Population Increase, Movement and Impact of the Brown Marmorated Stink Bug, Halyomorpha halys (Stål) into New York State

Agr.Assistance Winter Fruit Grower Meeting
Lyons, NY
March 4, 2014

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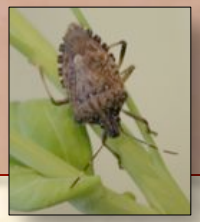
Brown Marmorated Stink Bug, *Halyomorpha halys*
Overview



- Brown Marmorated Stink Bug first detected in Allentown, PA
in 1998, confirmed in 2001.

- First NY BMSB confirmed in 2007, Hudson Valley in **December of 2008.**

- Economic injury caused by BMSB in the mid-Atlantic occurred in commercial apple in 2009; extensive injury in 2010 causing 37 million dollars in pome fruit damage.

- **Economic damage to apple on three Hudson Valley Farms in Ulster and Orange Counties in 2012.**

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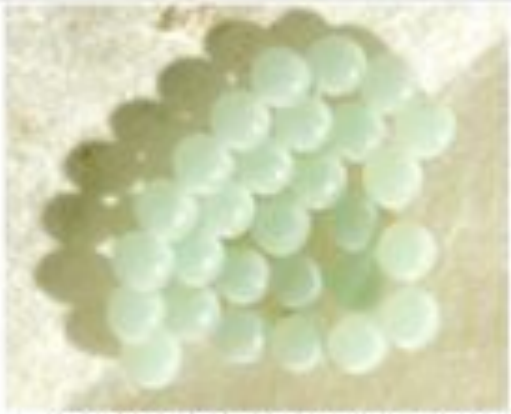


Eggs: Average 28/cluster; light green to white

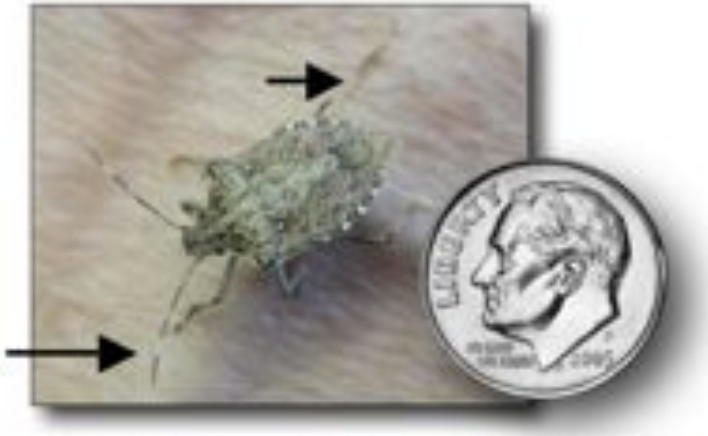
1st instar: black & red; cluster near eggs

2nd instar: striped antennae

3rd instar: striped antennae and legs

4th instar: thoratic spur striped antennae & legs

5th instar: wing pads striped antennae & legs



BMSB Adults: red eyes, 4 cream colored dots on shoulders; banding on legs and antenna, smooth blunt shoulders. Banded abdomen; 14 -17 mm in length.

Spined Soldier Bug
Pointed shoulders
No leg stripe

Brown stink bug
No leg stripe

Rough Stink Bug
'Teeth' along shoulders

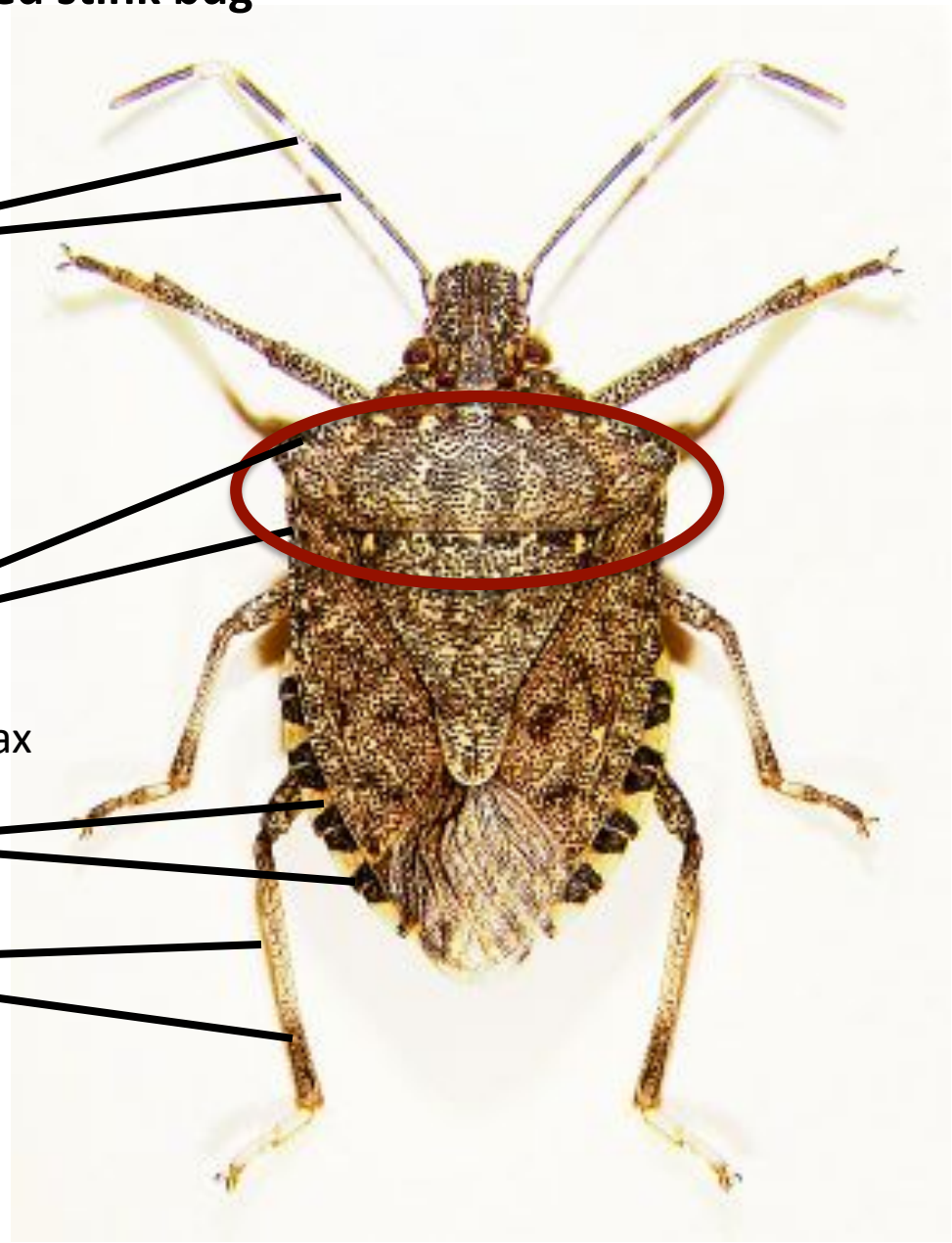
Green Stink Bug
No leg stripe

Squash Bug
No leg stripe

Western conifer seed bug
'leaf footed'

Key features of the brown marmorated stink bug

Halyomorpha halys



Antenna:

light & dark banding

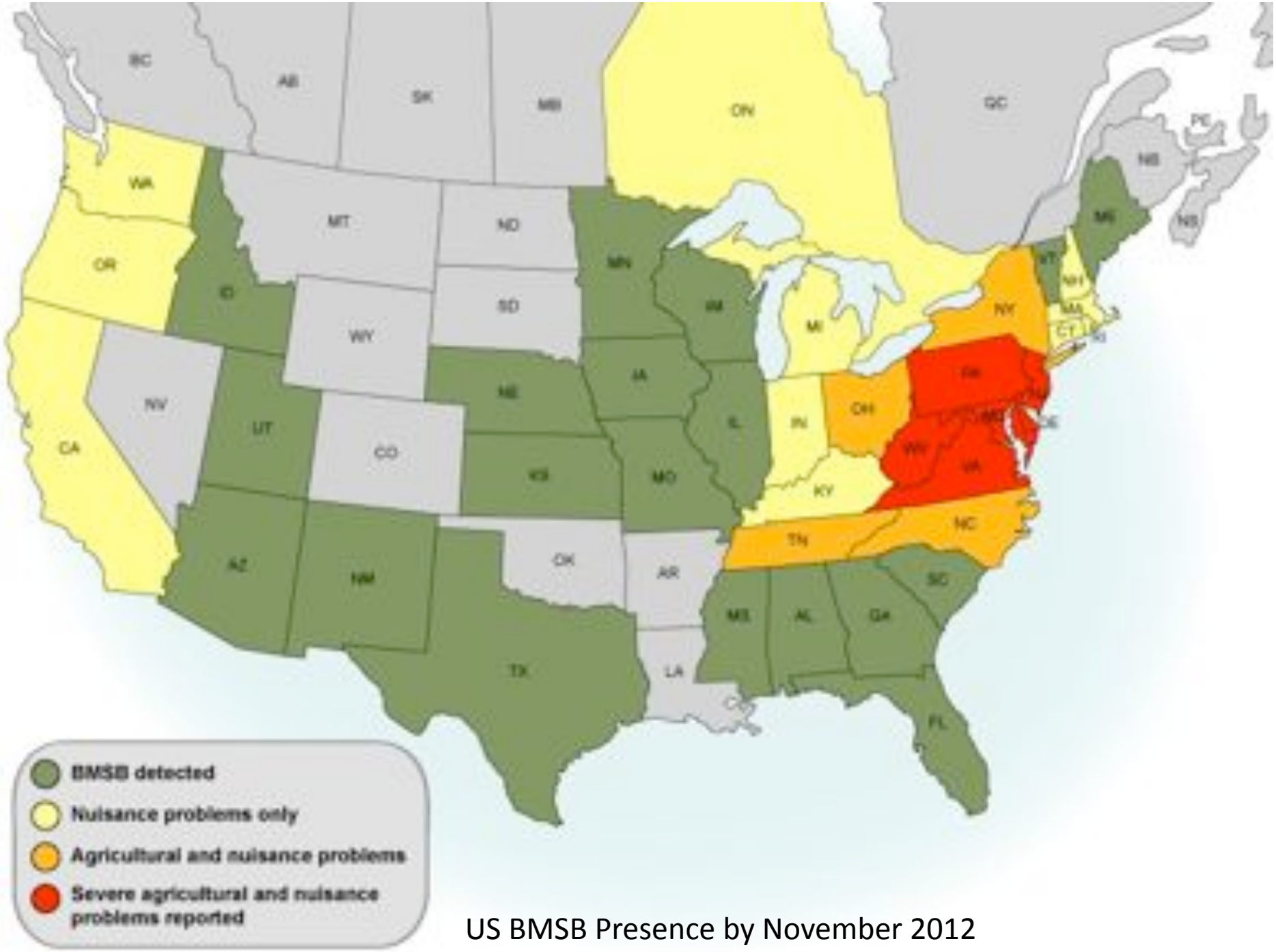
2 sets of 4

Cream colored dots on thorax

Wing pads & Legs:

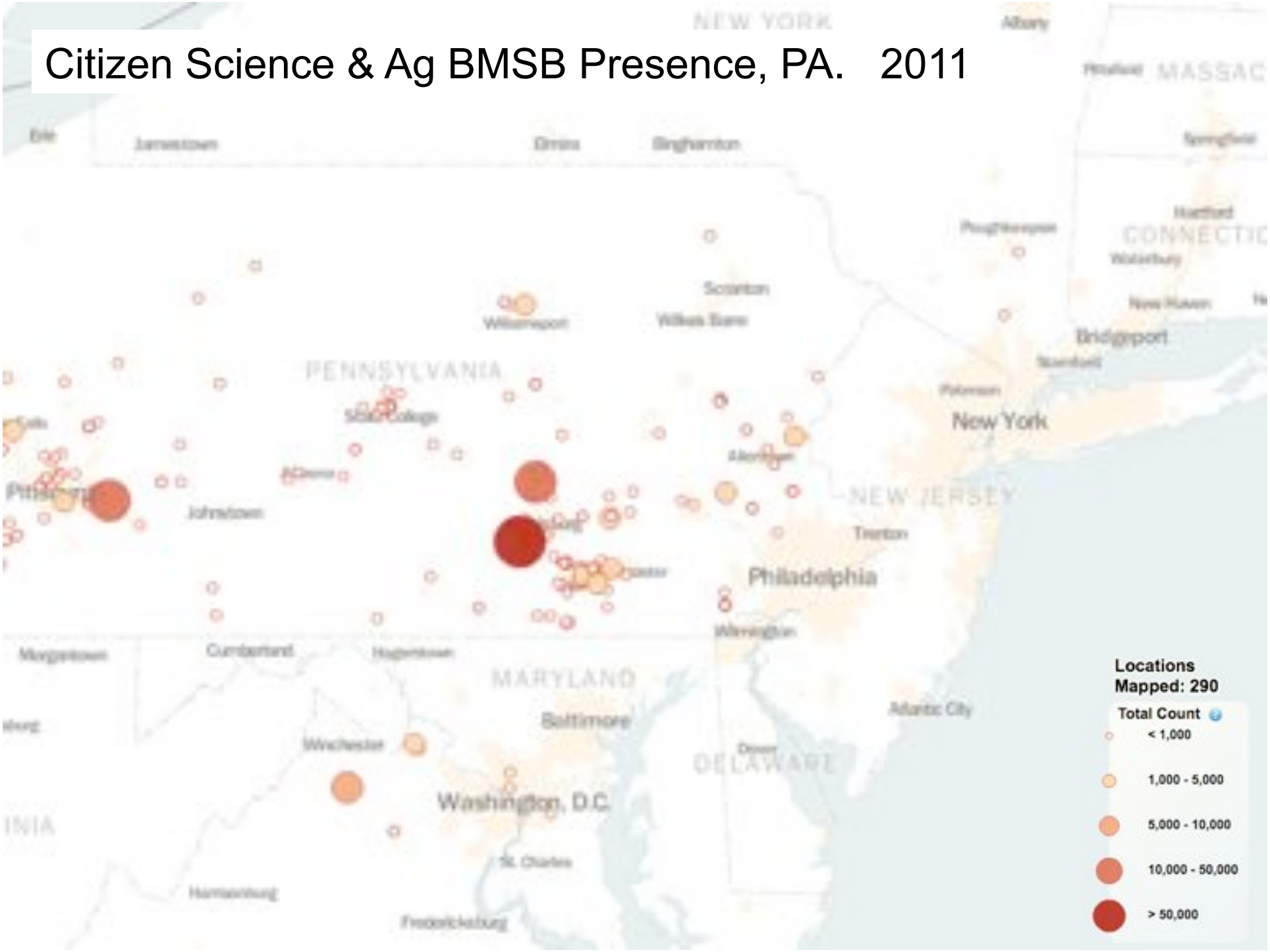
light & dark banding

Photo by David J. Shetlar
Ohio State University

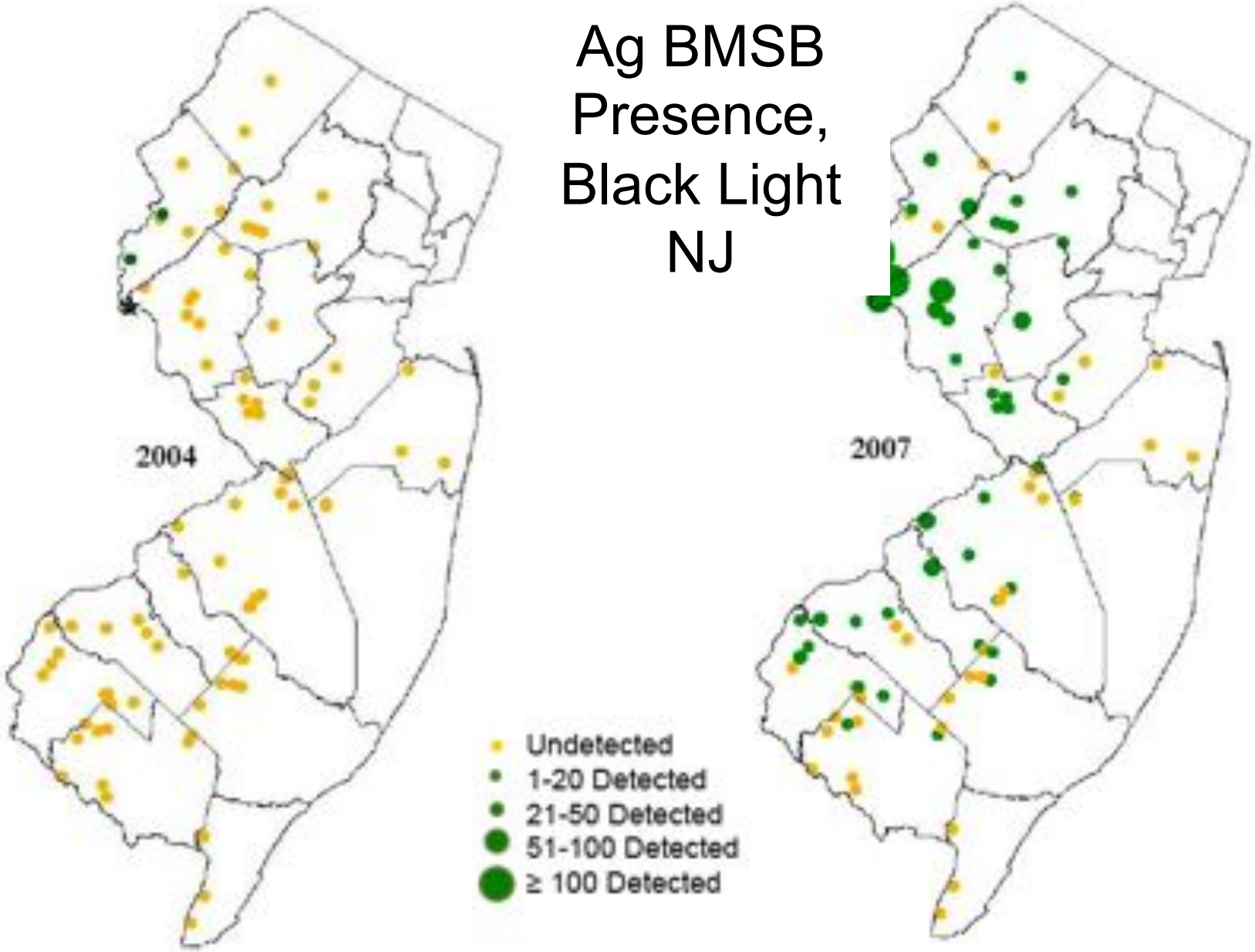


US BMSB Presence by November 2012

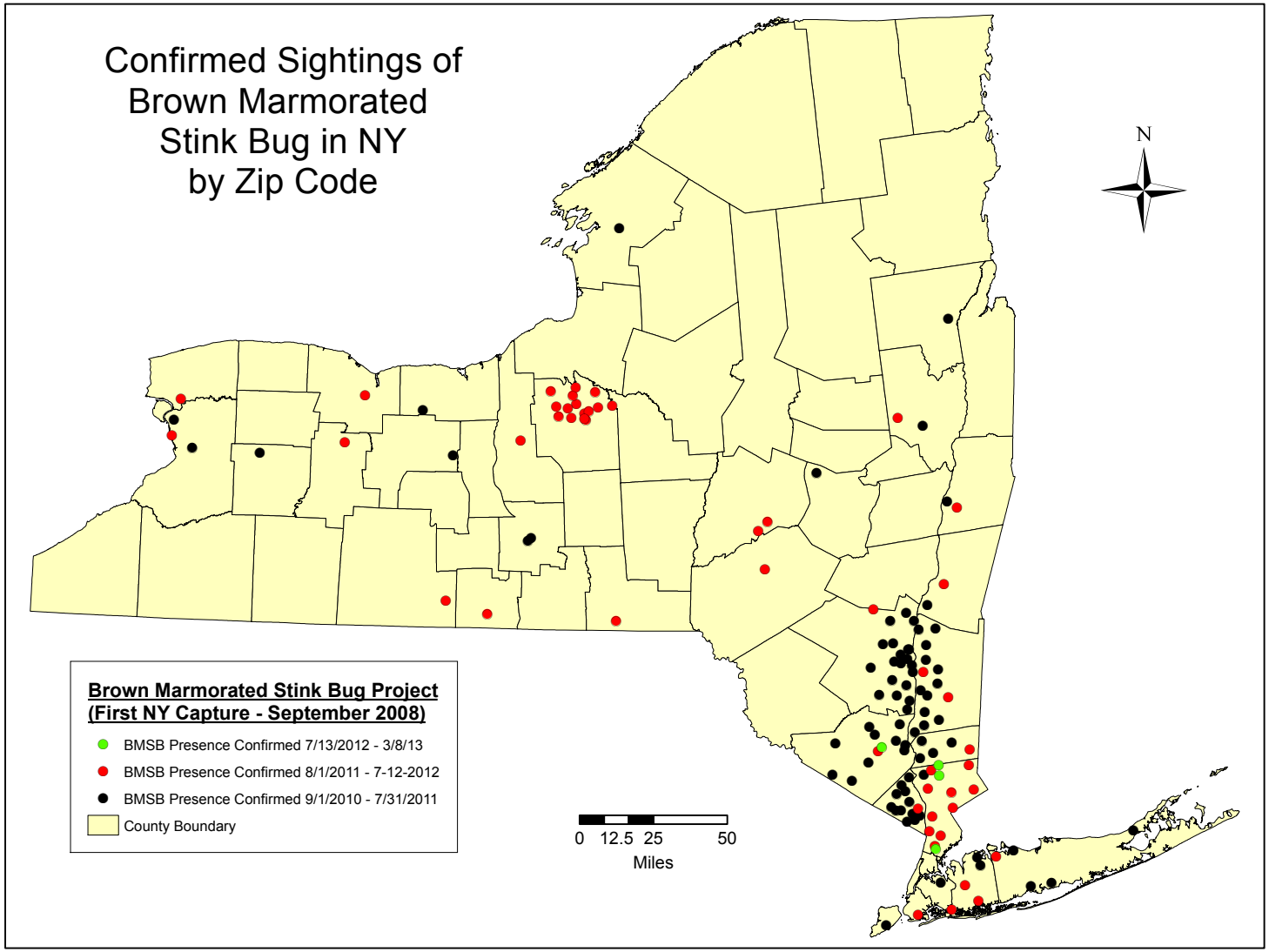
Citizen Science & Ag BMSB Presence, PA. 2011



Ag BMSB Presence, Black Light NJ



Urban mapping of BMSB (from Citizen Science submissions) showing population concentrations in 33 Counties of New York.



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Brown Mamorated Stink Bug 2012; N=64

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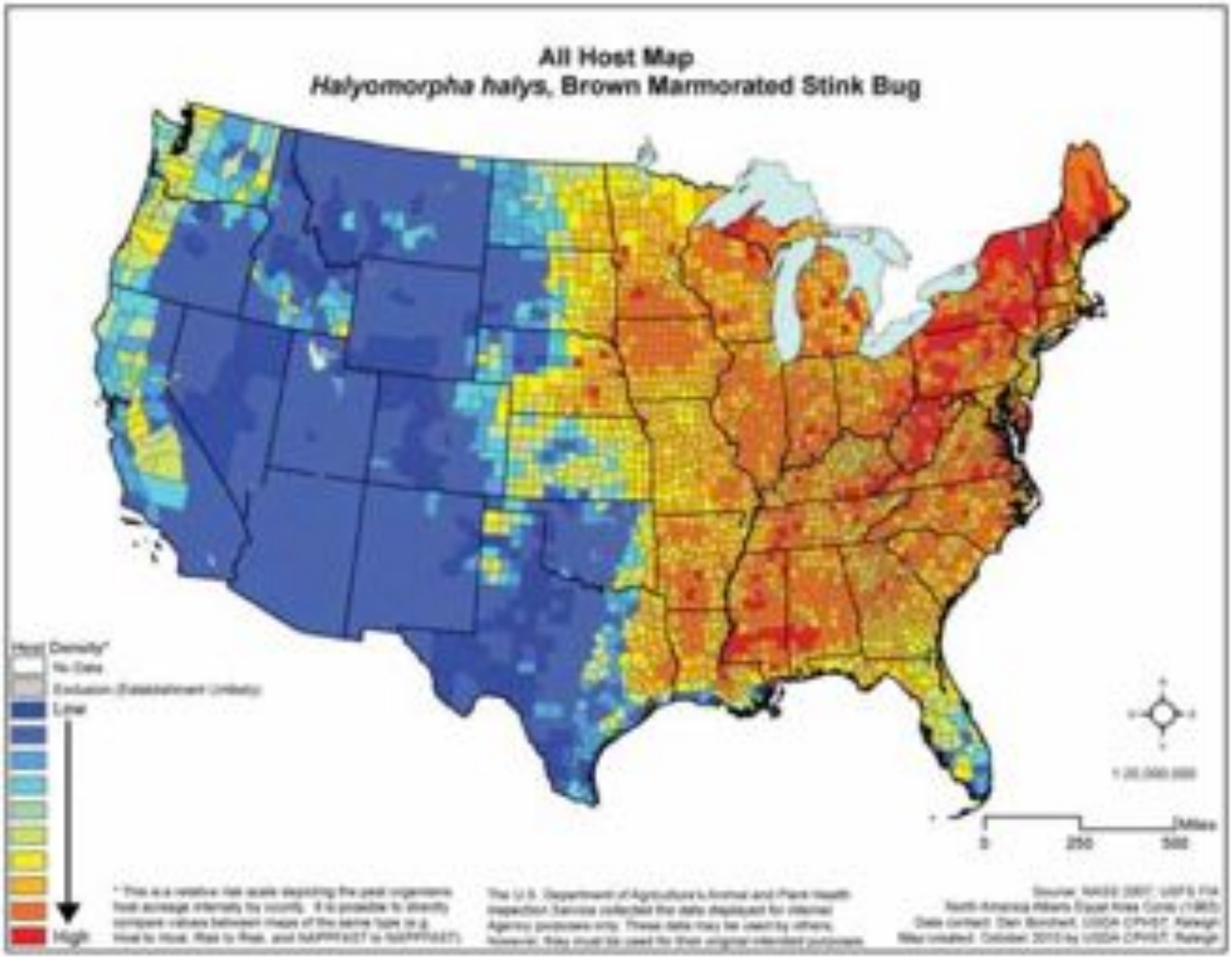


Figure 1: Risk maps displaying the relative density of field, vegetable, and fruit crop hosts plants of BMSB throughout the United States.

United States Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine

Qualitative analysis of the pest risk potential of the brown marmorated stink bug (BMSB), *Halyomorpha halys* (Stål), in the United States

October 2010

Rev: Original

Polyphagous insect with an expansive host range

- Observed on over 300 plants; arboreal
- Deciduous trees, tree fruit, legumes

Appendix A: BMSB Host List

Table 2: Reported host list for BMSB. This pest's host range is likely larger than what has been reported in the literature and likely includes a wide variety of ornamentals and weeds that have not been specifically documented in the literature. (* indicates hosts used to develop the risk maps in Figure 1 and 2).

Host	Common name	Reference
Abeliea x grandiflora (André) Rehd	Glossy abelia	Bernon, 2004
Acer campestre L.	Hedge maple	Bernon, 2004
Acer palmatum Thunb.	Japanese maple	Bernon, 2004
Acer platanoides L.	Norway maple	Bernon, 2004; Hamilton and Shearer, 2003
Acer pseudoplatanus L.		Wermelinger et al., 2008
Acer rubrum L.	Red maple	Bernon, 2004
Acer spp.*	Maple	Hoebeke and Carter, 2003; Wermelinger et al., 2008
Amelanchier spp.	Shadbush	Bernon, 2004; Hoebeke and Carter, 2003
Arctium minus Bernh.	Burdock	Bernon, 2004
Arctium spp.		Wermelinger et al., 2008
Asparagus officinalis L.*	Asparagus	Hamilton and Shearer, 2003
Asparagus spp.		Bernon, 2004; Wermelinger et al., 2008
Basella rubra Linn.	T'ang ts'oi or Climbing spinach	Hoffman, 1931
Beta vulgaris L.	Beat Root	Hua, 2000
Betula spp.	Birch	Bernon, 2004
Buddleja davidii Franch.	Butterfly bush	Bernon, 2004; Wermelinger et al., 2008
Buddleia spp.	Butterfly bush	Hamilton and Shearer, 2003
Camellia oleifera C. Abel	Tea-oil camellia	Hua, 2000
Capsicum annuum L.*	Bell pepper	Bernon, 2004; Leskey, 2010a, 2010b
Caragana arborescens Lam.	Siberian pea shrub	Bernon, 2004; Nielsen and Hamilton, 2009
Carya spp.	Pecan	Bernon, 2004
Catalpa spp.*	Catalpa	Bernon, 2004; Hoebeke and Carter, 2003
Celastrus spp.	Bittersweet	Bernon, 2004
Celosia argentea L.	Princess feather or Cock's comb	Hoffman, 1931
Celtis occidentalis L.	Hackberry	Bernon, 2004
Cercis canadensis L.	Redbud	Bernon, 2004
Cleome spp.	Cleome	Bernon, 2004
Citrus spp.*	Citrus	Wermelinger et al., 2008; Hoebeke and Carter, 2003
Cornus racemosa Lam.	Gray dogwood	Bernon, 2004
Cornus sericea L.	Redosier dogwood	Bernon, 2004

Host	Common name	Reference
Tilia americana L.	Linden	Bernon, 2004
Tilia spp.*	Basswood	Hoebeke and Carter, 2003
Triticum aestivum L.	Wheat	Hua, 2000
Tropaeolum majus L.		Wermelinger et al., 2008
Ulmus spp.	Elm	Hua, 2000
Uncultivated hedge		Nielsen and Hamilton, 2009
Viburnum opulus var. *americanum* Ait.	Highbush cranberry	Nielsen and Hamilton, 2009
Viburnum prunifolium L.	Blackhaw viburnum	Bernon, 2004; Nielsen and Hamilton, 2009
Viburnum setigerum Hance	Tea Viburnum	Bernon, 2004
Vibernum spp.	Cranberry bush	Bernon, 2004
Vigna sesquipedalis L.	Chinese long bean	Hoffman, 1931
Vitis spp.*	Grape	Bernon, 2004; Hamilton, 2009
Vitis vinifera L.	Grapevine	Wermelinger et al., 2008
Zea mays L.*	Corn	Leskey, 2010a, 2010b

Host	Common name	Reference
Corylus colurna L.	Turkish filbert	Bernon, 2004
Crataegus spp.	Hawthorn	Bernon, 2004
Cryptomeria spp.	Japanese cedar	Wermelinger et al., 2008
Cucumis sativus L.	Cucumber	Bernon, 2004
Cupressus spp.	Cypress	Wermelinger et al., 2008
Decaisnea fargesii Franch.		Wermelinger et al., 2008
Diospyros kaki L.	Persimmon	Hoebeke and Carter, 2003
Diospyros kaki Thunb.	Japanese persimmon	Kawada and Kitamura, 1983
Diospyros spp.*	Persimmon	Bernon, 2004; Hoebeke and Carter, 2003; Wermelinger et al., 2008
Elaeagnus angustifolia L.	Russian olive	Nielsen and Hamilton, 2009
Euonymus alatus (Thunb.) Siebold	Winged Euonymus	Bernon, 2004
Euonymus spp.	Euonymus	Bernon, 2004
Ficus spp.	Fig	Hoebeke and Carter, 2003
Fraxinus americana L.	White ash	Nielsen and Hamilton, 2009
Fraxinus spp.	Ash	Bernon, 2004
Glycine max Merrill	Soybean	Bernon, 2004; Hoebeke and Carter, 2003; Wermelinger et al., 2008 Hua, 2000; Sun et al., 2008
Gossypium spp.	Cotton	Hua, 2000
Helianthus spp.	Sunflower	Bernon, 2004
Hibiscus rosa-sinensis L.	Chinese hibiscus	Hoffman, 1931
Hibiscus spp.		Wermelinger et al., 2008
Ilex opaca Ait.	American holly	Bernon, 2004; Hamilton and Shearer, 2003
Ilex spp.*	Holly	Bernon, 2004
Ilex verticillata (L.) A. Gray	Winterberry holly	Bernon, 2004
Juglans nigra L.*	Walnut	Bernon, 2004
Koelreuteria spp.	Goldenrain Tree	Bernon, 2004
Ligustrum spp.	Privet	Bernon, 2004
Lonicera spp.	Honeysuckle	Bernon, 2004; Hoebeke and Carter, 2003; Wermelinger et al., 2008
Lycopersicon spp.	Tomato	Bernon, 2004
Magnolia soulange (Siebold & Zucc.) Maxim.	Star magnolia	Bernon, 2004
Malus domestica L. (or Brokh)*	Apple	Hua, 2000; Hoebeke and Carter, 2003
Malus spp.	Crabapple	Bernon, 2004; Hamilton and Shearer, 2003; Wermelinger et al., 2008
Morus spp.	Mulberry	Wermelinger et al., 2008; Bernon, 2004; Hoebeke and Carter, 2003
Paulownia spp.	Paulownia	Hoebeke and Carter, 2003
Paulownia tomentosa (Thunb.) Siebold & Zucc. ex Steud.*	Princess Tree or Paulownia	Bernon, 2004; Hoebeke and Carter, 2003; Wermelinger et al., 2008
Phaseolus lunatus Linn.	Lima beans	Hoffman, 1931

Host	Common name	Reference
Phaseolus spp.*	Pole bean, Bush bean	Bernon, 2004
Phaseolus vulgaris L.	String beans	Hamilton and Shearer, 2003; Wermelinger et al., 2008
Pisum sativum L.	Pea	Wermelinger et al., 2008
Platanus occidentalis L.	Sycamore	Bernon, 2004
Prunus armeniaca L.	Apricot	Bernon, 2004; Wermelinger et al., 2008
Prunus avium L.	Cherry	Wermelinger et al., 2008; Hoebeke and Carter, 2003
Prunus domestica L.	Plum	Bernon, 2004; Wermelinger et al., 2008
Prunus grayana Maxim.	Japanese bird cherry	Funayama, 2007
Prunus mume Sieb. et Zucc	Japanese apricot	Hoebeke and Carter, 2003
Prunus persica Batsch	Japanese peach	Hoebeke and Carter, 2003; Wermelinger et al., 2008; Hua, 2000
Prunus spp.*	Peach,	Bernon, 2004; Leskey, 2010a, 2010b; Wermelinger et al., 2008
Prunus spp.	Ornamental plum, Sour cherry, Black cherry	Bernon, 2004
Pyracantha coccinea M. Roem	Firethorn	Wermelinger et al., 2008
Pyracantha spp.	Firethorn	Bernon, 2004; Hamilton and Shearer, 2003
Pyrus pyrifolia Nakai	Japanese pear	Hoebeke and Carter, 2003
Pyrus pyrifolia (Burm. f.) Nak	Asian pear	Nielsen and Hamilton, 2009
Pyrus spp.*	Pear	Bernon, 2004; Nielsen and Hamilton, 2009; Hua, 2000;
Rhamnus spp.	Buckthorn	Bernon, 2004
Rhodotypos scandens (Thunb.) Makino	Jetbead	Bernon, 2004
Rhus spp.	Sumac	Bernon, 2004
Rosa rugosa Thunb.	Rugosa rosea	Bernon, 2004; Nielsen and Hamilton, 2009;
Rosa spp.	Rose	Hamilton, 2009
Rubus spp.*	Raspberry	Bernon, 2004; Hamilton and Shearer, 2003; Wermelinger et al., 2008
Salix spp.	Willow	Bernon, 2004; Wermelinger et al., 2008
Sambucus spp.	Elder	Bernon, 2004
Sicyos angulatus L.	Burcucumber	Bernon, 2004
Solanum nigrum L.	Black nightshade	Hoffman, 1931
Solanum spp.	Nightshade	Bernon, 2004
Solanum spp.*	Tomato	Hamilton, 2009; Leskey, 2010a, 2010b
Sorbus spp.	Mountainash	Bernon, 2004
Spiraea spp.	Spirea	Bernon, 2004
Stewartia pseudocamellia Maxim.		Wermelinger et al., 2008
Symphytum spp.	Comfrey	Bernon, 2004
Syringa spp.	Lilac	Bernon, 2004; Wermelinger et al., 2008


Tree of Heaven, *A. altissima*.
Warwick, NY
September, 2012

***Ailanthus altissima* (Mill.) Swingle 'Tree of Heaven'**

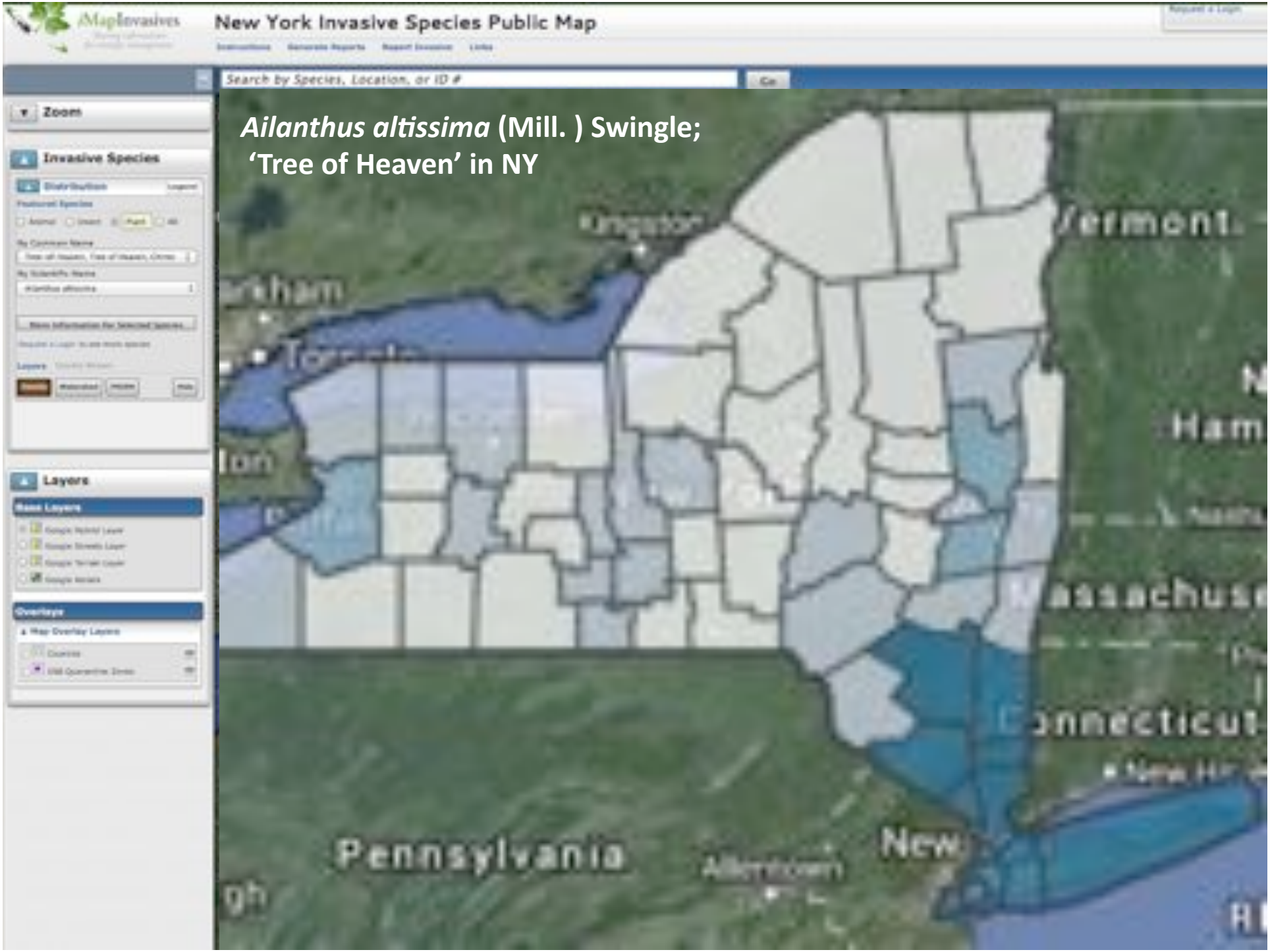
A. altissima has spread through the U.S. including NY.

Contributing to the increase of BMSB in this part of NY state?

The 'Tree of Heaven' *is* a primary food source for BMSB.

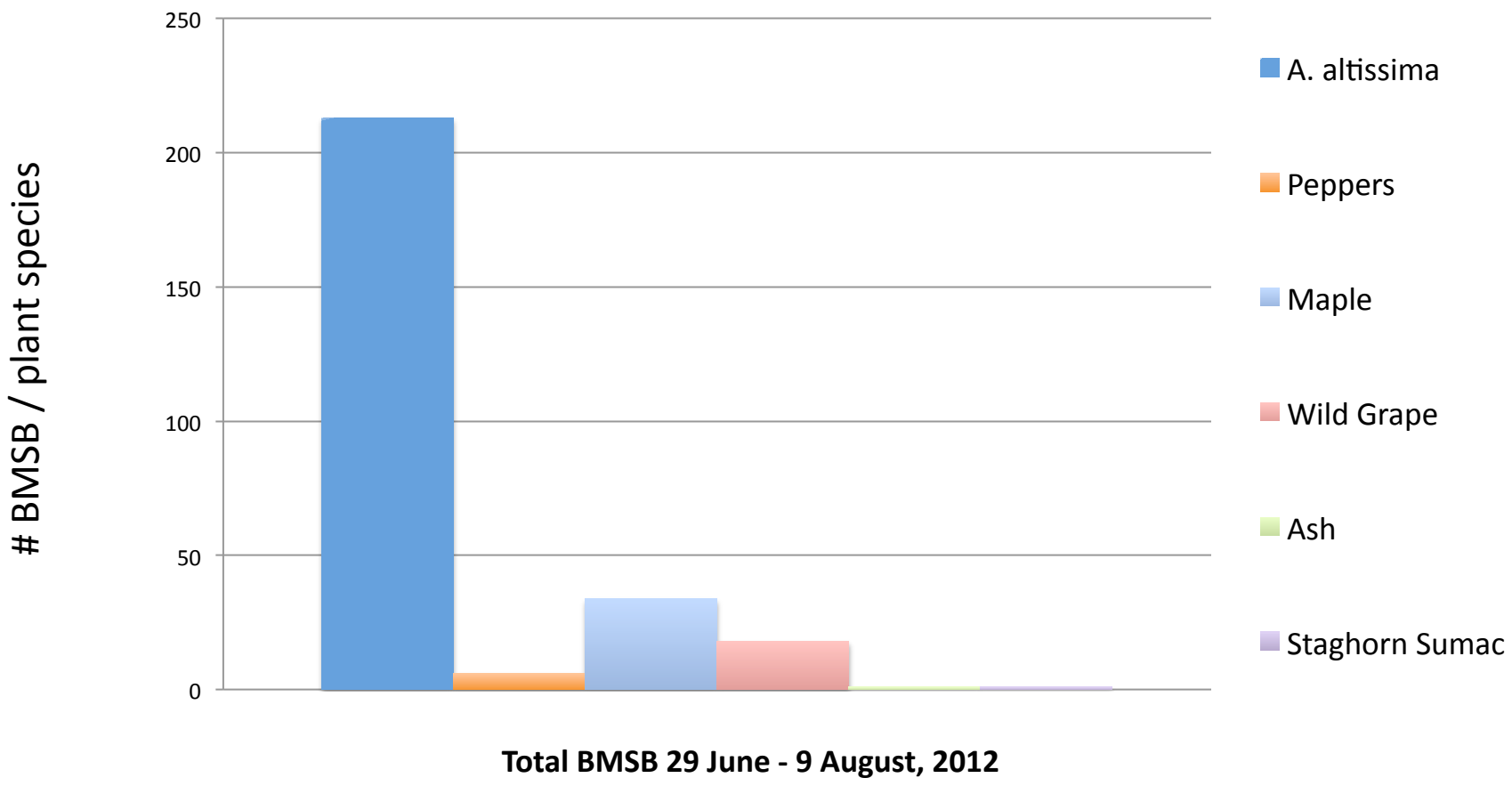
Feeding occurs on foliage and seed while it also acts as a site for reproduction of 2 BMSB generations in NY.

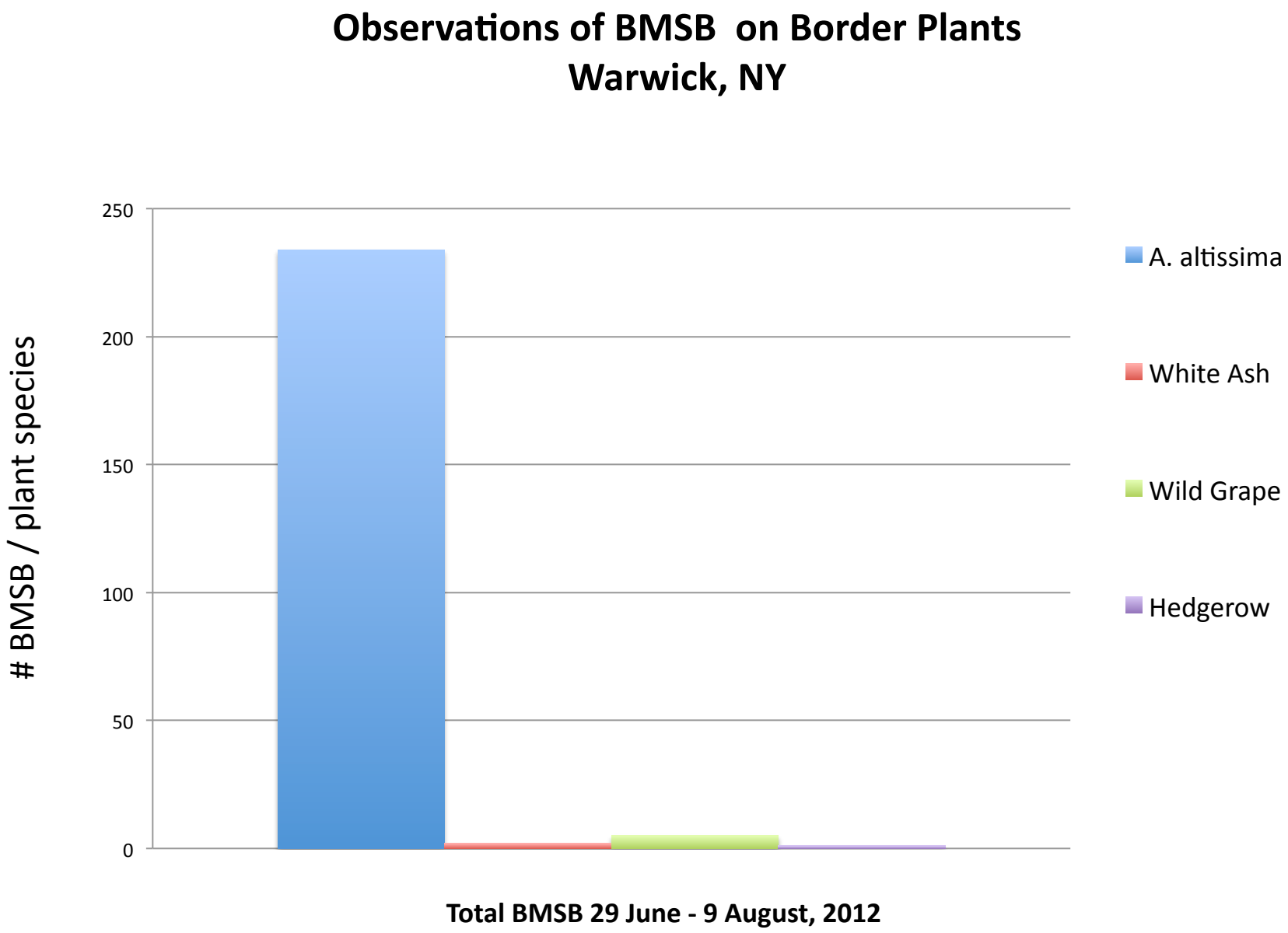
Very present in 'undesirable' urban niches.



Ailanthus altissima (Mill.) Swingle;
'Tree of Heaven' in NY

Observations of BMSB on Border Plants
Marlboro, NY




Observations of BMSB on Border Plants
Warwick, NY
BMSB / plant species
250
200
150
100
50
0
A. altissima
White Ash
Wild Grape
Hedgerow
Total BMSB 29 June - 9 August, 2012

2012 Trap and Kill Project

- Injection of Acephate

Into cambium of *A. altissima*

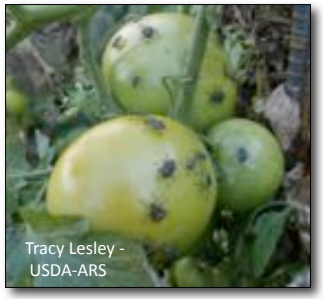
1. *To reduce BMSB*
2. *To maintain tree attractiveness*
3. *Act as a trap and kill*

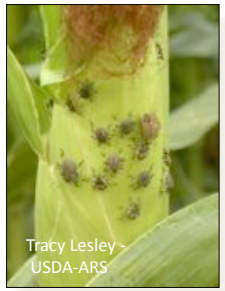
Brown Marmorated Stink Bug on Tree Fruit, Small Fruit & Vegetable

Tree fruit (apple, pear, peaches, cherry)

Small fruit (grape, bramble fruit)

Vegetables (tomato, pepper, sweet corn, Lima Beans, soybean).





Hudson Valley Complex:
SB species of economic importance

Brown Stink Bug, *Euschistus servus* (Say)

Adult Stink bug damage

GT TC P Bloom PF 1C 2C 3C 4C 5C 6C 7C 8C

21 March 21 April 27 April 1 May 14 May 28 May 10 June 25 June 5 July 15 July 1 Aug. 15 Aug. 1 Sept.

Green Stink Bug, *Acrosternum hilare* (Say).

Adult Stink bug damage

GT TC P Bloom PF 1C 2C 3C 4C 5C 6C 7C 8C

21 March 21 April 27 April 1 May 14 May 28 May 10 June 25 June 5 July 15 July 1 Aug. 15 Aug. 1 Sept.

1st Generation 1st & 2nd Generation

Brown marmorated stink bug, *Halyomorpha halys* (Stål)

Adult SB Presence | Adult & Nymph Stink bug damage

GT TC P Bloom PF 1C 2C 3C 4C 5C 6C 7C 8C

21 March 21 April 27 April 1 May 14 May 28 May 10 June 25 June 5 July 15 July 1 Aug. 15 Aug. 1 Sept.

Establishing Brown Marmorated Stink Bug Presence In NYS: Agriculture Environment

- Standard use of Tedders trap and pheromone lures to determine presence / absence of BMSB

- Black Tedders triangular station with cone trap and clear plastic jar
- USDA #10 + MDT (*methyl* (E,E,Z)-2,4,6-*decatrienoate)*
- Killing strip
- Weed free base

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Lure Comparison Study to Monitor BMSB
Columbia, Dutchess & Orange Co., NY 2013

7 Orchard locations using #10 + MDT standard lures & Black Light

Monitoring Site/ Orchard	BMSB Pheromone Type	Lat.	Long.
Warwick, NY (Orange County)	#10 + MDT SCRI Monitoring Site	41°13'59.16"N	74°23'15.12"
Warwick, NY (Orange County)	Lure Comparison	41°13'48.35"N	74°23'9.33"W
Campbell Hall, NY (Orange County)	#10 + MDT SCRI Monitoring Site	41°25'36.46"N	74°14'18.91"W
Campbell Hall, NY (Orange County)	Lure Comparison	41°25'43.37"N	74°14'11.79"W
Marlboro, NY (Orange County)	#10 + MDT SCRI Monitoring Site	41°38'8.77"N	73°58'5.19"
Hudson, NY (Columbia, Co.)	#10 + MDT SCRI Monitoring Site	42°11'50.31"N	73°49'34.59"W
Tivoli, NY (Dutchess Co)	#10 + MDT SCRI Monitoring Site	42° 2'43.32"N	73°51'15.90"W

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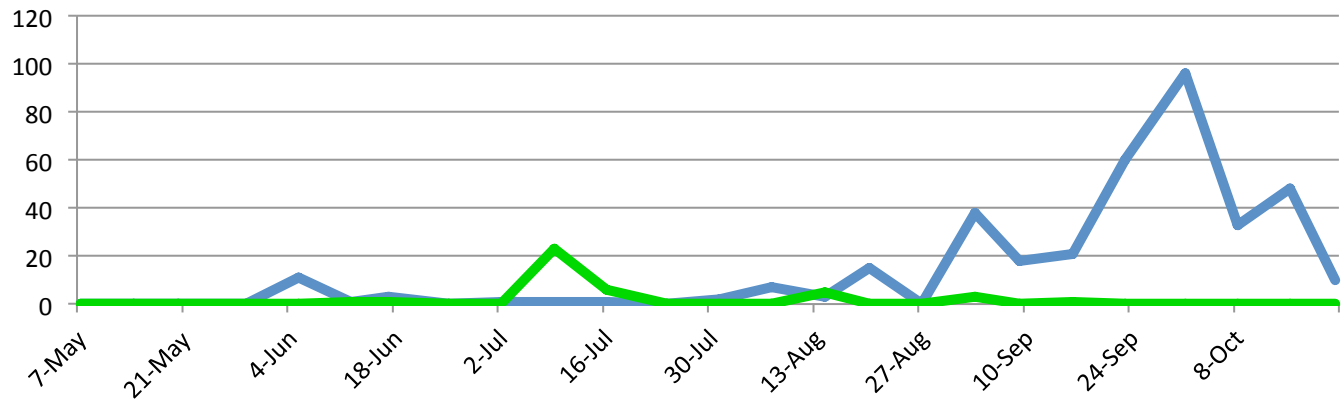
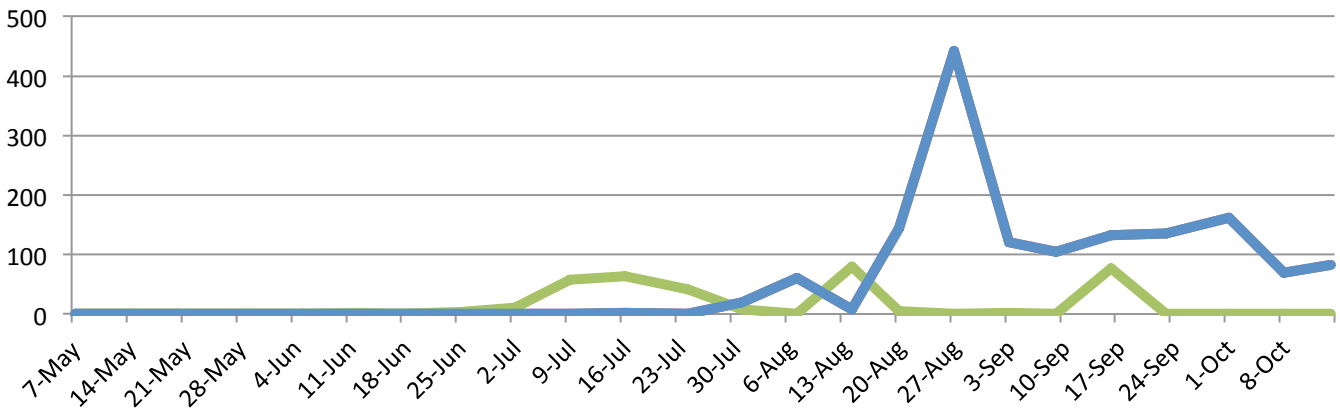
BMSB Monitoring of 3 NY Orchards, 2013

Tedder / pheomone

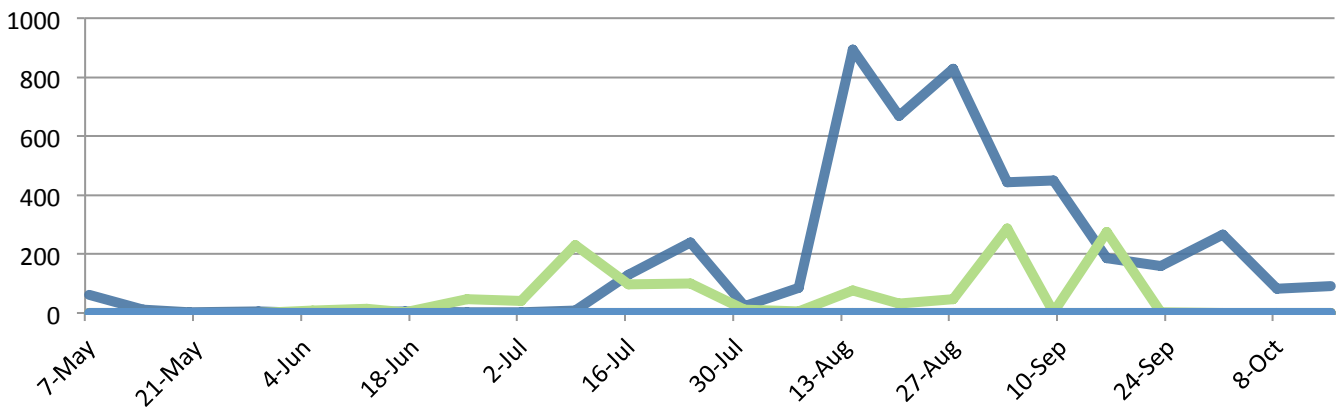
Black Light



Campbell Hall, NY



Milton, NY



Marlboro, NY

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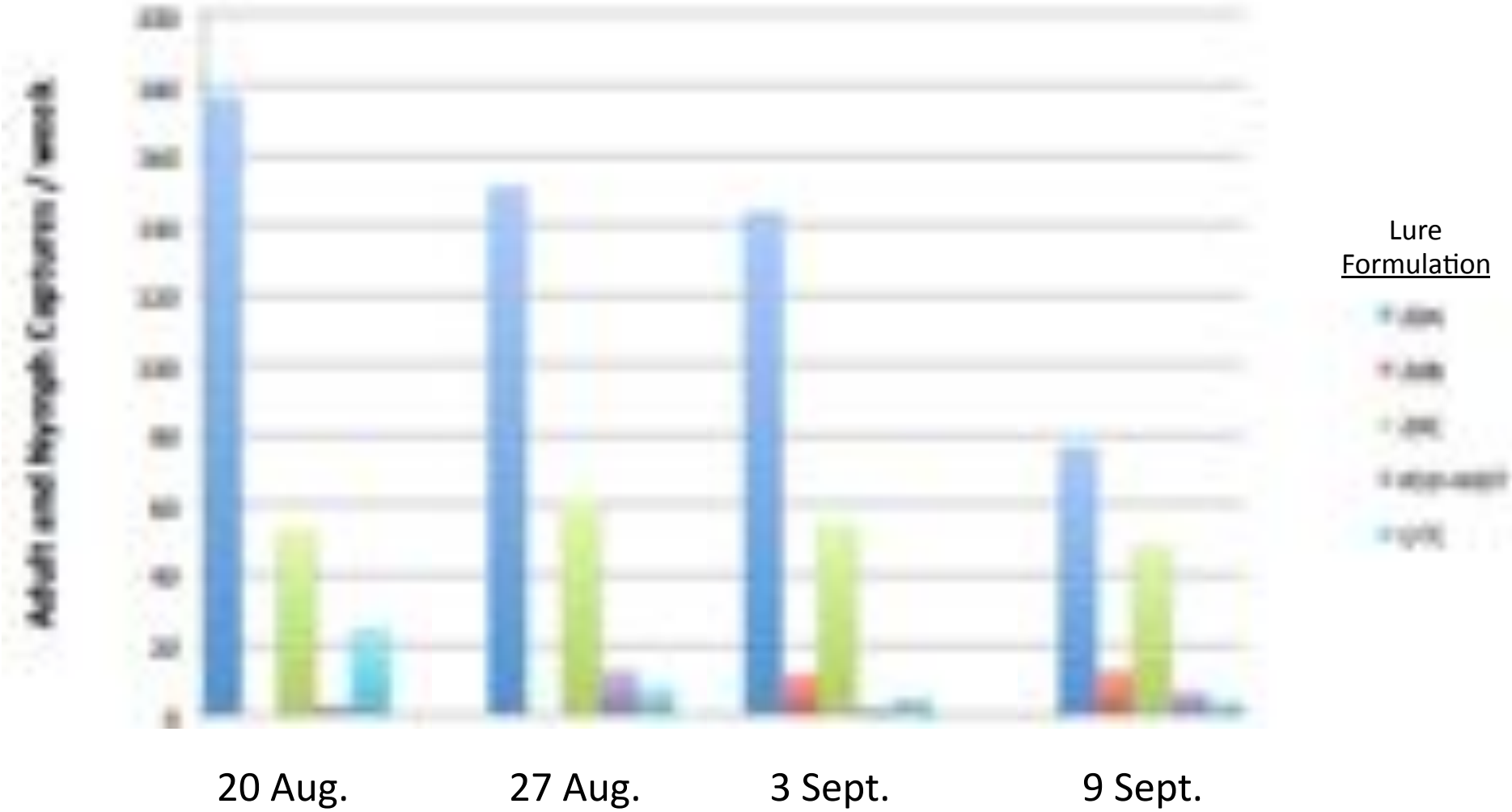
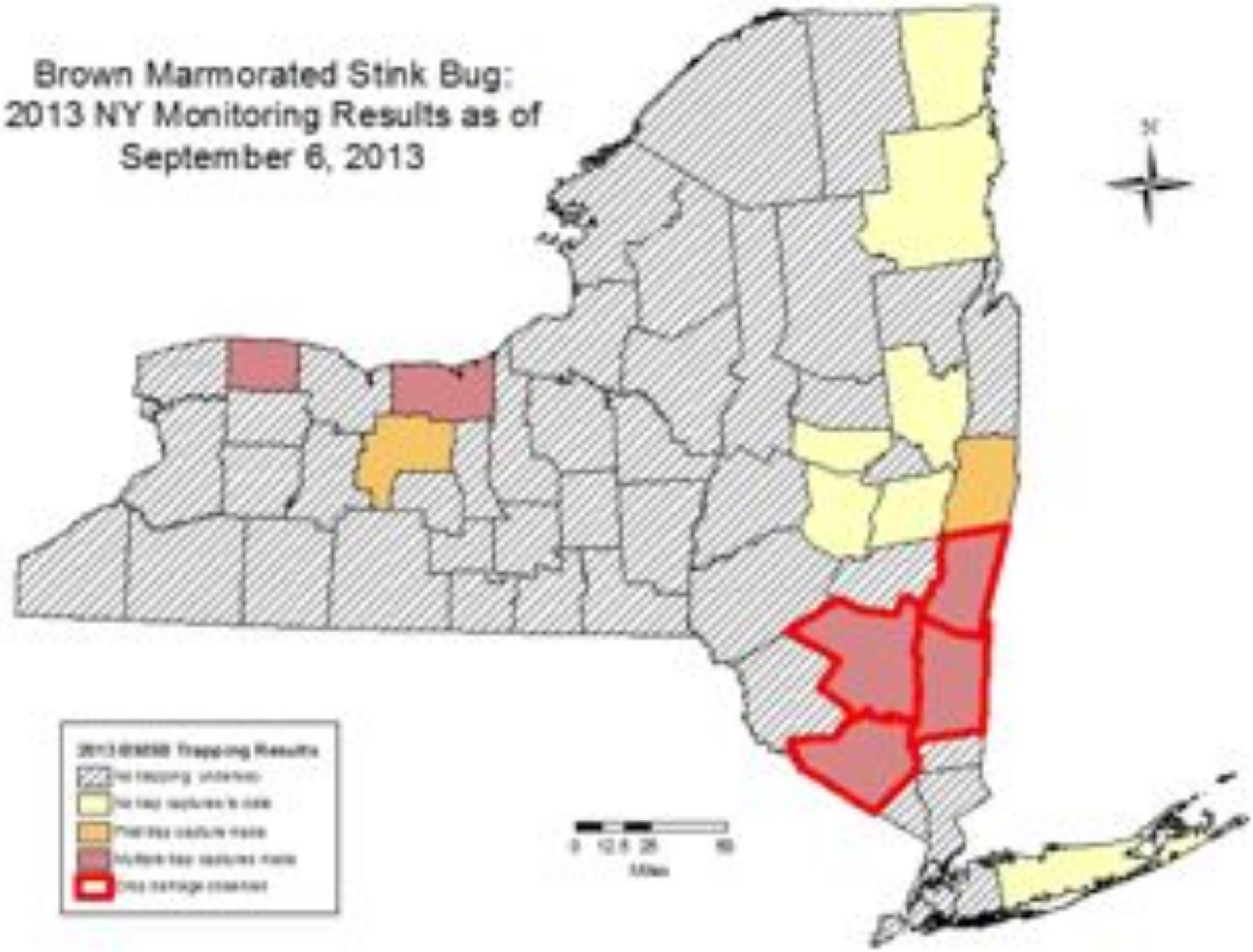
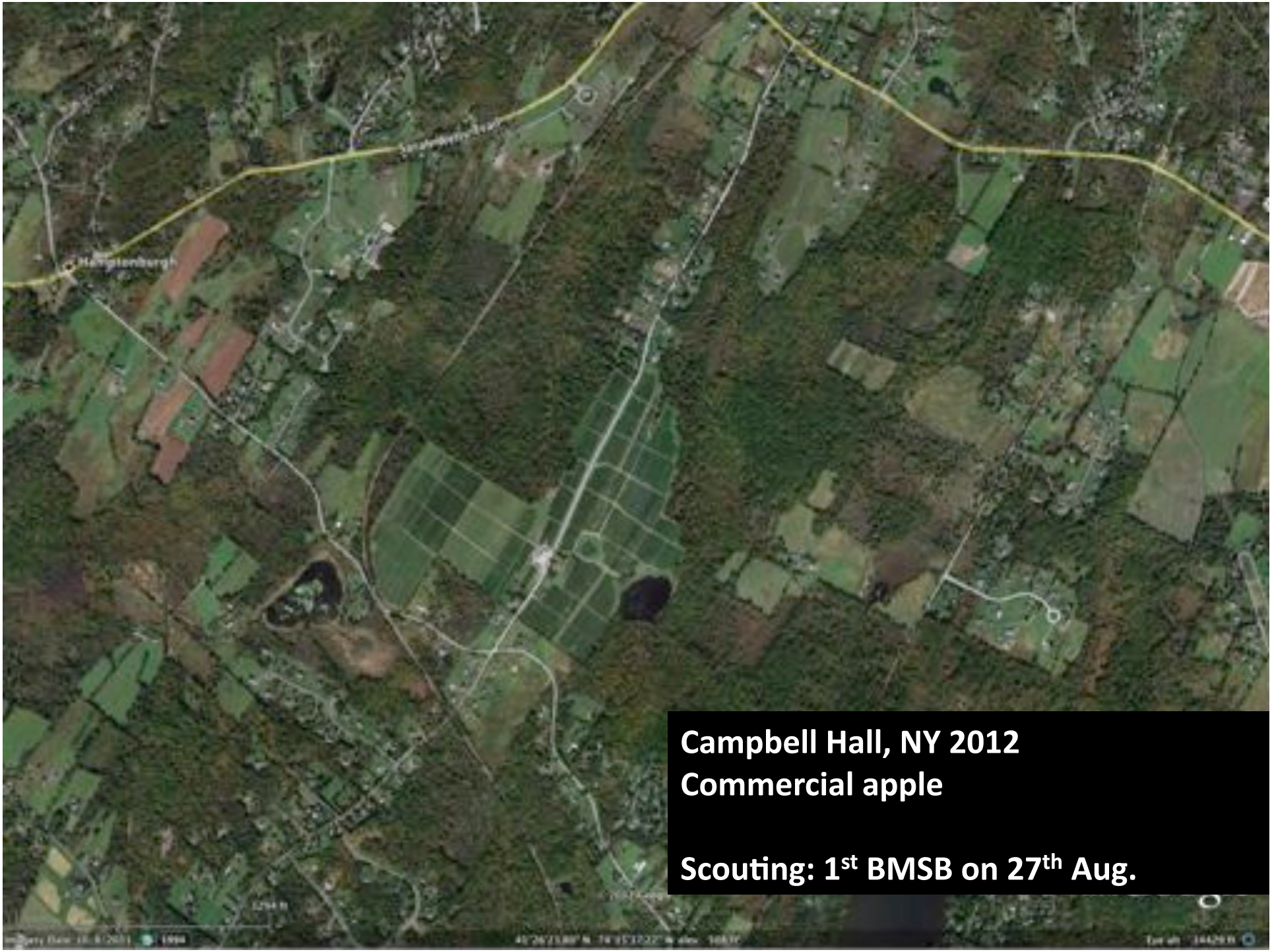
Lure Comparison Study to Monitor BMSB
Warwick, NY 2013

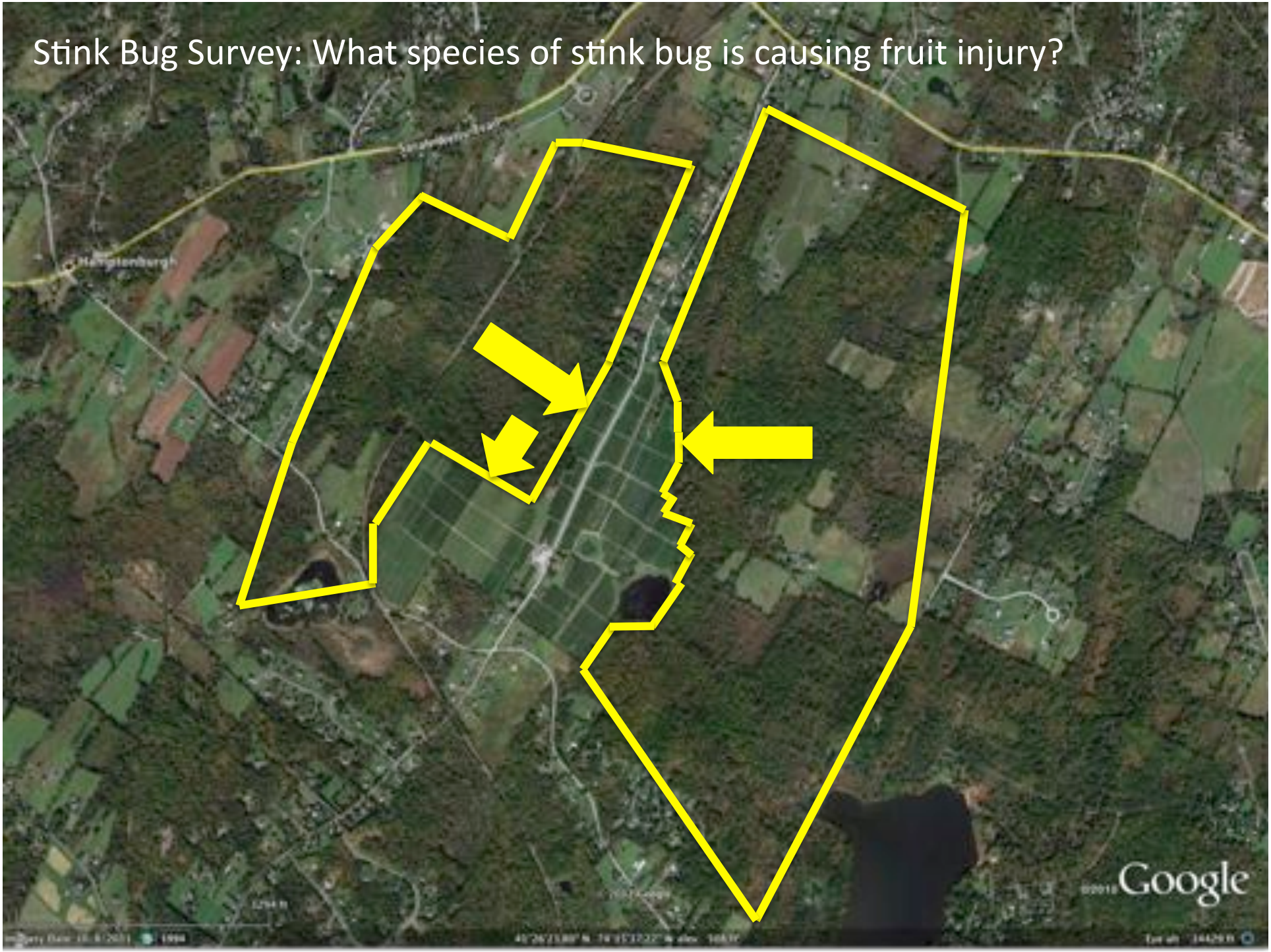



Brown Marmorated Stink Bug:
2013 NY Monitoring Results as of
September 6, 2013
N

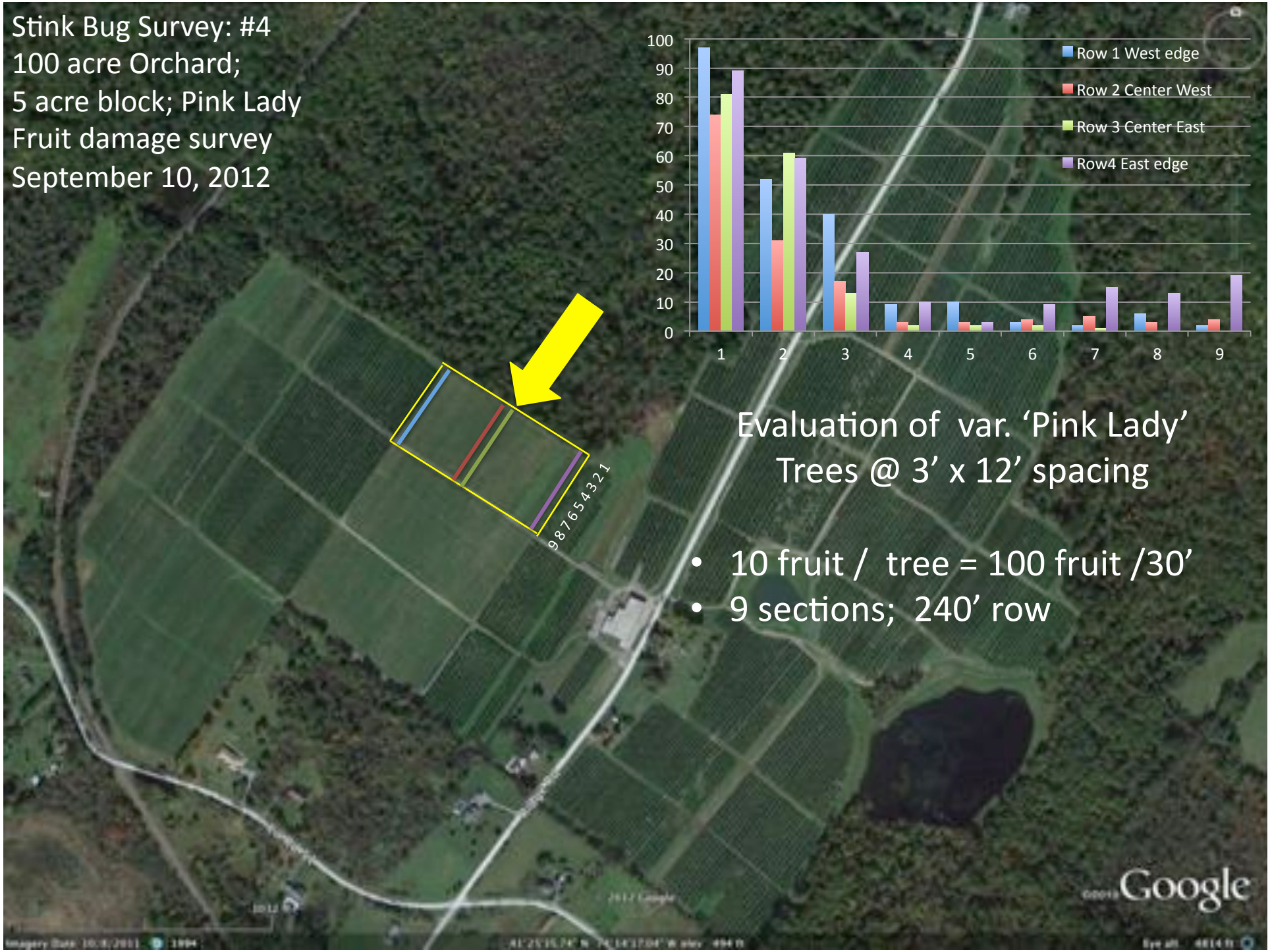

Campbell Hall, NY 2012
Commercial apple
Scouting: 1st BMSB on 27th Aug.


Fruit damage survey
>15% SB Injury in Red Delicious
September 10, 2012

Stink Bug Survey: What species of stink bug is causing fruit injury?



Stink Bug Survey: #4
100 acre Orchard;
5 acre block; Pink Lady
Fruit damage survey
September 10, 2012



Evaluation of var. 'Pink Lady'
Trees @ 3' x 12' spacing

- 10 fruit / tree = 100 fruit /30'
- 9 sections; 240' row

Stink Bug Survey: #4
100 acre Orchard;
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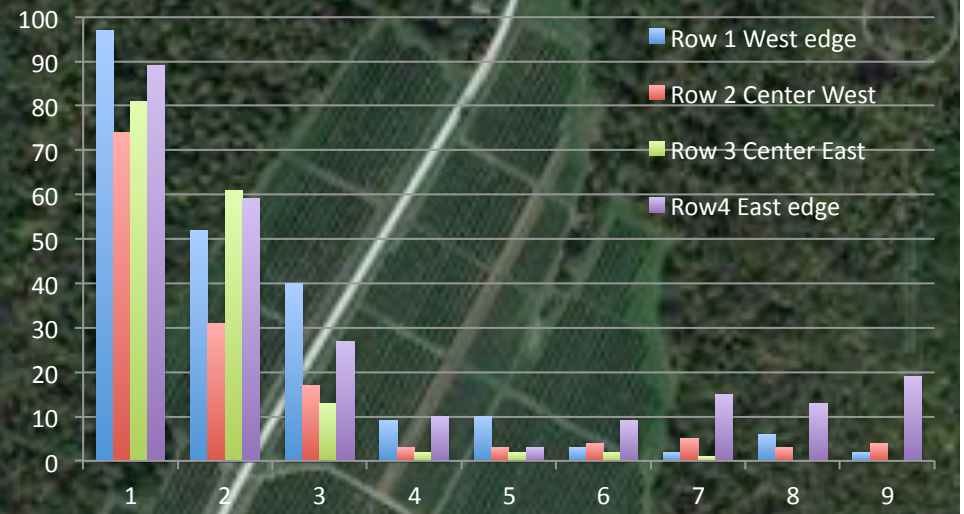
September 10, 2012



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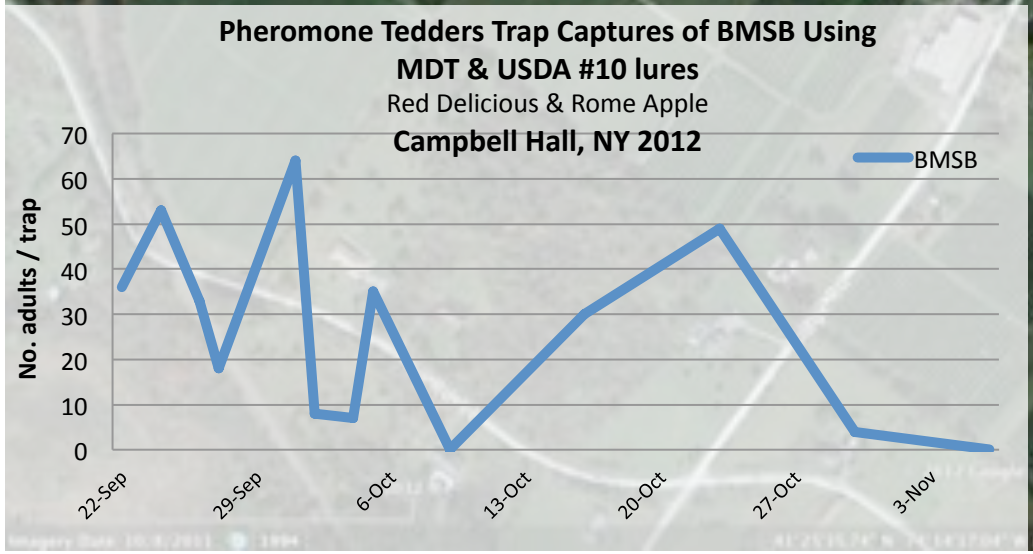

Stink bug injury to Pink Lady apple on 4 September, 2012


Bitter Pit
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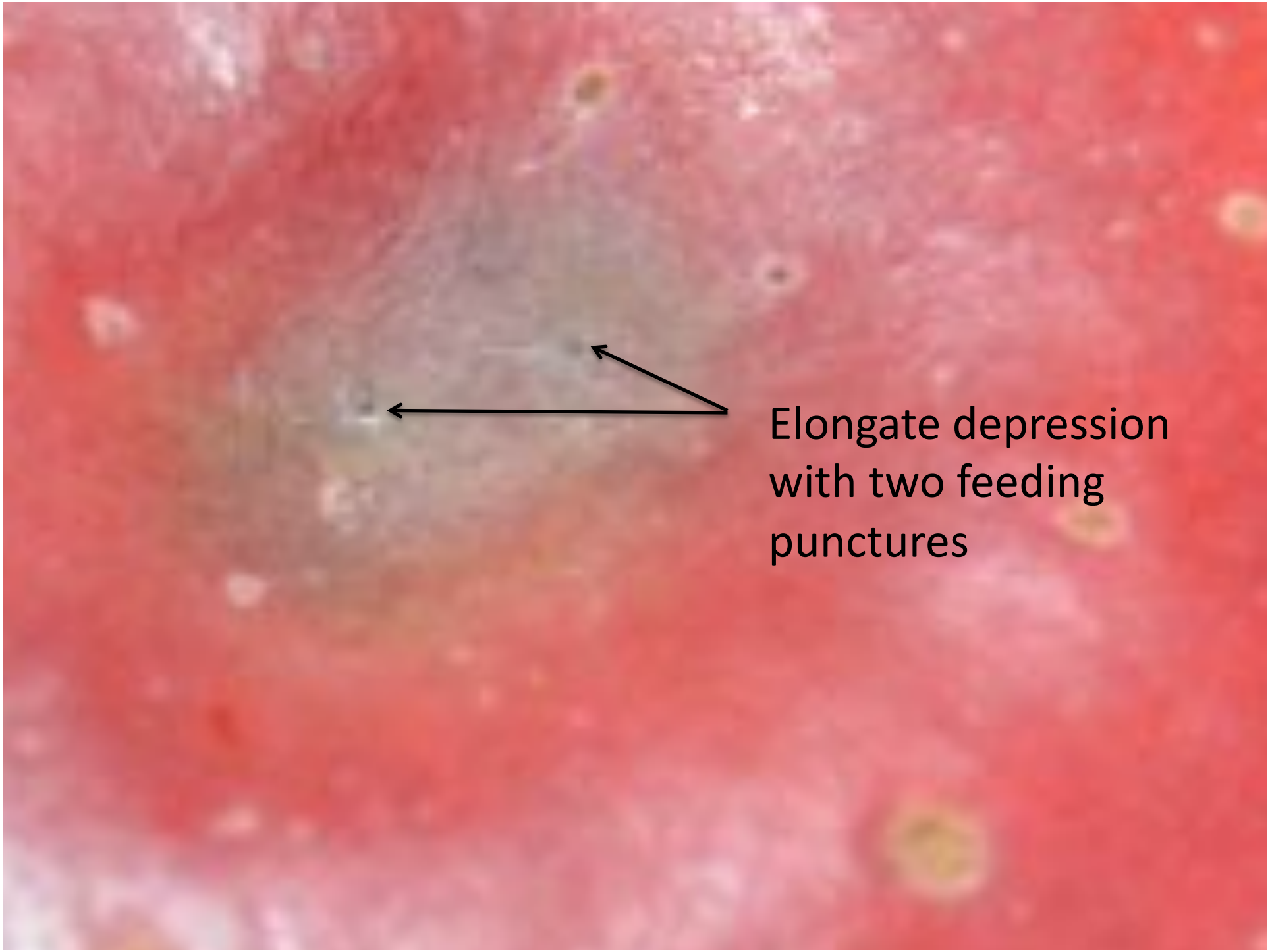
Determination of Stink Bug Injury

- Bitter pit lesions clustered
- Corking beneath skin surface with separation

Stink bug feeding site always visible
Corking up to skin surface

Bitter Pit

Stink Bug Injury

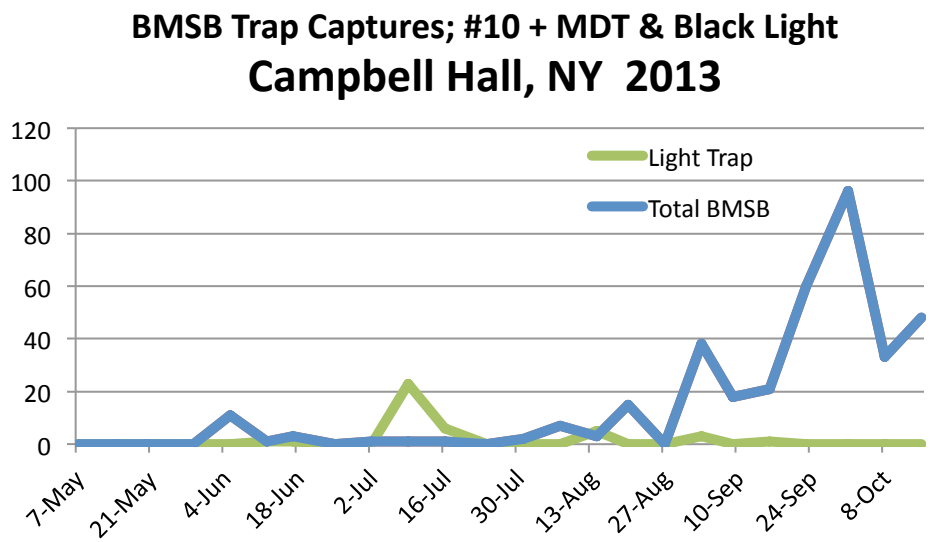

Elongate depression
with two feeding
punctures

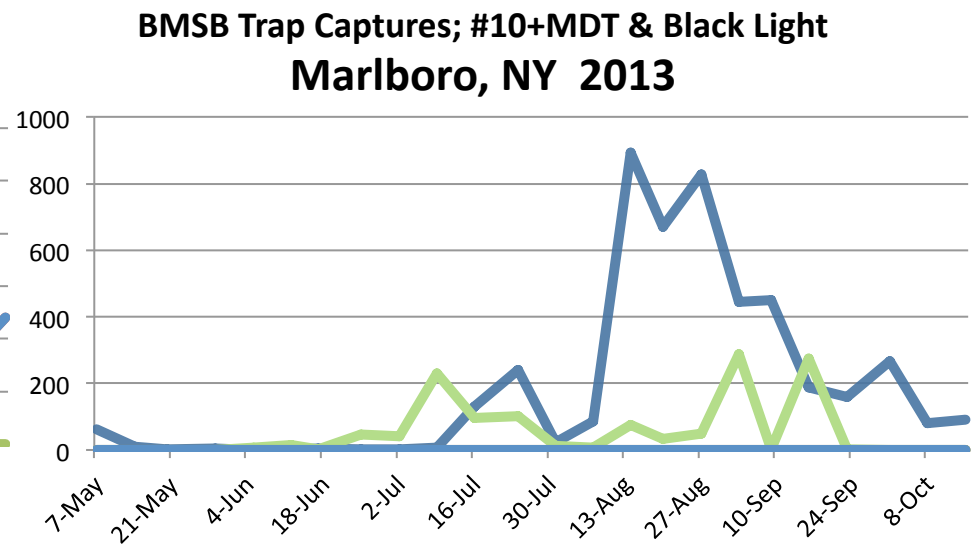

Hail Injury
CORNELL'S
Hudson Valley
LABORATORY

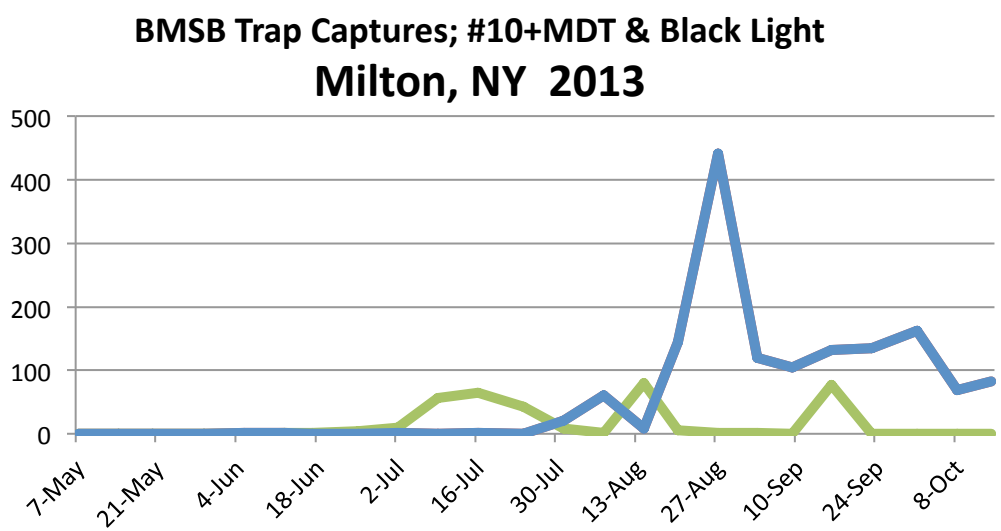
Studies of the Brown Marmorated Stink Bug, *Halyomorpha halys* (Stål), in New York State

2013:

I. Established trap captures with the use of #10 + MDT synergist







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Studies of the Brown Marmorated Stink Bug, *Halyomorpha halys* (Stål), in New York State

2013:

I. Early trap captures with the use of #10 + MDT synergist

II. Monitored BMSB adults on trees: observed on pome & stone fruit in isolated orchards

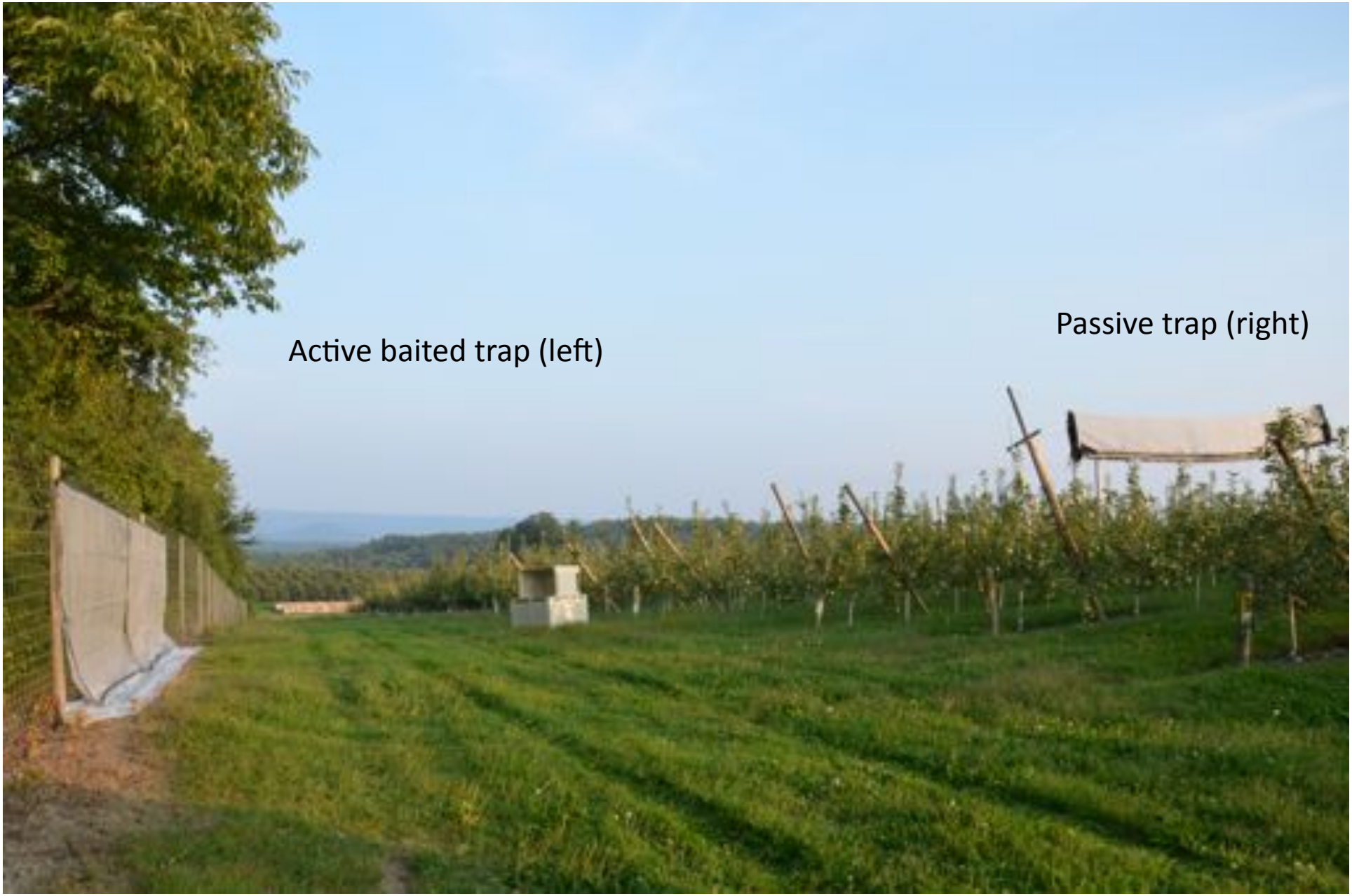
III. Recommendations:

- **Initiate trapping to detect BMSB along the orchard perimeter**
- **If BMSB is captured in traps then scout perimeter orchard rows**
- **1 BMSB observed within 100' of scouting = orchard perimeter application using efficacious insecticides (bioassay results).**
- **Repeat scouting after 4d, using observations of 1 BMSB along perimeter orchard rows as a trigger for subsequent perimeter application.**
- **Following applications would employ alternate row at 7d followed by whole orchard application as observance of BMSB becomes evident.**
- **Repeating scouting and perimeter spray sequence.**

Studies of the Brown Marmorated Stink Bug, *Halyomorpha halys* (Stål), in New York State

2013:

IV. Employed 'active' and 'passive' traps using fix netting over canopy (Campbell Hall, NY)
- Both traps sprayed with Bifenthrin 10 DF (3.0 oz./quart).
- Active trap pheromone baited using #10 + MDT, bi-weekly charge.


Active baited trap (left)
Passive trap (right)

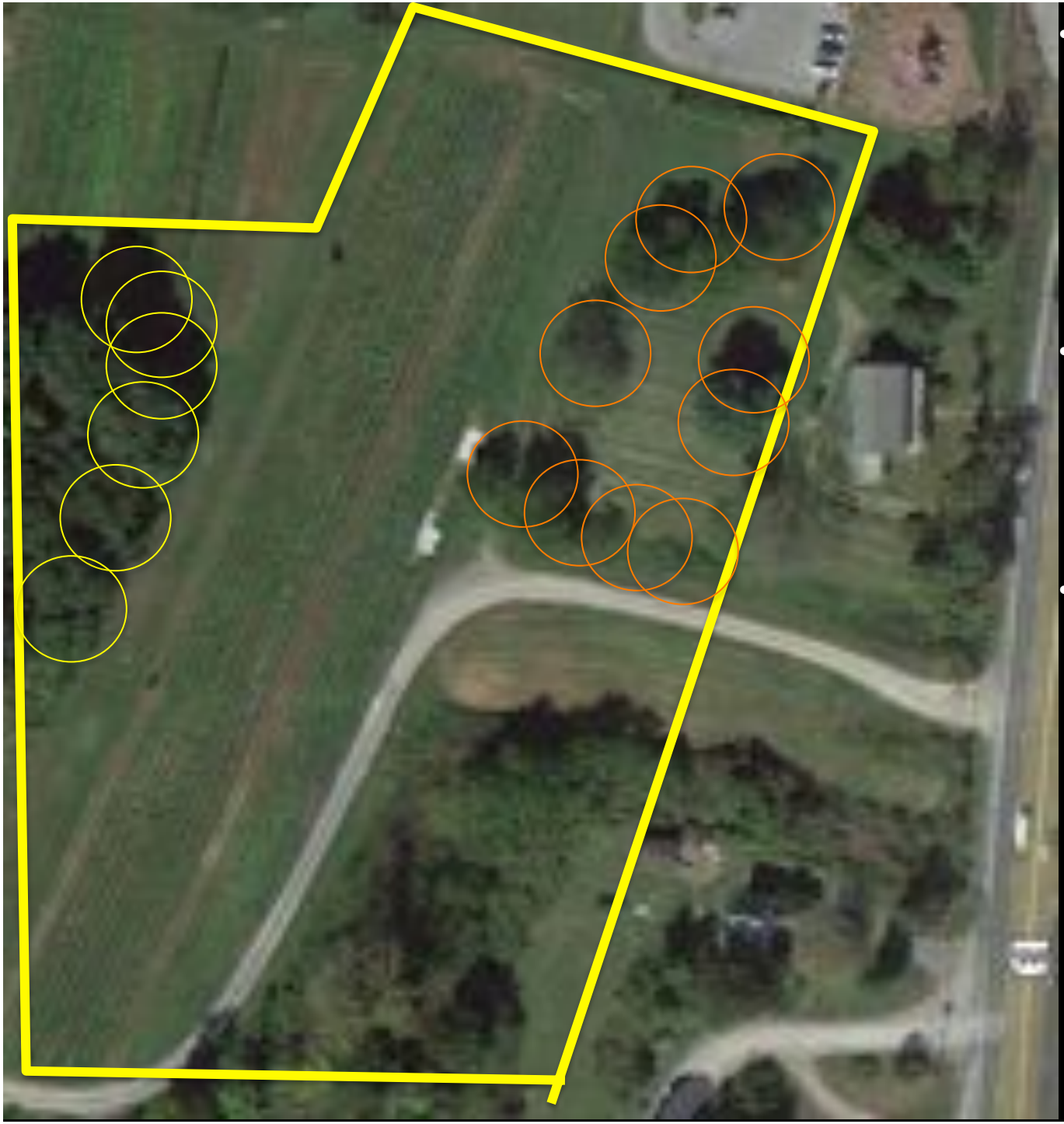

Active Pheromone Baited Trap
& Halogen Lighting
Insecticide Treated Netting

Active Pheromone Baited Trap

Rescue Lure
MDT

USDA
#10

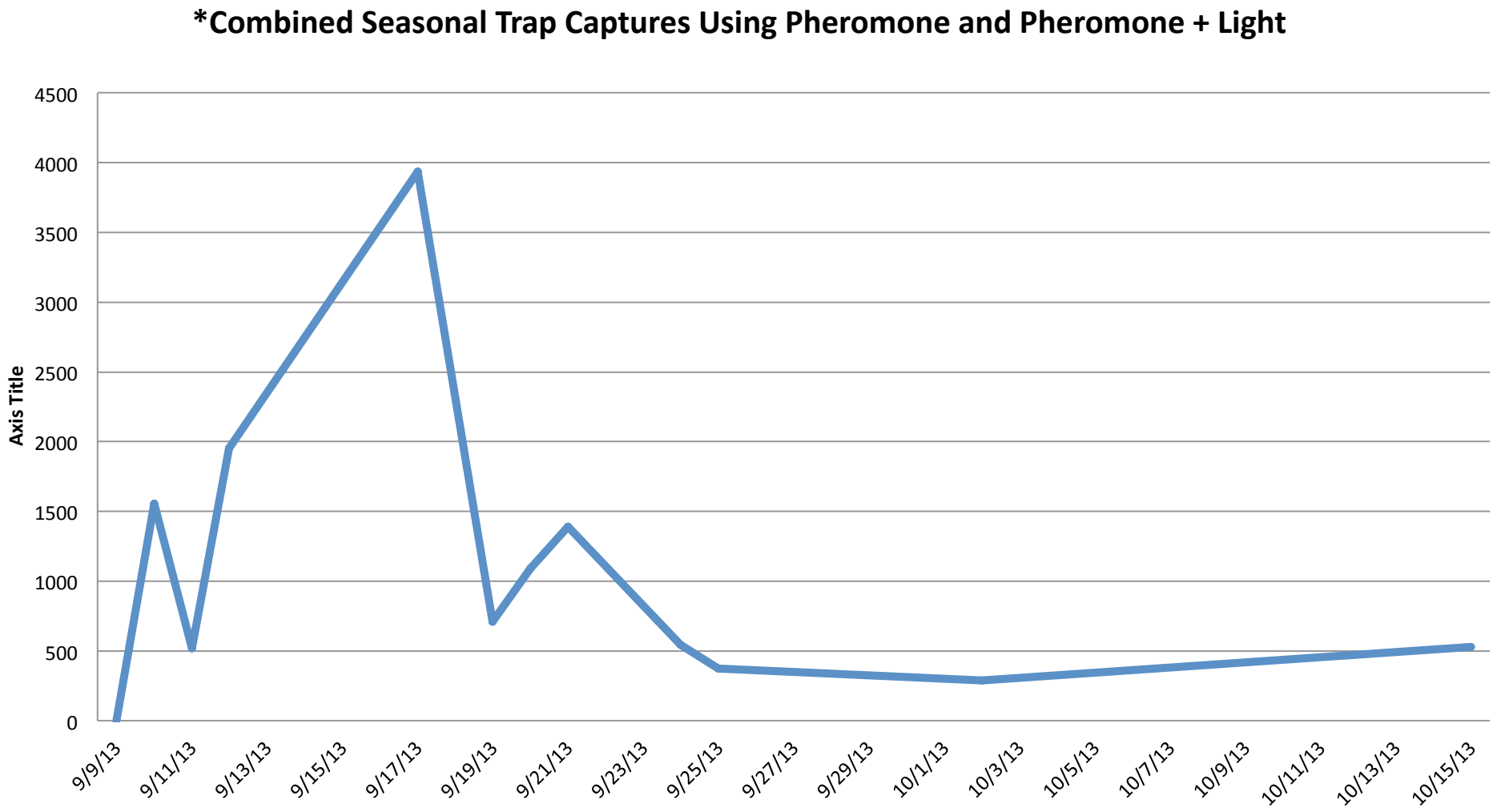
Infestation occurrences in Ag. Commodities: >20% Loss in Organic Jalapeno Pepper in 2013



- BMSB populations were observed on Black Walnut and Tree of Heaven, which may have acted as intermediate hosts, fostering migrations to pepper in high numbers.
- BMSB locations on netting traps with pheromone were equally dispersed on the field and forested sides of net.
- Nights when lights were on, BMSB were heavily concentrated on the field side in front of the light with higher numbers observed.

Ailanthus altissima
Juglans nigra

Studies of the Brown Marmorated Stink Bug, *Halyomorpha halys* (Stål), in New York State



*Over 13,000 BMSB captured

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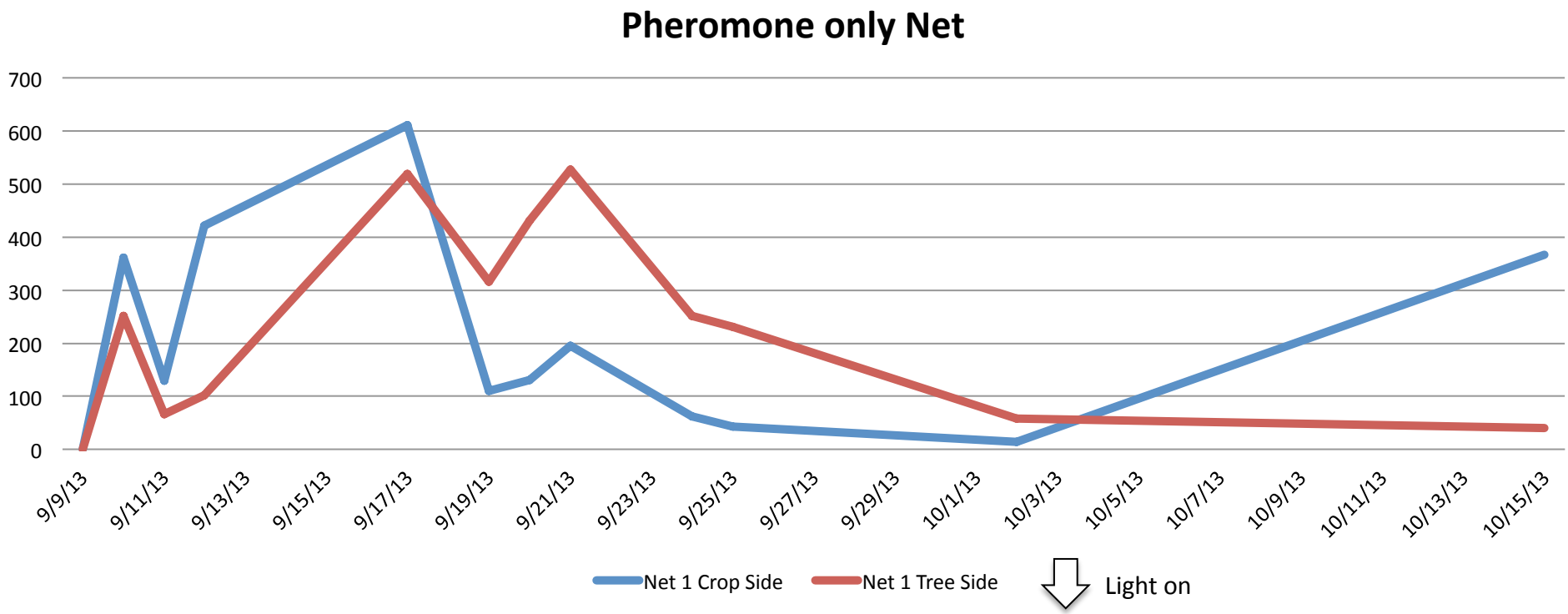
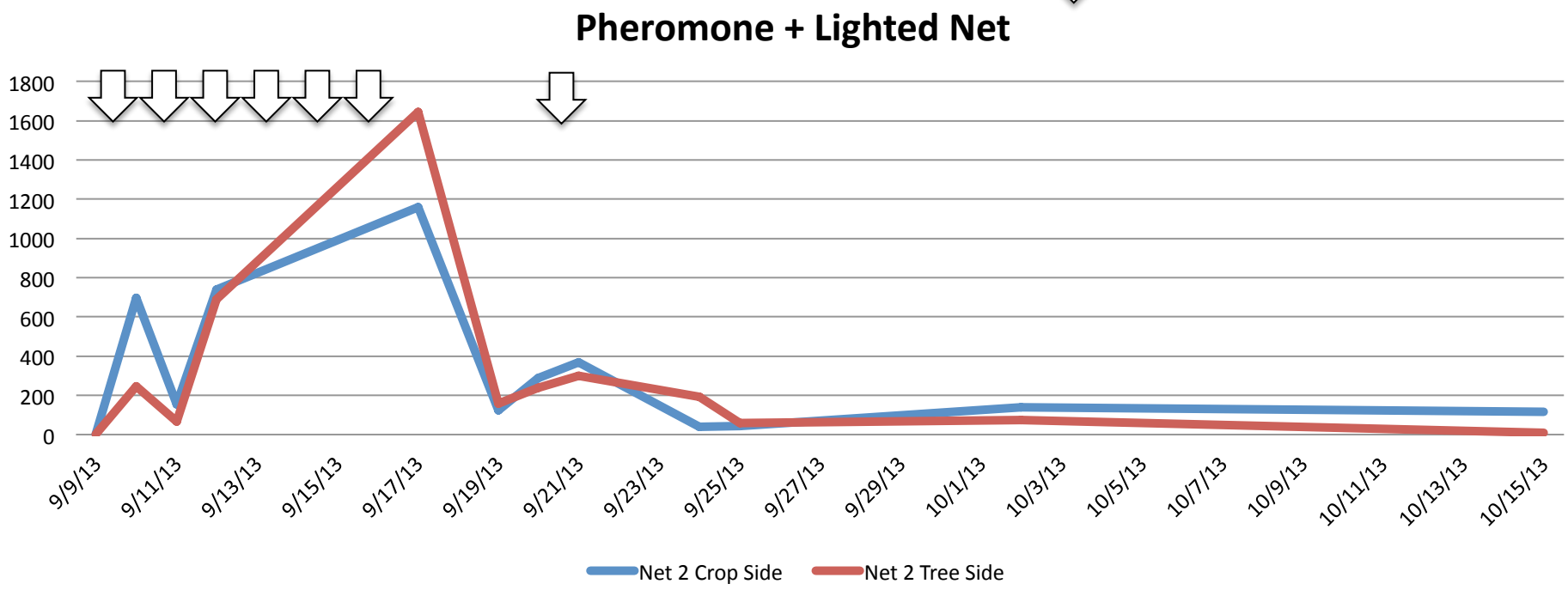
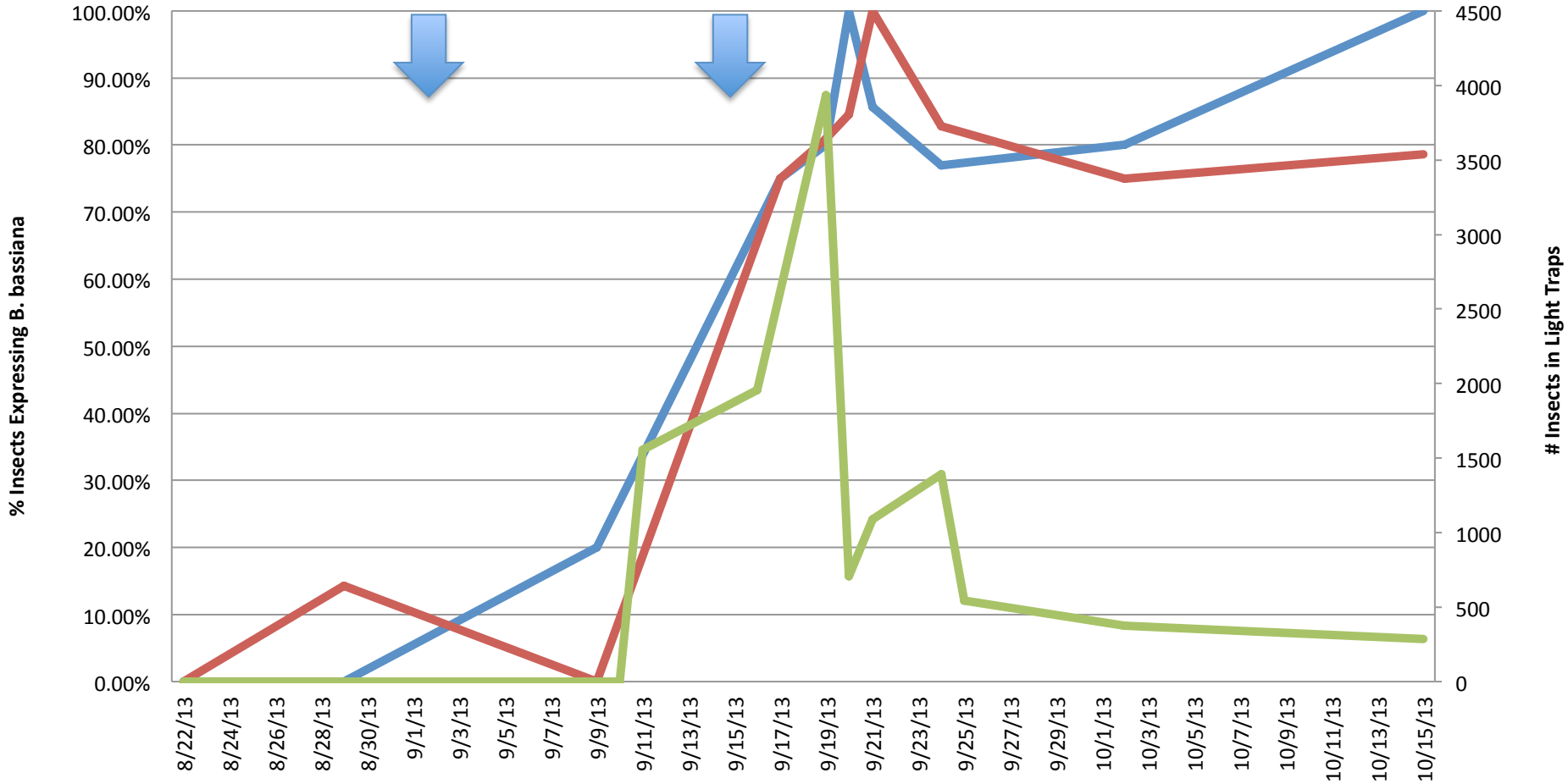

Pheromone only Net
700
600
500
400
300
200
100
0
9/9/13
9/11/13
9/13/13
9/15/13
9/17/13
9/19/13
9/21/13
9/23/13
9/25/13
9/27/13
9/29/13
10/1/13
10/3/13
10/5/13
10/7/13
10/9/13
10/11/13
10/13/13
10/15/13
Net 1 Crop Side
Net 1 Tree Side
Light on


Pheromone + Lighted Net
1800
1600
1400
1200
1000
800
600
400
200
0
9/9/13
9/11/13
9/13/13
9/15/13
9/17/13
9/19/13
9/21/13
9/23/13
9/25/13
9/27/13
9/29/13
10/1/13
10/3/13
10/5/13
10/7/13
10/9/13
10/11/13
10/13/13
10/15/13
Net 2 Crop Side
Net 2 Tree Side

B. bassiana expression over Time



	8/22/13	8/29/13	9/9/13	9/10/13	9/11/13	9/16/13	9/17/13	9/19/13	9/20/13	9/21/13	9/24/13	9/25/13	10/2/13	10/15/13	
Net 1 infection	0.00%	0.00%	20.00%			73.66%		75.00%	80.00%	100.00%	85.71%	76.92%		80.00%	100.00%
Net 2 infection	0.00%	14.29%	0.00%			82.95%		75.00%	80.95%	84.62%	100.00%	82.76%		75.00%	78.57%
Population	0			0	1556	521	1954		3935	708	1090	1392	545	375	287

- *Beauvaria bassiana* strain GHA applications *(Mycotrol-O @ 16 oz./A)*


BMSB Infested With
Beauveria bassiana strain GHA
(Mycotrol-O @ 16 oz./A)

What are the factors influencing the movement of BMSB to Ag Commodities in NYS

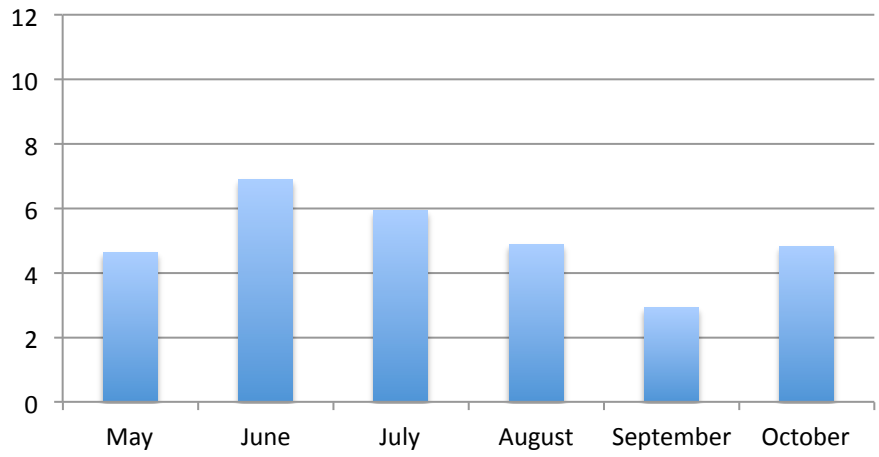
- Population density leading to reduced host viability
  - High overwintering and 1st generation BMSB can reduce the viability of seed and foliage for the 2nd generation in deciduous forest trees
- Climatic conditions
  - Under drought conditions
    - Seed and plant tissue becomes stressed with reduced moisture
    - Seed of deciduous trees reduce moisture stores
    - BMSB will move from deciduous trees to crops as seed viability is reduced
- Can we use rainfall & RH as predictors for BMSB movement to crops?

CORNELL'S Hudson Valley LABORATORY

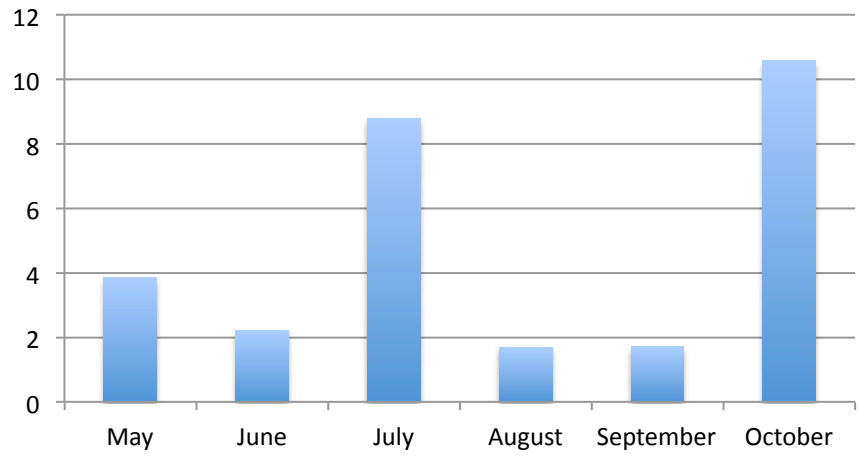
Factors Influencing BMSB Fruit Feeding

Mid-Atlantic, Allentown, PA 2009 & 2010

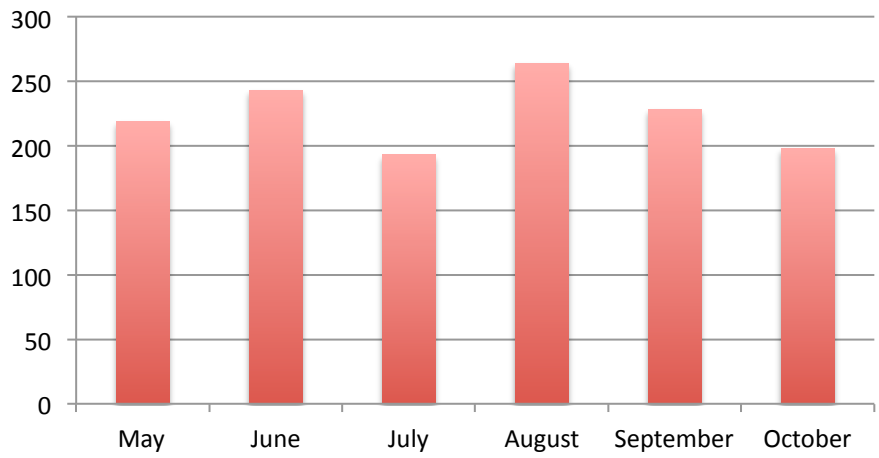
2009 Total Rain (37.88 in.)



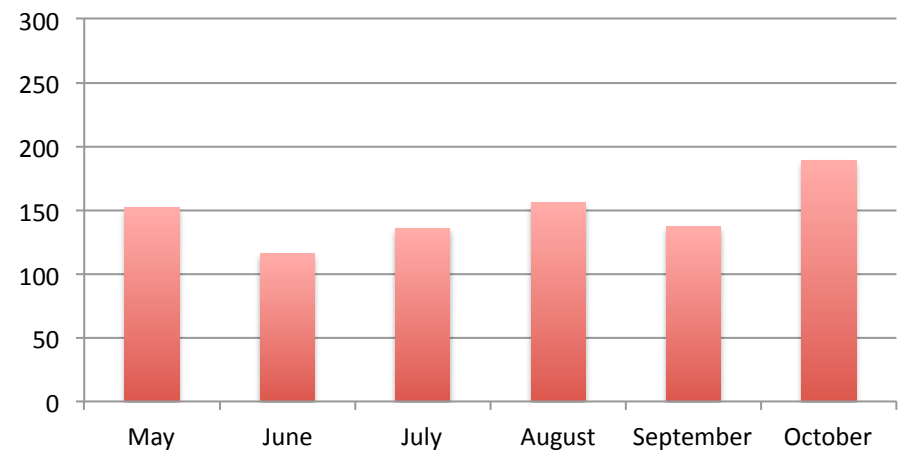
2010 Total Rain (28.85 in.)



RH Hrs >= 90% (1345 hrs.)



RH Hrs >= 90% (886 hrs.)

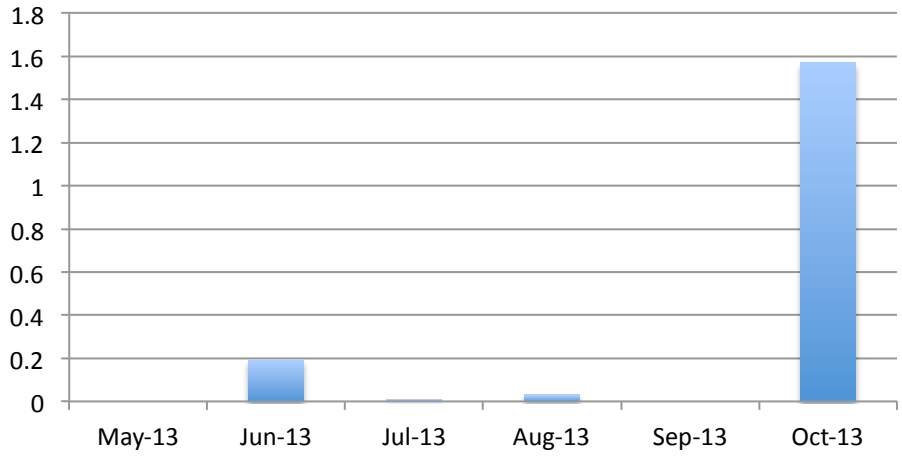


Factors Influencing BMSB Fruit Feeding

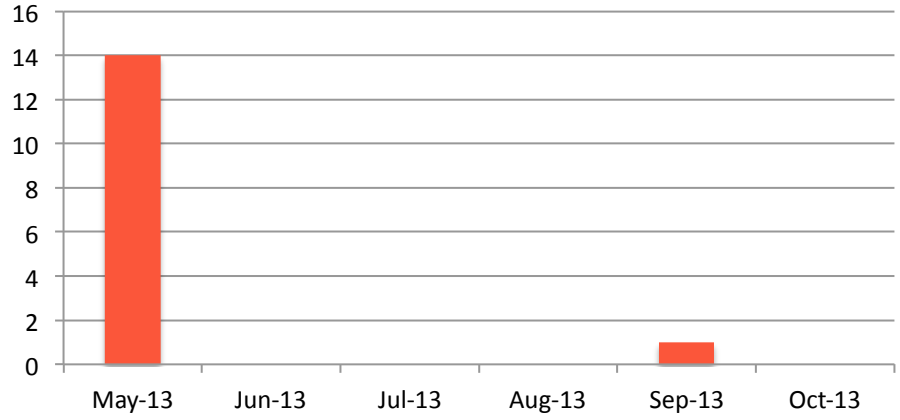
Rainfall & RH, Campbell Hall, NY

>21% Fruit Injury (N=3600) 2012

Total Rain (1.8 in.)

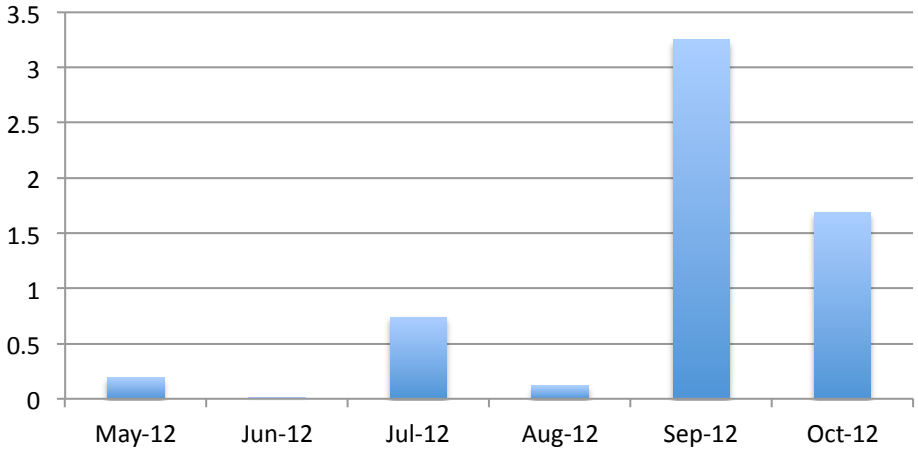


RH Hrs >= 90% (15 hrs.)

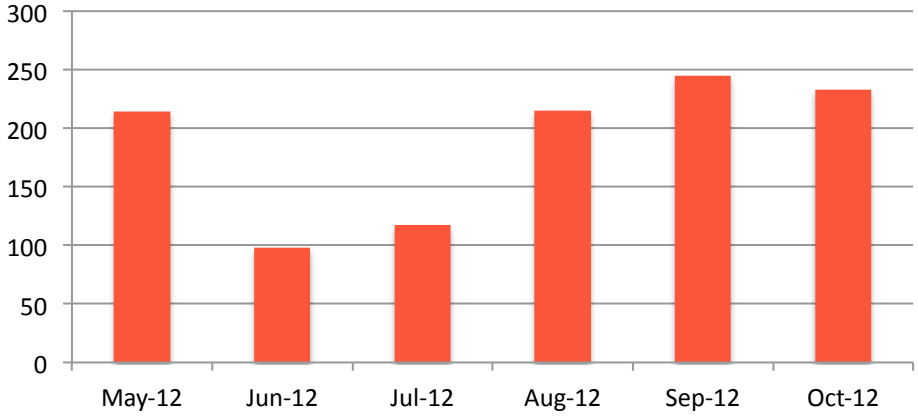


0.1% Fruit Injury (N=12,000) 2013

Total Rain (6.0 in.)



RH Hrs >= 90% (1122 hrs.)



BMSB Monitoring, Threshold and Application Strategy

- **Recommendations: Tiered monitoring & sequenced applications**

- **<u>Monitoring:</u> Initiate monitoring using Tedders + pheromones to detect BMSB along the orchard perimeter**

- **If BMSB is captured in traps then scout perimeter orchard rows**

- **<u>Threshold:</u> 1 BMSB observed within 100' of perimeter scouting**

- **<u>Application Strategy:</u> Use 1 perimeter orchard application using effective insecticides.**

- **<u>Monitoring:</u> Repeat scouting after 4d, using 1 BMSB threshold along perimeter orchard rows as a trigger for subsequent application.**

- **<u>Application Strategies:</u> Use alternate row middle applications (ARM) at 7d**

- **<u>Monitoring:</u> Repeat perimeter scouting using 1 BMSB threshold**

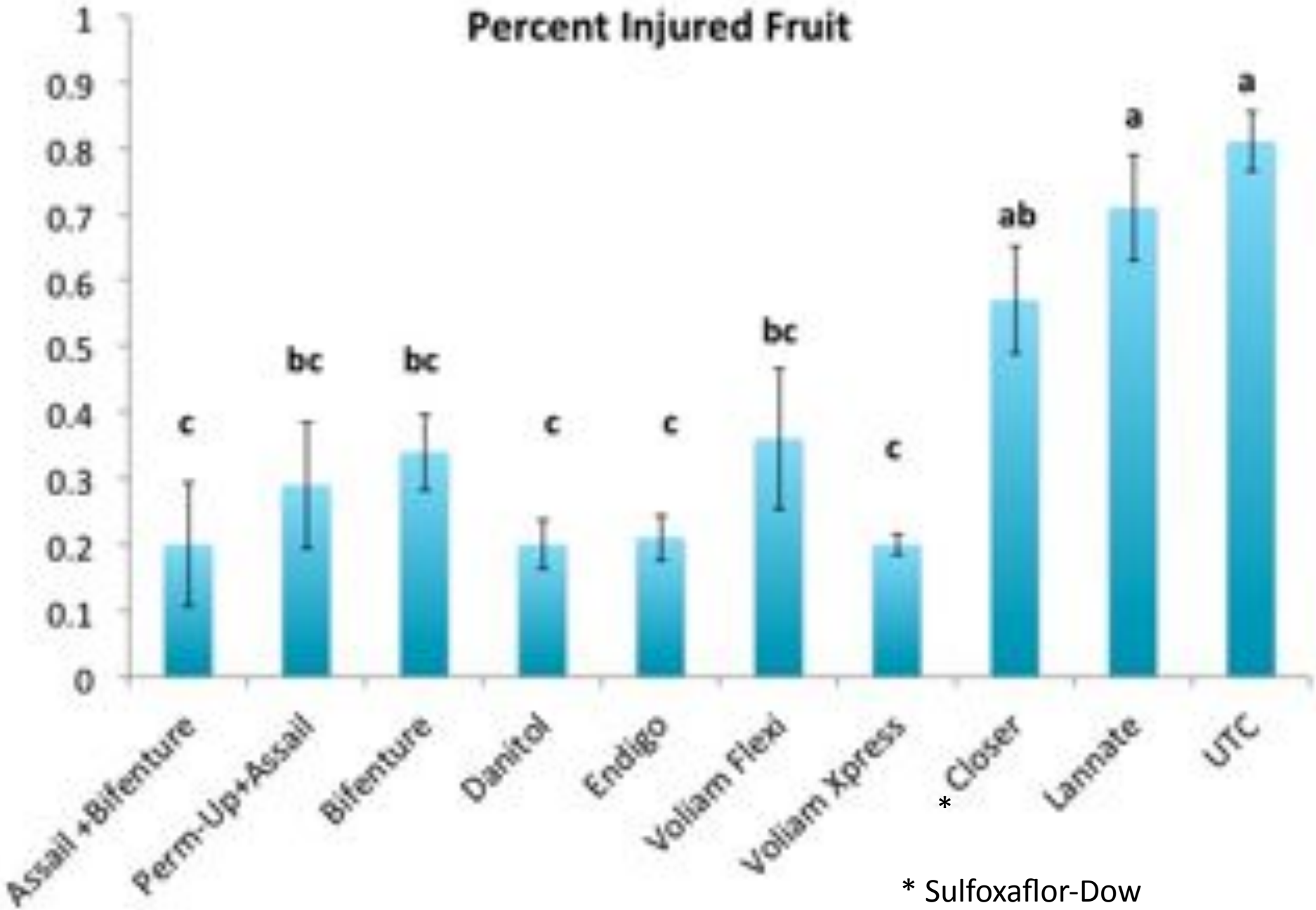
- **<u>Application Strategies:</u> Use whole orchard application. Repeat sequence.**

Insecticide Use

Insecticide Group	Product	Active Ingredient	% Adult BMSB Mortality[1]
Pyrethroid	**Bifenture**	bifenthrin	100
	Danitol	fenpropathrin	95
	Warrior II	lambda-cyhalothrin	73
Carbmate	**Lannate**	methomyl	92
	Vydate	oxymyl	68
Neonicotinoid	**Actara**	thiamethoxam	92
	Assail	acetamiprid	87
	Calypso	thiacloprid	58
Pre-mix	**Leverage 360**	imidacloprid and bifenthrin	95
	Endigo	lambda-cyhalothrin and thiamethoxam	98
	Voliam Flexi	chlorantraniliprole and thiamethoxam	98

1. Direct contact activity of insecticides against BMSB adults in a lab setting may be very high, yet the activity of field-aged residue may, over time, quickly becomes ineffective at preventing feeding injury.

BMSB Mgt. in Peaches at 10 d Intervals: Rutgers

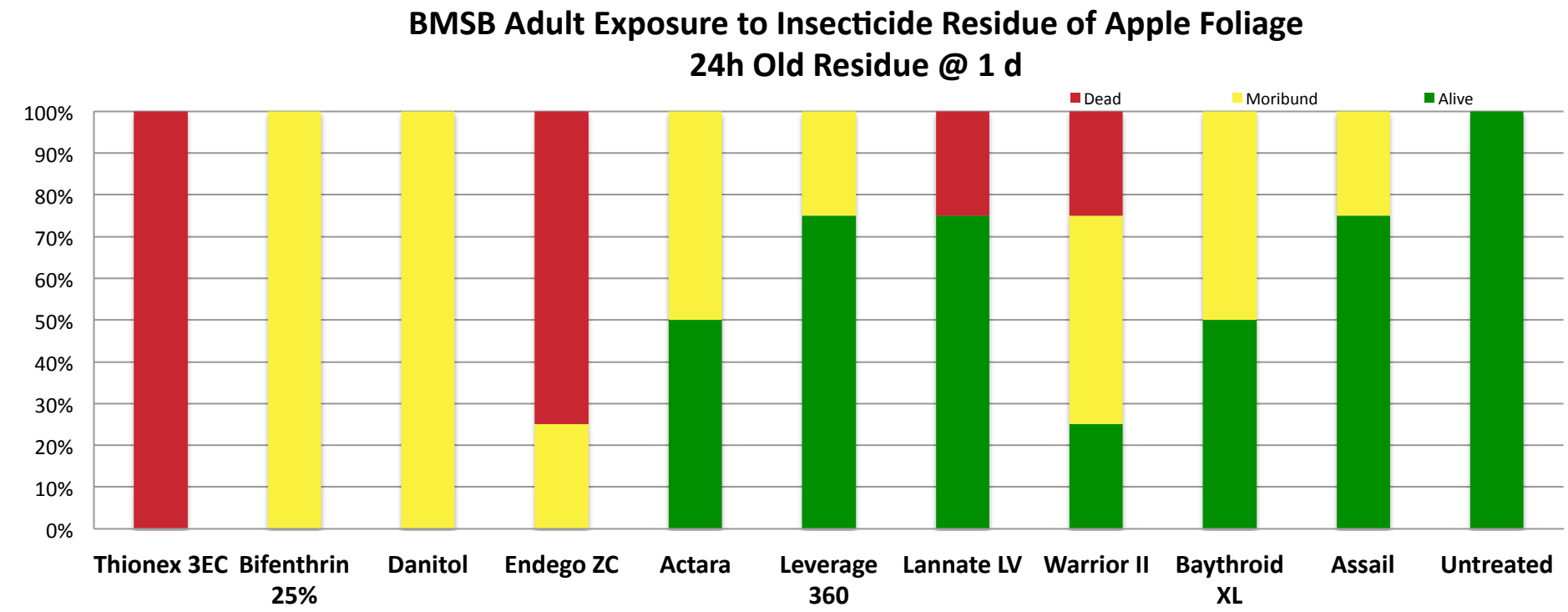


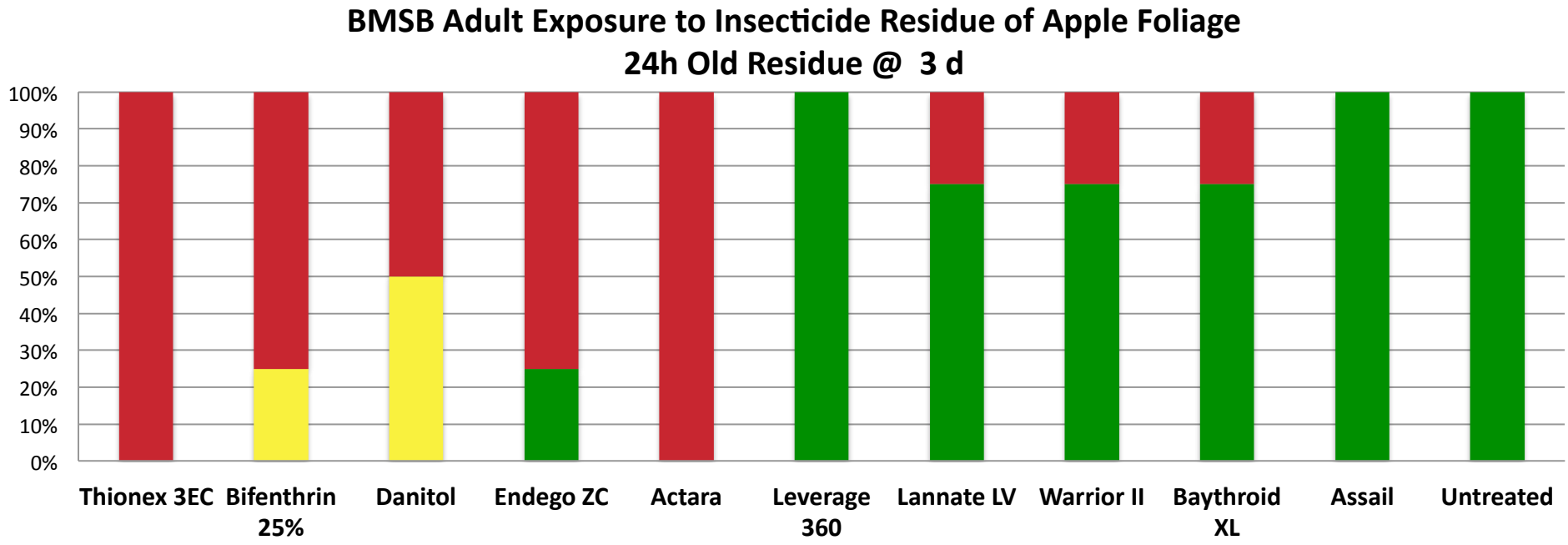
* Sulfoxaflor-Dow

Studies of the Brown Marmorated Stink Bug, *Halyomorpha halys* (Stål), in New York State

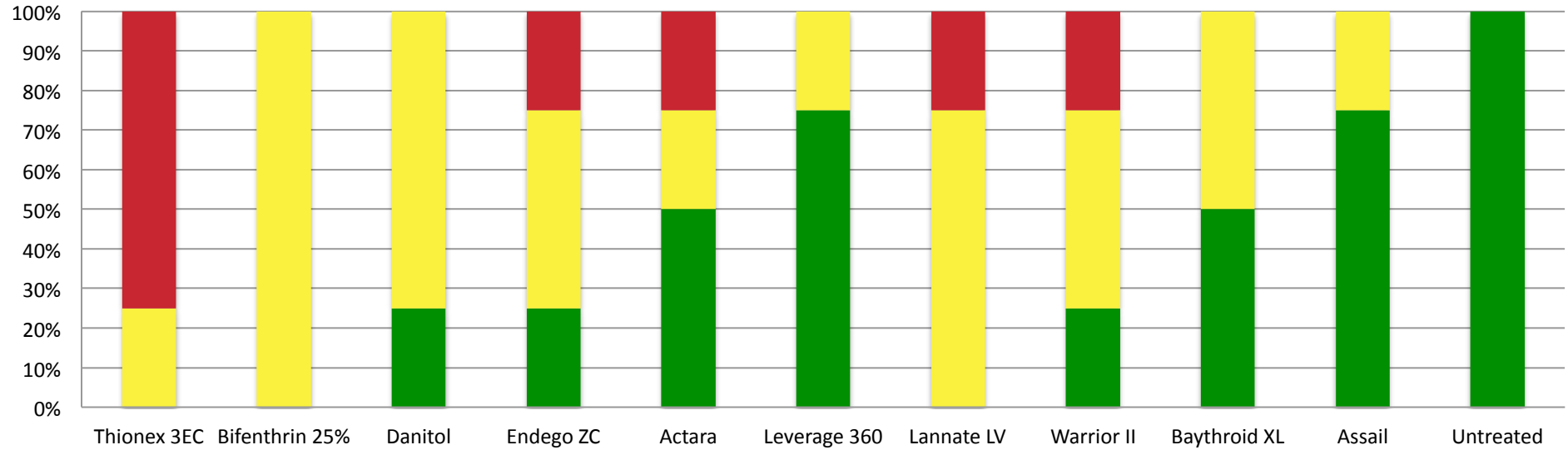
Residual field bioassay of adult BMSB on treated foliage:

- **Four tree plots, 4 replicates** treated with the highest labeled rate of insecticides using tractor mounted airblast sprayer
- Foliage collected 24, 48 and 72 hours after application.
- 1st generation adults placed on portions of 4 leaves wrapped on the inside of a 1 oz. enclosed container.
- Adults were observed at 1 and 3 day intervals and evaluated as live, morabund or dead, held at 70°F.

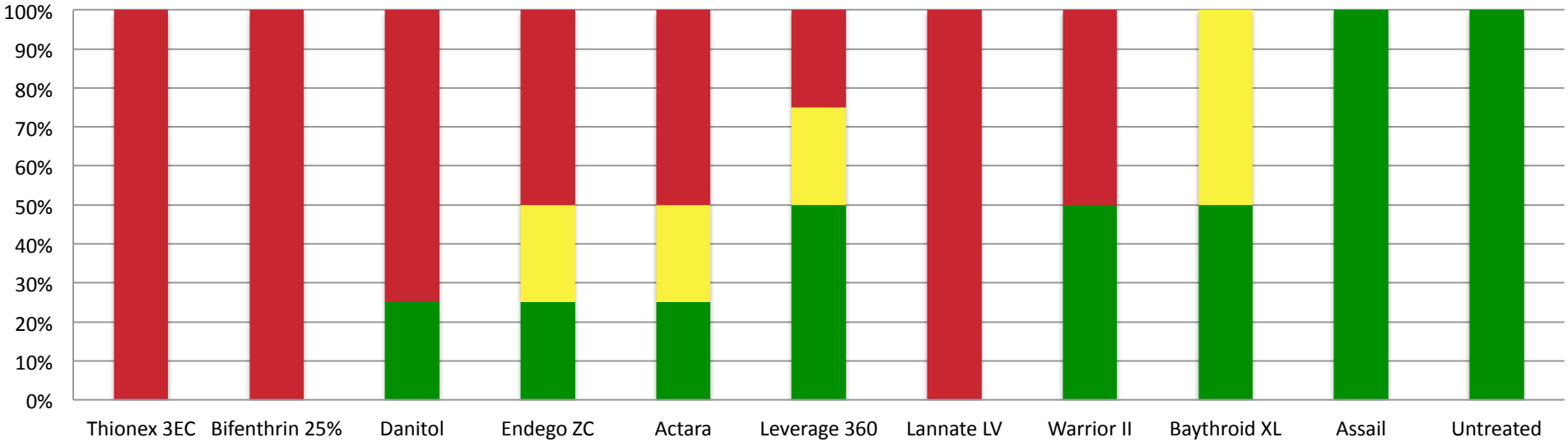

BMSB Adult Exposure to Insecticide Residue of Apple Foliage
24h Old Residue @ 1 d
Dead
Moribund
Alive
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Thionex 3EC
Bifenthrin 25%
Danitol
Endego ZC
Actara
Leverage 360
Lannate LV
Warrior II
Baythroid XL
Assail
Untreated


BMSB Adult Exposure to Insecticide Residue of Apple Foliage
24h Old Residue @ 3 d
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Thionex 3EC
Bifenthrin 25%
Danitol
Endego ZC
Actara
Leverage 360
Lannate LV
Warrior II
Baythroid XL
Assail
Untreated

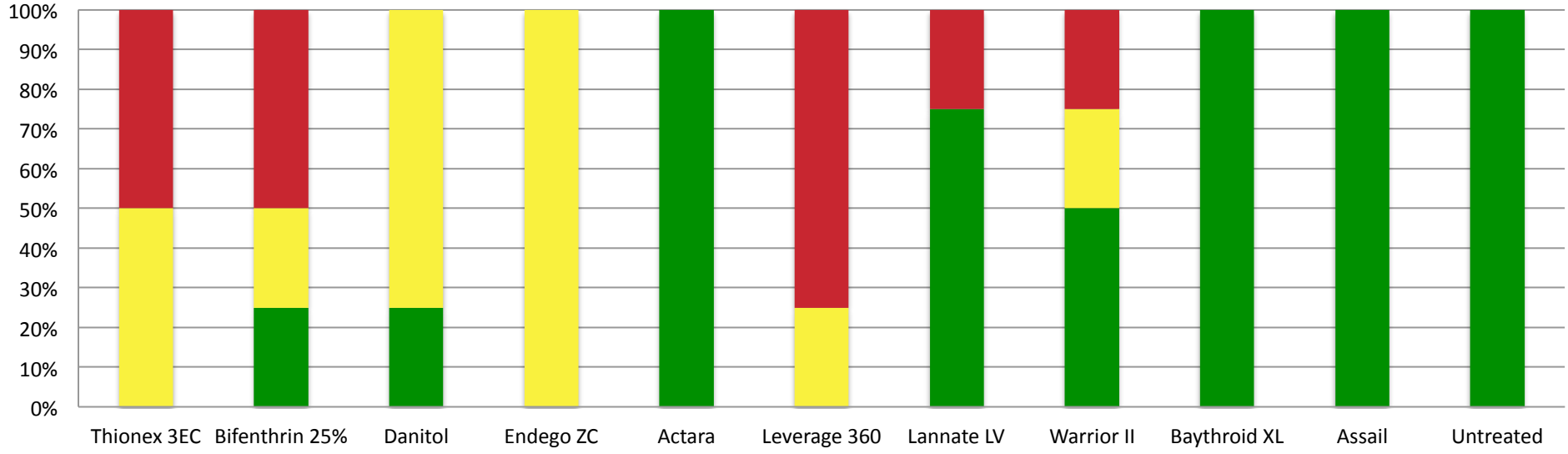
BMSB Adult Exposure to Insecticide Residue of Apple Foliage
48h Old Residue @ 1 d



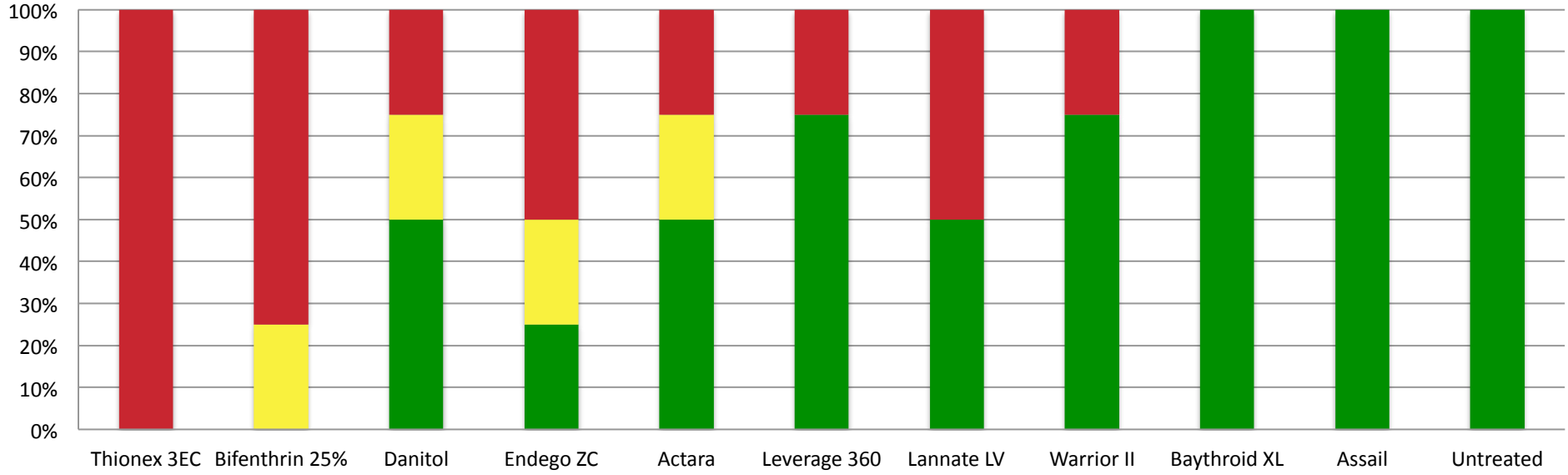
BMSB Adult Exposure to Insecticide Residue of Apple Foliage
48h Old Residue @ 3 d



BMSB Adult Exposure to Insecticide Residue of Apple Foliage
72h Old Residue @ 1 d



BMSB Adult Exposure to Insecticide Residue of Apple Foliage
72h Old Residue @ 3 d



17 April (+/- 16d)	23 April (+/- 13d)	May 1 (+/- 15d)	May 14 (+/- 10d)
Tight Cluster	**Pink**	**Bloom**	**Petal Fall**
1st BMSB	BMSB Adult	BMSB Adult & nymph	BMSB Adult & nymph
TPB, RAA, SJS, STLM	TPB, RAA, SJS, STLM, OBLR		PC, EAS, OBLR, OFM
Lorsban	Lorsban		Carzol +
Pounce / Ambush	Pounce / Ambush		Actara or
Baythroid 2E	Baythroid 2E		Danitol or
Baythroid 2E	Baythroid 2E		Warrior II or
Danitol	Danitol		Baythroid 2E or
Warrior II	Warrior II		Endigo ZC
			Movento (WAA/SJS)

Formulation/(SB Labeled)

Active ingredient	Restrictions
Lorsban(NL) *chlorpyrifos*	1 pre-bloom appl./season
Pounce(NL) *permethrin*	2 pre-bloom (0.5 lb. a.i./A)
Carzol(L) *formetanate hydrochloride*	1 PF appl./ season
Actara(NL) *thiamethoxam*	11.0 oz./ season (0.258 lb. a.i./A)

May 28.	June 11.	June 25.	July 10.
1C	**2C**	**3C**	**4C**
BMSB Adult & nymph	BMSB Adult & nymph	BMSB Adult & nymph	BMSB Adult & nymph
PC	<PC, CM	SJS, OBLR, <AM	SJS, AM, OBLR
A Sample of Some Insecticide Options			
Endigo ZC or	Danitol	Lannate 90SP; LV or	Lannate 90SP; LV or
Danitol or	Baythroid 2E or	Baythroid 2E or	Baythroid 2E or
Warrior II or	Endigo ZC	Endigo ZC	Endigo ZC
Thionex 3EC	Thionex 3EC	Thionex 3EC	Thionex 3EC
Baythroid 2E or	Warrior II or	Danitol or	Danitol or
Leverage 360 or	Leverage 360 or	Leverage 360 or	Leverage 360 or
+ Vydate	+ Vydate	+ Vydate	+ Vydate

Formulation/(Labeled)

Active ingredient	Restrictions
Endigo (L) *lambda-cyhalothrin* *Thiamethoxam*	19.0 fl.oz./ season (0.16 lb. a.i./A) (0.172 lb. a.i./A)
Danitol (L) *fenpropathrin*	2 pre-bloom (0.5 lb. a.i./A)
Lannate 90SP (NL) *methomyl*	5.0 lb./season & *5 appl./season* 7d min interval
Thionex 3EC (2ee) *endosulfan*	≤ 3 appl./season ≤ 2 appl. to fruit Stop use date for BMSB 2(ee): 7/31/2014 Stop use date for apple: 7/31/2015

July 24.	Aug. 8.	Aug. 22.	Sept. 1.
5C	6C	7C	8C
BMSB Adult & nymph	BMSB Adult & nymph	BMSB Adult & nymph	BMSB Adult & nymph
AM, OBLR	AM, CM	AM, CM	<AM, OFM
Lannate 90SP; LV or	Lannate 90SP; LV (14d PHI) or	Lannate 90SP; LV (14d PHI) or	Leverage 360 (7d PHI) or
Assail 30SG or	Assail 30SG or	Assail 30SG or (7d PHI)	Assail 30SG or (7d PHI)
Endigo ZC or	Warrior II (21d PHI) or	Warrior II (21d PHI) or	Warrior II (21d PHI) or
Baythroid 2E or	Baythroid XL (7d PHI) or	Baythroid XL (7d PHI) or	Baythroid XL (7d PHI) or
Danitol or (14d PHI)	Danitol or (14d PHI)	Danitol or (14d PHI)	Danitol or (14d PHI)
Leverage 360 or	Leverage 360 or	Leverage 360 (7d PHI)	+ Vydate 14d PHI
+ Vydate	+ Vydate 14d PHI	+ Vydate 14d PHI	

Formulation/(Labeled) *Active ingredient*	Restrictions
Leverage (L)	2.8 fl.oz./ season
Imidacloprid	(0.044 lb. a.i./A)
β-cyfluthrin	(0.022 lb. a.i./A)
	1 appl./season
Assail (NL)	32.0 fl.oz./ season
acetamiprid	(0.6 lb. a.i./A)
	≤ 4 appl./season
	≥ 12d interval
Danitol (L)	16.0 fl.oz./ appl.
fenpropathrin	(0.3 lb. a.i./appl.)
	(0.6 lb. a.i./A)
	14d PHI
Lannate 90SP (NL)	5.0 lb./season &
methomyl	*5 appl./season*
	7d min interval
Brigade 2EC (L)	**Section 18 label**
Bifenture 10DF (L)	**for 2013**
Bifenture EC (L)	30d appl. interval
bifenthrin	

Key points to remember

- BMSB is arboreal, forest pest, very mobile to and out of agricultural crops.
- Large decidious forests likely have high BMSB populations.
- Fruit damage takes 2-3 weeks for expression mid-late season.
- Low populations can equate to high feeding injury levels

Strategies for control

1. Early trapping **with Tedders trap + #10 and MDT combo lure**
2. **Scouting** pome and stone fruit **at first trap capture**
3. Border applications at first observation along border
4. Maintain border applications if BMSB presence continues
5. Alternate row applications at 4-7 days as BMSB enter orchard

Insecticide efficacy is critical

- Use materials **with greatest efficacy & longest residual**
- Maintain 'fresh' residue every 4-5 days when needed employing alternate row middle (ARM) applications.

Thanks to the staff at the HVL for all their support:

Technical Assistant..... Allen Clayton
Summer Research Assistant ..... Tim Lamposona
Summer Research Assistant ..... Kellyn Will
PT Summer Research Assistant ..... Henry Grimsland
Summer Research Intern (CCE BMSB)..... Susan Weibman
PT Summer Intern ..... Brianna Flonc

Farm Manager ..... Albert Woelfersheim
Administrative Assistant ..... Donna Clark
HVL & NEWA Weather Data..... Anne Rugh, Joe Whalon