Brown Marmorated Stink Bug as a Pest of Tree Fruits in the Southern Appalachians

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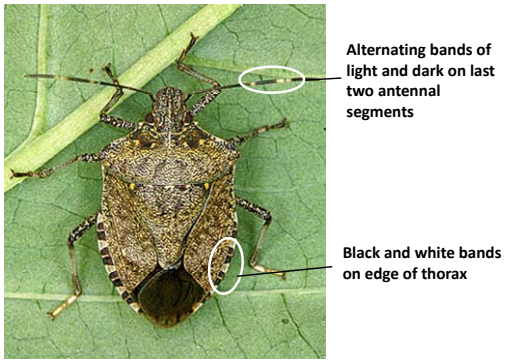
The brown marmorated stink bug (BMSB) is an invasive pest of Asian origin that was first detected in the US in Allentown, PA, in 1998. In subsequent years it spread from this focal point, establishing itself as a pest of minor significance on various crops, primarily tree fruits in the Mid-Atlantic States. In 2010, BMSB populations developed to extremely high densities in the mid-Atlantic region of northern VA, eastern WV, MD, DE, and south central PA, causing unprecedented damage to a diversity of crops, including apples, peaches, caneberries, tomato, pepper, sweet corn and soybeans.

BMSB was first observed in western North Carolina in 2010, with sporadic reports of late-season damage to peaches and apples. There were also several reports of BMSB adults congregating near homes in western NC in October 2010. The congregation of adults on buildings in the late fall is characteristic of BMSB, many of which overwinter in dwellings. Based on the fact that a BMSB adult was detected in Knoxville, TN, in October 2008, it is likely that the first individuals arrived in NC before 2010. Several species of native stink bugs, most commonly the brown and green stink bug, can also affect fruits and vegetables in NC, but they have not demonstrated the potential to cause the level of damage as that of the BMSB.



Potential Severity to Southern Appalachian Fruit Crops

The BMSB is in the early stages of colonizing the southern Appalachian region. The first report of BMSB in this region was in Knoxville, TN, in 2008, so it is likely that it has been present throughout the region at low densities for several years, but did not increase to levels capable of causing noticeable damage until 2010. Based on the isolated nature of damage, it appears that populations are currently highly aggregated within the region, but populations (and damage) will become more widespread as population densities increase over time. Unfortunately, conditions in this region are highly favorable for the rapid buildup and spread of BMSB. These factors include:

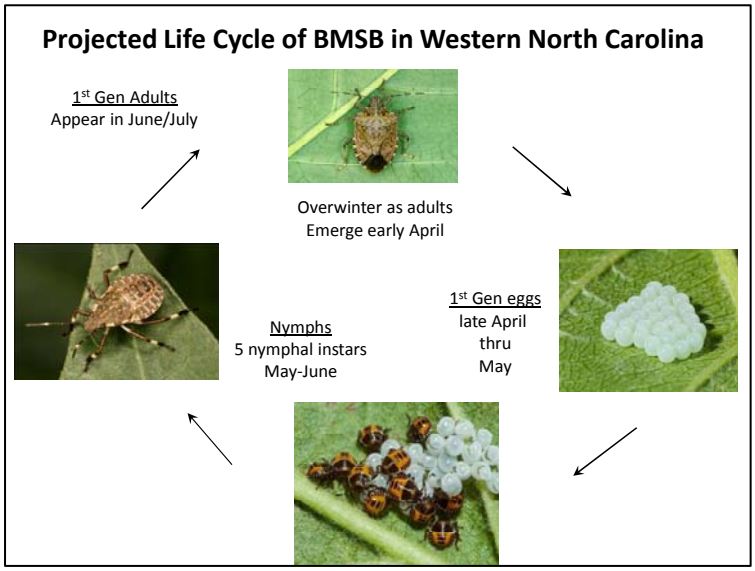
1) Warm weather conditions that will allow for 2 to 3 generations per season, compared to only one in more northern locations.

2) Availability of a diversity of BMSB host plants in both managed and non-managed habitats – those hosts in non-managed habitats will play an important role generating large numbers of stink bugs.
3) Absence of effective natural enemies. BMSB is a non-preferred host of stink bug parasites native to this region, and consequently there is minimal natural control in either crops or non-managed habitats.

While conditions in the southern Appalachian Mountains appear to be highly favorable for BMSB to become a key pest of fruit and vegetable crops, the time frame in which this adaption will occur and the severity of damage is impossible to predict.

Life History and Biology of BMSB

BMSB overwinters in the adult stage. While adults are known to aggregate near and enter homes and other dwellings in the fall, the importance of various outdoor habitats as overwintering sites is unknown, although woodlands are known overwintering sites. Adults begin to emerge in the spring and migrate from overwintering sites to nearby host plants, where they mate, and then lay eggs in clusters on the underside of leaves. Adult emergence and egg laying in western NC is expected to occur during April and May. Following the hatch of nymphs from eggs, young nymphs remain near egg masses from which they hatched, and not until they molt to the second instar will they disperse to feed on plant tissue. Nymphs complete five molts, increasing in size with each successive molt, before adults with fully developed wings appear. Based on knowledge of the developmental rate of BMSB, it is estimated that first generation adults will emerge during late June to July, with a second generation of nymphs appearing in July and August, and the second generation of adults emerging during August and September.



BMSB has a wide host range that includes many fruits (apple, peaches, grape, caneberries), vegetables (tomato, pepper, bean, cucurbits, sweet corn), field crops (corn, soybeans, and probably cotton), and numerous ornamental plants including, but not limited to, butterfly bush, empress tree, maple, dogwood, crabapple, hawthorn, elm, sycamore and serviceberry.

Damage

BMSB have sucking mouthparts, with an elongated "beak" protruding from the front of the head and extending underneath the abdomen. Contained within this sheath are the stylets that enter plant tissue when feeding. The stylets are used to both remove plant sap as well as inject salivary secretions that help to break down plant tissue. Although damage symptoms vary depending on the crop, in general feeding results in an external distortion and discoloration of fruit, which can extend several cm into the fruit. Both adults and nymphs can inflict damage.

Control

In view of the absence of effective BMSB natural enemies and their high capacity to cause damage, insecticides are likely to be the primary tool for managing this insect on high value fruit and vegetable crops. Currently there is little information on the field efficacy of various insecticides for control of BMSB. The best data currently available are from laboratory toxicity bioassays (Tracy Leskey, USDA-ARS-AFRS, Kearneysville, WV). These studies subjected stink bug adults to insecticide residues applied to glass surfaces for 4.5 hr, with the bugs removed to a clean surface with food where mortality was observed over a 7-day period. These bioassays were used to generate a Lethality Index that was a measure of the intensity and speed of insecticide effects. The highest value (most toxic) attainable was 100. Appearing in Tables 1 and 2 are those insecticides registered on apples and peaches, respectively, which have the highest Lethality Indices against the BMSB.

In 2011, BMSB populations are expected to be at their highest densities from July through September. Unfortunately the insecticides with the highest lethality index ratings are materials that a) have a very long preharvest interval, or b) due to seasonal rate limitations can be applied only once or twice per season. For instance, 3 of the 5 highest rated insecticides registered on apples cannot be applied after petal fall, well before BMSB is expected to be most problematic. In addition to preharvest intervals and seasonal rate limits, several other factors need to be considered when choosing an insecticide, including 1) re-entry period into orchards by workers, 2) need for buffer zones around bodies of water (e.g., Guthion and Thionex), 3) the residual activity of the insecticide in the field, and 3) impact of insecticides on biological control agents (most prominently predatory mites).

It should be noted that while the information in Tables 1 and 2 is the best information currently available, these are laboratory bioassays and may not reflect the performance of materials under field conditions. Obtaining field efficacy data against the BMSB in a diversity of fruit and vegetable crops will be a high priority of our program in 2011.

Table 1. APPLE-Registered Insecticides: Relative toxicity of various insecticides (in descending order) to Brown Marmorated Stink Bug based on Lethality Index (LI), along with preharvest intervals (PHI), re-entry intervals (REI), labeled rate per acre, maximum amount of product allowed per acre per season, and estimated maximum number of applications per season for use on APPLES. Be sure to read label before use, because many products have additional restrictions regarding buffer zones between orchard and bodies of water.

Insecticide	**Trade Name**	**BMSB LI***	**PHI (days)**	**REI (hr)**	**Rate/A**	**Season Limit/A**	**Maximum number of applications per season limit**
Methidathion	Supracide 2EC	92.5	>100	72	2-4 qt	—	1 application, and do not apply after bloom
Endosulfan	Thionex 3EC Thiodan 50WP	90.4	21	7 day 20 day	3 1/3 qt 2-4 lb	3 1/3 qt 5 lbs	3 total, 2 post bloom. But seasonal limit of 5 lbs means 1 or 2 applications.
Methomyl	Lannate 90SP	90.1	14	72	1 lb	5 lb	5 applications
Chlorpyrifos	Lorsban 4EC Lorsban 50WP Lorsban 75WDG	89.0	>100	96	2 qt 3 lbs 2-2.67 lb	—	Regardless of formulation, do not make foliar applications after bloom.
Permethrin	Ambush 3.2EC	77.1	>100	12	4-12 fl oz	20 fl oz	Do not apply after petal fall.
Azinphosmethyl	Guthion 50WP	71.3	21**	48	2 lb	3 lb	With limit 3 lb/acre/season, can make 1 appl. at 2 lb or 2 appl. at 1.5 lb..
Fenpropathrin	Danitol 2.4EC	66.7	14	24	16-21 1/3 fl oz	42 2/3 fl oz	With 42 2/3 oz seasonal limit, can make 2 applications.
Formetanate	Carzol 92SP	63.5	>100	5 days	1-1.25 lb	1.25 lb	Apply only at petal fall
Thiamethoxam	Actara 25WDG	56.3	35	12	4.5 oz	16.5 oz	At max rate, 4 applications.
Clothianidin	Clutch 50WDG Belay	55.6		12	3-6 oz	6.4 oz	With 6.4 oz seasonal limit, can make 1 or 2 applications.
Beta-cyfluthrin	Baythroid XL 1EC	54.8	7	12	2-2.8 fl oz	2.8 fl oz	At the max rate, 1 application
Gamma-cyhalothrin	Proaxis 0.5EC	53.8	21	24	2.6-5.1 fl oz	20.48 fl oz	At the max rate, 4 applications post bloom
Lambda-cyhalothrin	Warrior 2.08CS	52.9	21	24	1.28-2.56 fl oz	12.8 fl oz	At the max rate, 5 applications post bloom
Zeta-cyhalothrin	MustangMAX 0.8EC	52.1	14	12	1.3-4.0 fl oz	24 fl oz	At the max rate, 6 applications
Cyfluthrin	Tombstone 2EC	49.0	7	12	2-2.8 fl oz	2.8 fl oz	At the max rate, 1 application
Esfenvalerate	Asana XL 0.66EC	43.3	21	12	4.8-14.5 fl oz	57 fl oz	At the max rate, 7 applications
Imidacloprid	Provado1.6F	40.0	7	12	4-8 fl oz	40 fl oz	At the max rate, 5 applications
Lambda-cyhalothrin + thiamethoxam	Endigo ZC	??	14	24	5-6 fl oz	19 fl oz	At the max rate, 3 applications

*BMSB Lethality Index (LI) as reported by Tracy Leskey (USDA-ARS, AFRS, Kearneysville, WV). Values are based on stink bug exposure to residues on glass dishes for 4.5 hr, and recording mortality for 7 days. The highest possible lethality value (maximum toxicity) is 100.

**Do not allow general public to enter orchards within 39 days of Guthion applications made at 1.2 to 2 lbs/acre (0.6-1.0 lb a.i./acre), or 44 days of using >2 lb (1 lb a.i.).

Table 2. PEACH-Registered Insecticides: Relative toxicity of various insecticides (in descending order) to Brown Marmorated Stink Bug based on Lethality Index (LI), along with preharvest intervals (PHI), re-entry intervals (REI), labeled rate per acre, maximum amount of product allowed per acre per season, and estimated maximum number of applications per season for use on APPLES. Be sure to read label before use, because many products have additional restrictions regarding buffer zones between orchard and bodies of water.

Insecticide	Trade Name	BMSB LI*	PHI (days)	REI (hr)	Rate/A	Season Limit/A	Maximum number of applications per season limit
Methidathion	Supracide 2EC	92.5	>100	72	2-4 qt	12 pt	1 application, before blooms open
Endosulfan	Thionex 3EC Thiodan 50WP	90.4	30	7 day 20 day	3 1/3 qt 2-4 lb	3 1/3 qt 5 lbs	Max of 2 applications/season, but seasonal limit essentially means 1 application.
Methomyl	Lannate 90SP	90.1	4	4 day	1 lb	6 lb	5 applications
Chlorpyrifos	Lorsban 4EC Lorsban 50WP Lorsban 75WDG	89.0	>100	96	2 qt 3 lbs 2-2.67 lb		Regardless of formulation, do not make foliar applications after bloom.
Permethrin	Ambush 3.2EC	77.1	14	12	4-10 fl oz	30 oz	Rate limits to 3 to 4 applications.
Fenpropathrin	Danitol 2.4EC	66.7	3	24	16-21 1/3 fl oz	42 2/3 fl oz	With 42 2/3 oz seasonal limit, realistically can make 2 applications.
Formetanate	Carzol 92SP	63.5	>100	5 days	1-1.25 lb	1.25 lb	Do not apply after petal fall, 1 application.
Thiamethoxam	Actara 25WDG	56.3	14	12	4.5-5.5 oz	11 oz	Seasonal rate limits to 2 applications.
Clothianidin	Clutch 50WDG Belay 2.13EC	55.6	21 21	12 12	3-6 oz 6 fl oz	6.4 oz 12 fl oz	With 6.4 oz seasonal limit, realistically can make 1 or 2 applications.
Beta-cyfluthrin	Baythroid XL 1EC	54.8	7	12	2-2.8 fl oz	5.6 fl oz	Seasonal rates limits to 2 applications.
Gamma-cyhalothrin	Proaxis 0.5EC	53.8	21	24	2.6-5.1fl oz	20.48 fl oz	At the max rate, 3 applications post bloom
Lambda-cyhalothrin	Warrior 2.08CS	52.9	14	24	1.28-2.56 fl oz	10.24 fl oz	At the max rate, 4 applications post bloom
Zeta-cyhalothrin	MustangMAX 0.8EC	52.1	14	12	1.3-4.0 fl oz	24 fl oz	At the max rate, 6 applications
Cyfluthrin	Tombstone	49.0	7	12	2-2.8 fl oz	5.6 fl oz	At the max rate, 2 applications
Esfenvalerate	Asana XL 0.66EC	43.3	14.5	12	4.8-14.5 fl oz	101 fl oz	At the max rate, 7 applications
Imidacloprid	Provado1.6F	40.0	0	12	8 fl oz	24 fl oz	At the max rate, 3 applications
Lambda-cyhalothrin + thiamethoxam	Endigo ZC	??	14	24	5-5.5 fl oz	19 fl oz	At the max rate, 3 applications

*BMSB Lethality Index (LI) as reported by Tracy Leskey (USDA-ARS, AFRS, Kearneysville, WV). Values are based on stink bug exposure to residues on glass dishes for 4.5 hr, and recording mortality for 7 days. The highest possible lethality value (maximum toxicity) is 100.