Black Stem Borer
Xylosandrus germanus

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Figure 1. Black stem borer adult is only 1 mm wide and 2 mm long. Photo by E. Tee

The black stem borer was introduced from eastern Asia and first detected in NY in 1932. It has since been detected in most parts of the US. It is a general wood boring insect, in the group called Ambrosia beetles, with a huge list of suitable hosts including American beech, maple, dogwood, black walnut, oak, magnolia, and several other ornamental and forest species. It continues to spread by flight (about 2 km) until it finds a suitable host. Long distance spread to Oregon and the West has likely occurred through intracontinental movement of untreated domestic solid wood packing material and other raw timber. It has also been documented in apple and sweet cherry in 1982. We first detected black stem borer in 2013 in 6 apple sites in the Lake Ontario Fruit Region of NY, and have identified more than 30 farms with this pest.

The tiny black beetles overwinter in galleries at the base of infested trees. The first beetles emerge from overwintering sites to infest new sites after 2-3 days with maximum temperatures ≥ 68°F. This means they can first become active in early-late April. In 2015, the first trap capture of adults was May 4. Most flight activity occurs during warm evenings. Based on literature from Ohio, the second flight is expected to start in late July or early August. However, in 2014, our traps continued to capture adult beetles in early July.

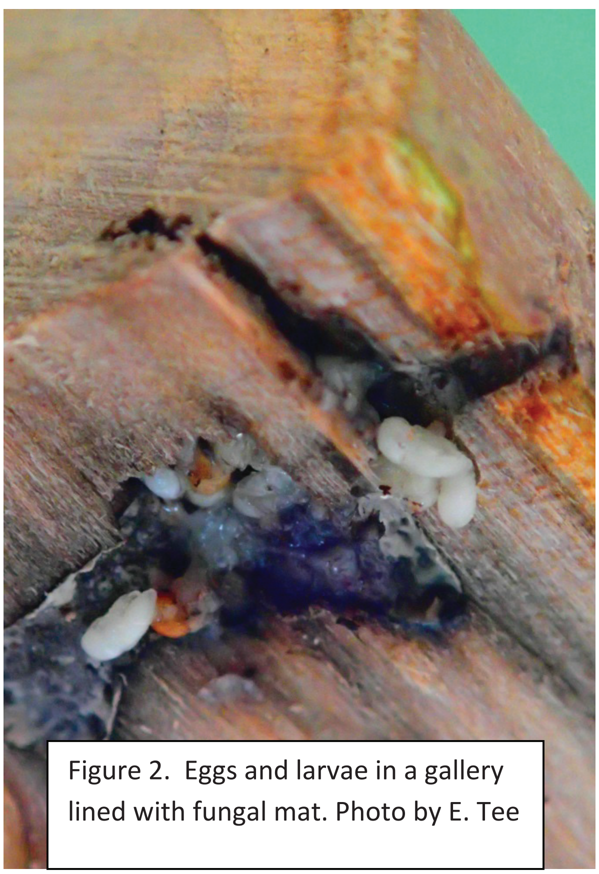


Figure 2. Eggs and larvae in a gallery lined with fungal mat. Photo by E. Tee

Figure 3. Black stem borer pupa. Photo by E. Tee

Only females fly and emerge in spring to colonize new trees. The adult female drills a hole ~1mm in diameter, and hollows out

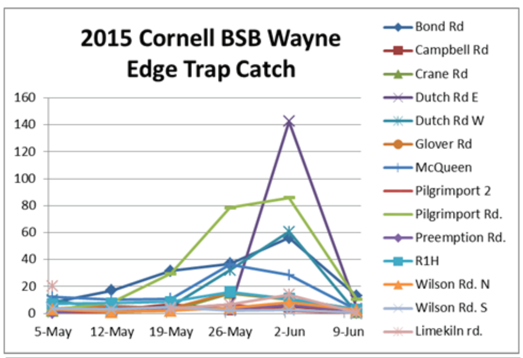
This trap has 15 black stem borers in the bottle trap.

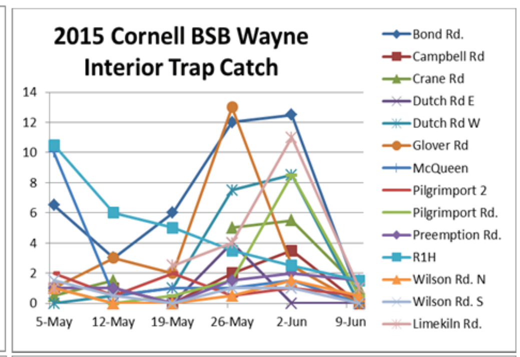
a channel into the sapwood of a small tree (2-50 cm diameter) and starts to culture a fungal food source, *Ambrosiella hartigii*. She lays her eggs (tiny, ~1mm white, football shaped) in the chamber. She lines the chambers with the Ambrosia fungus for the larvae, (also white with 3 instars) to feed on before they pupate to develop as an adult. It is this fungus that the larvae will feed on in the brood chambers, not the tree. It takes about 30 days for development from egg to adult in optimal temperatures. But in the field it can take 55-60 days. The ratio of females to males is about 10:1. The females can lay 2-54 eggs, but they average about 18 per brood. After the female is finished nurturing her larvae, she backs into the entrance, plugging the hole, and dies there. The males that develop in the first brood stay generally in the brood chamber and mate with their sisters. The mated females disperse from that brood chamber to make another chamber or reclaim an old one. The males do not fly. Infestations of only a few females can result in a significant problem under the right conditions.

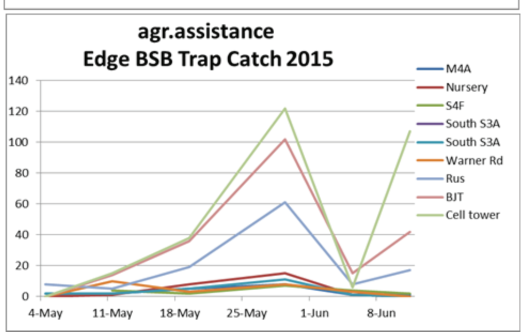
This insect has 2 generations per year in NY. Late in the summer the beetles from the second brood will migrate to a hole lower in the trunk to overwinter where researchers have found as many as 100 in a chamber. These beetles go into diapause in the late summer and will not be active again until the next spring.

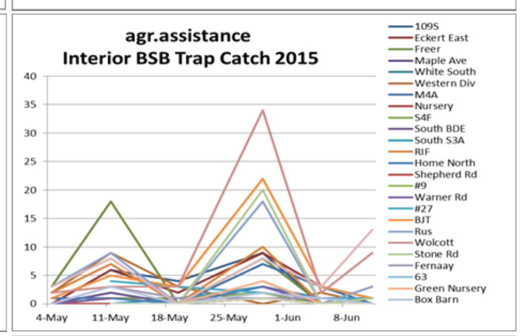
Trap Network for 2015

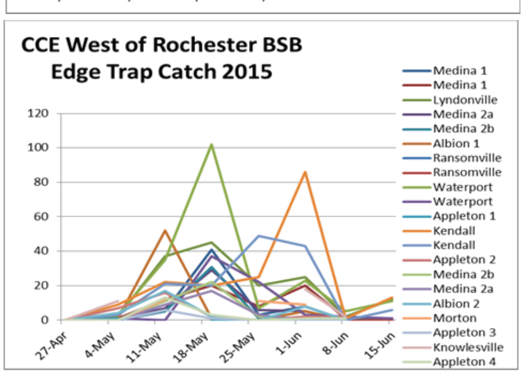
There is a collaborative effort among CCE, Cornell faculty and fruit consultants to monitor flight activity in and adjacent to orchards. Although trap capture does not generally correlate with damage in orchards, it is an indicator of their presence, and if there are stressed trees in the orchard, we expect to see BSB. Thanks to agr.assistance, Paddock Ag Services, and Eve Farm Services for collaborations and running traps. Traps are

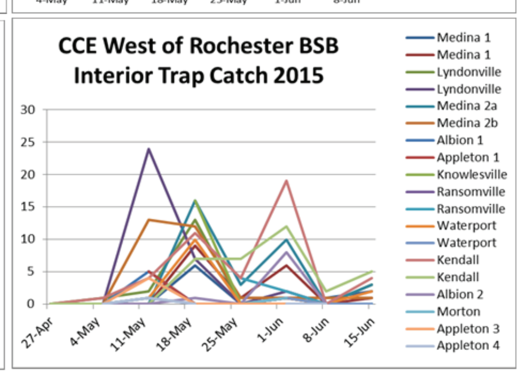












composed of a fruit juice bottle with side openings cut with an ethanol lure (http://www.agbio-inc.com/) hung from the bottom of the bottle, enviro-safe antifreeze is in the cap. The bottle is inverted and hung about 2-3 feet off the ground. We always catch more on the edges near woods or brush. We have caught an average of 30-40 BSB per site, ranging from 0 – 288 per site so far in 2015.

Tree Symptoms

Although these borers have a reputation of attacking stressed trees that are giving off ethanol volatiles, they also have been reported to attack "apparently healthy trees." The trees in the spring look like they are weaker than non-infested trees, with some flaky or blistered bark, but some look perfectly healthy. Some are oozing sap or fire blight ooze from the entry holes. If the weather is calm and dry, growers might be lucky enough to see the "toothpick" of compressed sawdust pushed out of the holes. Upon close inspection, growers might find small pinpricks (1 mm diameter), and the tiny black beetle in the hole. Using loppers or a pruning saw, growers can cut ¼–½ inch away from the hole to see the galleries that extend perpendicular to the trunk of the tree and are hollowed out a bit vertically to accommodate the brood of eggs; additional channels may be cut into the pith of the tree.


Toothpick "frass" photo by E. Tee

The fungus the beetles carry with them does not generally kill the tree, but sometimes the tree response is to wall off the fungus in the transport vessels, thus, starving the tree. Dr. Kerik Cox has been isolating microbes from infested tissue related to BSB. In 2014, he primarily found *Nectria haematococca* (anamorph *Fusarium solani*) in the beetles and apple tissues. In 2015, his lab is finding a *Nectria haematococca* and bacteria (non-fire blight) in beetles. In apple galleries, we're finding a lot of *Botryosphaeria dothidea* and a little *Nectria haematococca*. With summer rain and BSB infestation, *Botryosphaeria* canker may show up later in the season or next fall/winter in infested orchards. It may look a lot like the *Nectria cinnabarina* of the last season, except that it will have black stroma instead of the salmon-colored stroma of *Nectria cinnabarina*.

The blistered tissue in apples associated with BSB-infested shoots remains a mystery that has baffled microbiologists, entomologists, and applied anatomy specialists. Tissue under the blistered epidermis is filled with clear white cells that are too large to be fungal. From blistered tissue, we routinely isolate fluorescent *Pseudomonas syringae*, which is associated with blister bark of apples in Europe.

So far, orchards where BSB has been detected are tall spindle or super spindle plantings in areas of wet soil conditions, where no irrigation is available, or in areas with frost or winter injury. Rootstocks most commonly are Bud9, followed by M9 clones and M26. One site reported infested trees on MM106 and MM111 rootstocks. The infested tree age ranges from planting year in 2000 to 2014, and also nursery plantings. The most common variety is Gala, followed by Fuji, Honeycrisp, and Paulared, followed by NY-2, Pazazz, Pink Lady, Gingergold, Macoun, and Empire.

Control

If growers identify black stem borer in their high density orchards, the recommendation (taken from ornamental nursery situations) is to remove and destroy the infested trees. Remove the rootstock as well, since it will continue to attract and harbor BSB. Take infested trees to a location where they can be burned immediately. The grower should start a trapping program using ethanol-baited traps, as in the photo, checking them weekly to time insecticide applications for when the beetles emerge from the galleries to find a new place.

The key to controlling this pest is maintaining tree vigor and eliminating whatever is causing the stress.

Repair drainage issues, install irrigation on droughty soils, and prevent fire blight infection. Select sites with low risk of winter injury and frost. Do not use any cultural practices that disturb the roots.

Although several chemical and biological controls have been tested, researchers have not yet identified anything that will stop these beetles. But with very wet spring or fall weather and poor soil drainage, you might see more damage the following season. The fungus carried by the beetle does not seem to be dependent on any particular weather conditions.

The ornamental nursery industry, where this is a serious, pest relies on pyrethroid trunk sprays on a 2-week schedule, which would certainly be a challenge in apples, given concerns of how it would impact mite control efforts. The nursery industry has also tested neonicotinoids, anthranilic diamides (cyazypyr, acelepryn), and tolfenpyrad, and has not found them to be effective in controlling BSB. There are currently no systemic insecticides effective for this pest. We have nothing registered specifically for control of this pest except for Lorsban, Warrior II or Grizzly (lambda-cyhalothrin), which are labeled for "tree borer species", but we have no data yet on efficacy to support any recommendations at this time. It is expected that chlorpyrifos trunk sprays for borers may be effective, but these will not prevent higher points of entry, which have been seen as high as 4 feet in the tree. Chemical control trials are under way.

For more information on trapping for this pest or identifying the problem, call or email Debbie (dib1@cornell.edu), or Art Agnello (ama4@cornell.edu).

Acknowledgements

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