Development of Stone Fruit IPM Guidelines for the Northeast

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In a 2009 survey, Connecticut growers identified the most important insect pests of stone fruits to be the catfacing insects (plant bugs and stink bugs), plum curculio, and peachtree borers. Other insects and mites considered to be less important include Japanese beetle, Oriental fruit moth, green peach aphids, and mites (European red mites and two-spotted spider mites). I have received funding from NE SARE to develop IPM guidelines for stone fruit pests in the Northeast region because such guidelines are not currently available.

Today's talk will focus on some of the major insect pests of stone fruits. Information will include life cycles, monitoring, cultural controls, mating disruption, use of degree days, and action thresholds. There will be a brief review of pesticide options (not included in this paper). Refer to the New England Tree Fruit Management Guide for effective pesticide options.

Catfacing Insects –Plant Bugs and Stink Bugs

Plant bugs that attack stone fruits include the Tarnished Plant Bug and the Oak/Hickory Bug Complex. **Stinkbugs** include the native species such as the brown, dusky and green stink bugs, as well as the new exotic species, the brown marmorated stink bug.

The **Tarnished Plant Bug (TPB)** feeds on over 100 different plant species. In New England it overwinters as an adult, usually in hedgerows outside the orchard, and is active from the bud stage to about three weeks after petal fall. Adults lay eggs in weeds and leguminous plants where the nymphs develop. The first generation adults move from these plants to stone fruits approximately mid-June to mid-July. There are 2-3 generations per year.

The **Oak/Hickory Bug Complex** (*Lygocoris spp.)* includes the white oak plant bug, the hickory plant bug, and *Lygocoris omnivagus* (no common name). These plant bugs overwinter as eggs on oak, hickory and other trees. They usually migrate to peaches in early to mid-June through July. They tend to be a sporadic occurrence in peach orchards depending on the site. More are expected in blocks with woody borders.

Plant Bug Injury - The type of injury caused by plant bugs depends upon the timing of the injury. If buds or blossoms are attacked, they will likely drop and "natural thinning" may occur. Fruit injury will occur if plant bug feeding occurs shuck-split or later. Plant bugs inject a toxin at the feeding site which causes fruit distortion called "cat-facing". The earlier in the season that the feeding occurs, usually the more severe the damage at harvest. Late season feeding may also result in stings with a gummy ooze.

Monitoring - White or pink sticky traps or beating trays (limb-jarring) can be used for monitoring adult plant bugs; however, no thresholds have been established. Sweep net sampling gives a good indication of catfacing insects present in the groundcover. The best way to monitor for plant bug injury is by direct fruit examination. Check 100-200 fruits per block for fresh injury; use a minimum of 10 fruit from 10 different trees. Check for other pest damage at the same time (such as plum curculio). An injury "threshold" is suggested at 1-2% of new damage

(or whatever your particular tolerance may be). Both old and new feeding should be recorded so that management programs can be adjusted or changed if needed.
Cultural Control -Groundcover Management – Research from Rutgers University has shown that plots with clean sod middles (free of broadleaf weeds) had fewer TPB in the ground cover than similar areas with broadleaf weeds. Two-thirds less TPB damage was found on peaches in clean sod blocks. Try to prevent broadleaved winter annual weeds and legumes in and around the orchard.
Chemical Control – The critical timing for TPB control is at petal fall, shuck fall and approximately 10 days after shuck fall. Applications at pink are often unnecessary because fruit injured at this time will likely abort. If treatments are necessary they should be applied during times of adult activity since this is the damaging stage in the orchard.

Stink Bugs – Native stink bugs such as the brown stink bug, dusky stink bug and green stink bug are relatively common in New England orchards. Adults overwinter in protected areas such as fence rows, under dead weeds, groundcover or stones and in the bark of orchard and other trees. The new invasive species, the brown marmorated stink bug (BMSB), has caused significant damage to pome and stone fruit crops in the Mid-Atlantic States for the last few years. It has been found in New England, but, as of yet, has not caused any crop damage. The BMSB overwinters as an adult in protected places, including houses, and that is where most of the New England sightings have occurred.
Stink Bug Injury – It is mostly the adults that injure fruit. Stink bug feeding damage is similar to that caused by plant bugs. Early feeding during bloom through shuck split will cause the flower or developing fruit to abort. Feeding from the shuck fall stage until fruit is about 1 inch in diameter will cause a catfacing similar to TPB. Feeding damage later in the season may result in depressed corky areas, bleeding spots of gum exuded out in droplets or strings, and various levels of cat-facing. Stink bug control is challenging because the insects tend to be highly mobile.
Cultural control – **Groundcover Management** – For native stink bugs (brown, green), groundcover management is very important, similar to the tarnished plant bug (see above). Research from Rutgers University has shown that plots with clean sod middles (free of broadleaf weeds) had fewer native stink bugs in the ground cover than similar areas with broadleaf weeds. See plant bug section (above) for more on groundcover management.
Monitoring – There has not been any success with sticky traps for monitoring of stink bugs. The best way to monitor for adults of the native stink bugs is by sweep sampling of the orchard floor or by limb jarring. A tentative threshold (Univ. of Arkansas) is that 1 stink bug/limb jar equates to approximately 1% of new damage. A pyramid shaped trap with a pheromone lure is being used for trapping of the BMSB. As of October, 2011, no BMSB were captured in these traps in Connecticut.

Plum Curculios (PC) overwinter as adults, usually in hedgerows, around the orchard perimeter. Adults lay eggs in the fruit and make a crescent shaped cut around the egg. The crescent shape is not as obvious on the peaches due to the fuzz, so you will need to scrape off the fuzz to see this.
Monitoring - The best way to monitor if the PC has arrived in the orchard is by direct examination of the fruit for injury or by the use of a beating tray (limb jarring) for adults. Monitoring should be done from bloom through at least two weeks after shuck fall. Concentrate monitoring along the edges and border rows of the block. A degree day model helps determine

when there should be no further immigration of PC adults into the orchard. This timing is when there is 308 degree days (base 50 ^{0} F) from **apple** petal fall.
Chemical Control - Treatments should begin at shuck-split stage if adults are present and causing fruit injury. No economic threshold has been established. An injury "threshold" is suggested at 1-2% of new damage (or whatever your particular tolerance may be).

Peachtree Borers – There are two species that attack stone fruits - **Peachtree Borer (PTB)** and **Lesser Peachtree Borer (LPTB).** They cause similar damage but are different in where and when they attack the trees. The peachtree borer has one generation per year and attacks healthy trees at the soil line. Tree vigor is reduced and small trees can be girdled or killed. The lesser peachtree borer has two generations per year and attacks scaffold limbs, especially those that are injured. They are often associated with Cytospora canker, pruning wounds, winter injury and mechanical damage. Both species overwinter as larvae that pupate and emerge during the summer.
Monitoring – Adults can be monitored using pheromone traps. Use at least 2 traps per block to determine adult flight. Install LPTB traps by petal fall and PTB traps by the first week of June. Populations seldom need treatment when trap catches peak at less than 10 moths/trap/week. Traps should always be used if mating disruption is employed (see below).
Monitoring for larvae or pupae will take more time but will be most helpful. For LPTB, inspect wounded areas on the upper trunk, scaffold limbs and branches for larvae and empty pupal cases protruding from the bark. It is easiest to find pupal cases during peak flight (associated with pheromone traps). Control is recommended if 1-2 larvae or empty pupal cases are found per tree. For PTB, inspect the base of the tree for gum containing frass and sawdust. It is best to do this during July through mid-August. Examine the soil at or near base of tree for cocoons and empty pupal cases. Control is recommended for trees up to 3 years old if any evidence of PTB is detected. In older orchards, control is recommended if 1 or more cocoons or empty pupal cases per tree are found. Suggested thresholds are from Virginia Tech.
Mating Disruption has been found to be an effective method for management of both borer species. Use Isomate PTB-Dual at a rate of 150 pheromone ties per acre. These should be installed at shucksplit before LPTB moth flight begins. Use a higher rate (200-250/A) for outside edges of border rows, areas that haven't been disrupted before and have high populations, and in blocks smaller than 5 acres (this is probably true for most stone fruit blocks in New England). If a block has GPTB infestations more than 30%, regardless of block size, use 200-250/A for the first year of treatment. In this situation, a trunk treatment of chlorpyrifos would also be advised for the first season to reduce the PTB population. Be sure to have pheromone traps in place for both PTB and LPTB. If the mating disruption is working, no moths should be captured in pheromone traps resulting in trap "shut-down".
Chemical control options include root dips for new plantings and sprays for trunk (PTB) and scaffold limbs (LPTB). The sprays for trunk and scaffold limbs are best applied with a hand-gun with low pressure and high volume. These can be applied post-harvest. Aim for the lower trunk at soil level for PTB and the upper trunk and scaffold limbs for LPTB. Although adult moths are not specifically targeted, insecticides used for other pests during the season may also provide some control.

Oriental Fruit Moth (OFM) overwinter as larvae on trees or in the ground. They pupate in the spring and begin to emerge around the ½ green stage of peach. There are 3-4 generations per

year in New England. The first generation larvae are mostly found in twig terminals from May to July and cause wilted leaves and "flagging". The second and later generation larvae usually enter the fruit. Infested small fruit may drop from the tree but larger fruit tend to remain on the tree.

Monitoring – For first generation larvae, check terminals for "flagging". Count the number of flags per tree on at least 10 trees. There are currently no thresholds established but it will give you some idea of the level of infestation. For second and later generation larvae, check at least 200 fruit per block (10 per tree on 20 trees) for infested fruit. There are no thresholds but if you keep records throughout the season or year to year you can assess what management methods may be working or if you need to fine tune your approach. To monitor for adult moths, install pheromone traps at the half-inch green stage of peach. Use at least 1 trap per 10 acres. There is a suggested action threshold of >15 moths per trap per week for first generation and >10 per trap per week for second and later generations. Suggested trap thresholds are from Cornell University.

Mating disruption has been found to be effective for management of this pest and is economically justified if 2-3 sprays are normally applied, and if no other insecticide sprays are routinely needed for other pests after petal fall. For this reason, mating disruption may not be economical for the first brood, as plum curculio sprays at this time (if chosen correctly) would also control OFM. If you skip the first brood, mating disruption pheromones should be applied by mid-June before initiation of the second flight. The need for re-application depends on the residual field life of specific formulations which range from 30-90 days.

Chemical control – A number of pesticides are effective on OFM – see the New England Tree Fruit Management Guide. For the best timing of treatments, you will need to use pheromone traps and track degree days. To do this, check traps daily (placed at ½ inch green stage) until biofix. The biofix is the first sustained catch of 2 or more moths per trap. Then check weekly and calculate degree days (base 45^0 F) from biofix date. The treatment timing is at beginning of egg hatch for each generation. The following information is from Penn State University.

DD Base 45^0F	Event	Action
150-200 DD	8-10% 1st gen. egg hatch	First treatment if >15 moths/trap/week
1150-1200 DD	8-10% 2nd gen. egg hatch	Treat if 10 moths/trap/week and/or fruit injury found
2100-2200 DD	8-10% 3rd gen. egg hatch	Treat if 10 moths/trap/week and/or fruit injury found

Spotted Wing Drosophila (SWD) – This new exotic pest arrived in most New England states (except for Vermont as of this writing) in late summer, 2011. SWD is a type of fruit fly that is a pest of most berry crops, grapes, and stone fruits, with a preference for softer-fleshed fruit. It was devastating to New England raspberry and grape crops in 2011 but was also found to a lesser extent on stone fruits. New England research and extension scientists will be developing recommendations for the 2012 season. Vinegar traps are used to trap adults.