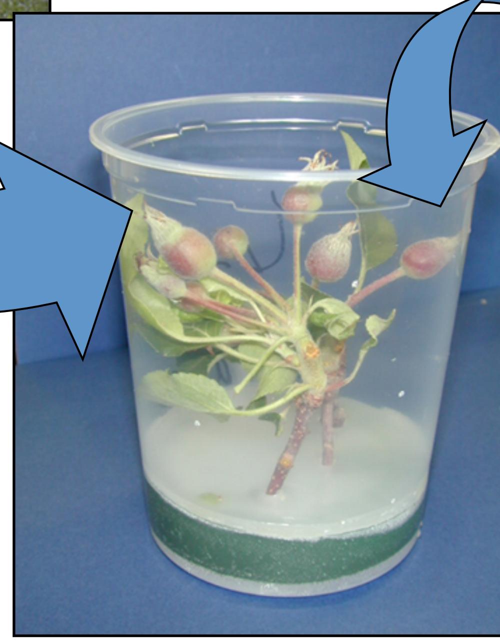
Treatment	Formulation amt./100 gal.	Timing	% infested Fruit	Ave. # caps / Fruit	Live SJS caps / Fruit
1. Damoil	3.0 gal.	GT	0.0 a	0.0 a	0.3 a
2. Damoil	2.0 gal.	HIG	0.9 a	0.3 ab	1.3 a
3. Lorsban 4E	1.0 pt.	HIG	3.0 ab	1.5 ab	1.2 a
4. Esteem	1.25 oz.	HIG	1.4 ab	1.3 ab	2.6 a
5. Assail	1.25 oz.	HIG	31.2 bc	29.6 cd	6.9 ab
9. Untreated	-	-	95.9 d	277.0 d	142.2 c

- Pre and Post Bloom Management
  - **Plum curculio (PC)**
  - Management for PC should begin at first sting / scar
  - Applications at 80% PF to reduce risk to pollinators
  - Continue until PC migration has ended using 308 DD base 50F predictive modeling.

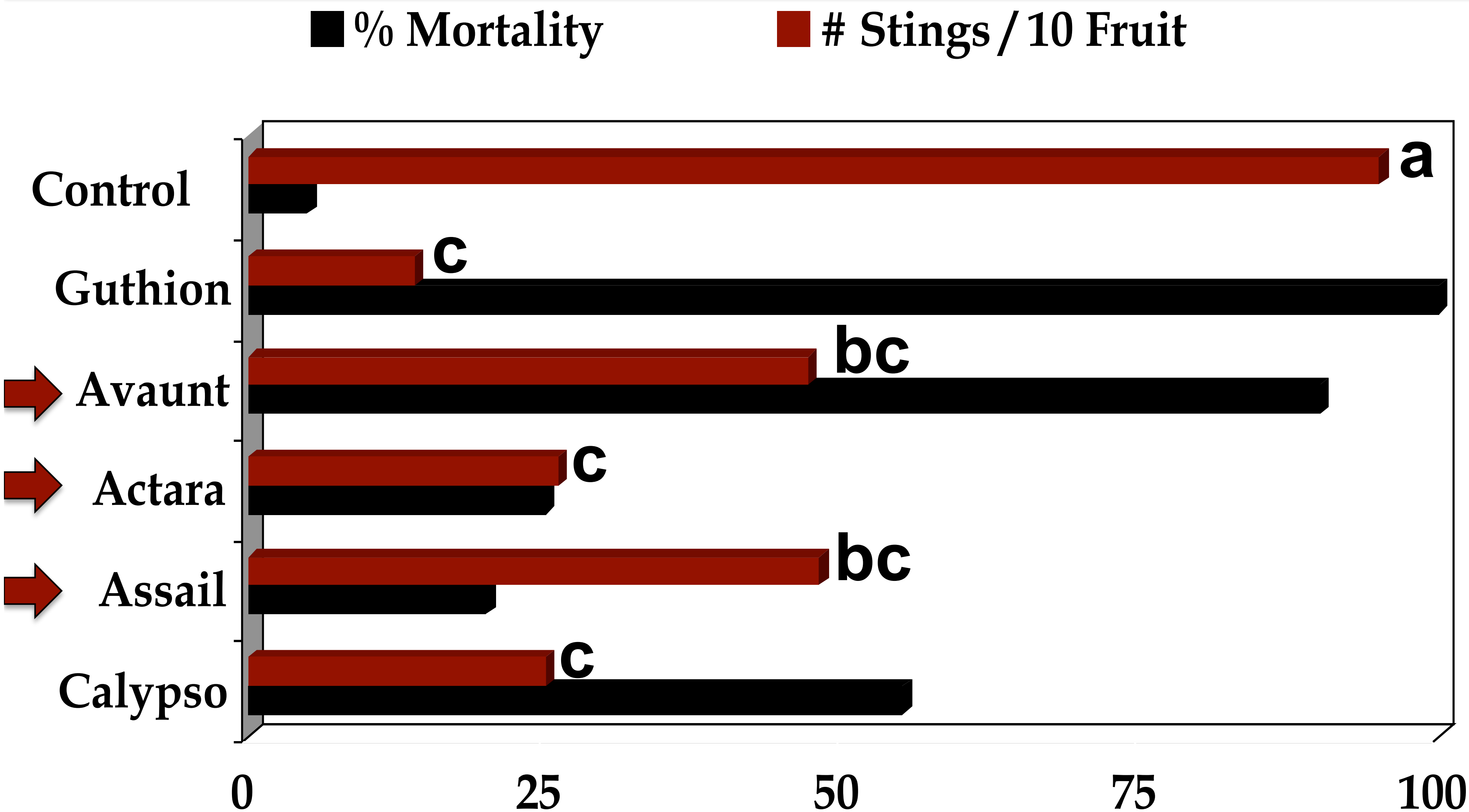


U. Michigan (J. Wise) Field-based bioassays:

- Spray compounds in the field
- Residual bioassays - field collected PC
- PC oviposition damage on fruit
- Mortality and non-lethal effects on PC

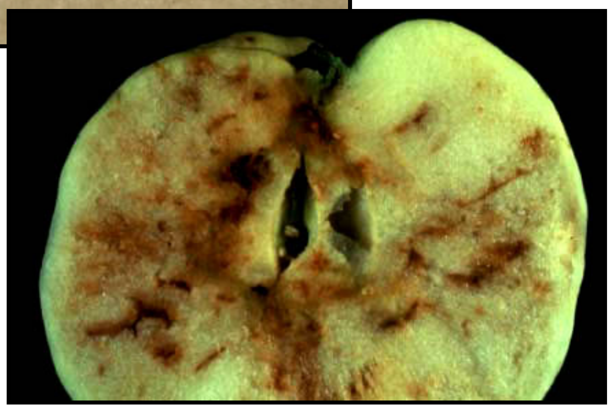


Residual Control of Plum Curculio



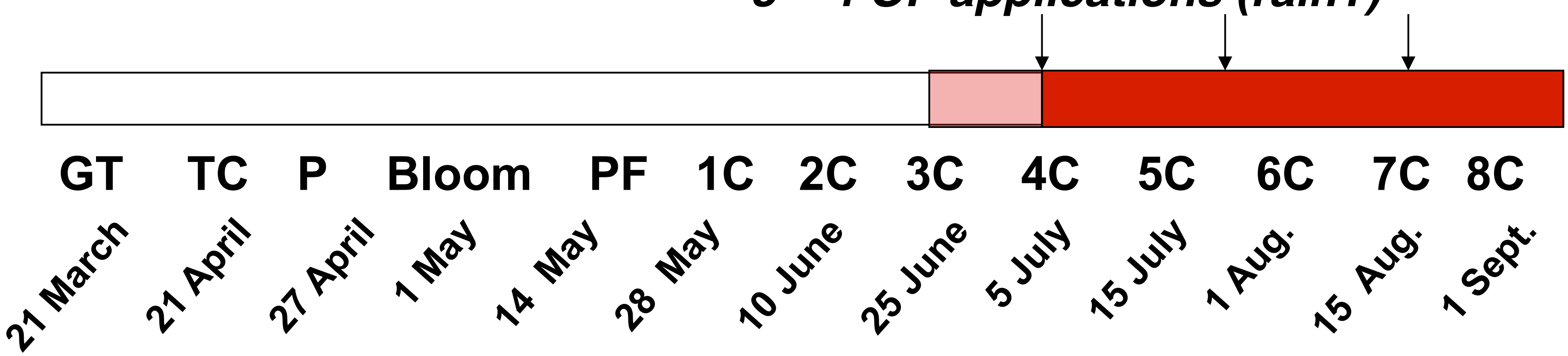
2002 PC adult bioassay, 7 days post-spray, TNRC (P= .05, LSD)

*John Wise - Michigan State

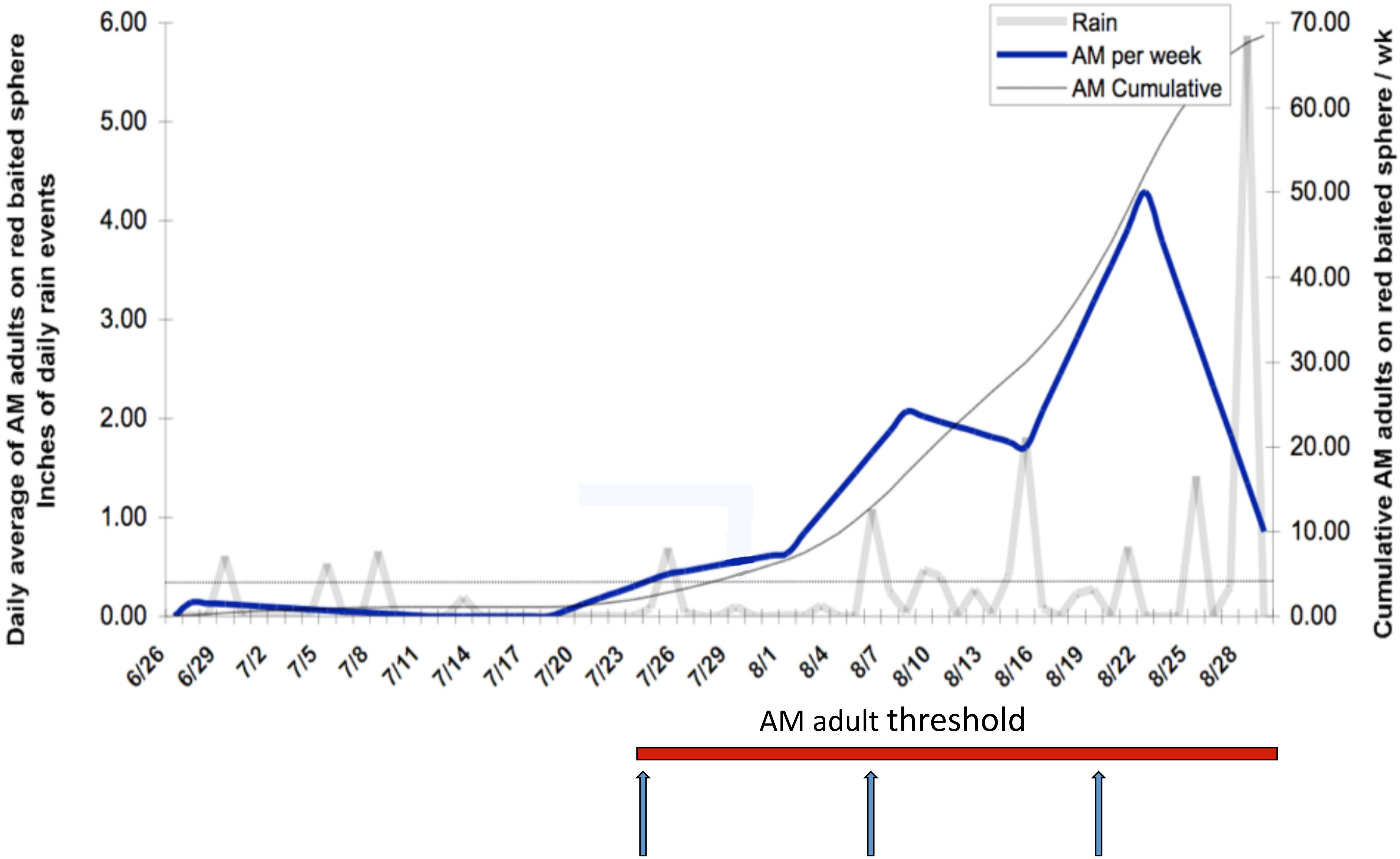


Apple Maggot:

- ***OW as pupae***
- ***Single generation / season***
- ***Emerge from soil late-June; emergence completed by 1 Sept.***
- ***Typically do not OW in commercial orchards (hail years)***
- ***Reduced risk AM materials include Assail, Actara, Provado, Delegate***
- ***3 – 4 OP applications (rain?)***



Apple Maggot & Rain Events
Cornell's Hudson Valley Laboratory ,
Highland, NY 2011



Insect Cultivar Preference

Evaluation of Insect Populations on NE-183 Varietal Apple Trial
USDA Tree Fruit Research Center., Kearneysville, WV.- 2005*

Variety / Rootstock	TPB	PC	CM & OFM	AM	% Clean Fruit
Braeburn/ M.9	1.4 e	7.9 a-d	8.9 lm	39.9 ab	35.3 h-k
Golden Supreme/ M.9	8.1 a	12.6 abc	17.6 ijk	11.0 h-k	56.7 bcd
Ginger Gold/ M.9	4.2 b-c	14.0 ab	6.3 lm	47.1 a	37.9 g-k
Pristine/ M.9	3.3 de	8.1 a-d	2.8 m	0.0	80.3 a
Yataka/ M.9	1.8 c	9.7 a-d	21.3 h-j	16.5 f-l	54.2 b-e

* H. Hogmire, S. Miller

Reduced Risk Materials for Apple Maggot Management

Trevor Nichols / John Wise - Michigan State - 2006

Formulation Treatment	amt./A	Timing	# AM. Stings per. 20 fruit	AM Pupa / bushel
Assail 30SG	5.0 oz.	14, 28 July, 11 Aug	3.5 b	0.0 c
Calypso 4F	6.0 oz.	14, 28 July, 11 Aug	7.5 ab	2.0 c
Provado Pro 1.6SC+	8.0 oz.	14, 28 July, 11 Aug	3.5 b	1.0 c
Nu-Film 17	14.3 oz.			
Provado Pro 1.6SC	8.0 oz.	14, 28 July, 11 Aug	8.5 ab	7.3 bc
Provado Pro 1.6F	8.0 oz.	14, 28 July, 11 Aug	14.3 a	9.5 bc
Nu-Film 17	14.3 oz.			
Guthion 50WP	1.5 lb.	14, 28 July, 11 Aug	7.5 ab	0.8 c
Untreated	-	-	10.8 a	40.0 a

Airblast 100 GPA at 2.5 mph. RCBD

BMSB Feeding and Mortality

Comparitive Efficacy of 4 Insecticides to Adult BMSB Topical Treatment & Field Applied (Fruit Residue)

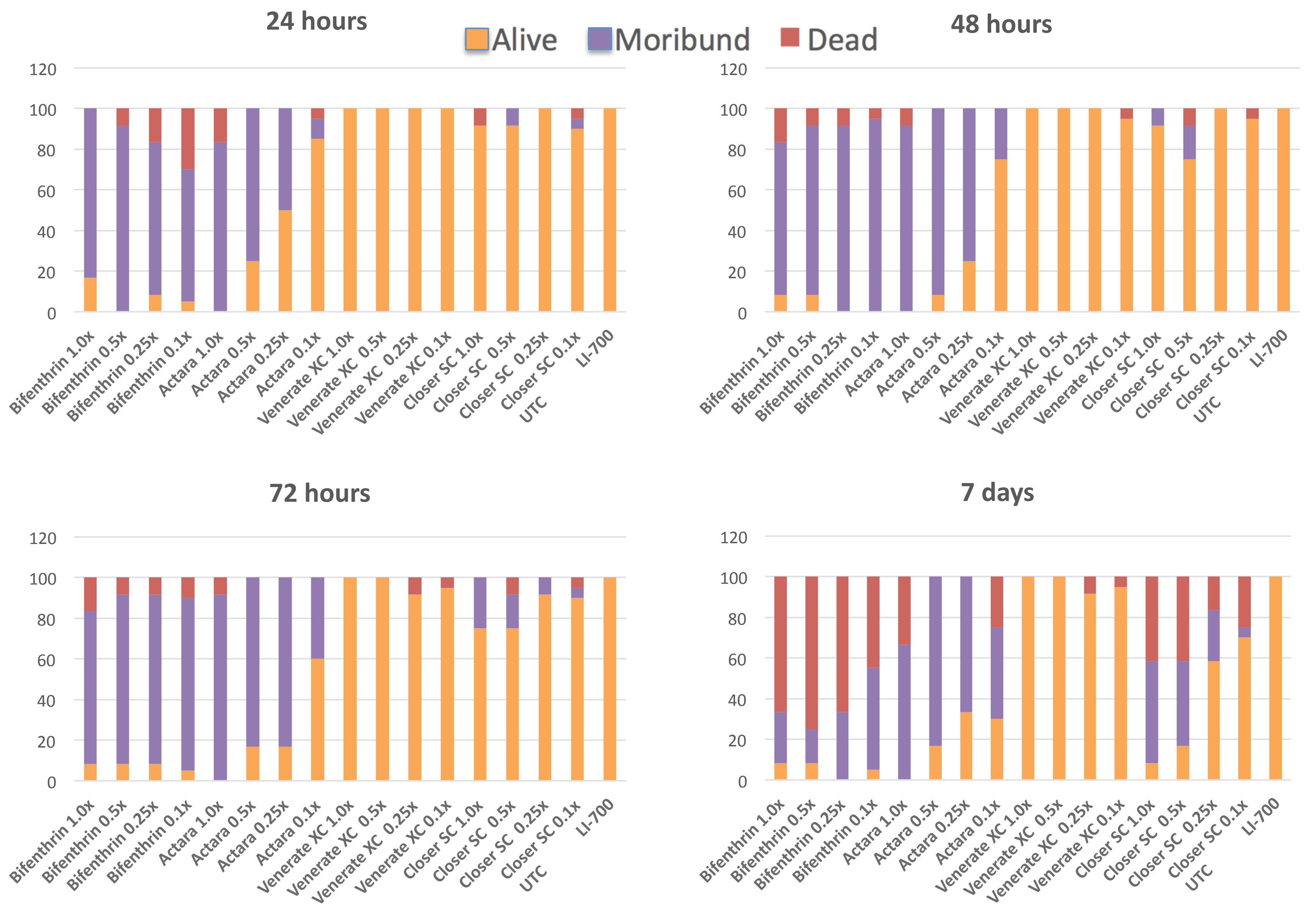
Adult BMSB Topical Bioassays

- Stink bug were separated into individual cups for **male and female**
- Individuals **received 2 uL of distilled water, 0.25% LI700,** individual insecticide to the dorsal thoractic plate.
  - Treatments: **Actara, Bifenthure, Closer, Venerate, UTC**
  - **Doses: 1, 0.5, 0.25, and 0.1** times the highest labeled rate
- Status **(alive, moribund, dead**) was recorded **at 24, 48, 72 hours and at 7d** post treatment.

BMSB Adult Topical Treatment

- Applications to BMSB adults on 28th Sept. 2017
- Placed on the tree in 10 replicates for each treatment
- BMSB were removed after 7d and evaluated for mortality
- Fruit was collected on 12th October
- Fruit feeding evaluations to assess feeding injury
- Evaluated ‘arena’ for surface dimpling,

Topical Bioassays



BMSB Adult Topical Treatment

BMSB treated topically on Sep.28, 2017 and placed on apples for 7 days.					
	Number of feeding sites per fruit	Dimpling per fruit	Corking per fruit	Clean fruit (%)	Survival (%)
Closer SC	0.3a	0.2a	0.2a	90a	30b
Bifenthrin	0.1a	0a	0a	90a	0b
Actara	0a	0a	0a	100a	10b
Venerate	0a	0a	0a	100a	100a
UTC	0.9a	0a	0a	60a	90a
Kruskal-Walis Test, Prob>ChiSq	0.1288	0.5348	0.5348	0.1093	<.0001

Means followed by the same letter are not significantly different by Steel-Dwass Method at α=0.05 Apples were rated on Oct.12, 2017. BMSB survival were recorded 7 days after exposure to the fruit.

2017 Field Application

Applications using tractor mounted sprayer on 20th Sept. 300 psi. handgun applications:

Closure SC	**7d PHI**	**5.75**	**fl.oz./A**
Bifrenthrin SC	**14d PHI**	**32.0**	**fl.oz./A**
Actara 25 WDG	**14d PHI**	**5.5**	**oz./A**
Venerate XC	**0d PHI**	**128.0**	**fl.oz./A**

- BMSB adults placement beginning on 20th Sept.
  - 24h; 48hr; 72hr placement. Collection made after 7d of placement.
  - Insects placed in screened portion cups onto the north side of fruit to reduce sun exposure with arena defined using marker.
  - Fruit harvested on 12 Oct. for fruit feeding evaluations

Field Application: Fruit Residue

BMBS placed on apples 24 hours after pesticide application on Sep.20, 2017.					
	Number of feeding sites per fruit	**Dimpling per fruit**	**Corking per fruit**	**Clean fruit (%)**	**Survival (%)**
Closer SC	0.1a	0.1a	0.1a	90a	0a
Bifenthrin	0a	0a	0a	100a	0a
Actara	0a	0a	0a	100a	0a
Venerate	0a	0a	0a	100a	20a
UTC	0.7a	0a	0a	50a	20a
Kruskal-Walis Test, Prob>ChiSq	0.0115	0.8123	0.8123	0.0136	0.3071
Means followed by the same letter are not significantly different by Steel-Dwass Method at α=0.05 Apples were rated on Oct.12, 2017. BMSB survival were recorded 7 days after exposure to the fruit.					

Field Application: Fruit Residue

BMBS placed on apples 48 hours after pesticide application on Sep.20, 2017.					
	Number of feeding sites per fruit	**Dimpling per fruit**	**Corking per fruit**	**Clean fruit (%)**	**Survival (%)**
Closer SC	0.1b	0.1a	0.1a	90a	0a
Bifenthrin	0b	0a	0a	100a	10a
Actara	0.1b	0.1a	0.1a	90a	0a
Venerate	0.2ab	0a	0a	80ab	40a
UTC	1.2a	0.4a	0.4a	20b	0a
Kruskal-Walis Test, Prob>ChiSq	0.0001	0.4313	0.4313	0.0002	0.0873

Means followed by the same letter are not significantly different by Steel-Dwass Method at α=0.05 Apples were rated on Oct.12, 2017. BMSB survival were recorded 7 days after exposure to the fruit.

Field Application: Fruit Residue

BMBS placed on apples 72 hours after pesticide application on Sep.20, 2017.					
	Number of feeding sites per fruit	**Dimpling per fruit**	**Corking per fruit**	**Clean fruit (%)**	**Survival (%)**
Closer SC	0.2a	0.2a	0.2a	90a	80a
Bifenthrin	0.2a	0.2a	0.2a	90a	10b
Actara	0.2a	0.2a	0.2a	90a	100a
Venerate	0.1a	0a	0a	90a	70a
UTC	1.2a	0.1a	0.1a	40a	30ab
Kruskal-Walis Test, Prob>ChiSq	0.0687	0.9254	0.9254	0.0795	0.0006

Means followed by the same letter are not significantly different by Steel-Dwass Method at α=0.05 Apples were rated on Oct.12, 2017. BMSB survival were recorded 7 days after exposure to the fruit.

New Materials vs. Old Pests

New & Old Insecticide Updates

Bio-Pesticides, New & Novel Tools

Tree Fruit Insecticide Efficacy Studies

New Monitoring Methods and Research Trials

New Pests: *Black Stem Borer*
Sudden or Rapid Apple Decline (SAD / RAD)

Early Tree Decline:
Slight Yellowing

Late Tree Decline:
Dramatic Yellowing & Browning

Tree Death

Single Season Decline and Tree Death
Fuji on M.9

New Pests: *Black Stem Borer*
Sudden or Rapid Apple Decline (SAD / RAD)

New Pests: *Black Stem Borer*
Sudden or Rapid Apple Decline (SAD / RAD)

New Pests: *Black Stem Borer*
Sudden or Rapid Apple Decline (SAD / RAD)

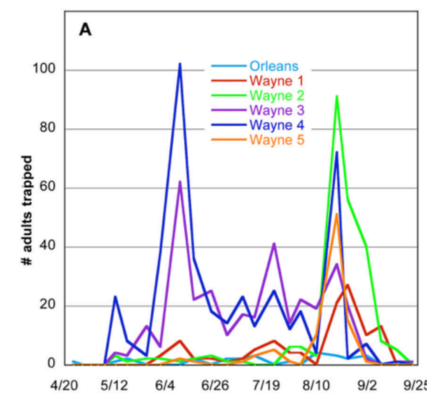
- Monitor BSB populations using ethyl alcohol or ethanol (ETOH) beginning in

- Using a bolt of 1 inch beech limb, soaked in ethanol to attract BSB. Monitor for start of boring activity.

- At first sign of BSB boring, make first pre-bloom (Pink) then Petal Fall application of directed insecticide using high volume and high pressure course trunk spray

Lorsban (Pre-bloom), Pyrethroid or Pyrethroid in Pre-mix will provide control of 1st generation

Continue monitoring throughout the season.



New Pests: *Dogwood Borer*
Sudden or Rapid Apple Decline (SAD / RAD)

- Monitor adult (clear wing moth) population using pheromone for first flight
- Use Mating Disruption in 5 acre block for best control after first flight and prior to egg laying
- A single application of Lorsban during pre-bloom using high volume and high pressure course trunk spray, or Assail in multiple applications
- Scout trunks of trees for presence of DWB larva in June. Additional applications may be required after second flight.

State-wide Trap Monitoring of BMSB in NY: Tedders Trap

Vented trap container:

- MDT/epoxy and bisabolen lure
- Killing strip of Vapon

Plywood /plastic triangle black base to mimmic tree trunk

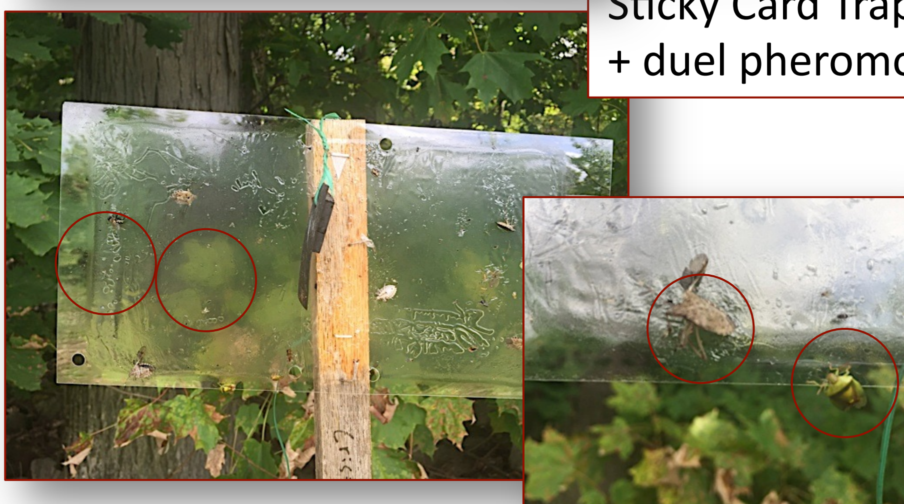
Screened base to reduce weeds and provide contrast for crawling SB

Placed along decidious woodland

AgBio-inc.com: Trap, lures, kill strip

State-wide Trap Monitoring of BMSB in NY: Tedders Trap vs. AtK

Tedders Trap
+ duel pheromone

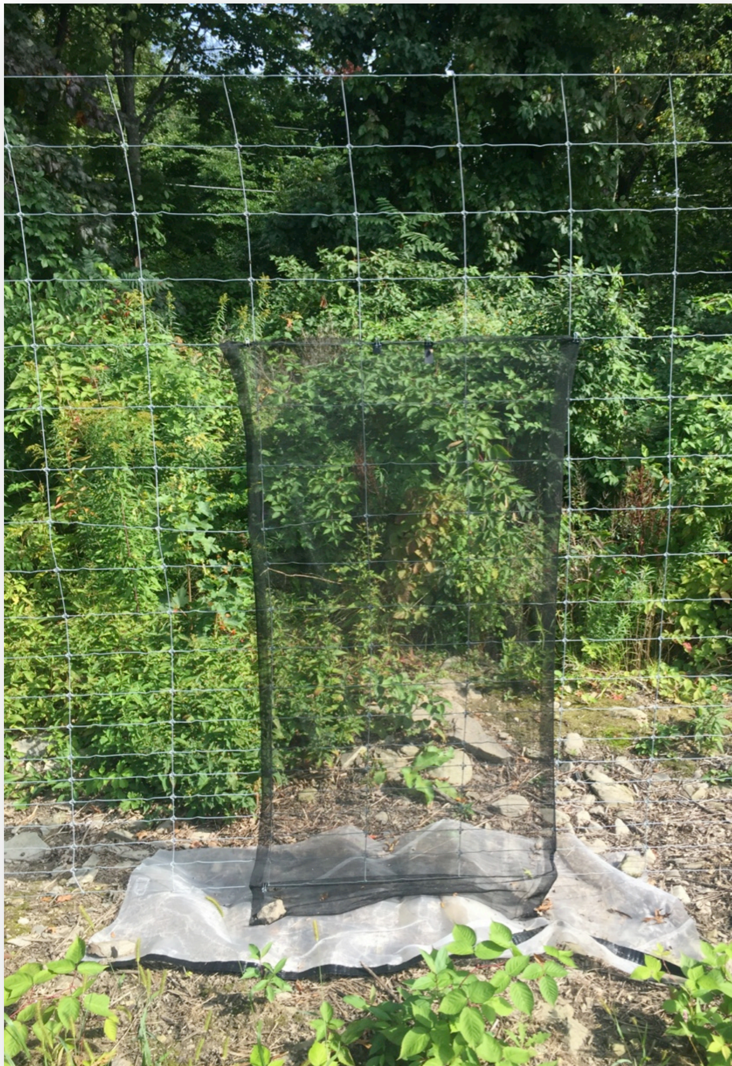


Sticky Card Trap
+ duel pheromone

AtK Trap (Vesteegard)
Net + duel pheromone

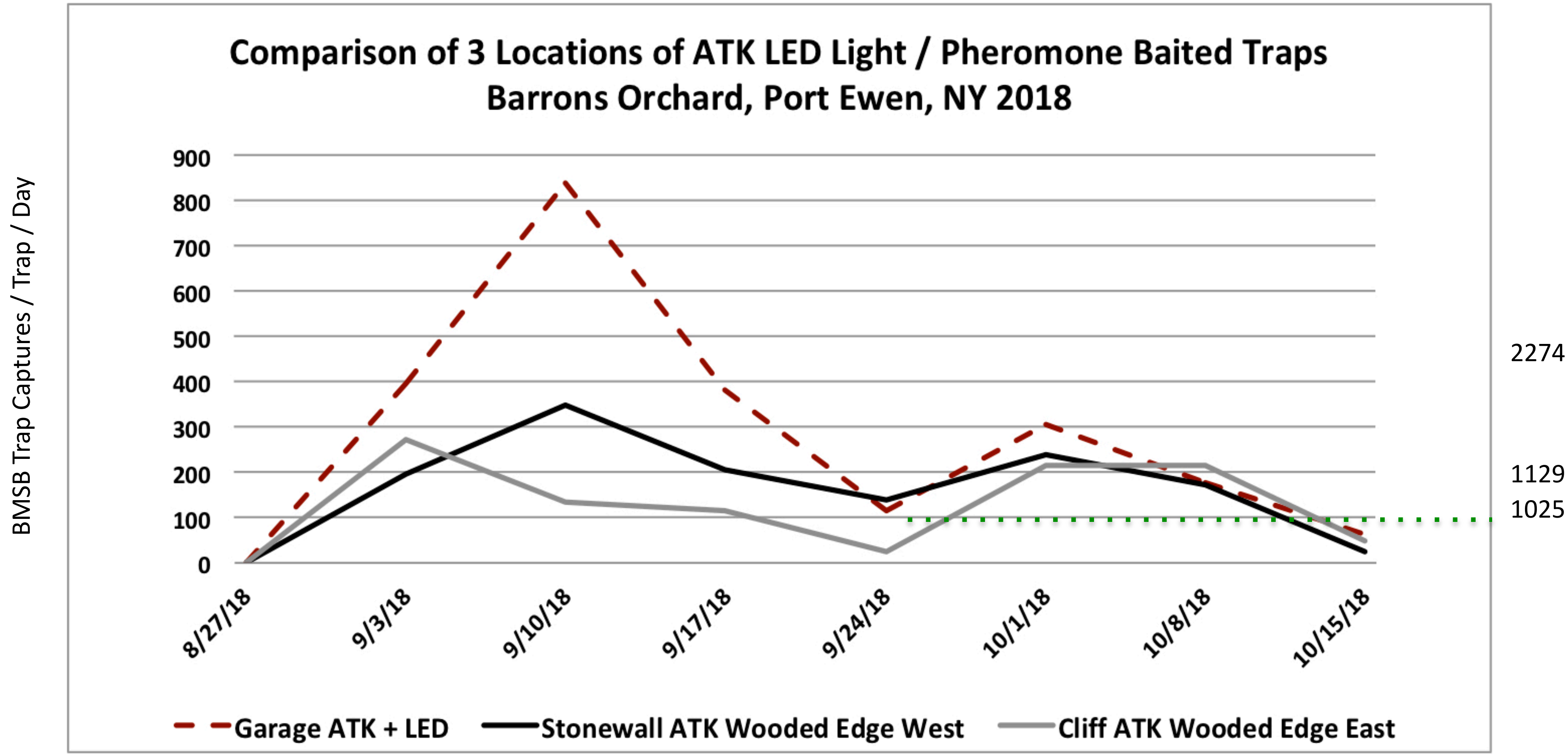
Threshold: 10 adults / trap / week

State-wide Trap Monitoring of BMSB in NY: AtK Net Trap

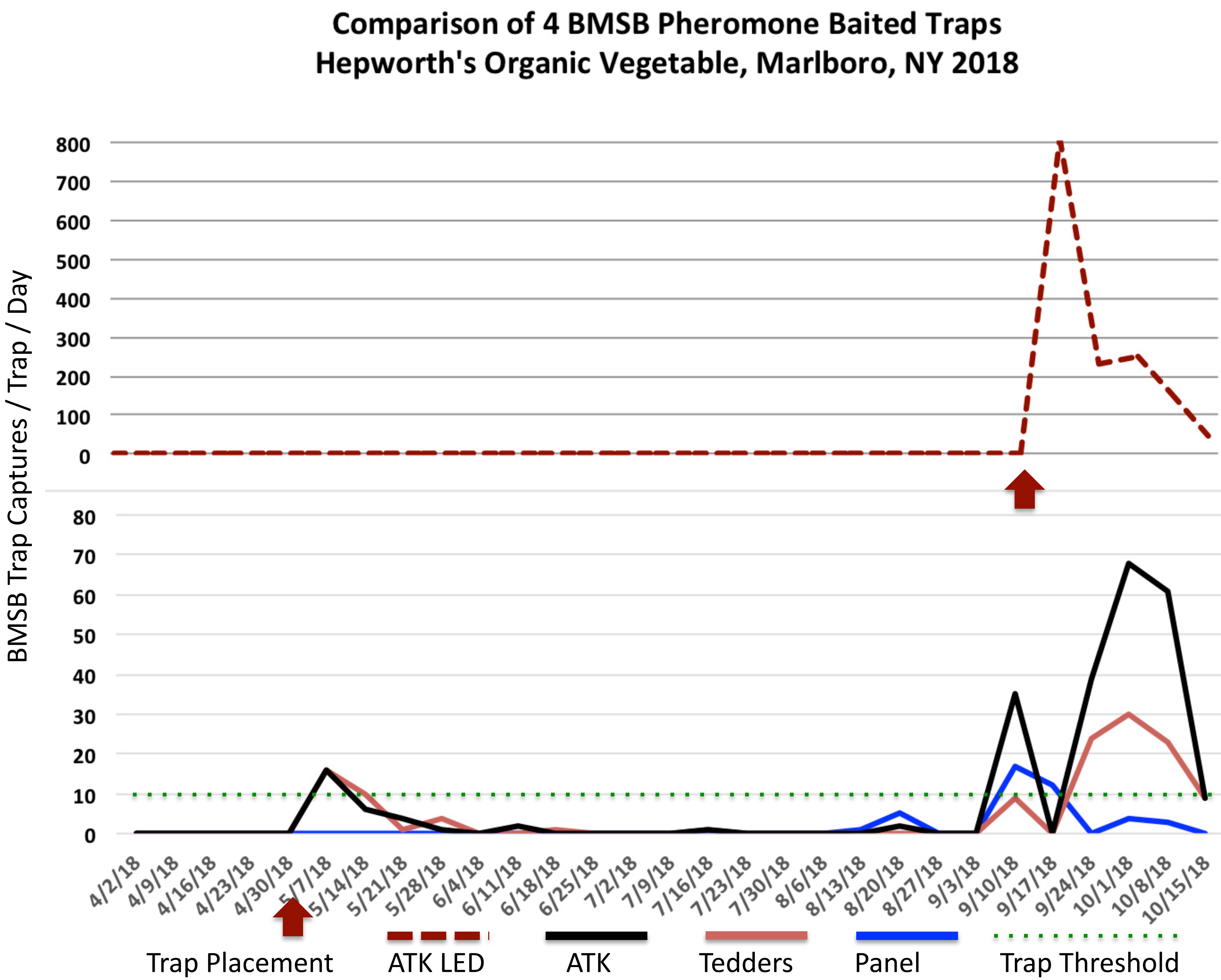


State-wide Trap Monitoring of BMSB in NY: Green Stink Bug

Attract & Kill of the Stink Bug Complex
To Reduce BMSB Populations Along the Orchard Edge



Including Solar LED auto-on with ATK / pher. increases BMSB captures


Comparison of 4 BMSB Pheromone Baited Traps
Hepworth's Organic Vegetable, Marlboro, NY 2018
BMSB Trap Captures / Trap / Day
800
700
600
500
400
300
200
100
0
80
70
60
50
40
30
20
10
0
4/2/18
4/9/18
4/16/18
4/23/18
4/30/18
5/7/18
5/14/18
5/21/18
5/28/18
6/4/18
6/11/18
6/18/18
6/25/18
7/2/18
7/9/18
7/16/18
7/23/18
7/30/18
8/6/18
8/13/18
8/20/18
8/27/18
9/3/18
9/10/18
9/17/18
9/24/18
10/1/18
10/8/18
10/15/18
Trap Placement
ATK LED
ATK
Tedders
Panel
Trap Threshold

Future Studies: Stink Bug Monitoring & Insect Exclusion

1. **Attract and Kill**
    - Pheromone and Insecticide impregnated netting
    - Use of LED rechargeable lighting to increase BMSB captures

2. Exclusion

- Drape netting to reduce hail, bird injury & sunburn
- Enclosure of the base seam (Zip Ties)
- Bee exclusion at King Blossom set to reduce crop load
- Stink bug exclusion

Drape Net Insect Exclusion Study
Samurai Wasp Conservation

Cornell University

Hudson Valley Research Laboratory

Drape Net Insect Exclusion Study
Stink Bug Exclusion ?

Cornell University

Hudson Valley Research Laboratory

Water Tower

ROW	2	4	6	8	10	12
	South Half					
	REP I	REP II	REP III	REP IV	REP V	REP VI
	5	1	3	10	7	8
	7	8	2	4	9	10
	1	9	1	9	3	4
	4	6	4	7	4	6
	9	5	6	5	6	1
	Cross Drive					
	6	2	7	1	8	9
	10	7	8	6	1	7
	3	4	9	8	10	5
	8	10	5	3	2	3
	2	3	10	2	5	2
	REP I	REP II	REP III	REP IV	REP V	REP VI
ROW	2	4	6	8	10	12
	North Half					

Varieties

1	(Winecrisp) ~~PRISTINE~~
2	(Pixie Crunch) ~~RED FREE~~
3	(Topaz) ~~NOVAMAC~~
4	NOVA EASYGRO
5	HONEYCRISP
6	CRIMSON CRISP
7	LIBERTY
8	SCARLET O'HARA
9	FLORINA QUERINA
10	ENTERPRISE
11	GOLDRUSH

Hudson Valley Research Lab

- Scab Resistant Block
- 11 Varieties on G.11
- 2018 Drape Net Study
    - Insect Exclusion

Drape Net Insect Exclusion Study
Samurai Wasp Conservation

Treatment/Formulation	RateTiming	Application Dates	
Early Season IPM			
Actara	5.5 oz/A	18th May	Pre-Net
Avaunt	6.0 oz/A	25th May	↓
Entrust SC	10.0 fl oz/A	8th June	Post-Net Application
Venerate	2.0 gal/A	21st June	↓
Season Long IPM			
Actara	5.5 oz./A	18th May	Pre-Net
Avaunt	6.0 oz./A	25th May	↓
Imidan 70W	4.9 lbs/A	7th June	Post-Net Application
Esteem 35WP	5.0 oz/A	21st June	↓
Assail 30SG	4.0 oz/A	21st June	
Altacor	4.5 oz/A	21st June	
Assail 30SG	4.0 oz/A	10th July	
Exirel	20.5 oz/A	24st July	
Exirel	20.5 oz/A	31st July	
Exirel	20.5 oz/A	6th Aug.	
Bifenture 10DF	32.0 oz/A	6th Aug.	

Drape Net Insect Exclusion Study
Samurai Wasp Conservation

Results of 2018 Insecticide and Acaricide Studies in Eastern New York. Jentsch et. al.

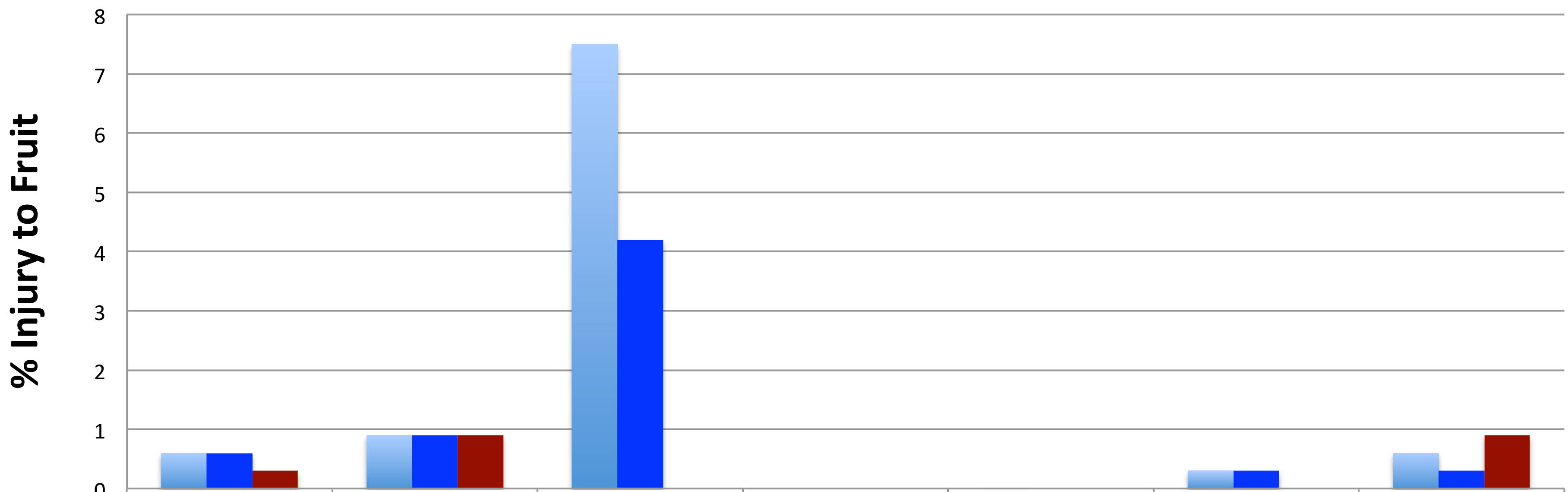
Table 1 **Management of the Apple Insect Complex Using 'Drape Net' IPM / Organic Split and Season Long IPM Management . Hudson Valley Research Laboratory, Highland, NY - 2018**

Net Type	Incidence (%) of insect damaged cluster fruit											
Treatment / Rate	PC	EAS	TPB	Lf.Rlr	Int. Lep	Ext.Lep	CM	AM.P	AM.T	SJS	SB	Clean
1. Black Drape Early Season IPM	3.0 a	0.6 a	4.4 a	10.9 bc	2.2 b	18.8 b	11.3b	0.6 b	0.6 b	96.3 a	0.3 b	1.3 c
2. White Drape Early Season IPM	4.7 a	0.0 a	4.4 a	11.9 b	3.1 b	20.3 b	12.5 b	0.9 b	0.9 b	95.6 a	0.9 b	0.6 c
3. No Drape Early Season IPM	**10.8 a**	**0.8 a**	**4.6 a**	**22.9 a**	**6.7 a**	**37.1 a**	**23.8 a**	**7.5 a**	**4.2a**	**83.8 b**	**3.8 a**	**1.3 c**
4. Black Drape Season Long IPM	5.6 a	1.3 a	7.8 a	0.3 d	0.0 c	1.6 c	0.3 c	0.0 bc	0.0 b	6.6 d	0.0 b	82.5 a
5. White Drape Season Long IPM	7.8 a	0.9 a	7.8 a	0.3 d	0.0 c	0.6 c	0.0 c	0.3 b c	0.3 b	20.0 c	0.0 b	65.9 b
6. No Drape Season Long IPM	**5.6 a**	**0.9 a**	**5.0 a**	**0.6 cd**	**0.3 c**	**1.3 c**	**0.0 c**	**0.6 b c**	**0.3 b**	**6.3 d**	**0.9 b**	**81.3 a**
P value	0.2062	0.6565	0.5998	0.0001	0.0001	0.0001	0.0001	0.0001	0.0135	0.0001	0.0154	0.0001

[a] Evaluation made on 'Crimson Crisp, Honey Crisp & Gold Rush cultivars harvested on 29 September. Data were transformed using arcsine(sqrt(x)) prior to ANOVA (P ≤0.05). Means separation by Fisher Protected (P ≤0.05); treatment means followed by the same letter are not significantly different. Arithmetic means reported.

Drape Net Insect Exclusion Study
Samurai Wasp Conservation

IPM / Organic Split and Season Long IPM in Apple Management Programs Using 'Drape Net' .



	Black Drape Early Season IPM	White Drape Early Season IPM	No Drape Early Season IPM		Black Drape Season Long IPM	White Drape Season Long IPM	No Drape Season Long IPM
AM.P	0.6	0.9	7.5		0	0.3	0.6
AM.T	0.6	0.9	4.2		0	0.3	0.3
SB	0.3	0.9	0		0	0	0.9

Conclusion – 2019

Failure to control apple pests in the field , especially the internal worm complex (CM), has caused economic losses over the past 3 years.

- Developing **rotational insecticide management strategies** is critical to long term management sustainability.
- Use of **exclusion netting** will likely aid in reducing insect populations, decreasing the need for late season pesticide use while reducing the insecticide resistance potential.

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Farm Manager …………………………………………	Albert Woelfersheim
Administrative Assistant ………………………………	Erica Kane
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ARDP - NYS Ag. & Mkts, NY Farm Viability Institute, NYS SCRI, NYS Orchards & Farmers

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