Integrated Pest Management for Brown Marmorated Stink Bug in Small Fruit

A synopsis of what researchers have learned so far and management recommendations using an integrated approach

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Basic Biology and Life Cycle of BMSB

- In addition to being a conspicuous household nuisance pest in the winter and spring, brown marmorated stink bug (BMSB) is a serious agricultural pest of numerous crops during the growing season, including small fruit crops.
- After emerging from shelters in late spring, BMSB adults begin mating and laying eggs on various trees and host plants in late May and June (Fig. 1).
- In most of its range in North America, BMSB completes one to two generations per year, progressing through an egg stage and 5 nymphal instars before molting into an adult (Fig. 2).

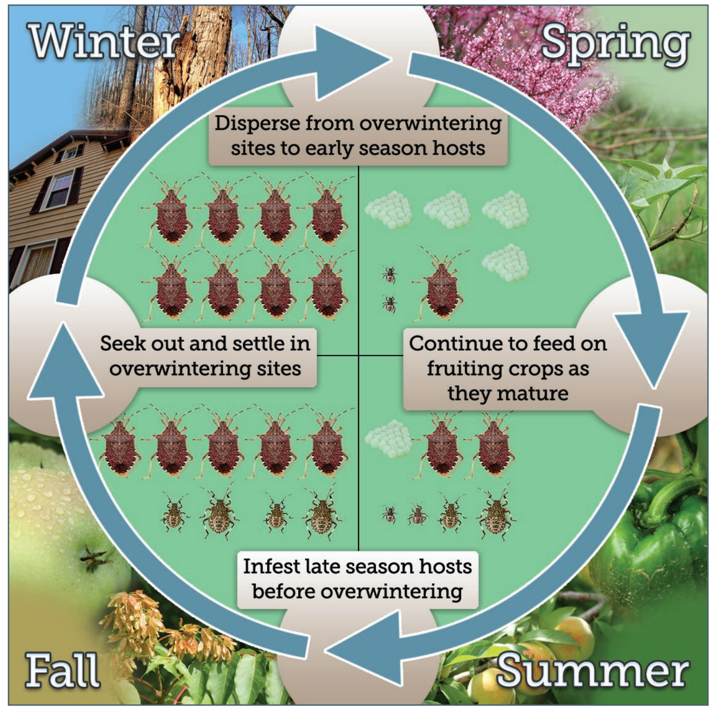


Fig. 1. Typical seasonal biology of brown marmorated stink bug.

Small Fruit Crops at Risk / Crops Not at Risk

- BMSB is a landscape-level threat that frequently switches between host plants and can come from wooded habitats or among agricultural/settled land (Fig. 10).
- BMSB primarily feeds on the fruit-bearing structures of crops, which puts small fruit crops at risk.
- The pest has the potential to feed and reproduce in blueberries (*Vaccinium* spp.), raspberries (*Rubus idaeus* L.), and blackberries (*Rubus* spp.).
- The risk to blueberries has so far been classified as moderate.
- Caneberries (*Rubus* spp.), both wild and cultivated, are attractive host plants for BMSB when buds have developed and during fruiting.
- No damage by BMSB has been observed in cranberries.

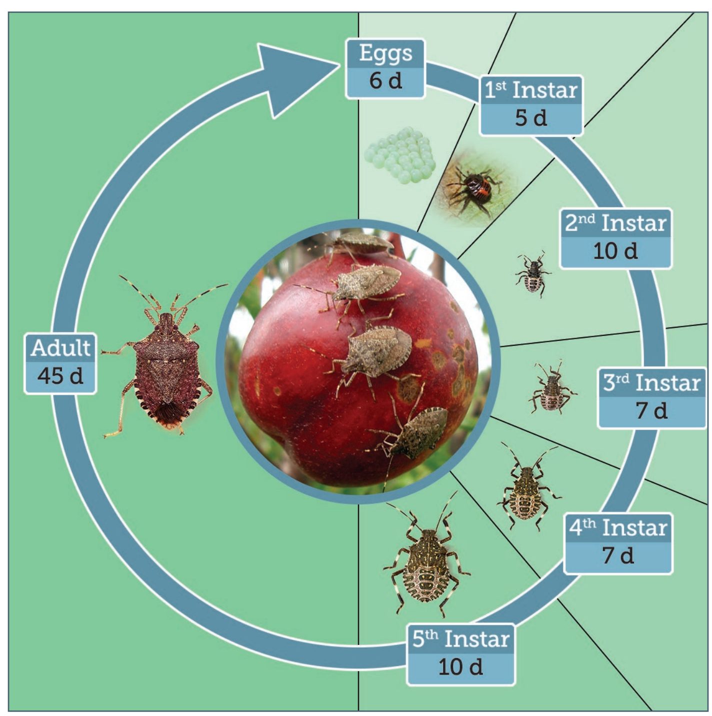


Fig. 2. Typical life cycle of brown marmorated stink bug.

Small Fruit Injury Diagnostics

Blueberry

- BMSB will feed on blueberries at all stages of fruit development.
- Feeding on green fruit can result in discoloration at the feeding site (Fig. 4).
- Sunken purple/red areas may form around the feeding site.
- Based on BMSB inclusion studies using bagged fruit and adults, there was a significant increase in the proportion of discolored berries when there were 10 or more BMSB per cluster of fruit. The lowest discoloration was found in Elliot followed by Bluecrop,

Duke and then Aurora, which had the highest discoloration level.

- Feeding on mature fruits can cause softening of fruit and necrosis of tissues under the berry skin. In this case, the discoloration at the feeding site is minimal.
- The effect of BMSB density on the percentage of berries from a cluster exhibiting necrotic internal tissues depends on the cultivar. The impact of necrosis was lowest in Elliot followed by Bluecrop, Aurora and Duke, which had the highest necrosis levels.
- Heavy feeding on ripe fruit causes a loss of firmness and shriveling (Fig. 5).
- The Brix values (a measure of total soluble solids, e.g., sugar content) of mature fruit may be affected as BMSB feeding can remove the sugars and other soluble solids. Sugar levels were less affected by BMSB in Duke, while the sugar levels in Aurora were more affected.
- Feeding on the fruits can cause premature ripening of the cluster, which may be a good indicator of BMSB infestation in the field (Fig. 6).
- Generally, the highest probing of fruit was found at about 17°C, with probing decreasing at both higher and lower temperatures.
- Contamination risks are of concern for blueberry growers who mechanically harvest and then sell their berries to processors or ship them to other countries and regions within the United States.

Caneberries (raspberry, blackberry, blackcaps)

- Feeding may target individual drupelets or the mouthparts may be inserted deeper into the fruit, penetrating the receptacle (Fig. 7).
- Feeding on individual drupelets causes localized loss of turgor and death of tissue (Fig. 8).
- Ultimately, the fruit will turn completely necrotic and may succumb to decay.
- Additionally, caneberries can absorb the defensive secretion of BMSB (and other stink bugs), which can impart off-flavors to the fruit. These compounds include tridecane and trans-2-decenal.
- Droppings produced by feeding stink bugs can add an unpleasant taste to the berries, and this risk is higher especially in mechanically harvested crops.
- Thus, contamination of the crop by BMSB nymphs and adults is a potential risk during harvest.

Period of Risk/Susceptibility

Blueberry

- The timing of BMSB attack on blueberries may depend on the buildup of populations in the environment and ripening of the crop.
- Different blueberry cultivars ripen over different periods (July–September), and later ripening varieties are presumed to have greater risk of attack from BMSB as populations of the pest have had a greater opportunity to increase before they disperse into the field.
- To the best of our knowledge the highest pressure in blueberry will be during harvest, with later maturing varieties being most susceptible to damage by BMSB.

▲ **Fig. 4.** BMSB feeding and damage on developing blueberry fruits.

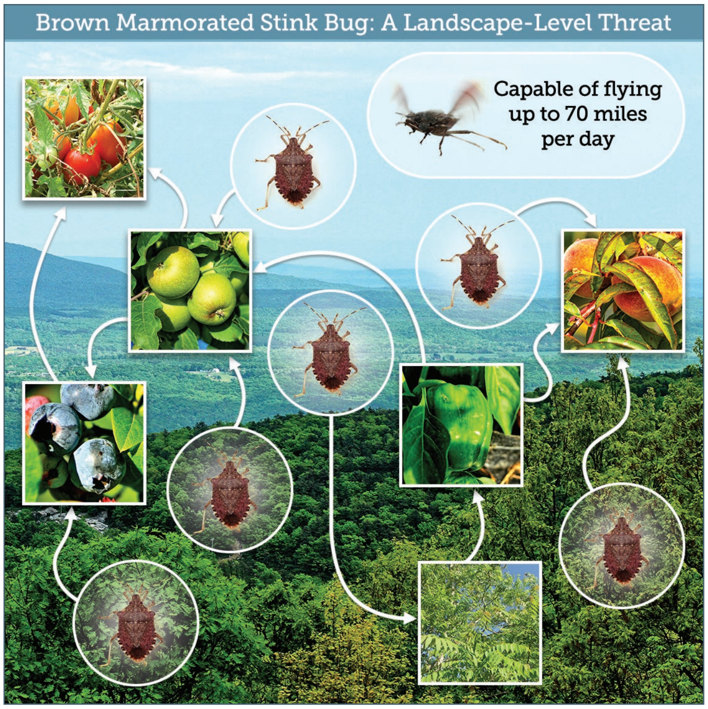
▲ **Fig. 5.** Severe BMSB feeding on ripe berries causes fruit to shrivel badly.

◄ **Fig. 6.** The cluster at right was subject to BMSB feeding and is showing premature ripening.

▲ **Fig. 7.** BMSB feeding on golden raspberry, red raspberry, and blackberry (photo of blackberry: B. Strik).

◄ **Fig. 8.** Feeding damage to blackberry caused by BMSB adults and nymphs (photo: B. Strik).

▲ **Fig. 9.** Commercial stink bug pheromone trap.



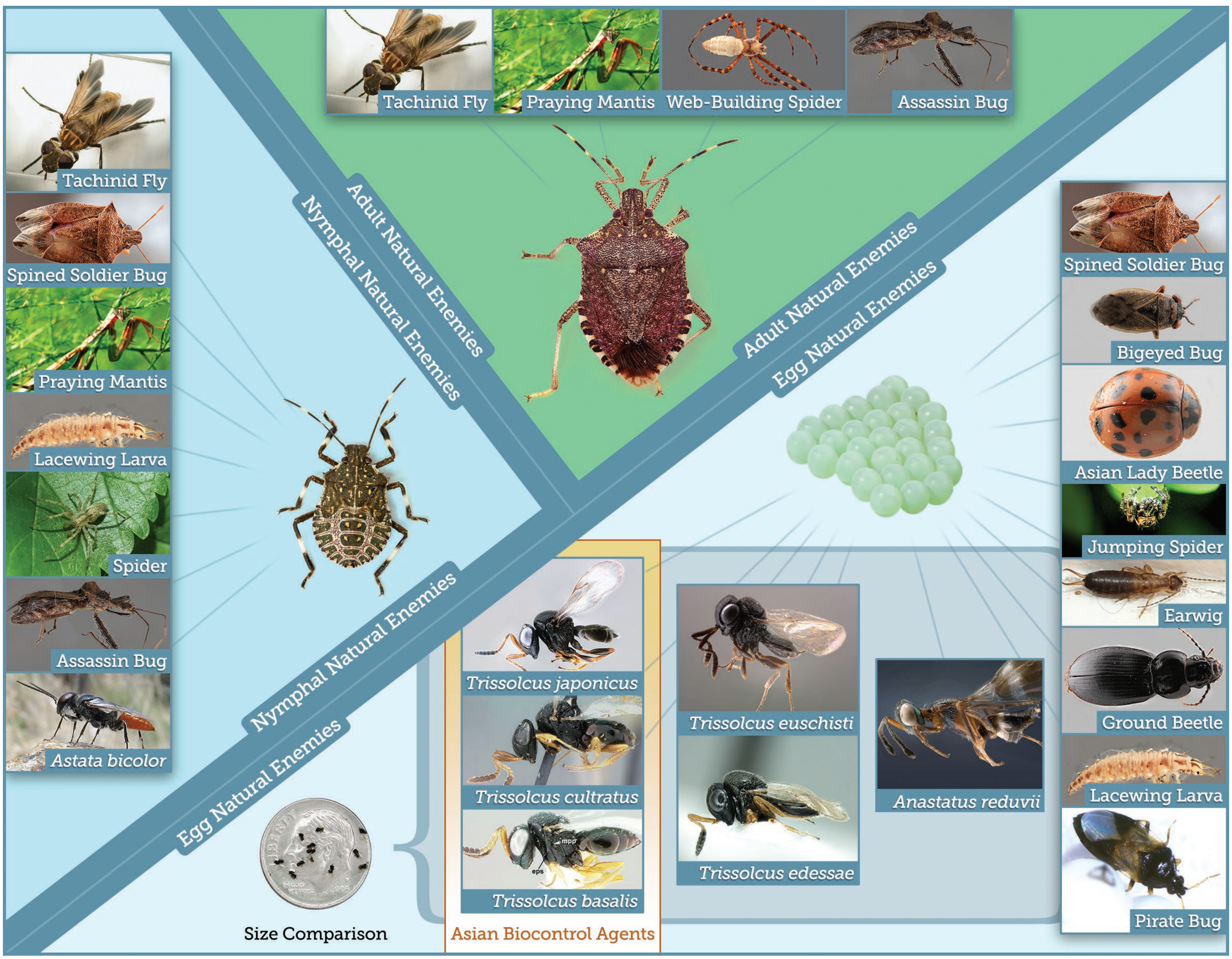
▲ **Fig. 10.** BMSB is a perimeter-driven pest that frequently switches crops hosts during the season as fruits mature.

Caneberries

- Given that the fruiting period may last several weeks with fruits in all stages of development, caneberries represent a rich and consistent resource for BMSB.
- Females often oviposit into the crop and nymphs will often aggregate around the fruits.

Provisional Monitoring Recommendations

- Pyramid traps baited with commercial lures containing BMSB aggregation pheromone and methyl decatrienoate are effective at capturing BMSB, even at low densities. These traps are excellent monitoring tools for detecting BMSB activity on farms (Fig. 9).
- Ideal placement of traps is usually along a forested edge adjacent to agricultural land.
- Action thresholds have not yet been developed.



▲ **Fig. 11.** Arthropod natural enemies of BMSB.

Biological Control

- For the most part, egg parasitoids are the key natural enemies that keep pest populations in check for stink bugs. However, the native stink bug egg parasitoids in North America do not develop well on BMSB and egg parasitism levels have been low in the mid-Atlantic U.S.
- However, the main (most effective) Asian parasitoid has been discovered in the wild in the eastern and western U.S. in Maryland, Virginia, and Washington, which may provide a source of increased biological control.
- Additionally, a number of generalist predators have been observed feeding on BMSB eggs and nymphs and play an important role in reducing pest densities (Fig. 11).

Provisional Management Strategies

- BMSB is a perimeter-driven pest, with populations highest on the edges of fields. This is particularly the case along field edges bordered by forest. Border sprays may be an option, especially on large fields.
- The most effective insecticides for BMSB (Table 1) also kill natural enemies, so they should be used sparingly and only when needed.
- Management for BMSB in small fruit crops is difficult because the most effective insecticides for BMSB cannot be used during the period when there are repeated harvests of berry fields.
- Chemical control may be further complicated by the need to conserve insecticides for use against spotted wing drosophila, another disruptive invasive species, during the harvest period in order to observe requirements for maximum applications per season.

Effective Insecticides for Controlling BMSB on Small Fruit Crops

The following is a list of insecticides registered for use on small fruit crops in the U.S. that have demonstrated efficacy against BMSB as part of an integrated pest management (IPM) plan. Before using any pesticide, make sure the product is registered for use on the crop in your state. This list is not a substitute for pesticide labeling. Always read, understand, and follow the label directions before using any pesticide. For certain states, also make sure that the product selected is labeled for use against stink bugs.

		Crops listed on pesticide label with pre-harvest interval (days). "NL" indicates not labeled on that crop.		
Active Ingredient (IRAC class*)	**Product Name(s)**	**Highbush Blueberry**	**Lowbush Blueberry**	**Caneberries**
bifenthrin (3A)	Bifenture, Brigade, Sniper, others	1	1	3
clothianidin (4A)	Belay	NL	21**	NL
imidacloprid (4A)	Admire Pro, Alias, Wrangler	3–7	3–7	7
fenpropathrin (3A)	Danitol	3	3	NL
methomyl (1A)	Lannate LV	3	3	3
thiamethoxam (4A)	Actara 25WDG	3	3	3***
zeta-cypermethrin (3A)	Mustang Maxx	1	1	1
zeta-cypermethrin + bifenthrin (3A)	Hero EC	1	1	3

Most products labeled for these crops do not include stink bugs as target pests except where noted (**; ***).

* – IRAC (Insecticide Resistance Action Committee) class: 1A = carbamates, 3A = pyrethroids, 4A = neonicotinoids.

** – labeled for stink bugs in lowbush blueberries only, but not in California.

*** – labeled for stink bugs in caneberries only.

Product names are mentioned for convenience only. No endorsement of products is intended, nor is criticism of unnamed products implied.

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