Apple I

Tuesday afternoon 2:00 pm

Where: Ballroom D
MI Recertification credits: 2 (1C, COMM CORE, PRIV CORE)
OH Recertification credits: 1.5 (presentations as marked)
CCA Credits: PM(2.0)
Moderator: David Smeltzer, MSHS Board, Bear Lake, MI

2:00 pm — Black Stem Borer - Experiences from New York Tree Fruit Production
- Deborah Breth, Cornell Univ. Extension

2:30 pm — Impact of OBLR Resistance on Field Residual Control in Apples (OH: 2B, 0.5 hr)
- John Wise, Entomology Dept., MSU

3:00 pm — Managing Oriental Fruit Moth and Other Historically Less Damaging Insects in Apples. (OH: 2N, 0.5 hr)
- Rick Weinzierl, Entomology Dept., Univ. of Illinois

3:30 pm — Michigan Apple Insect Management Update (OH: 2B, 0.5 hr)
- Larry Gut, Entomology Dept., MSU

4:00 pm — Session Ends

Black Stem Borer - Experiences from New York Tree Fruit Production

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Black stem borer, *Xylosandrus germanus*, was introduced from eastern Asia and detected in NY in 1932. It has since been detected in most parts of the US. It is a general woodboring insect, in the large 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. But it has also been documented in apple and sweet cherry. The beetle carries a fungal food source, *Ambrosiella hartigii*. Its presence signals the tree that it is under attack, and as the tree walls off its vascular system in response, symptoms develop including wilting, dieback, tree decline and death.

Ambrosia beetles are known for attacking weak and dying trees, but BSB will also attack apparently healthy trees, or trees with some stress but no symptoms are visible. Stressors include flooding or over-watering, drought, frost injury, excessive heat, girdling, pollutants, pathogens, and impaired root function like root pruning. Trees can start to emit ethanol within 1-2 days after the stress is applied.

The tiny black beetles overwinter in galleries at the base of infested trees. The mated females (foundress) emerge in the Spring from overwintering sites to infest new sites starting after 2-3 days with maximum temperatures ≥ 68°F. This means they can first become active as early as late April. One study cited the first activity occurring within 4 days after first bloom on Norway maple, and full bloom on border Forsythia. The adult female drills a hole ~1mm in diameter, and hollows out a channel into the heartwood of small trees (2-50 cm diameter). She lines the chambers with the Ambrosia fungus. She lays her eggs (tiny, ~1mm white, football shaped) in the chamber. The white larvae hatch and develop through 3 instars, feeding on *Ambrosiella* before they pupate and emerge as an adult. It takes about 30 days for development of egg to adult under optimal conditions. The females can lay 2-54 eggs, depending on the host, but they average about 18. The ratio of females to males is about 10:1. This insect has a broad host range because it does not rely on the trees its attacks for food, just shelter. We believe that this insect has 2 generations per year in NY. The second generation starts in late July or early August.

Only females fly and can fly as far as 2 km an dcan spread 10's of km per year. The males do not fly, but after mating with their siblings, the males can come out of the brood chambers and disperse by crawling into other holes in the trees.

In 2013, infestations of *X. germanus* were seen for the first time in commercial apple trees, in multiple western NY sites. In these sites, growers were seeing 30% of trees in parts of their orchards collapsing. At least 30 additional infestation sites have been documented, extending to the Hudson Valley and Long Island, and it appears that these ambrosia beetles may have been present in the area for a some years before first being detected. BSB are now able to be found in nearly every orchard where these types of tree decline symptoms are seen; hundreds of trees have already been destroyed.

What do growers need to look for? So far, orchards where BSB has been detected are tall spindle or super spindle plantings with areas of wetter soil conditions, or where no irrigation is available. Infested trees in the spring look like they are weaker than uninfested trees. Some are oozing sap or fire blight ooze from the entry holes with black sooty mold running down the trunks. In some trees the bark appears to be blistered indicating some type of damage, such as winter injury. Upon close inspection, growers might find small pin pricks (1 mm diameter), and the tiny black beetle in the hole. Using loppers or a pruning saw, growers can cut ¼ to ½ inch 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. A sign of infestation is also the staining pattern in cross sections of the trunks. If the weather is calm, and dry, growers might be lucky enough to see the "toothpick" made of compacted sawdust that initially sticks out of the trunk.

How do we control or prevent BSB infestation in orchards? There must be an integrated approach to preventing BSB attacks.

1) **Minimize stress?** This gets back to site selection and site preparation before planting. Install tile in wet spots in the proposed planting site, do not plant in a frost pocket or be prepared to install frost protection, provide irrigation in case of drought, and prevent fire blight infections.

2) **Monitoring the activity** of these insects is easy since they are attracted to ethanol which stressed trees emit. Traps are constructed from inverted juice bottles with squares cut out of the sides baited with a 10-15% ethanol lure from AgBio and a small bit of low toxicity antifreeze or soapy water in the lid for a drowning solution. These traps are hung 2-3 feet off the ground on the edge of the orchard near a woodlot, and in the interior of the orchard. Traps are funneled through filter paper, and checked weekly for BSB, separating them from other insects that are captured. We often capture other Ambrosia beetles, and BSB will hide by hanging onto other insects and debris in the trap. So look closely.

   Hundreds of traps were set this season across western NY and other fruit regions of NY. *X. germanus* was captured in all fruit growing regions, but tree damage has only found in WNY, Long Island, and the Hudson Valley. The first beetles caught were early May in 2015. There are generally 3 peak flights detected, one for the overwintering emergence, the second of adults from the first brood that were dispersing to new trees or parts of trees, and the third was the late August flight when adults from the second brood were relocating to their overwintering sites.

3) **Remove and destroy infested wood.** Do not pile the trees on the edge of the orchard unless they are burned quickly.

4) **Insecticides?**
   The use of an effective insecticide will depend on the ability to intercept the adult females when they move from chamber to chamber between generations. Insecticide will need to be renewed often or have a long residual. With these pests, spray coverage will be an issue – they attack the trees from top to bottom, so whole tree trunks will need treatment. The best spray coverage will result if insecticide is applied before the trees leaf out. The best coverage is achieved using more water, spraying at a slower speed, and spraying every row. Good weed and sucker control help to get good coverage of the lower trunks.

   The ornamental nursery industry where this is a serious pest relies on pyrethroids, permethrin, on a 2-week schedule. This strategy would certainly be a challenge in apples because of concerns over how it would impact mite control, and apples only have a prebloom label. The nursery industry has also tested neonicotinoids, anthranilic diamides (cyazypyr, acelepryn), and tolfenpyrad, and has not found them to be effective in controlling BSB. So far, the ornamental researchers have not identified any systemic insecticides that are effective. Insecticides labeled as bark treatments for borers may be used against new attacks but only while the adults are outside of the tree. Ther is no point sprying if there is no flight activity in the traps.

5) **Other controls?**
Laboratory studies have shown that *X. germanus* adults and brood are susceptible to microbial pathogens such as *Beauveria bassiana* and *Metarhizium brunneum* (Castrillo, 2011). Some researchers are testing fungicides against the fungus in the lab but none have been effective in the field. And there are commercial suggestions of nutritional programs and SARS but we have no experience with these.

Insecticide Trials:
Since apple nursery producers have been struggling with this pest as well as many tall spindle apple producers, we set up trials for testing controls using various insecticide treatments registered for control of trunk borers as the first line of defense. But to encourage attraction of beetles to the test trees, used a potted tree approach, flooding them so they would emit ethanol from the stress (Ranger, 2013).

Nursery Tree Trial: We potted sleeping eye trees on B9, and applied 8 treatments, 4 reps, 4 trees per rep on 2 sites, Roberts Farm Market and Wafler Nursery. The trees were lined along a woods edge near an infested site, placing them in larger plant containers lined with plastic bags and filled with water to simulate flooding stress. Treatments were applied using a CO2 sprayer wand with a full cone nozzle to cover the bark of the tiny nursery trees. We evaluated the trees for holes by pulling potted trees and scraping bark to find the holes, and cut cross-sections to determine the success of BSB rearing brood for each hole.
Tall Spindle Trial: We potted 2-year old nursery trees on M9 and tested 5 treatments, in 4 reps, with 5 trees per rep and placed them in infested rows of established tall spindle plantings at Cherry Lawn Farms and Roberts Farm Market. Treatments were applied to the potted trees and the adjacent established trees using a handgun to get full coverage of the trees in treatment plots. The grower standard was applied using an airblast sprayer. We evaluated the trees for holes by pulling potted trees and scraping bark to find the holes, and cut cross-sections to determine the success of BSB rearing brood for each hole.

Preliminary results:
Table 1 shows nursery trees that had no stress were not infested, but Lorsban was effective at reducing the pressure in the Wafler nursery site compared to the flodded, untreated checks. The pyrethroids did not show very promising control. The *Metarhizium*, biological control fungus, appeared to be effective but all the green tissue on the tree was severely burned indicating as it is an EC formulation. The Roberts nursery tree test was not as clear with no damage in the untreated flooded trees. This site was adjacent to larger established trees in a wet area in the orchard that were infested and likely more attractive to BSB than the tiny nursery trees. We need to continue to work on the methods to get clearer results. Table 2 shows results in tall spindle plantings with more damage in untreated controls compared to other treatments.

Table 1. Nursery Trial for control of 1st generation BSB at Wafler - 2015

Stress	Treatment	% Infested	# Holes	Gallery	Adults	Brood	Adult dead
No flood	untreated	0	0	0	0	0	0
Flooding	untreated	38	14	3	3	2	2
Flooding	Lorsban	13	2	0	0	0	0
Flooding	Lorsban then Permup	13	2	0	0	0	0
Flooding	Permup x2	38	10	0	3	0	4
Flooding	Warrior x2	56	16	1	3	0	2
Flooding	Warrior then Keyplex	25	6	2	7	1	3
Flooding	Metarhizium	6	1	0	0	0	0

Table 2. Tall Spindle Control at Cherry Lawn - 2015

Treatment	Avg. # holes/ tree	Avg. # infestation sites with presence of			
		galleries	live adults	brood	dead adults
Untreated	**2.25**	**1.30**	**0.45**	**0.25**	**0.05**
Warrior	**1.00**	**0.80**	**0.05**	**0.05**	**0.10**
Declare	**0.95**	**0.85**	**0.40**	**0.30**	**0.05**
Lorsban	**1.30**	**0.85**	**0.25**	**0.20**	**0.05**
Grower Std	**0.25**	**0.20**	**0.00**	**0.05**	**0.00**

We will need to repeat these trials with some modifications in high pressure sites.

References:

Castrillo, L. A., M. H. Griggs, C. M. Ranger, M. E. Reding, and J. D. Vandenberg. 2011. Virulence of commercial strains of *Beauveria bassiana* and *Metarhizium brunneum* (Ascomycota: Hypocreales) against adult *Xylosandrus germanus* (Coleoptera: Curculionidae) and impact on brood. Biol. Control 58: 121 - 126.

Christopher M. Ranger, Michael E. Reding, Peter B. Schultz and Jason B. Oliver. Influence of flood-stress on ambrosia beetle host-selection and implications for their management in a changing climate. Agricultural and Forest Entomology (2013), 15, 56–64.

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Managing Oriental Fruit Moth and Other Historically Less Damaging Insects in Apples

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Increased prevalence of oriental fruit moth (OFM) infestations of apples have been observed since the late 1990s. Infestations have often, but not always, been greatest in areas where peaches and apples are grown in close proximity, in part because peaches are a favorable host early in the season and apples are a favorable host after peach harvest has ended. Where insecticide resistance has been observed in peach orchards and has led to population increases, problems in apples have also been greatest. Resistance to organophosphates and pyrethroids has been documented in specific populations of OFM in North America (see References Cited).

Managing OFM in apples is not inherently difficult. It is controlled effectively by the same reduced-risk insecticides that work against codling moth, including Altacor, Assail, Delegate, and Rimon. OMRI-approved products such Entrust and Madex are moderately effective in organic production, and pheromone products for mating disruption are available for OFM alone or in combination with codling moth pheromones. Mating disruption has proven very effective for OFM control where apples and peaches are both treated if they are located in adjacent blocks.

Managing OFM in apples is complicated by the fact that it does not fly, lay eggs, or enter fruit at the exact same times as codling moth. Figures 1 and 2 illustrate OFM and codling moth flights in unmanaged orchards in southwestern IL after an early April freeze had reduced crops so dramatically that the growers did not make any insecticide applications. Because flight peaks and periods of larval entry into fruit differ for the two species, additional insecticide applications can be necessary where OFM poses a threat to apples.

Our (IL) recommendations for growers in areas where OFM threatens apples include:

- Monitor for OFM in apples, nearby peaches, and along wooded borders using a large delta trap baited with OFM L2 lures replaced on an 8-week interval.
- If control practices for other pests are not effective against OFM because they are too specific (for example, mating disruption against codling moth alone or pyrethroids where OFM is resistant) or insecticides have dissipated or been washed off, make specific applications timed for OFM control according to counts from pheromone traps.
- Mating disruption using OFM-specific dispensers or CM-OFM combination products are effective if applied in both apples and peaches where blocks are adjacent.
- Altacor, Assail, Delegate, and Rimon are effective against OFM and codling moth. OMRI-approved products such Entrust and Madex are moderately effective in organic production
- Carefully identify the Lepidopteran larvae found in fruit. With a hand lens or other device that allows 10X to 20X magnification, an “anal comb” is visible on the rear end of OFM larvae but is not present on codling moth larvae. (See http://entomology.tfrec.wsu.edu/Cullage_Site/OFM.html.) Altering management plans to better control one of these pests will not help if the other is responsible for the majority of damage.

Other pests that have become or threaten to become more troublesome in isolated situations in the Midwest include …

- Potato leafhopper. Where our growers are using Altacor, Delegate, or Rimon in late May or early June, potato leafhopper immigration and infestations sometimes go unnoticed long enough that hopper burn and stunting of shoot growth occur. Monitoring for potato leafhopper during this period and using an effective insecticide if needed are especially important.
- Woolly apple aphid. Pending (possible) cancellations of Lorsban registrations will make the management of this insect more challenging. Prebloom sprays of Lorsban have been very effective for woolly aphid control in Illinois. Well-timed post-bloom applications of Admire-Pro or Movento may be needed instead.
- San Jose scale (and oystershell scale). We see scattered outbreaks of San Jose scale (and even oystershell scale) in orchards where prebloom oil sprays, sometimes with Lorsban, have been applied. Inadequate coverage is most likely much of the problem. Esteem applied when crawlers are active has been the most effective answer; we have seen little use of Centaur in Illinois, and growers have had mixed results with Movento.
- Stink bugs, including brown marmorated stink bug. Green stink bug was more prevalent in Illinois orchards in 2015 than in any recent year, and brown marmorated stink bug is now present as a minor pest as well (minor in 2015, in the future … ?). Of the insecticides rated as highly effective against stink bugs, especially brown marmorated stink bug, Assail and Belay, if used after bloom to reduce risk to bees, can be used without disrupting predaceous mites and triggering mite outbreaks, but pyrethroids will likely trigger European red mite infestations.
- European red mite. See the note about stink bugs. If we start controlling brown marmorated stink bugs with pyrethroids, we'll become familiar with miticide rotation plans again.

References Cited

Jones, M.M., J.L. Robertson, and R.A. Weinzierl. 2010. Susceptibility of oriental fruit moth (Lepidoptera: Tortricidae) to selected reduced-risk insecticides. Journal of Economic Entomology 103: 1815-1820.

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Kanga L., D. Pree, J. van Lier, and G. Walker. 2003. Management of insecticide resistance in oriental fruit moth (Grapholita molesta; Lepidoptera: Tortricidae) populations from Ontario. Pest Management Sci. 2003. 59: 921-927.

Figure 1. Oriental fruit moth flight, Calhoun County, IL,2007.

Dashed line: Traps in apples. Solid line: Traps in peaches.

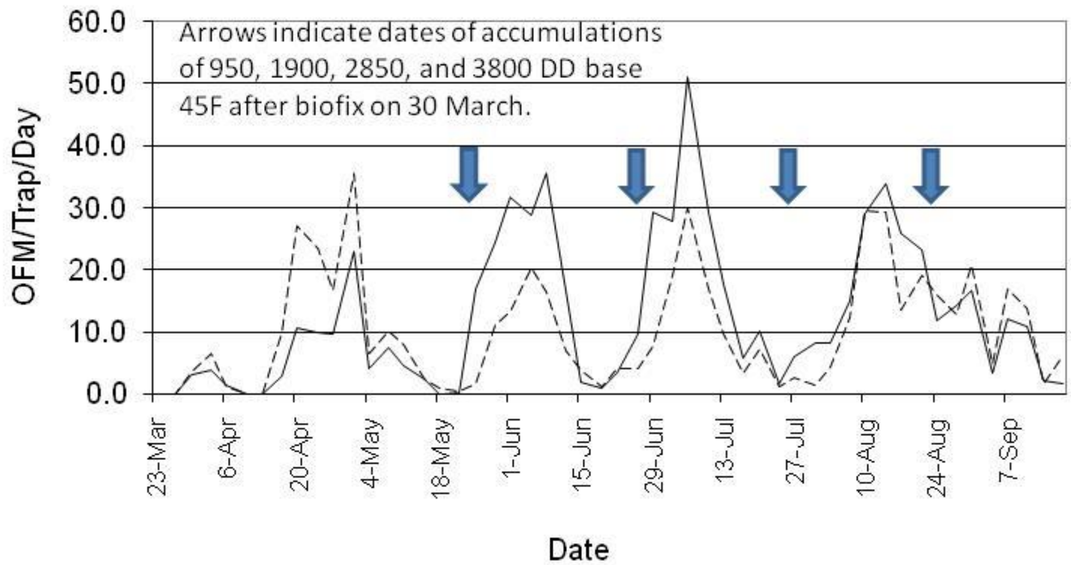

Figure 2. Codling moth flight, Calhoun County, IL, 2007.

Dashed line: Traps in apples. Solid line: Traps in peaches