Monitoring & Management of the Brown Marmorated Stink Bug

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2021 ENYCHP Winter Fruit Schools
Virtual Conference

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

Plant Protection Presentations

Fruit Production IPM Presentations:

2021

Monitoring & Management of the Brown Marmorated Stink Bug. New York Winter Tree Fruit Conference, February 2nd 2021.

2020

Invasive Insect Tsunami Menacing Brown Marmorated Stink Bug in NYS Orchards

Webinar: Management Options For The Stink Bug Complex On Pome Fruit Near Harvest.

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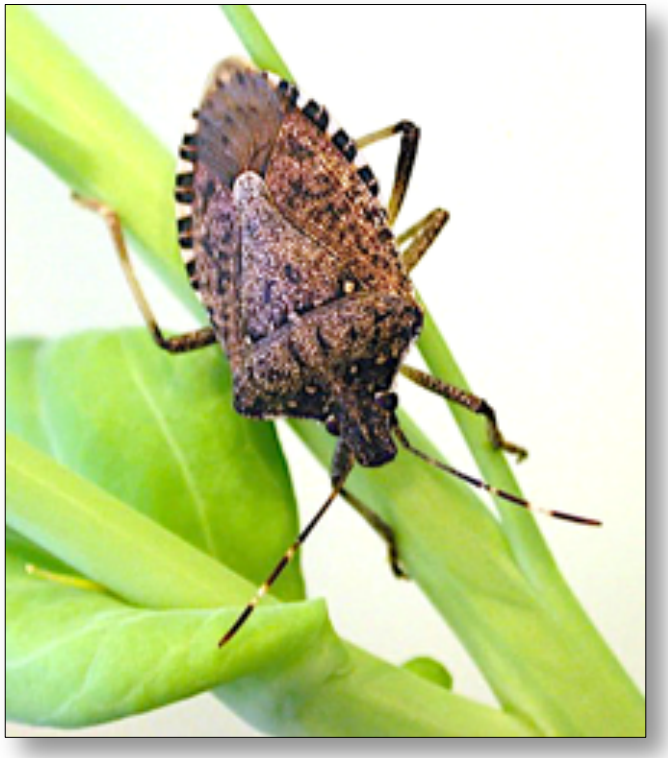
- Support Ag Sustainability. Become a farm member of HVRL in 2021! Donations are 2020 Tax Deductions ! December 9, 2020

The Brown Marmorated Stink Bug in NYS: (BMSB)
(*Halyomorpha halys* (Stål) (Hemiptera: Pentatomidae)

- **BMSB Background, Ecology & Biology**
- **Urban BMSB: Home Infestations**
- **Monitoring / Scouting**
- **Management**
  - **Biological Control Efforts**

Brown Marmorated Stink Bug: Background



- Asian invasive Ag. pest, first detected in Allentown, PA in 1996, confirmed in 2001.

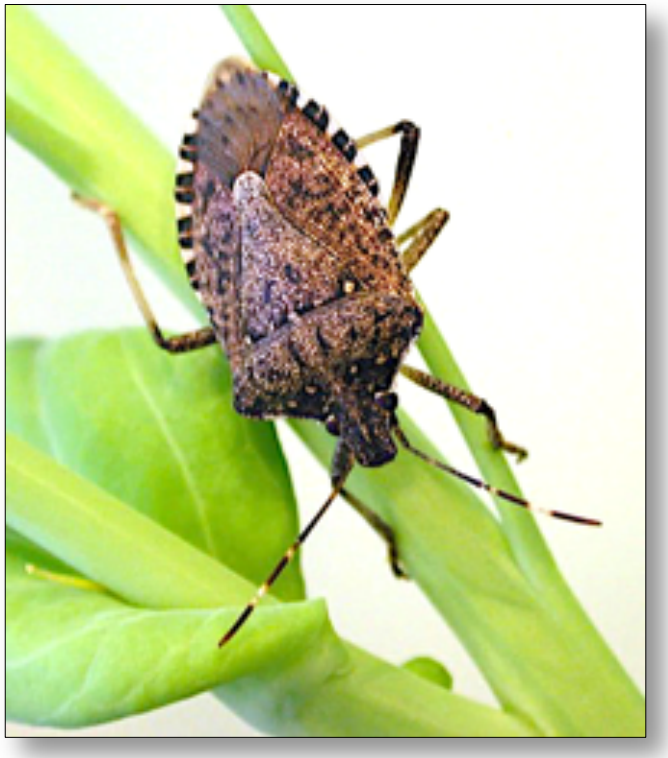
- First NY BMSB confirmed in 2007, Hudson Valley in December of 2008.

- 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.

- In 2012, economic damage to apple and pepper was assessed on three Hudson Valley Farms in Ulster and Orange Counties.

- BMSB remains a significant and growing urban pest in NYS.

Brown Marmorated Stink Bug: Biological Habits



- **BMSB (green stink bug) arboreal insects, migrate to Urban & Ag. from woodlands.**

- **Geotropic movement to tops of tree canopy to overwinter upper canopy & attic of homes.**

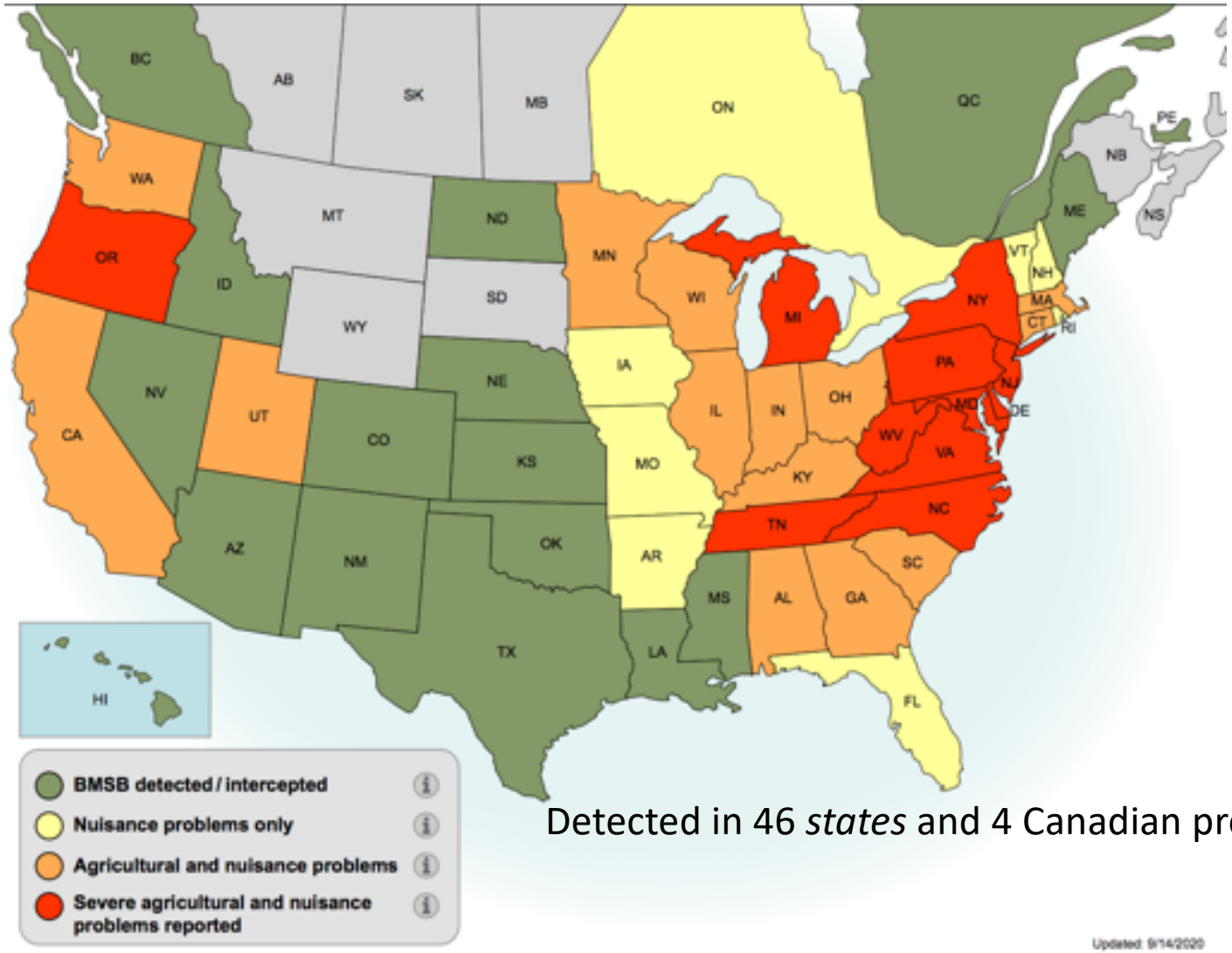
- **Use aggregation pheromones (long chain aldehydes) to gather in large numbers for mating, resource finding and over-wintering.**

- **Adult BMSB have the capacity for group flight can exceed 2km / day**

- **Unpredictable patterns of infestation. Trap presence does not fit 'IPM Threshold'.**

- **Injury to crop (apple) expressed 10-14 days after feeding, often after harvest.**

Brown Marmorated Stink Bug: Presence &



Detected in 46 *states* and 4 Canadian provinces

Hudson Valley Stink Bug Complex (Pentatomidae)
Species Of Economic Importance

Brown Stink Bug, *Euschistus servus* (Say)

- Native to North America
- Feeds on broad leaf plant & seed (Mullen, Dock, Plantain)
- Moves to apple borders during periods of drought
- Pyrethroids, Pre-mix Neonic + Pyrethroid

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

- Native to North America
- Arborial dwelling, feed on seed, stems and foliage
- Moves to apple borders during periods of drought

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

- Newly invasive in North America
- Arborial dwelling, feed on seed, stems and foliage
- Moves to apple borders during periods of high population, early season peach, late drought in apple

Hudson Valley Stink Bug Complex
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.

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.

Brown Marmorated Stink Bug: Biology

Overwintering adult

1st gen. mid-season adult

2nd gen late season OW adult

1st generation

after 550 DD_{50F} Mating Begins

Overwintering adult
Egg cluster (≅28)
1st instar
2nd instar
3rd instar
4th instar
5th instar
Adult

2nd generation

Egg cluster (≅28)
1st instar
2nd instar
3rd instar
4th instar
5th instar
Adult

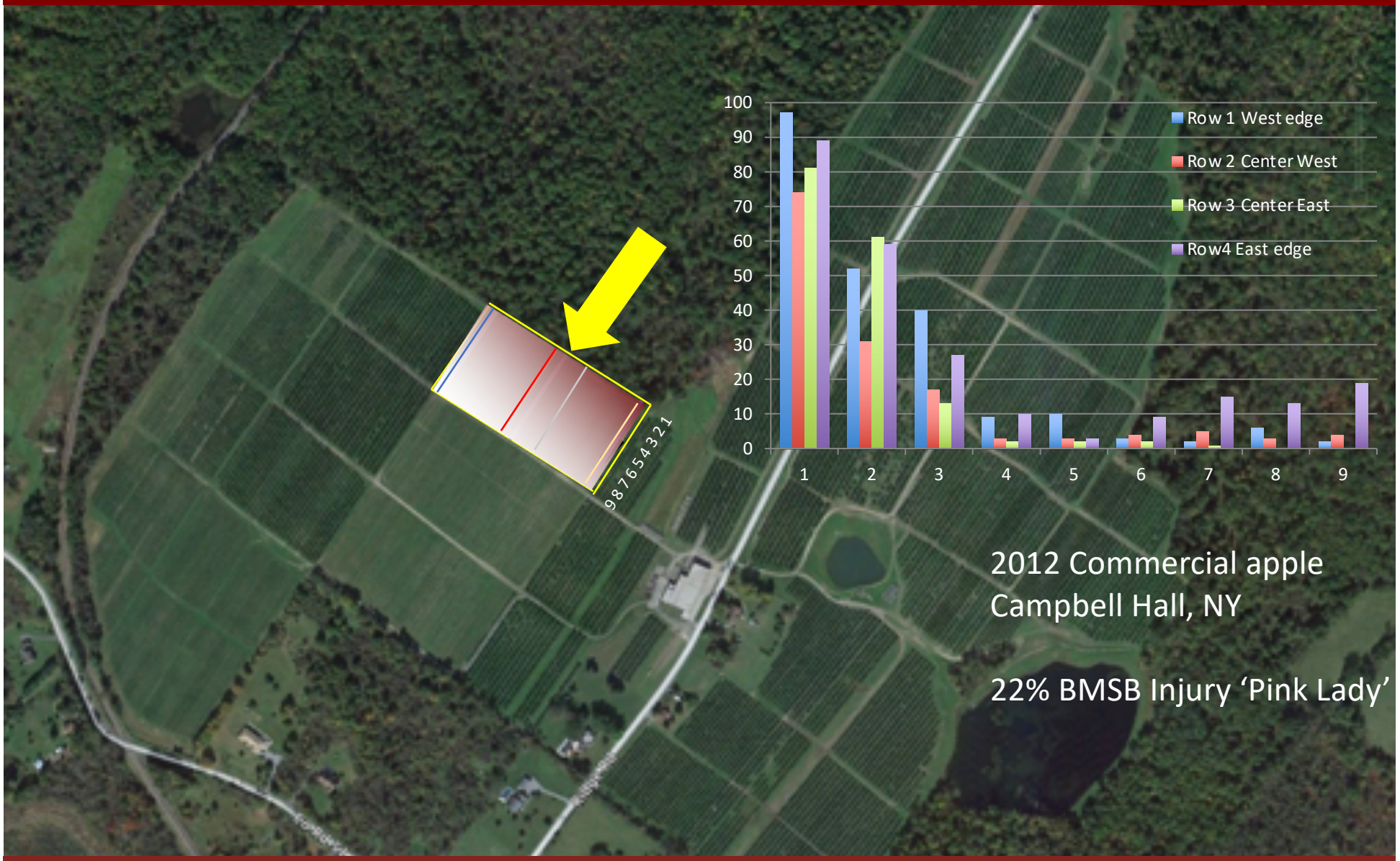
11th

May June July August September October

14 hour daylength
for 2nd gen egg laying

Pink Lady 2012

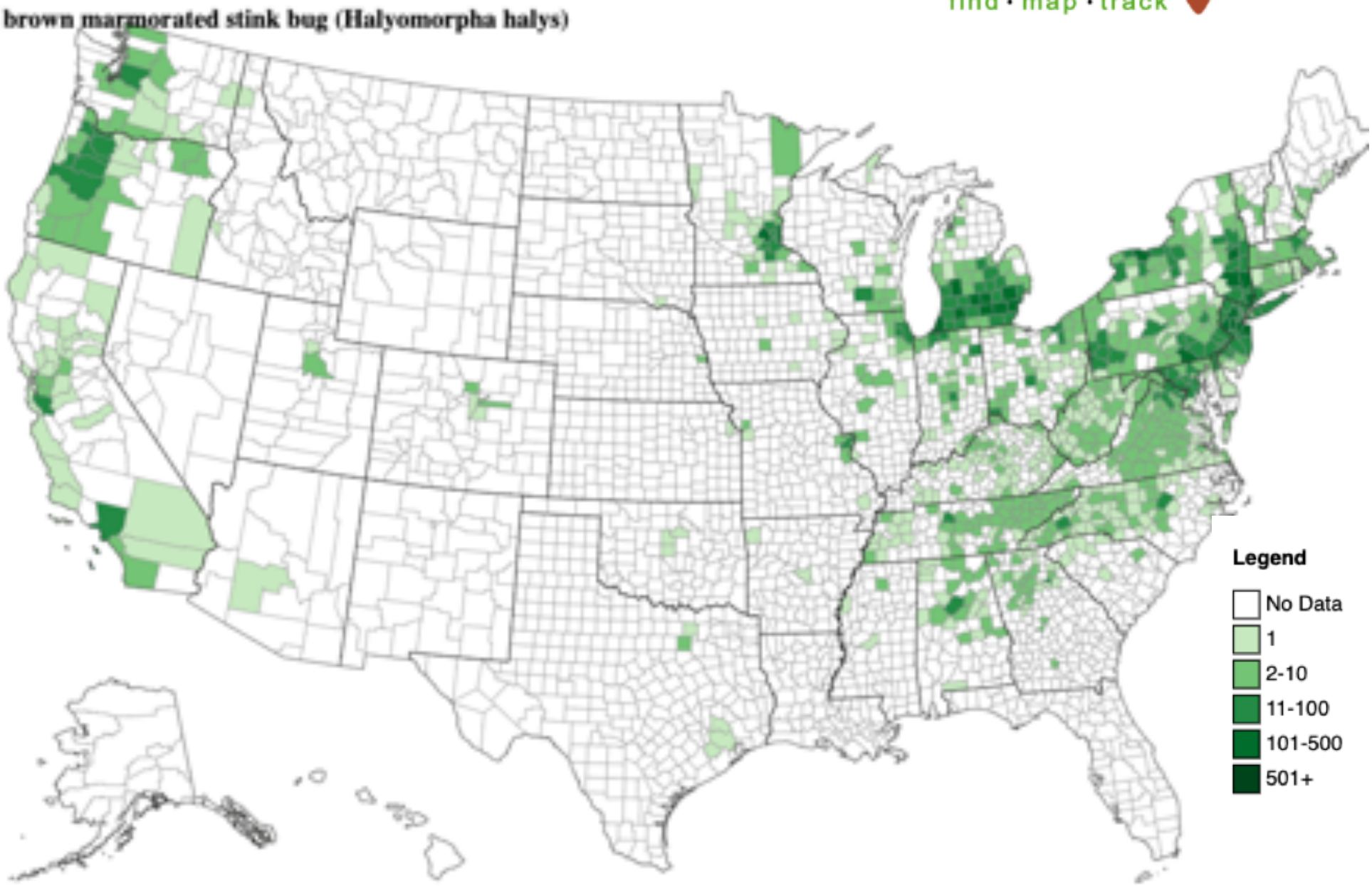
Brown Marmorated Stink Bug
Arboreal Woodland Insect / Migrates to Ag. Crop Borders



2012 Commercial apple
Campbell Hall, NY

22% BMSB Injury 'Pink Lady'

Citizen Science Verified Submission Based Mapping System



EDDMaps. 2021. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. Available online at http://www.eddmaps.org/; last accessed January 3, 2021.

Brown Marmorated Stink Bug

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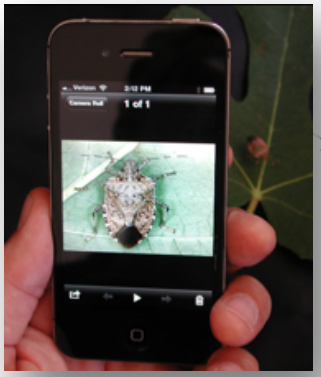

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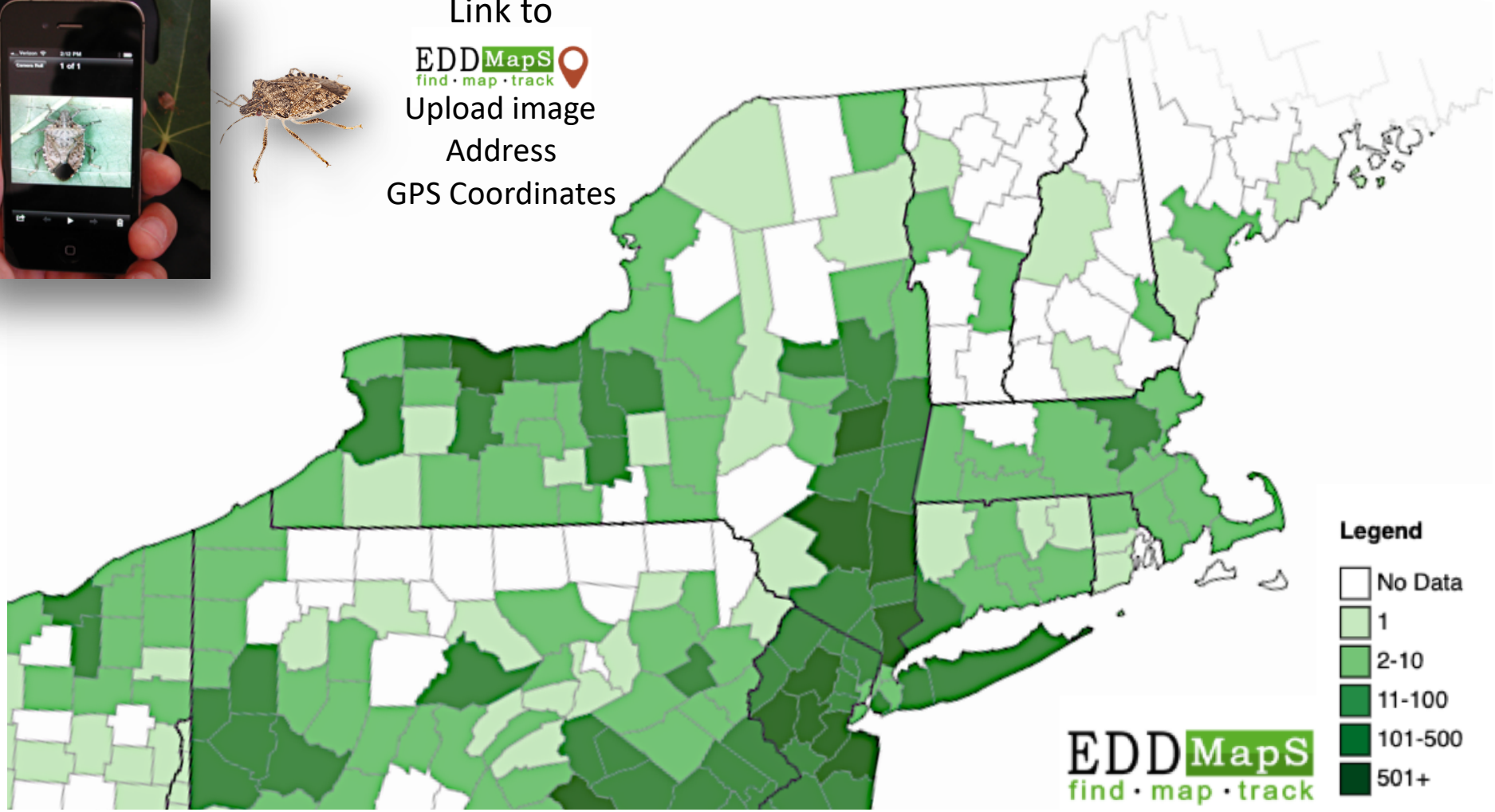


Brown Marmorated Stink Bug

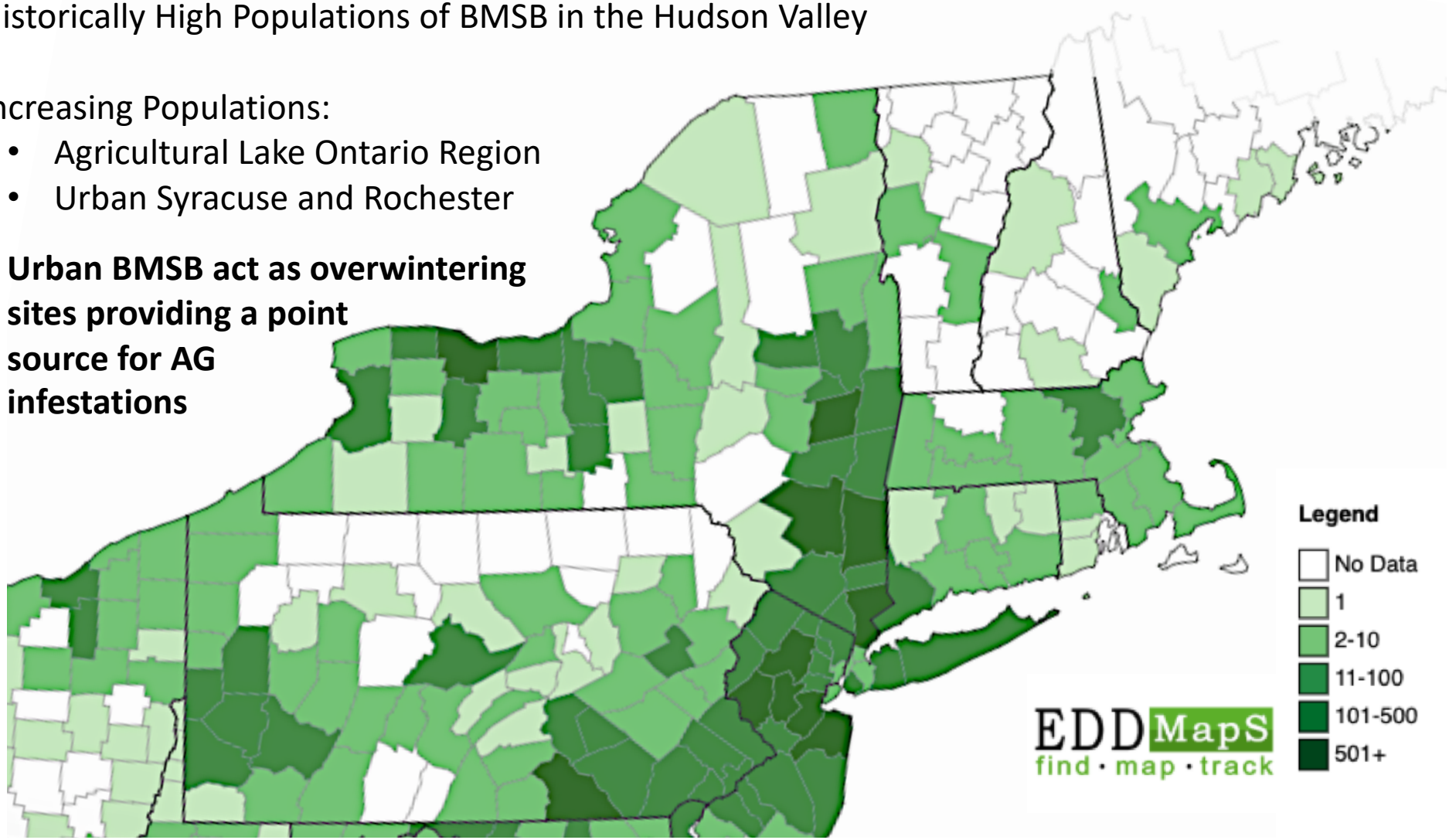
Citizen Science Verified Submission Based Mapping System

Historically High Populations of BMSB in the Hudson Valley

Increasing Populations:

- Agricultural Lake Ontario Region
- Urban Syracuse and Rochester

Urban BMSB act as overwintering sites providing a point source for AG infestations



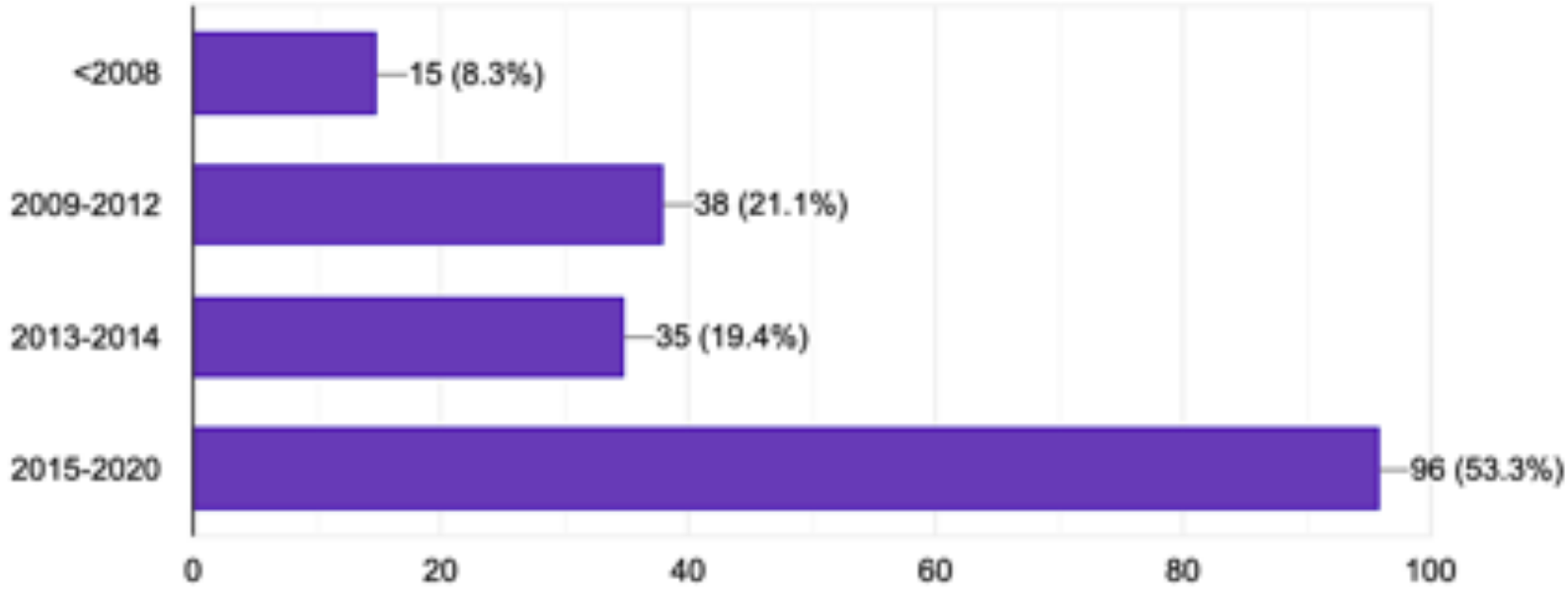
Brown Marmorated Stink Bug
2021 Citizen Science Survey: BMSB in Homes in NYS

In January 2021 we emailed 1440 NYS residents who submitted BMSB images to EDDMaps during the 'March Madness' 2017 survey to 'Put BMSB on the map'.

We asked them to answer 5 questions:

The first year BMSB first appeared in your home?

180 responses of 1440 NYS survey respondents to the 'March Madness' 2017 survey.



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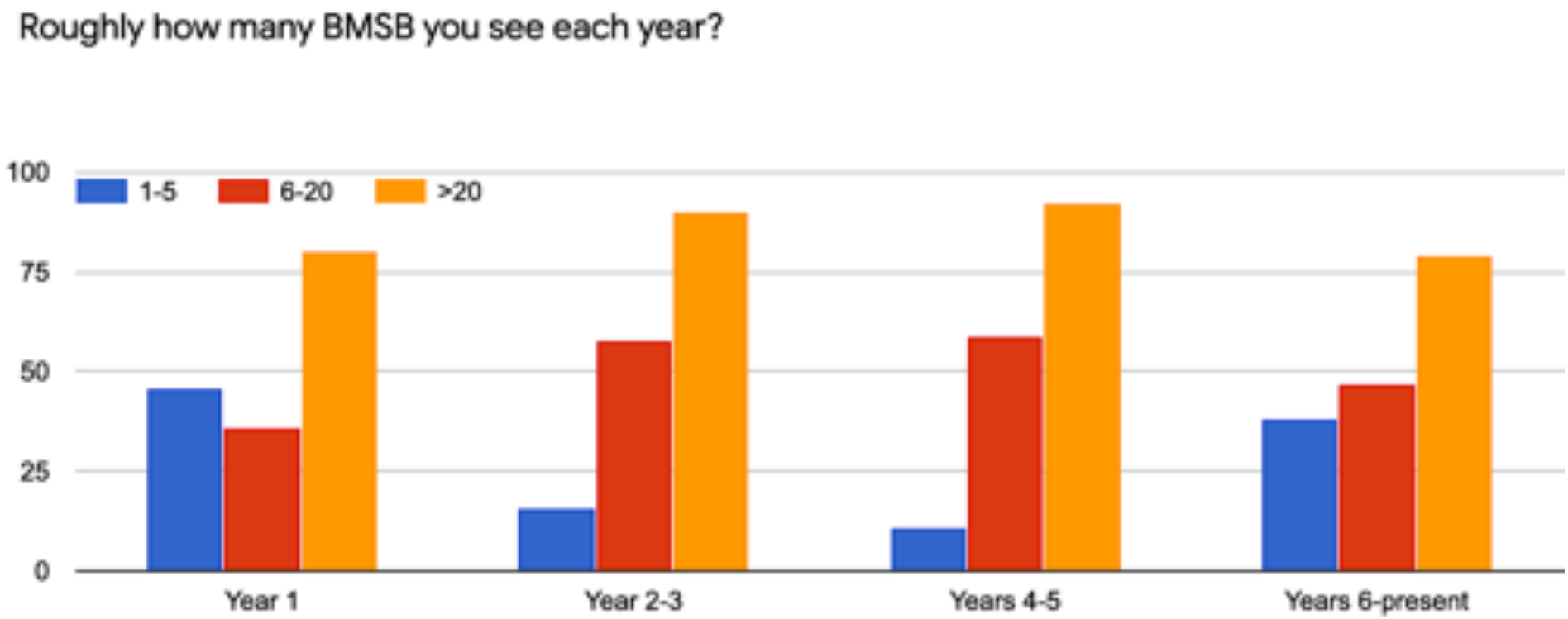
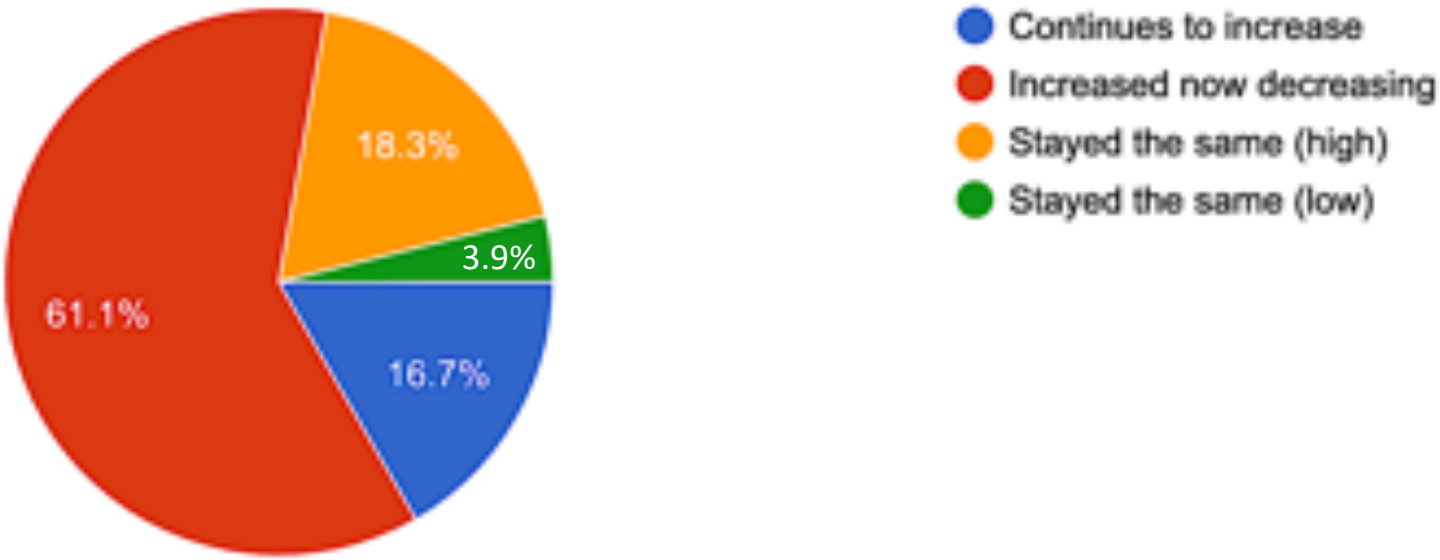


Brown Marmorated Stink Bug
2021 Citizen Science Survey: BMSB in Homes in NYS

Are populations of BMSB increasing or decreasing since it first appeared ?

180 responses



Generally: Populations of BMSB are declining in homes across NYS
Populations of BMSB trending in decline in ENY

Brown Marmorated Stink Bug
2021 Citizen Science Survey: BMSB in Homes in NYS

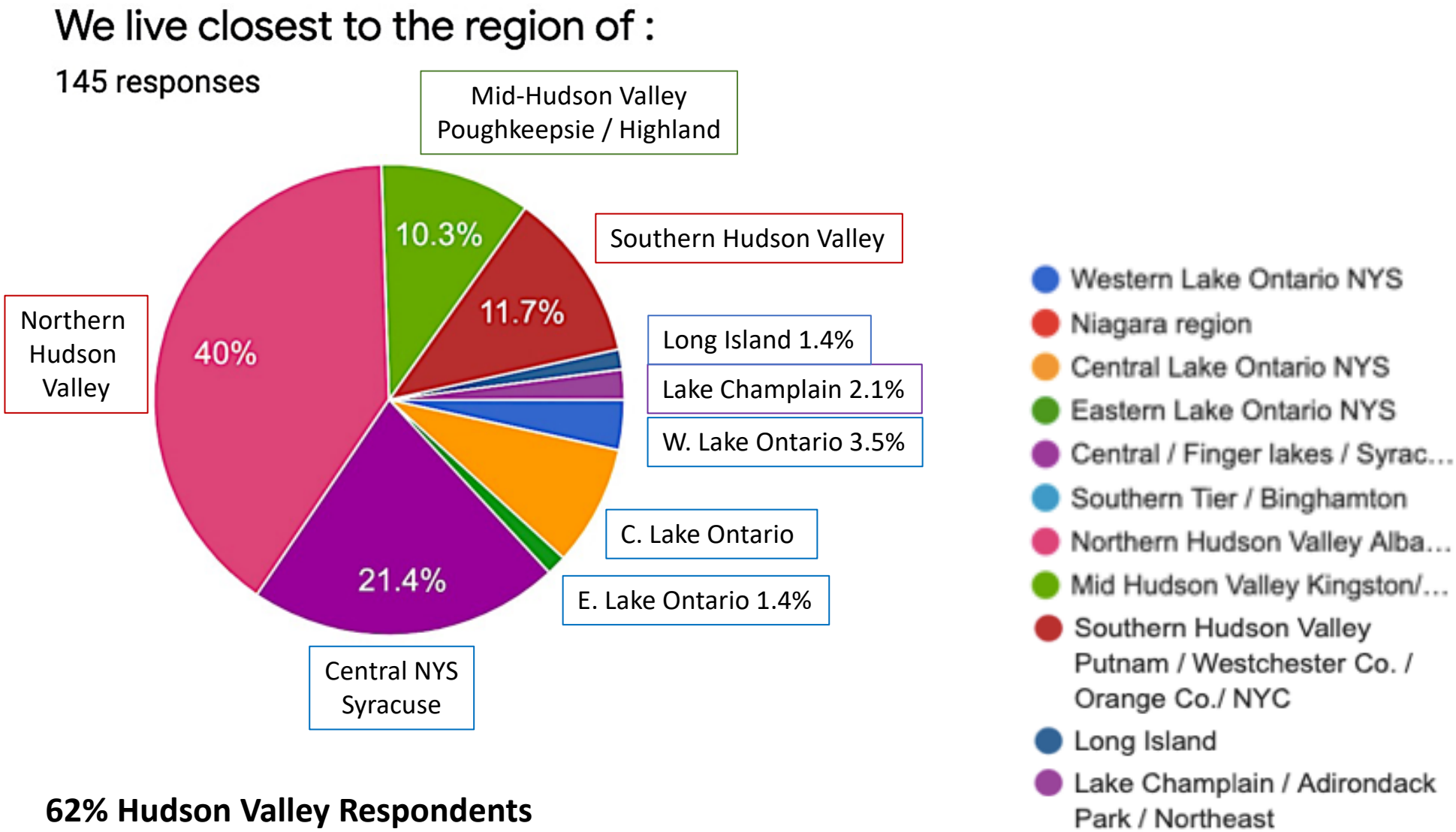
Do you think the use of biological control to reduce pesticide use is a good option for agricultural and urban reduction of pests such as Brown Marmorated Stink Bug?

179 responses

Generally: Most people agree that biological control is a good option to reduce BMSB

43% are cautiously optimistic with concerns about ecological disruption

Brown Marmorated Stink Bug
2021 Citizen Science Survey: BMSB in Homes in NYS



62% Hudson Valley Respondents

Citizen Science Release of *Trissolcus japonicus*

Stink Bug Feeding Sheath

Predatory Feeding of eggs

Parasitized & Emerged

Spined soldier bug
Podisus maculiventris

Tettigoniidae
Grasshopper, Crickets

Samurai Wasp
Trissolcus japonicus

Impact of Native Biological Control on BMSB

Normal, hatched BMSB egg mass.

BMSB eggs showing damage from sucking predators.

Native Predatory feeding and Parasitism

Predatory feeding accounts for approx. 20-37% reduction of BMSB eggs

BMSB eggs showing damage from chewing predators.

Spined soldier bug Podisus maculiventris

Impact of Native Biological Control on BMSB

Normal, hatched BMSB egg mass.

Parasitized BMSB eggs.

Native Predatory feeding and Parasitism

- Parasitism by native parasitoids account for < 1% to 5% dependent on habitat.

Trissolcus brochymenae

Telenomus podisi

Trissolcus euschisti

Impact of BMSB From Environmental Conditions on BMSB

- **Environmental conditions favoring BMSB:**
  - Successful under high temperature extremes & drought

- **Environmental conditions negatively impacting BMSB:**
  - The majority of BMSB reside in the woodland habitat (Standing Dead Oak (*Quercus* spp.), Locust (*Robinia* spp.) Lee, Doo-Hyung et al. 2014)

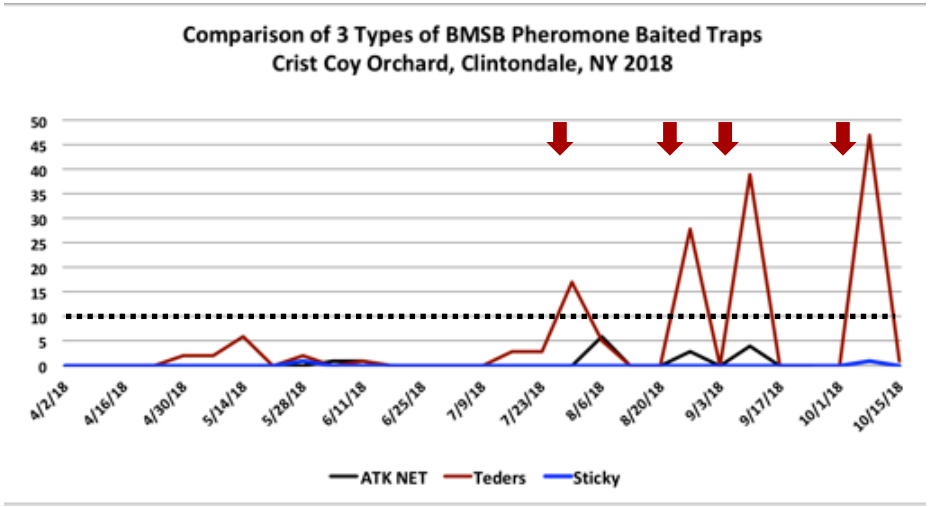
  - In woodland habitat, temperatures below -18°C or -0.4^{o}F will kill 90% of the population (Kuhar, T. 2016)

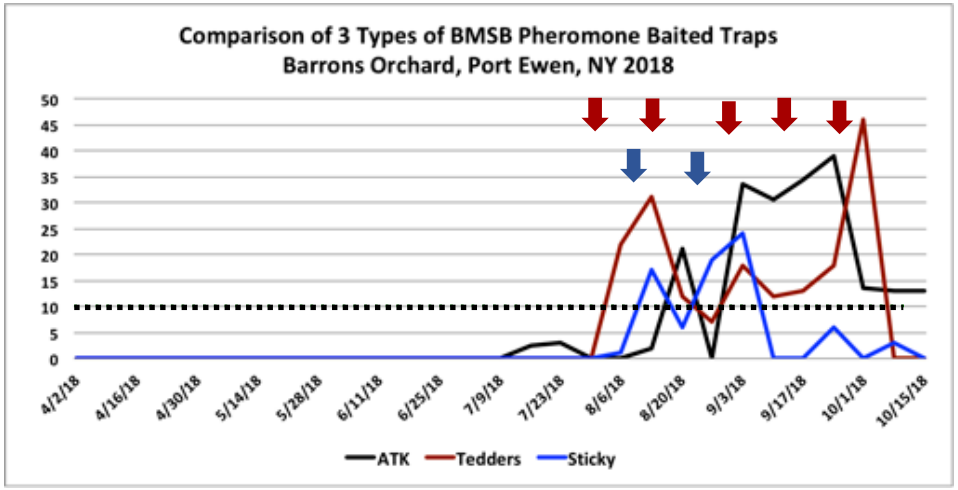
- **Persistent rain and high humidity cause disease**
    - Microsporidia: *Nosema maddoxi*
    - *Beauveria bassiana*

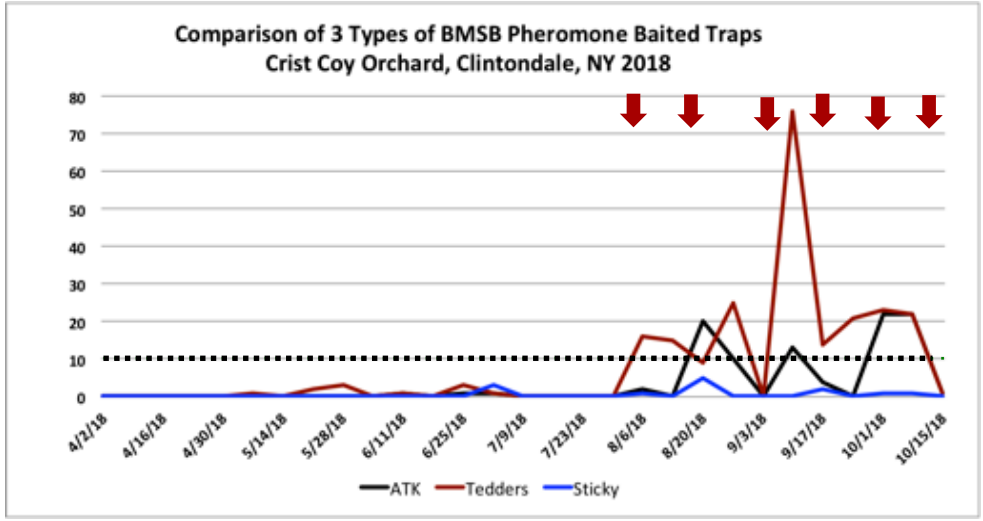
NYS BMSB Survey – 2018-2020
Tedders and Clear Sticky Card Pheromone Trap Captures

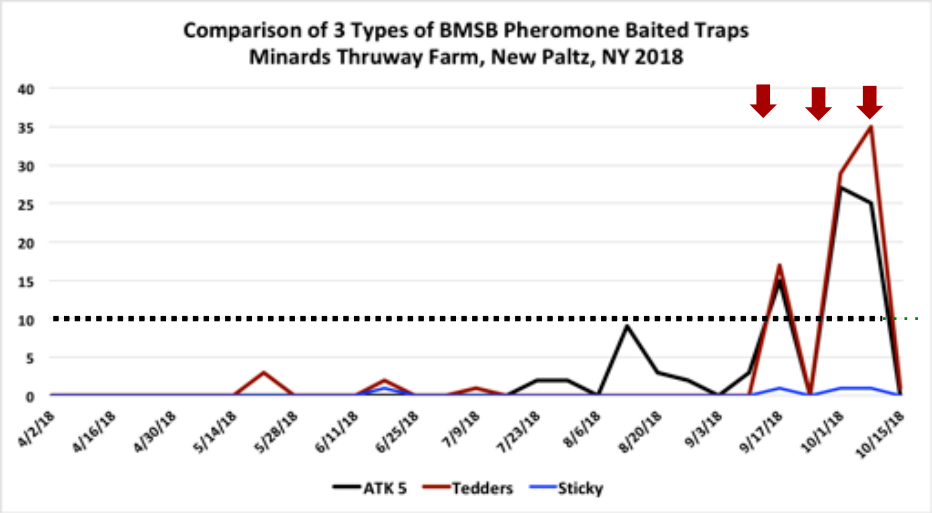
NYS BMSB Survey –2020
Clear Sticky Card Pheromone Trap Captures

BMSB Aggregation Pheromone Monitoring
Tedders Traps Captures Higher Than Sticky Cards

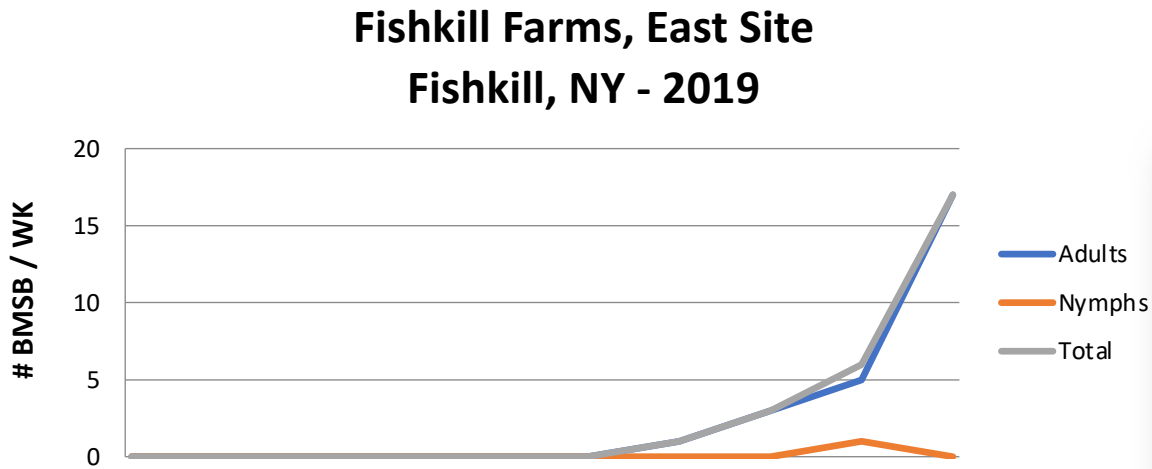


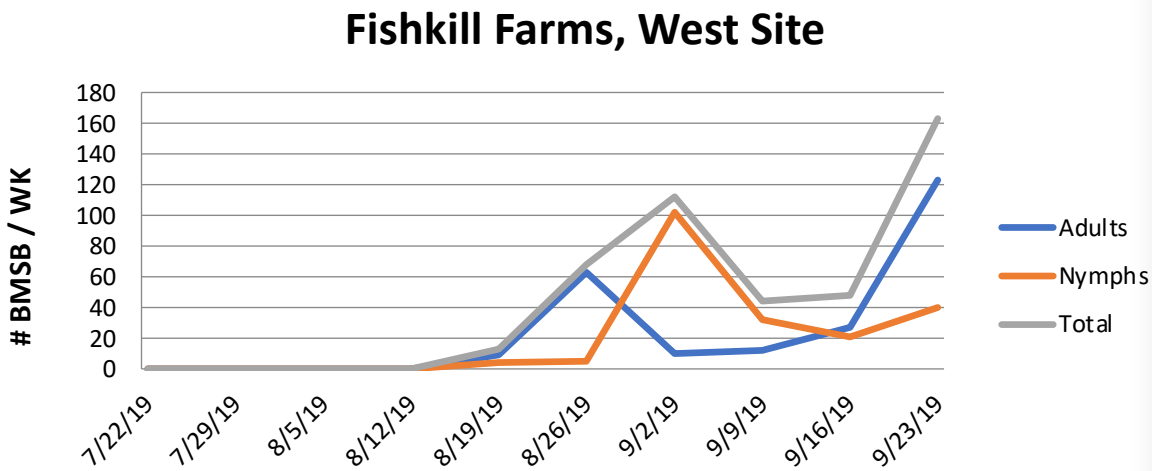






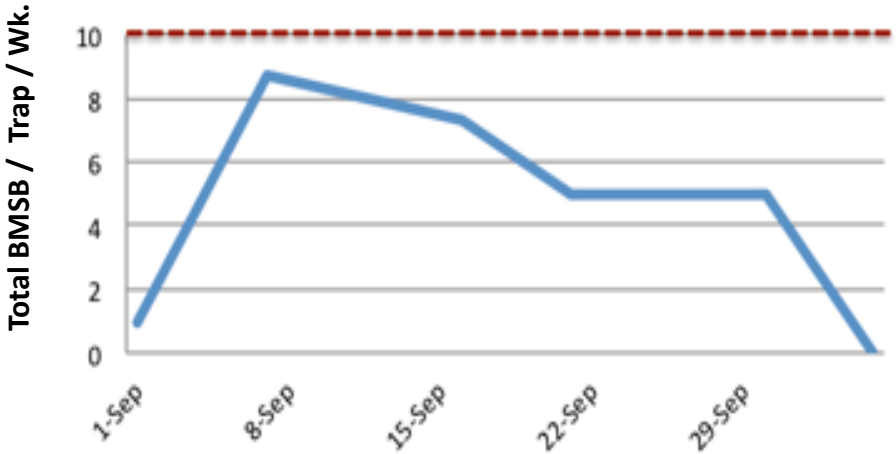
BMSB Aggregation Pheromone Monitoring
Trap Placement Location Critical



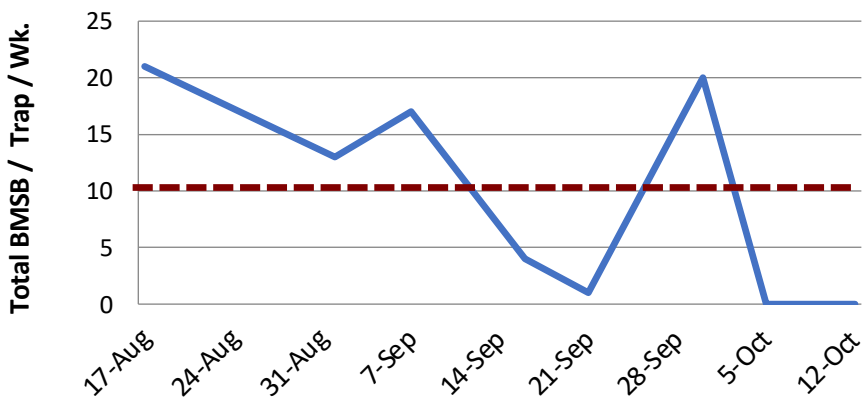


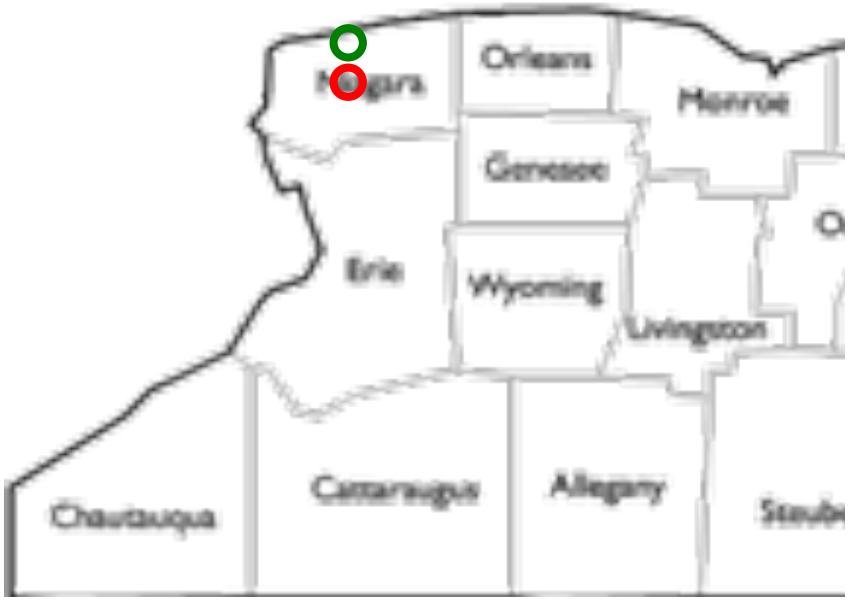
Lake Ontario Fruit Growing Region: BMSB Monitoring 2020

Appleton, NY – 2020
Niagara



Lockport, NY
Niagara Co. - 2020





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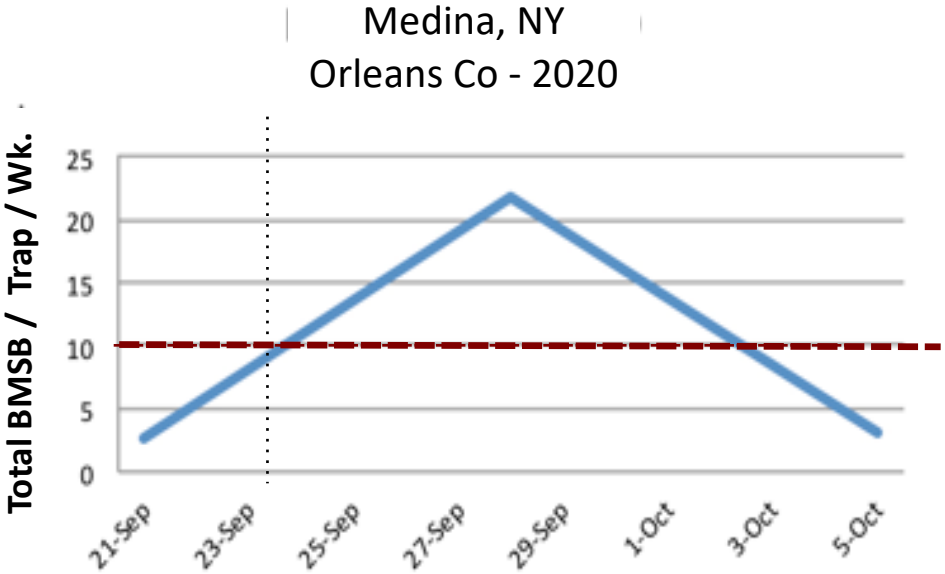
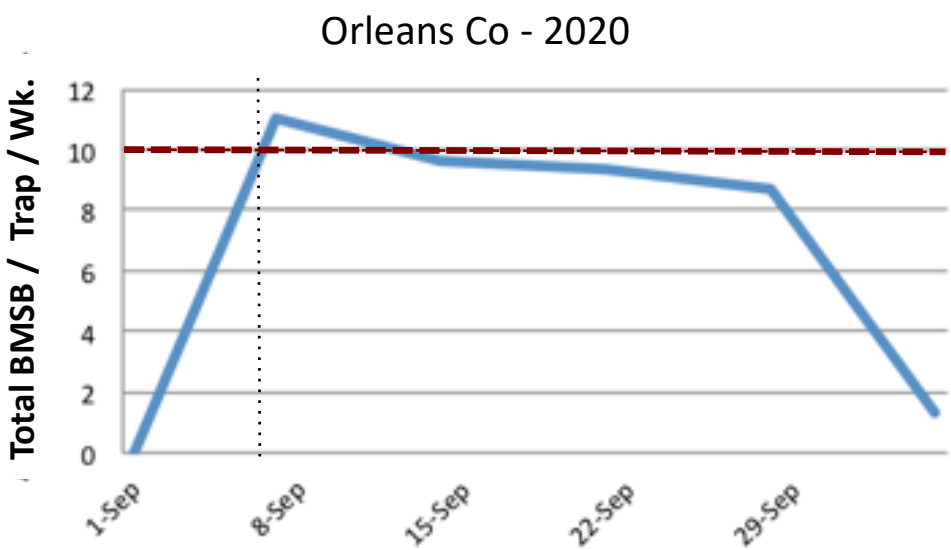
Lake Ontario Fruit Growing Region: BMSB Monitoring 2020





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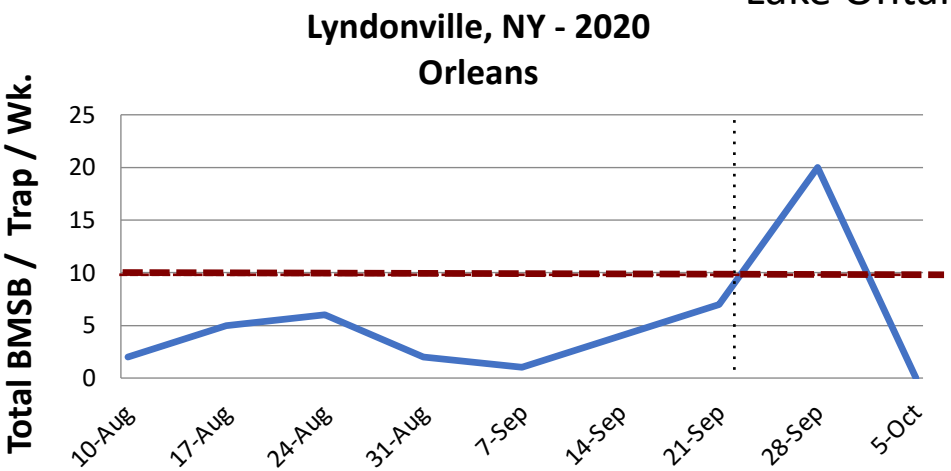

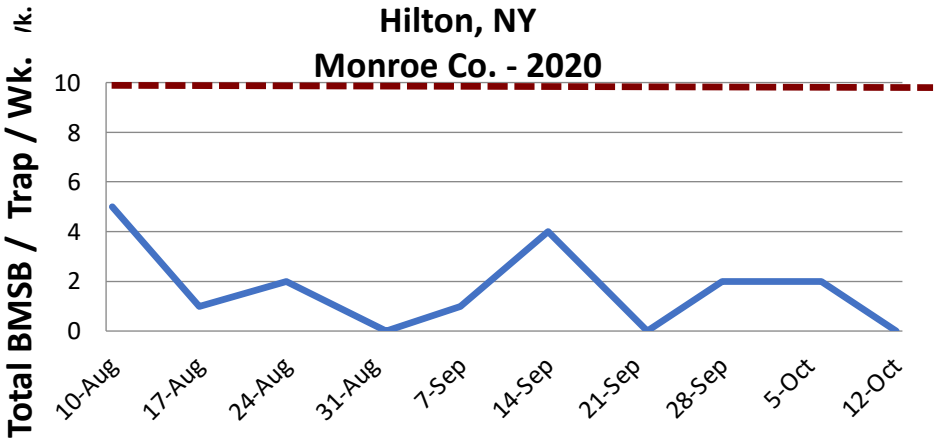

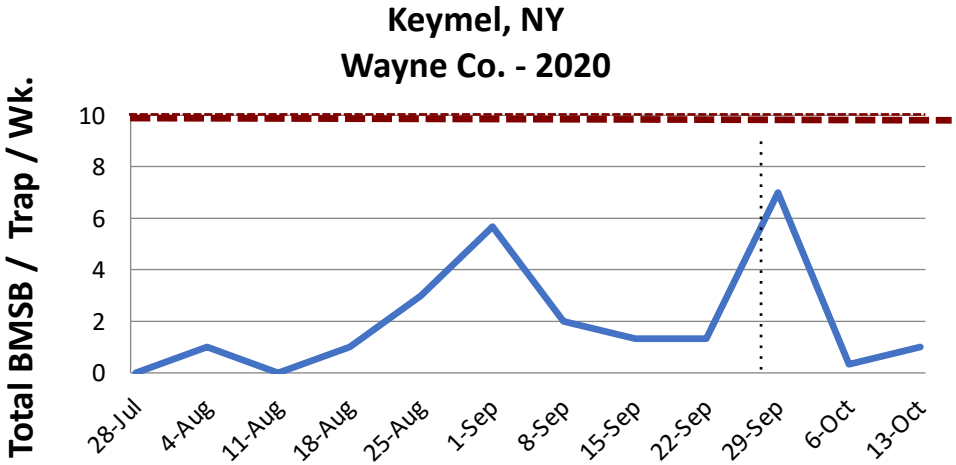

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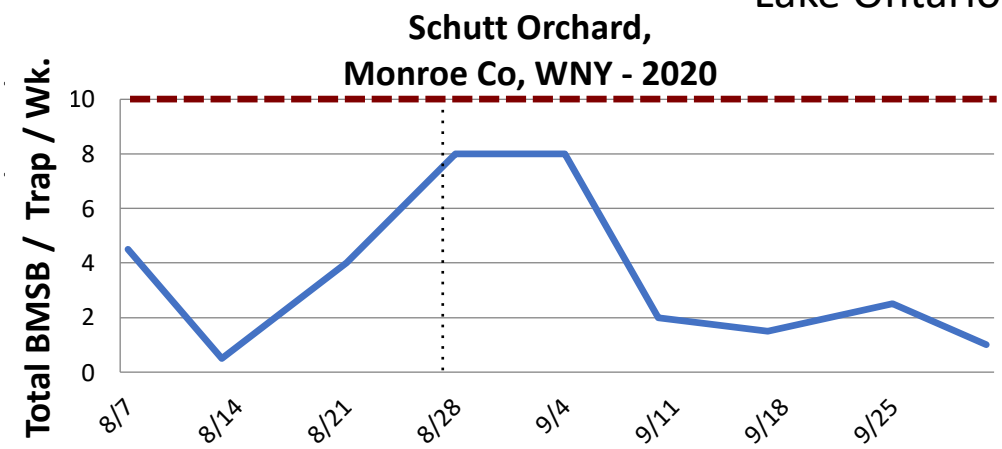

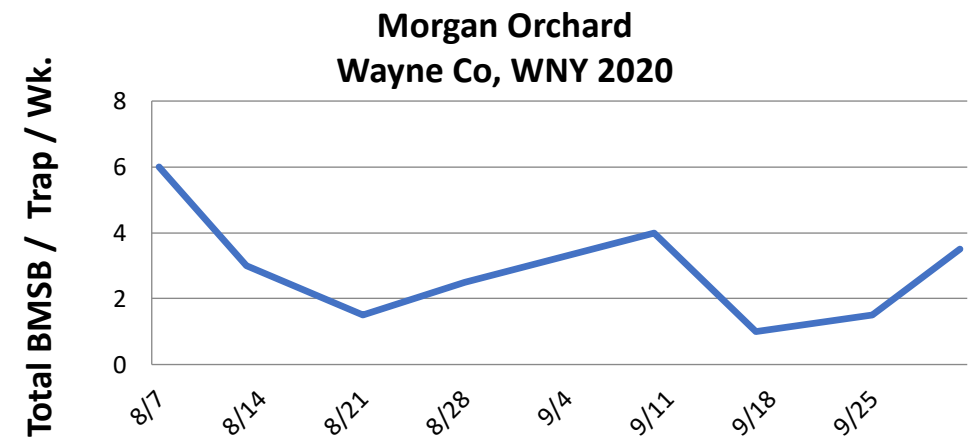

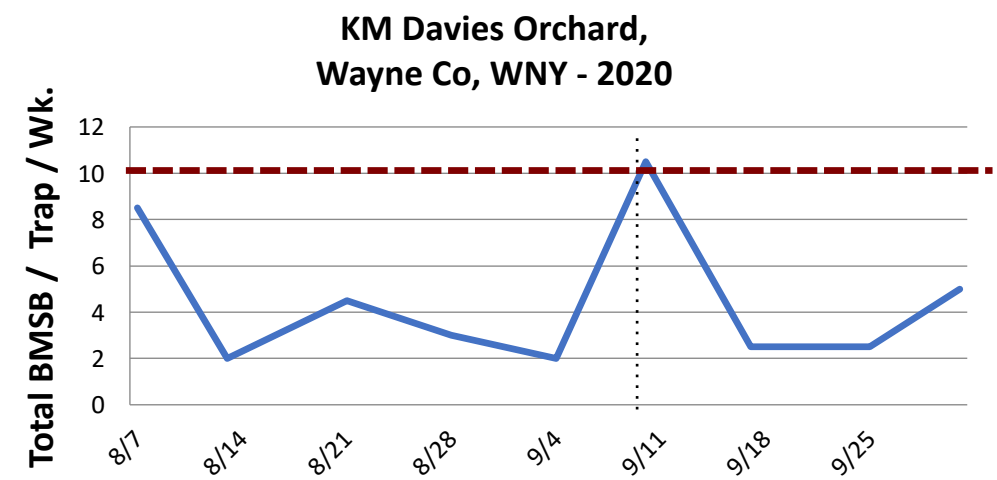

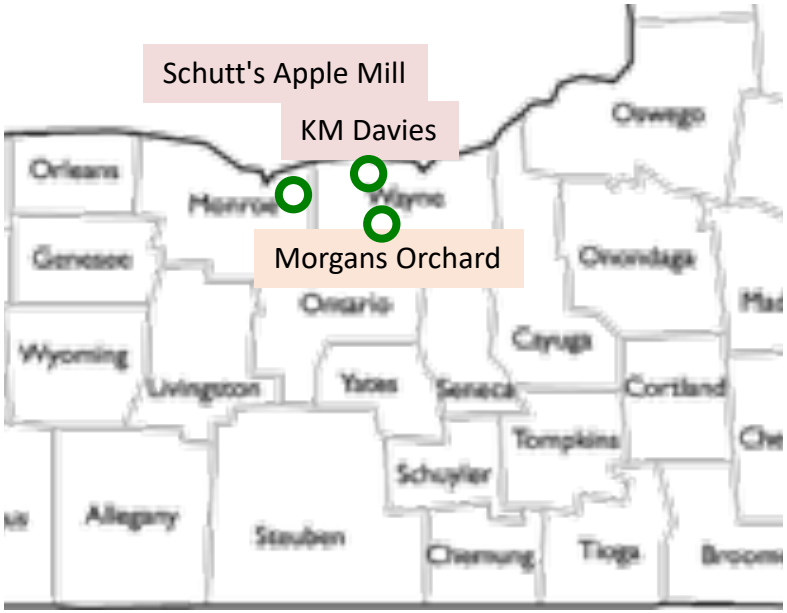

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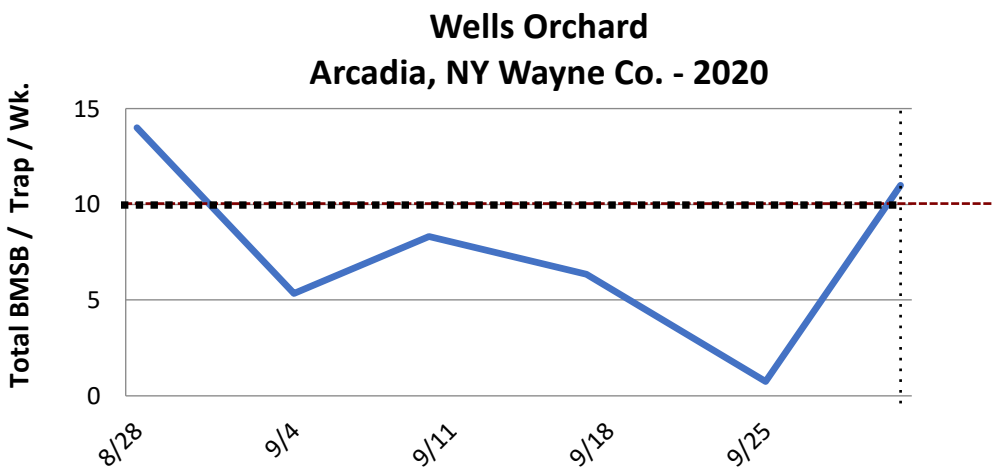
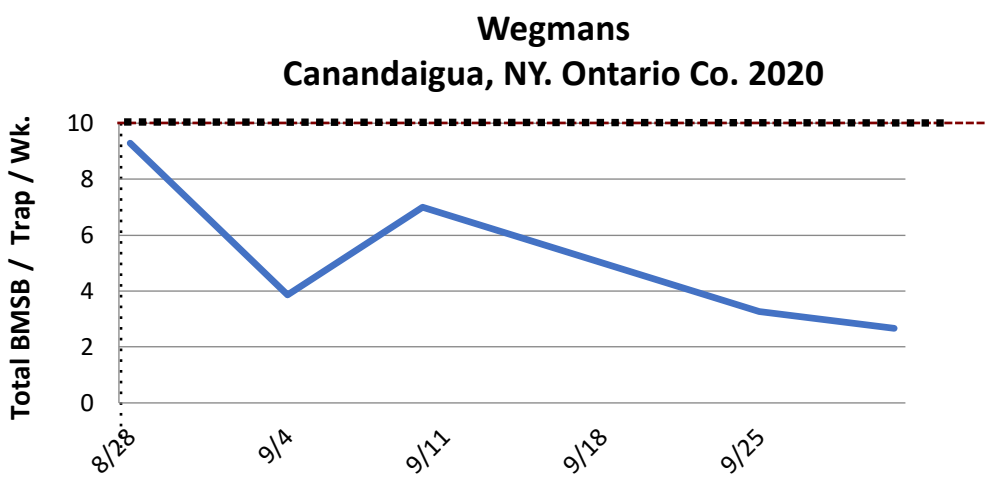
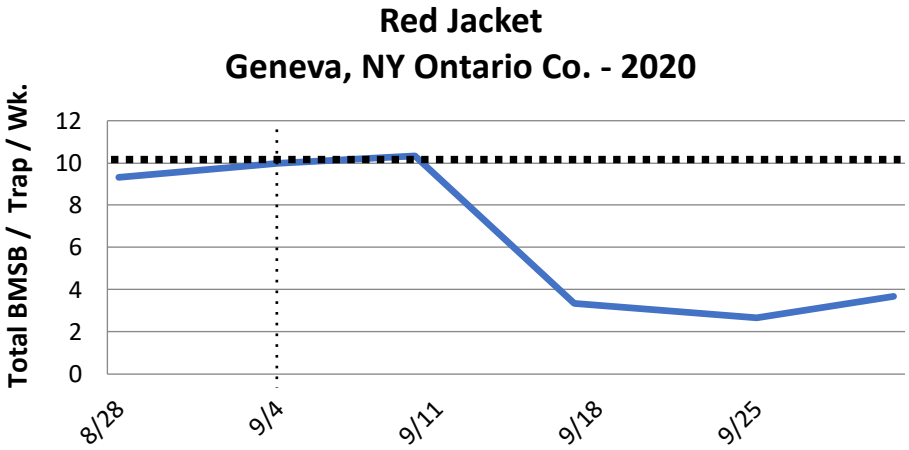
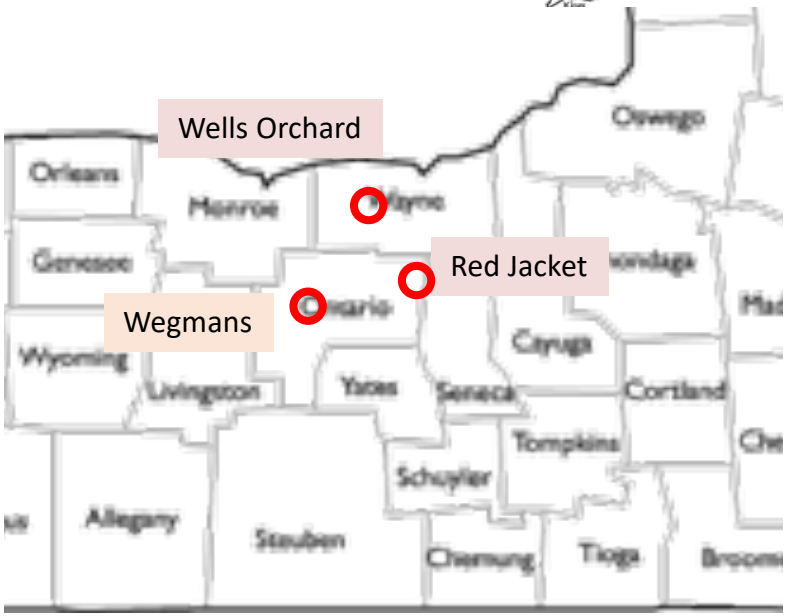
Lake Ontario Fruit Growing Region: BMSB Monitoring 2020









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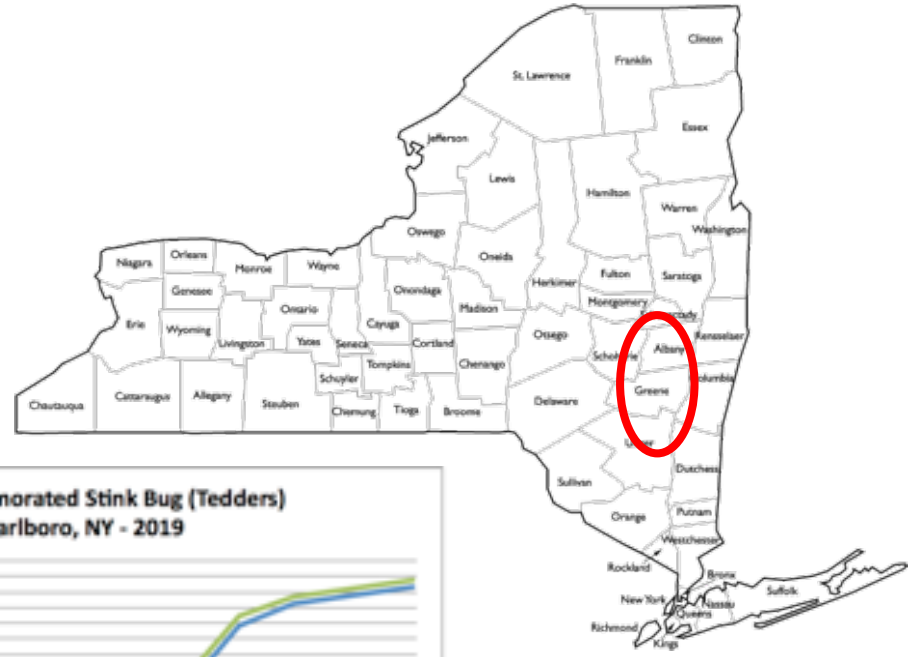
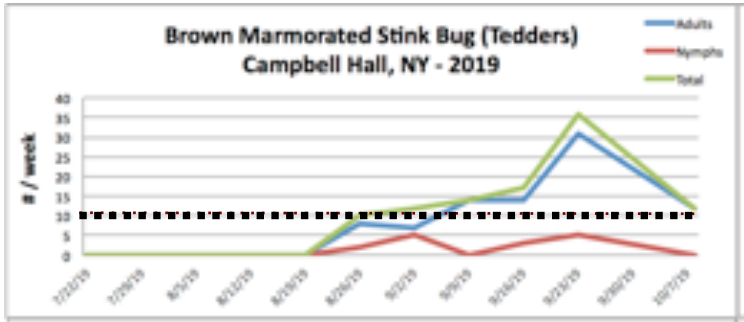
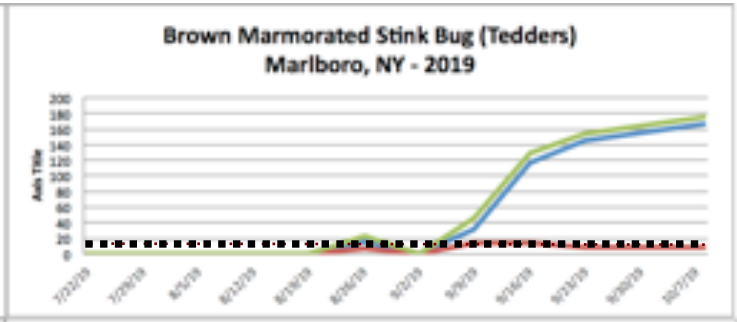
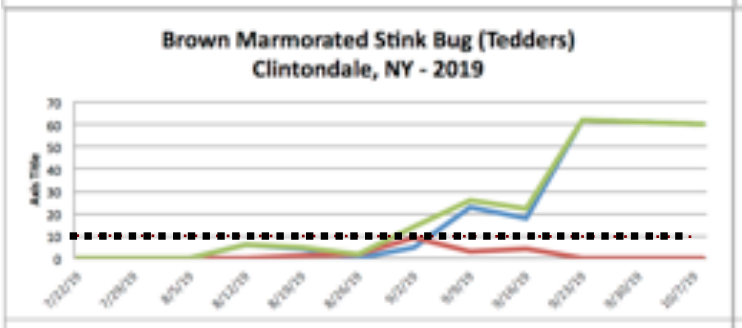
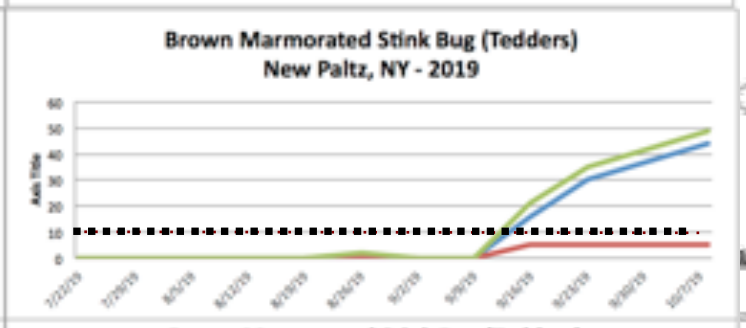
Hudson Valley BMSB Monitoring 2019

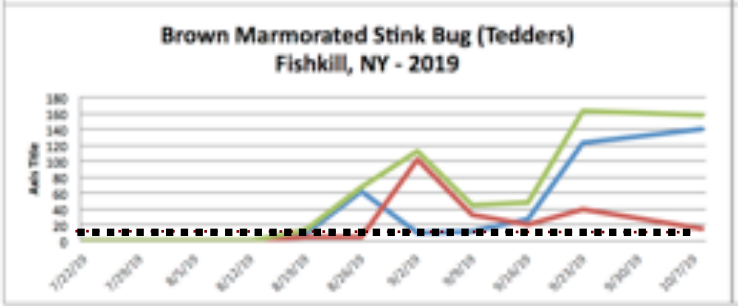


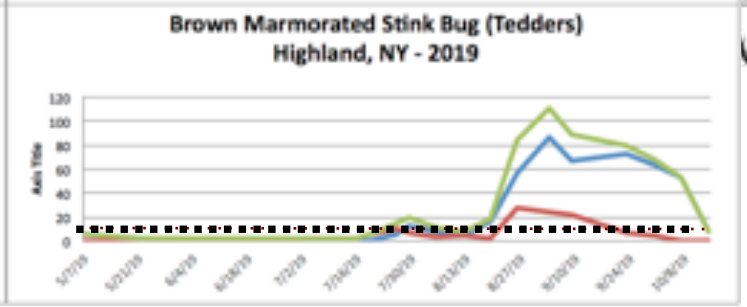


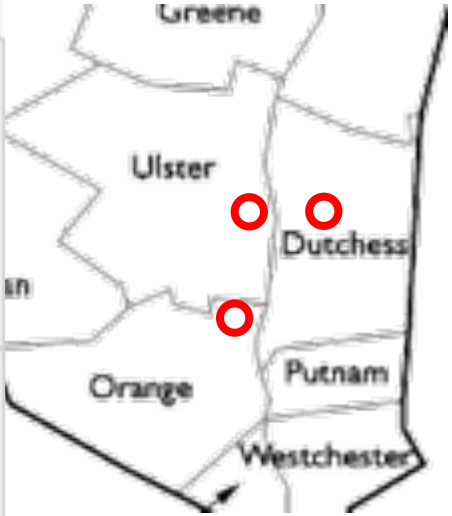




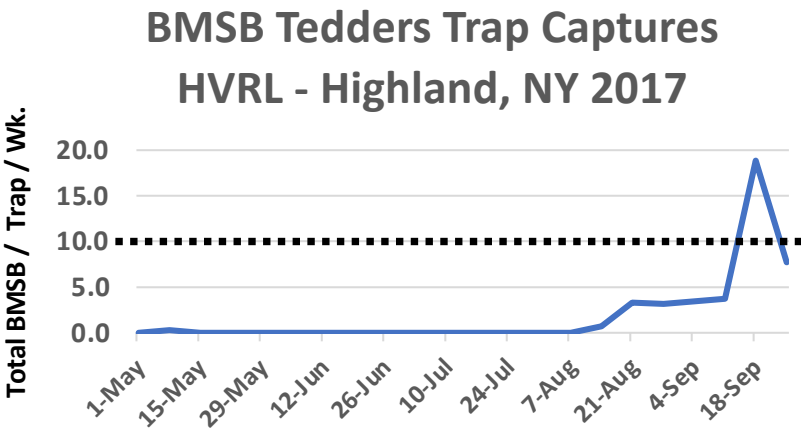


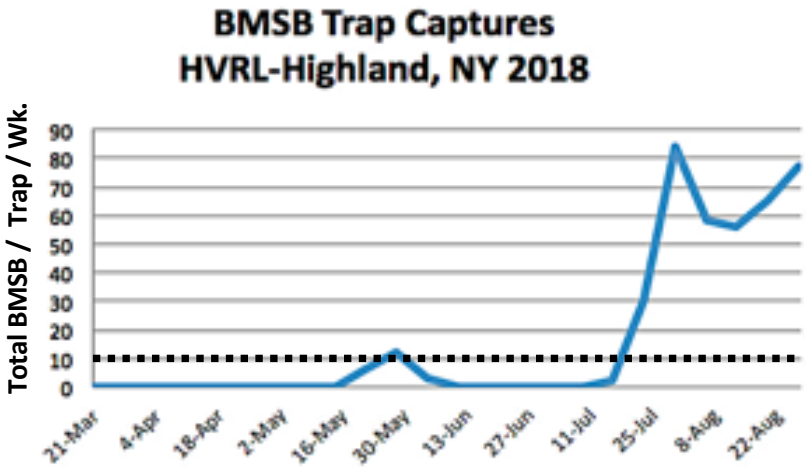




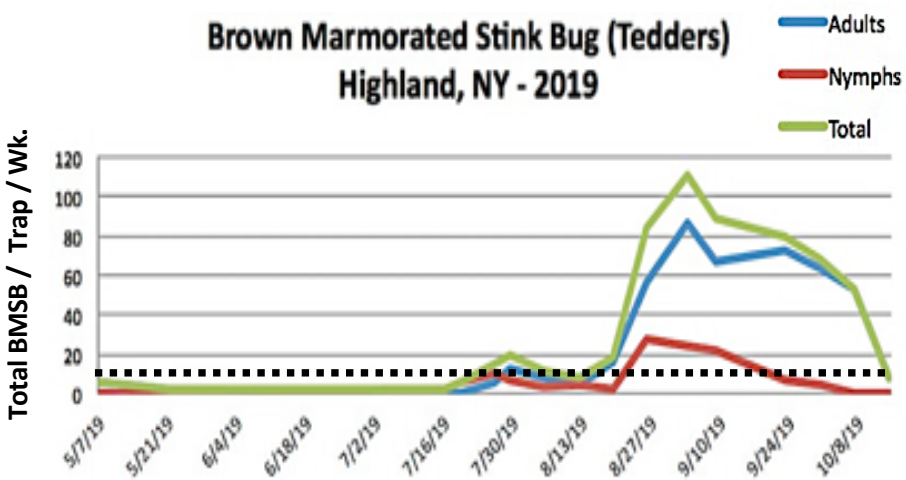


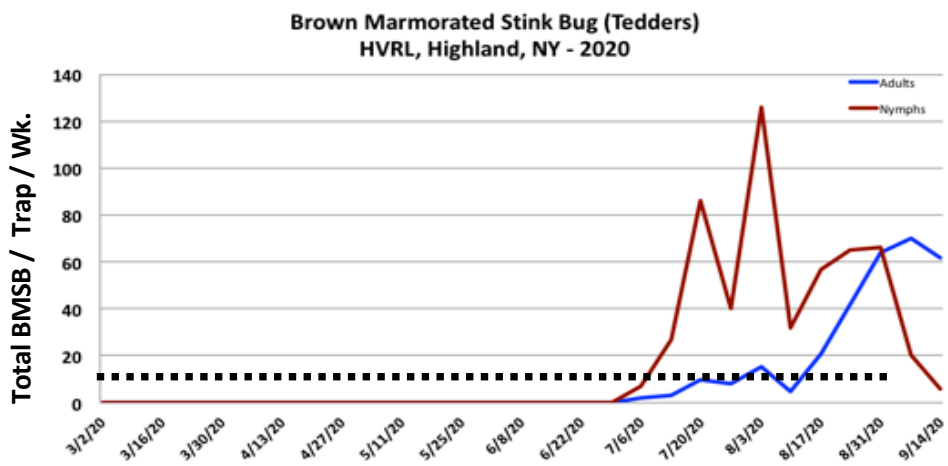
Hudson Valley BMSB Monitoring 2017-2020





Peak BMSB Adults / Week	
2017	N = 18
2018	N = 83
2019	N = 84
2020	N = 70





Hudson Valley Research Lab, Highland NY
BMSB Monitoring 2017-2020

Table 1: BMSB Caught in Dual Lure Baited Tedders Traps[1]
Hudson Valley Research Laboratory, Highland, NY – 2017-2020

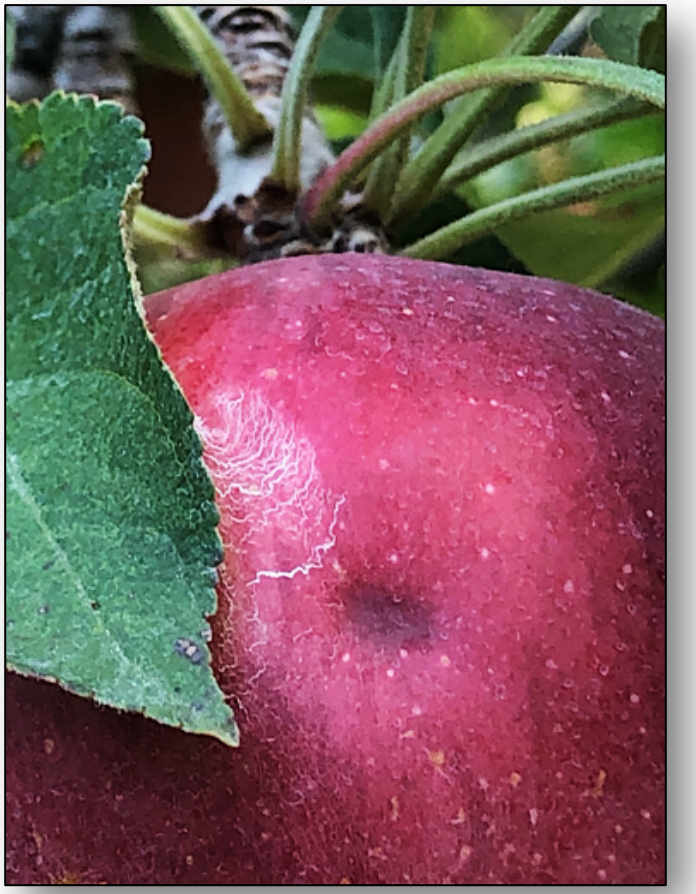
Year	Adult BMSB/ Trap/ Week	Adult BMSB/ Trap/ Day	Peak # Adult BMSB	Date of Peak Capture
2017	11.6 b	1.7 b	18	18 Sept
2018	99.6 a	14.2 a	273	17 Sept
2019	39.8 ab	5.7 ab	111	2 Sept
2020	39.9 ab	5.7 ab	141	3 Aug
P-value	0.0112	0.0112		

1. Representing data from 4-years beginning Aug.7th – September 11th

***Continue to see high population migration to pheromone lure & injury to fruit in the Hudson Valley**

Hudson Valley Research Lab, Highland NY
BMSB Injury September 25th, 2020

BMSB Feeding site
with stylet sheath



*** ≤ 1% in weekly scouting of boarder rows. Hudson Valley wholesale management pest management programming on a 7– 10 day rotational full & ARM program.**

Hudson Valley Stink Bug Complex (Pentatomidae) Management

Stink Bug Biology

- Large 'Shield' bug body form (3.5 cm)
- Proboscis (moutparts) shielded prior to insertion into fruit
- Body held above the surface of foliage and fruit
- Tarsi hold insect on small segments onto smooth surfaces
- Limited exposure to residual insecticides

Hudson Valley Stink Bug Complex (Pentatomidae) Management

PRODUCT	ACTIVE INGREDIENT	FIELD RATE tested	FRUIT REGISTRATION*	Percent DIRECT MORTALITY**			RESIDUAL: LETHALITY INDEX[1]
				24 h	72 h	120 h	
Asana XL	esfenvalerate	14 oz	Apple, Pear, SF	15	27	48	43
Baythroid XL	beta-cyfluthrin	2 oz	PF, SF, G	7	13	37	55
Baythroid XL	beta-cyfluthrin	2.8 oz	PF, SF, G	42	30	53	55
Bifenture EC	bifenthrin	12.8 oz	G, Pears	98	100	100	92
Brigade 2EC	bifenthrin	10 oz	G, Pears	100	100	95	92
Danitol 2.4EC	fenpropathrin	12 oz	PF, SF, G	87	65	60	67
Danitol 2.4 EC	fenpropathrin	16 oz	PF, SF, G	95	82	82	67
Hero	bifenthrin zeta-cypermethrin	10 oz	Not registered	93	87	82	92 52
Lambda-Cy EC	lambda-cyhalothrin	4.4 fl oz	Not registered	52	40	35	53
Mustang Max	zeta-cypermethrin	4 oz	PF, SF, G	67	37	30	52
Pounce 25 WP	permethrin	16 oz	PF, SF	45	42	35	77
Warrior II	lambda-cyhalothrin	2 oz	PF, SF	73	72	77	53
Warrior II	lambda-cyhalothrin	2.5 oz	PF, SF	52	51	53	53

*PF- Pome Fruits, SF- Stone Fruits, G- Grapes
** Mortality includes dead plus moribund

[1] – based on dry residual bioassays T. Leskey, USDA ARS

NY Management Options

Product	Active ingredient	Rate / A	REI Hrs.	PHI Days	Efficacy (USDA)	Max. per crop / season	App. Interval
Actara 25WDG	Thiamethoxam	2.0-5.5 oz/A	12	35	+++	16.5 oz./A (0.258 lb. a.i./A)	10d
Asana XL 0.66EC	Esfenvalerate	4.8-14.5 fl oz/A	12	21	++	101 fl oz/A (0.525 lb AI/A).	NA
Baythroid XL 1EC	Beta-Cyfluthrin	1.4-2.8 fl oz/A	12	7	++	2.8 fl oz/A (0.022 lb AI/A).	14d
Bifenture EC	Bifenthrin	5.2-12.8 fl oz/A	12	14	++++	32 fl ozs (0.50 lbs ai)	30d
Bifenture 10DF	Bifenthrin	12.8-32.0 oz/A	12	14	++++	80 ozs (0.50 lbs ai)	30d
Brigade WSB	Bifenthrin	12.8-32.0 oz/A	12	14	++++	80 ozs (0.50 lbs ai)	30d
Danitol 2.4EC	Fenpropathrin	10.66-21.33 fl oz/A	24	14	+++	42.56 fl ozs (0.80 lbs ai)	10d
Endigo ZC	Thiamethoxam / Lambda-cyhalothrin	5-6 fl fl oz/A	24	35	++++	19 fl oz./A (0.172 lb ai) NY	10d
Lannate 2.4LV*	Methomyl	2.25 pt/A	72	14	++++	240 ozs (0.50 lbs ai)	7d
Lannate 90SP*	Methomyl	8-16 oz/A	72	14	++++	5.0 lbs	7d
Leverage 360	Beta-Cyfluthrin / Imidacloprid	2.4-2.8 fl oz/A	12	7	+++	2.8 fl oz/A	14d
Surround 95WP	Kaolin	25-50 lb/A	4	0	+	NA	0d
Voliam Xpress EC	Chlorantraniliprole / Lambda-cyhalothrin	6-12 fl oz/A	24	21	+++	31.0 fl oz/A	10d
Vydate 2L*	Oxamyl	4-8 pt/A	48	14	++	281 fl oz/A (128 oz AI/A).	7d
Warrior 1CS	Lambda-cyhalothrin	2.56-5.12 fl oz/A	24	21	++	20.48 fl. oz. (0.28 lb. a.i.)**	5d
Warrior II 2.08CS	Lambda-cyhalothrin	1.28-2.56 fl oz/A	24	21	++	10.24 fl. oz. (0.28 lb. a.i.)**	5d

- Although these materials have excellent topical ratings in lab bioassay studies, field efficacy studies have shown economic fruit injury from BMSB feeding, suggesting low residual levels.

** Post bloom applications

(+) low to (++++) high efficacy

Early-mid August

- **Single Application** (Thiamethoxam)
- NYS total 11.0 oz./A of Actara WDG; 35 DTH
- Whole orchard application

NY Management Options

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Actara 25WDG	Thiamethoxam	2.0-5.5 oz/A	12	35	+++	16.5 oz./A (0.258 lb. a.i./A)	10d
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Baythroid XL 1EC	Beta-Cyfluthrin	1.4-2.8 fl oz/A	12	7	++	2.8 fl oz/A (0.022 lb AI/A).	14d
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** Post bloom applications

(+) low to (++++) high efficacy

late August – early September

- 7-10 d application schedule
- Alternate row middle (2)
- 21 DTH

NY Management Options

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** Post bloom applications

(+) low to (++++) high efficacy

Mid-September to EOS

- 7-10 d application schedule
- **Border applications**
- Focus on MRL reduction

BMSB Feeding and Mortality Study – 2017-18

Comparative Efficacy of Insecticides Using Topical & Field Applied Treatments (Fruit Residue)

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 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

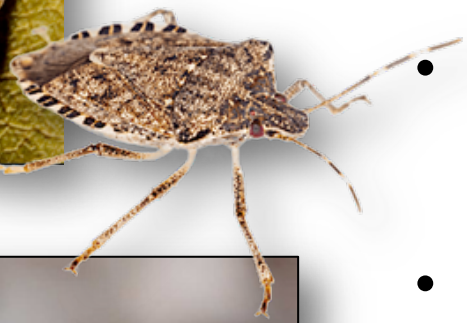
Means followed by the same letter are not significantly different by Steel-Dwass Method at α=0.05 Apples were rated on Oct.12, 2017. BMSB survival were recorded 7 days after exposure to the fruit.

Introduction to *Trissolcus japonicus* (Samurai Wasp) For BMSB Management ?

Trissolcus japonicus

- In its native Asian habitat, BMSB is controlled by Samurai Wasp
- It is considered a sporadic pest of apple

Redistribution of Samurai Wasp, Trissolcus japonicus (Ashmead) In NYS



- Samurai wasp, *Trissolcus japonicus*, is an egg parasitoid of the BMSB
- Lays 1 egg into each BMSB egg
- Wasp larva feed on BMSB nymph
- Adult wasp emerges from BMSB eggs
- Can have 5 generations / year

Redistribution of Samurai Wasp, Trissolcus japonicus (Ashmead) In NYS

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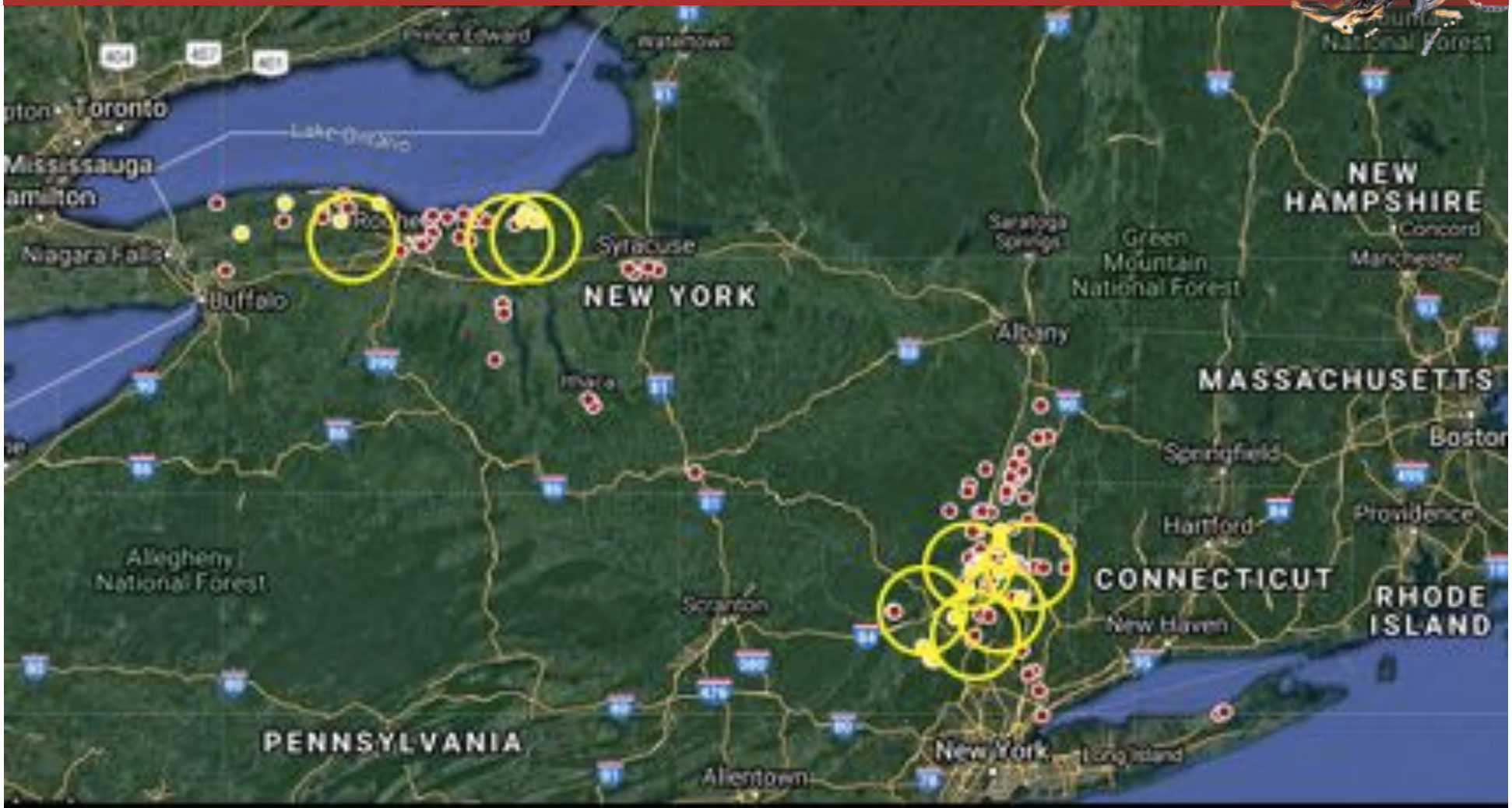
- Lays 1 egg into each BMSB egg
- Wasp larva feed on BMSB nymph
- Adult wasp emerges from BMSB eggs
- Can have 5 generations / year

Live along the wooded edge of Ag.

Resides in BMSB deciduous tree hosts

Limited exposure to insecticides

NY Management – Biological Control
Redistribution of Samurai Wasp in NYS



NYS Samurai Wasp Redistribution Project

2020 Samurai Wasp Recapture Site (N=8)

2017-2020 Samurai Wasp Redistribution Sites (N=154)

Monitoring & Management of the Brown Marmorated Stink Bug

Thank You !

Many thanks go out to the team working to redistribute Samurai Wasp & trap BMSB

Art Angello, Cornell AgriTech

Janet Van Zoren & Liz Tee, CCE-LOFT

Lydia Brown, Maddie Stewart, Jared Jager, Lucas Canino, Albert Woelfersheim, & Margaret Kent Cornell AgriTech – HVRL

Funding from

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- Specialty Crop Research Initiative (USDA-NIFA SCRI #2016-51181-25409).
- *New York Farm Viability Institute (#FYI 19 017)*