Project: Brown Marmorated Stink Bug: Damage Survey and Monitoring Efforts
Institution: Appalachian Fruit Research Station, USDA-ARS, Kearneysville, WV 25430
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Background

The brown marmorated stink bug (BMSB), *Halyomorpha halys* (Stål) was introduced from Asia into the mid-Atlantic region. The epicenter of this infestation is believed to have originated in Allentown, PA in the mid 1990s. Since then, BMSB has spread to New Jersey, Maryland, Delaware, West Virginia, and Virginia. Limited populations also have been detected in Mississippi, Ohio, Oregon, and California. BMSB is polyphagous pest whose host range includes tree fruit, ornamentals, hardwood trees and cultivated crops such as soybean. Among host plants surveyed in the mid-Atlantic, several hosts emerged as supporting populations of BMSBs at different periods throughout the season. Nymphal abundance appeared to be associated with maturing fruit and pods.

BMSB is known to attack high value crops, such as tree fruit, in Asia. In the mid-Atlantic, BMSB populations were detected on apple and pear, particularly later in the season in Pennsylvania and cage studies revealed the potential for BMSB damage on both stone and pome fruits. In the region encompassing western Maryland, the eastern panhandle of West Virginia and southeastern Pennsylvania, populations have steadily increased annually since first detection in 2003. During the 2009 growing season, serious economic injury to peach, apple, and Asian pear due to large BMSB populations was commonly detected in commercial late in the season. Some commercial growers used late-season pyrethroid applications in an attempt to control BMSB and mitigate economic injury, while other growers were unaware of the extent of BMSB injury until harvest. These late-season applications severely disrupt beneficials within the orchard agroecosystem and result in limitations to fundamental IPM practices put in place over the past several decades. Thus, as the threat posed by BMSB to U.S. agriculture continues to increase, there is no established detection method, treatment threshold or control strategy for BMSB in any cropping system including tree fruit. In order to effectively monitor and manage BMSB in the narrow-spectrum, reduced-spray environment of tree fruit, it is imperative that insecticide treatments be triggered by tools designed to detect increases in BMSB abundance or activity.

Current Study

In 2010, the USDA-ARS Appalachian Fruit Research Station initiated a study with commercial growers in Maryland and West Virginia aimed at defining the threat posed by BMSB in commercial orchards, as severe injury was detected early in the growing season for the first time. This study includes weekly sampling of fruit to identify abundance and severity of injury in peach and apple. One hundred fruit are picked from both perimeter and interior trees in ~3-4 acre blocks. Each fruit is visually examined for the presence of external injury. The side of the fruit bearing the most severe injury is subsequently sectioned multiple times. The total number of injured fruit and the number of distinct BMSB feeding sites per fruit are recorded. If a fruit has greater than 10 injury sites, it is rated a 10+. In addition, three black pyramid traps baited with a known attractant for BMSB have been deployed in the perimeter row of the sampled apple block in each grower orchard. Total numbers of adults and nymphs per trap are removed and counted weekly. Collaborators in PA, NJ, and VA also have agreed to conduct similar studies in commercial orchards in their respective states.

Peach Injury Caused by BMSB

Apple Injury Caused by BMSB

Current Results and Observations

Damage in commercial orchards affected by BMSB has reached critical levels with some growers losing entire blocks of stone fruit, and with severe injury also being detected in apples and Asian pears.

The threat from BMSB in tree fruit begins in early May as overwintered adults enter orchards to feed on developing fruit. Fruit injury from nymphal and adult feeding can continue until harvest. This is different from native stink bugs in that injury is only inflicted by adults and generally only very early in the season on stone fruit and later in the season in apple.

Early season feeding on stone fruit may not only result in dimpling and cat-facing, but also in internal injury, with areas of corky or gummy tissue found below the skin and extending deep into the flesh almost to the pit. Injury in apple and Asian pear results in severe corky areas beneath the skin

Aggressive management against BMSB appears to reduce economic injury. However, concerns regarding IPM programs and resistance management must be carefully considered.

Even small populations of BMSB can cause serious economic injury if left unchecked.

The current monitoring system is inadequate and requires improvement to allow for reliable season-long captures of adults.

Questions? Please contact Dr. Tracy Leskey, (304)-725-3451x329, tracy.leskey@ars.usda.gov;

Current Commercial Orchard Results (September 2010)

Fruit	Orchard	Overwintering BMSB Population Size	Management Level Targeting BMSB	Mean Captures Per Trap / Week		Perimeter Orchard Sample		Interior Orchard Sample	
				Nymph	Adult	% Fruit Injury	# Feeding Sites (Severity)	% Fruit Injury	# Feeding Sites (Severity)
Apple	WV 1	Large	Moderate	1093.3	5.7	81.0	3.2	61.0	3.2
	WV 2	Large	Aggressive	1.0	6.0	29.0	1.6	6.0	1.5
	WV 3	Large	Light	1007.7	27.0	99.0	6.9	88.0	3.9
	MD 1	Moderate	Moderate	129.3	3.0	70.0	3.4	29.0	2.6
	MD 2	Small-Moderate	Moderate	7.3	0.0	70.0	3.5	46.0	3.3
	MD 3	Small	Light	5.3	0.3	24.0	1.8	20.0	2.0
			Regional Average	*374.0*	*7.0*	*62.1*	*3.4*	*41.7*	*2.8*
Peach	WV 1	Large	Moderate	---		16.0	1.6	13.0	1.5
	WV 2	Large	Aggressive	---		58.0	2.5	18.0	1.7
	WV 3	Large	Light	---		47.0	2.3	10.0	2.0
	MD 1	Moderate	Moderate	---		74.0	3.6	---	---
	MD 2	Small-Moderate	Moderate	---		92.0	5.1	85.0	4.7
	MD 3	Small	Light	---		24.0	2.1	15.0	1.4
			Regional Average	*---*		*51.8*	*2.9*	*28.2*	*1.9*

Apparent Biology and Phenology of Brown Marmorated Stink Bugs in Tree Fruit Orchards in the Mid-Atlantic

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Brown Marmorated Stink Bug Life Stages

Egg Mass

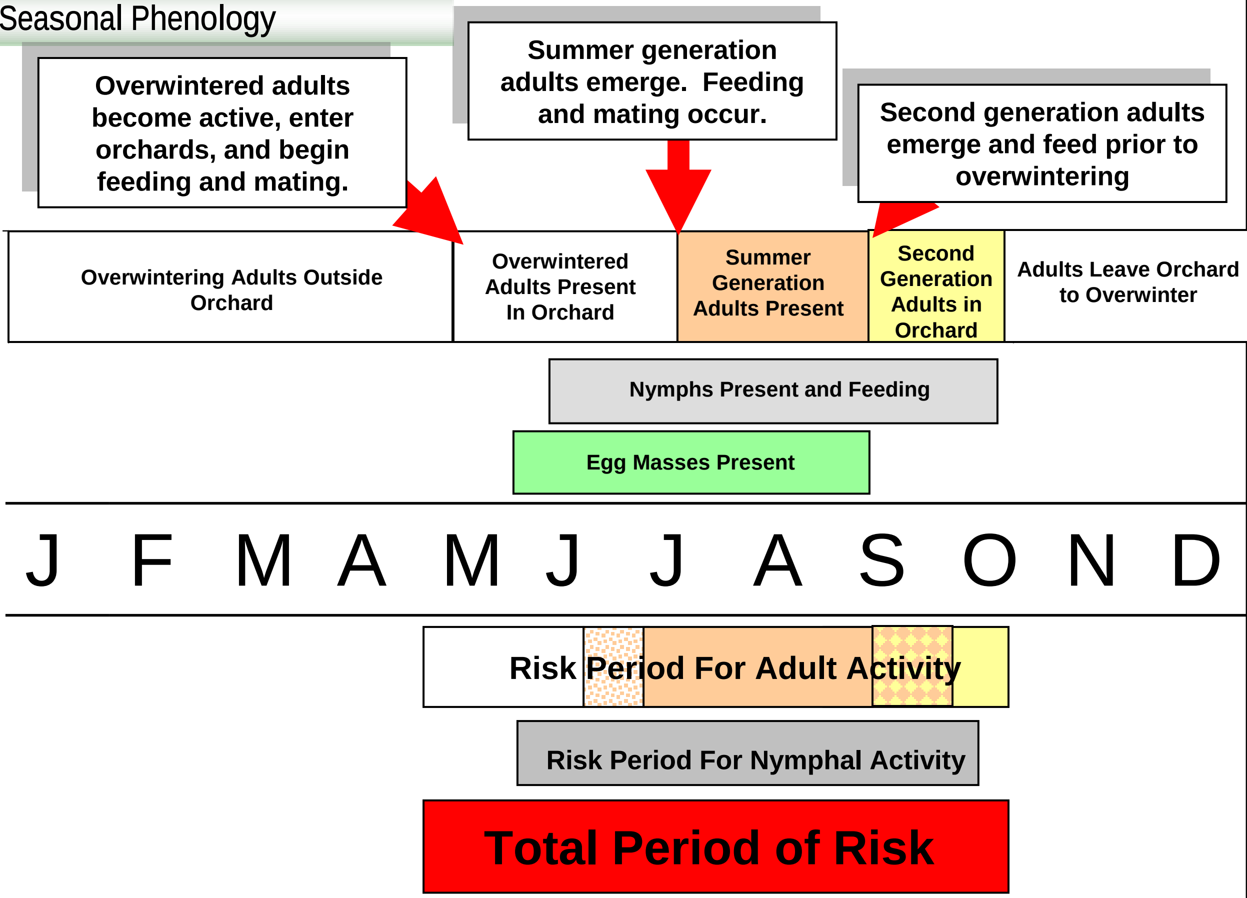
1st Instar Nymphs

2nd 3rd 4th 5th
Instar Nymphs

Adult Male

Adult Female

Apparent Seasonal Phenology



Observations and Tentative Conclusions

There appears to be two distinct generations per year, and three primary periods of adult risk. However, there are periods when activity likely overlaps between generations.

Unlike native stink bugs, adult brown marmorated stink bug can easily reproduce within tree fruit orchards.

Unlike native stink bugs, brown marmorated stink bug nymphs will feed on and damage fruit. Nymphal activity within the orchard can occur season-long if proper control measures are not put in place.

Biology and seasonal phenology of brown marmorated stink bug must be closely studied and thoroughly documented.

Photos courtesy of Wilbur Hershberger and Ralph Scorza

Toward Development of Effective Monitoring Traps and 'Attract and Kill' Strategies for Brown Marmorated Stink Bug

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INTRODUCTION Due to the introduction of and subsequent increases in populations of brown marmorated stink bug (BMSB), fruit growers have suffered serious economic injury. In 2009, severe injury to peach, apple, and Asian pear due to large BMSB populations was commonly detected in the mid-Atlantic forcing growers to apply late-season pyrethroid insecticides. In 2010, severe early-season injury to stone fruit was detected, as was increasing injury to apple. BMSB has the potential to dismantle IPM strategies put in place over the past several decades. As the threat posed by BMSB to U.S. agriculture continues to increase, there is no established detection method, treatment threshold, or control strategy for BMSB in any cropping system including tree fruit. In order to effectively monitor and manage BMSB, it is imperative that insecticide treatments be triggered by tools designed to detect increases in BMSB abundance or activity.

Current Experiments and Results

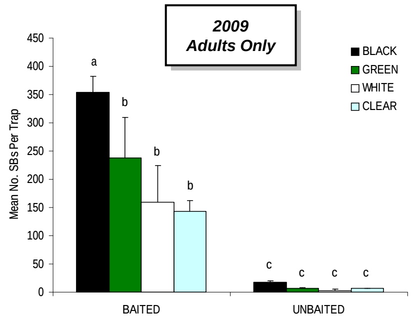
VISUAL STIMULI (TRAP COLOR) AND OLFACTORY STIMULI (LURES) We found in late 2009 (9 October – 16 November) that BMSB adults were captured in significantly greater numbers in ground-deployed black pyramid traps baited with lures containing 45 mg of methyl 2,4,6-decatrienoate compared with all other baited and unbaited traps. This was surprising because native species such as *Euschistus servus* (Say), the brown stink bug, have been captured in significantly greater numbers in foliar-mimicking yellow pyramid traps.

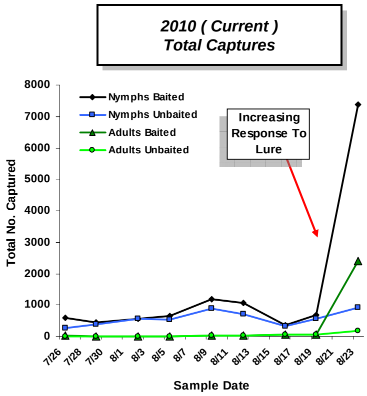
In late July 2010, we began to quantify responses of BMSB adults and nymphs to baited and unbaited traps representing a range of visual stimuli. These traps were constructed of white Sintra (partially extruded PVC) sheets and painted in the following colors: black, green, yellow, or white. Another set of traps was constructed of clear polycarbonate. Traps were baited with 50 mg of methyl 2,4,6-decatrienoate or left unbaited, and lures are replaced every 4 weeks. The number of nymphs and adults are counted twice weekly.

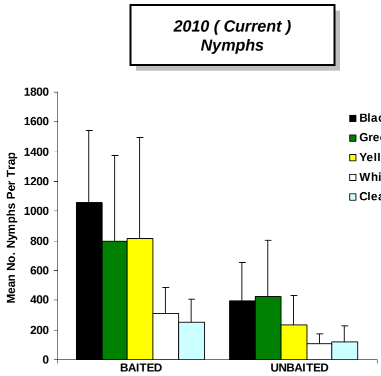
To date, we have found that: 1) nymphs respond season-long to the lures, but increased response appears in late August; 2) adults appear to only respond to the lure beginning late in August.

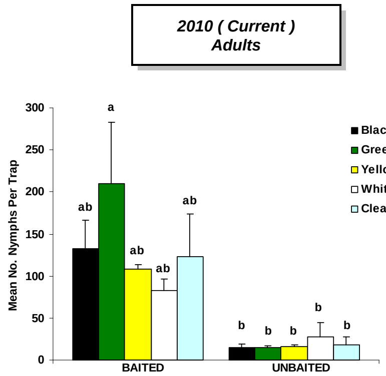
Black | Green | Yellow | White | Clear

Trunk Mimic | Foliar Stimulus | Foliar Stimulus | No Stimulus | No Stimulus









Observations and Future Directions

BMSB nymphs likely respond to lures of methyl 2,4,6-decatrienoate season-long and over long distances, but adults only respond later in the season.

An olfactory stimulus attractive to BMSB season-long is critical in terms of developing effective monitoring tools.

Because both adults and nymphs do aggregate within the vicinity of methyl 2,4,6-decatrienoate lures, this behavioral response could lead to development of a late-season "attract and kill" strategy.

Odor collection from adults aggregating and mating at a light source. We are now attempting to determine if a pheromone is being produced by adults.