IPM Guidelines for Insects and Diseases of Stone Fruits

These Integrated Pest Management (IPM) guidelines were developed for the most common insect and disease pests of stone fruits grown in the northeastern United States. For pesticide recommendations for commercial growers consult the New England Tree Fruit Management Guide or the appropriate recommendations for your state. For more details such as pest life cycles, photos of pests and damage, etc., see the links for each pest.

Developing an IPM program for stone fruit involves more than putting together a pest spray program. It involves a pro-active approach to growing, beginning with site and cultivar selection, and an understanding of cultural practices that will help to delay, reduce or eliminate potential problems. It also involves an understanding of the life cycle of the pest, (whether it be insect, mite, disease pathogen, weed, nematode, etc); knowing which insect vectors which disease pathogen; being able to identify beneficials and understanding their life cycles; understanding how the environment impacts potential pest problems and plant health; an understanding of how different pesticides work and the proper timing; understanding and utilizing alternative management methods; and understanding economic and injury thresholds.

CULTURAL PRACTICES

- Avoid varieties susceptible to bacterial spot. When siting a new stone fruit block, keep it away from an existing block of susceptible varieties.
- Maintain healthy trees
    - Prune correctly. Opening up the tree allows for rapid drying which aids in reducing disease incidence and allows for optimum spray penetration. Remove small weak shoots in the center of trees to reduce perennial canker incidence.
    - Prune at the proper time. Peaches are best pruned once growth has started in the spring to reduce cold injury and to allow for rapid wound healing. Open wounds are entry sites for disease organisms and borers.
    - Prune in dry weather to avoid the spread of perennial canker and other diseases.
    - Maintain healthy trees with appropriate nutrient levels in the soil and trees. Use routine soil and foliar analysis. Avoid late summer and fall nitrogen applications that will encourage trees to grow late into the fall. Maintain optimum potassium levels in the trees. Potassium is important in winter hardiness of trees and buds, as well as fruit size.
    - Avoid damaging trees with mowers and other equipment. These wounds are entry sites for borers and canker development.
    - Thin fruit to avoid limb breakage. Open wounds are disease and insect entry sites.

- Remove and destroy mummified fruit and cankers to reduce disease inoculum.
- Thin fruit so no two fruit are touching. This reduces moisture buildup which is needed for disease development, and reduces the potential spread of brown rot from one fruit to another.
- Thin fruit for maximum size development and to avoid limb breakage.
- Control broadleaf weeds that harbor plant bugs and native stinkbugs.
- Control weeds in the tree row. Weeds will compete with trees for available water and nutrients.
- All stone fruits should be irrigated to avoid stressing trees during periods of drought.
- Install and calibrate weather monitoring equipment.

RECORD KEEPING

- Keep records of emergence time, location, numbers of insect & mite pests. Maintain environmental records combined with management tools utilized to better understand factors that increased or reduced insect and disease problems. Historical records are important to understanding what was done and what can be tweaked for better control in upcoming seasons.

INSECT MANAGEMENT

Catfacing Insects –Plant Bugs and Stink Bugs

Plant Bugs – Tarnished plant bug (TPB) and Oak/Hickory Bug Complex (*Lygocoris spp.*)

- Monitor for adult plant bugs using white or pink sticky traps, limb jarring or sweep net samples of groundcover; however, no thresholds have been established for traps or limb jarring. Sample the groundcover with a sweep net, taking 2 sets of 25 sweeps. If a total count exceeds 3-4 combined tarnished plant bugs and native stink bugs potential problems exist.
- Monitor for plant bug injury (catfacing) 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). A tentative injury threshold is suggested at 1-2% of new damage. Both old and new feeding should be recorded so that management programs can be adjusted or changed if needed.
- Manage groundcover by preventing broadleaved winter annual weeds and legumes in and around the orchard. Orchards with clean sod middles (free of broadleaf weeds) harbor fewer TPB and native stink bugs in the ground cover than similar areas with broadleaf weeds.
- Insecticide treatments for TPB control are best timed for 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.

- The oak/hickory bug complex tends to be sporadic in nature and usually migrate to peach orchards in mid-June through July.
- For more information on monitoring, see the New Jersey Commercial Tree Fruit Production Guide, Rutgers Cooperative Extension, Publication E002.
- For other information, including photos of plant bugs and injury, see http://virginiafruit.ento.vt.edu/tpb.html and http://extension.psu.edu/plants/tree-fruit/insects-mites/tarnished-plant-bugs-other-plant-bugs-and-stink-bugs

Stink Bugs – Native stink bugs and brown marmorated stink bug (BMSB)

Native stink bugs including the brown stink bug, dusky stink bug and green stink bug are relatively common in northeastern US orchards. 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. BMSB has been found in New England and New York but has not caused any crop damage in New England states as of 2013. However, fruit damage had been reported in NY's Hudson Valley in 2013.

Native Stink Bugs

- Monitor for adults of native stink bugs by sweep net sampling of the orchard floor or by limb jarring; however no thresholds have been established for limb jarring. See plant bug section (above) for sweep net sampling methods and tentative action thresholds.
- Monitor for stink bug feeding injury. Feeding from the shuck fall stage until fruit is about 1 inch in diameter will cause 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 catfacing. A tentative injury threshold is suggested at 1-2% of new damage. Both old and new feeding should be recorded so that management programs can be adjusted or changed if needed.
- Manage groundcover by preventing broadleaved winter annual weeds and legumes in and around the orchard. Orchards with clean sod middles (free of broadleaf weeds) harbor fewer TPB and native stink bugs in the ground cover than similar areas with broadleaf weeds.
- Chemical control of native stink bugs is challenging because the insects tend to be highly mobile and can occur throughout the season.
- For more information on monitoring, see the New Jersey Commercial Tree Fruit Production Guide, Rutgers Cooperative Extension, Publication E002.
- For more information including photos see, http://extension.psu.edu/plants/tree-fruit/insects-mites/tarnished-plant-bugs-other-plant-bugs-and-stink-bugs and http://www.virginiafruit.ento.vt.edu/StinkBugs.html

Brown Marmorated Stinkbug (BMSB) – This is a developing pest in the northeast US. Follow the latest Extension recommendations in your state regarding monitoring and management as new information becomes available.

- Monitor for BMSB adults and nymphs on leaves and fruit; beginning with the perimeter of the orchard within 30 feet of bordering woodlands or hedgerows. Be sure to also scout a few days after any treatments to determine effectiveness.
- Monitor for BMSB using pyramid traps baited with pheromone lures and with DDVP killing strips. Traps should be placed in orchards along perimeter/woodline by mid-April to capture first adults as they emerge from overwintering sites.
- Monitor fruit weekly for insect presence and damage to determine if damage is increasing with trap captures.
- Pesticide applications would be suggested after confirmed BMSB sightings or confirmed BMSB damage in the orchard. Follow the latest Extension recommendations in your state as new monitoring and treatment thresholds become available.
- Initially, perimeter treatments may be effective as BMSB migrate into the orchard. However, the entire orchard block may need to be treated where BMSB damage extends into the orchard interior.
- Chemical control will be difficult as BMSB will continually migrate from areas outside the orchard.
- Buildings around BMSB high risk blocks should be inspected for overwintering populations of BMSB. Destruction of overwintering BMSB in structures can help with control.
- For more information see, http://stopbmsb.org

Green Peach Aphid (GPA)

- Monitor leaves for presence of aphids and damage (curled leaves). The threshold for peaches is two or more colonies per tree between petal fall and shuck-split and five or more colonies by late May. For nectarines, the threshold is one colony per tree at any time on bearing trees.
- Many beneficial organisms, including lacewings, lady beetles, syrphid flies and soldier beetles, are effective predators of the GPA. Monitor for their presence before applying a pesticide.
- For more information, see http://www.virginiafruit.ento.vt.edu/GPA.html

Japanese Beetle (JB)

- Monitor fruit and foliage for Japanese beetle adults from mid-July through fall. No thresholds have been established. Chemical control is important to minimize the opportunity for brown rot infections in feeding sites.
- For more information see, http://www.virginiafruit.ento.vt.edu/JBPeach.html

Mites (European Red Mites (ERM) and Twospotted Spider Mites (TSSM))

- Use a dormant oil spray for ERM eggs, especially if mites have been a problem in previous year.
- Monitor for mites during the season by counting mites per leaf with a hand lens. Take 10-40 leaves from the canopies of 10 trees. Provisional action thresholds for peaches would be 10 mites per leaf in early season and 20 mites per leaf in late season.
- Mite predators such as predatory mites, *Stethorus punctum* (a native lady beetle) and *Orius insidiosus* (minute pirate bug) can be effective at maintain mite populations below threshold.
- For more information see, http://www.virginiafruit.ento.vt.edu/ERMPeach.html

Oriental Fruit Moth (OFM)

- First generation OFM- Monitor terminals for "flagging" caused by larvae burrowing into new growth. Count the number of flags per tree on at least 10 trees. There is currently no threshold established but monitoring will give an idea of infestation level.
- Second and later generations – Sample at least 200 fruit per block for larvae. There are no thresholds established, but if records are kept throughout the year or season to season, management methods can be assessed and fine-tuned.
- Install pheromone traps at half-inch-green stage of peach to monitor adults. Suggested action threshold is an average of >15 moths per trap for first generation and >10 per trap for later generations. See http://www.fruit.cornell.edu/lof/ipm/pdfs/codling_moth.pdf
- For correct timing of treatments, use pheromone traps to determine biofix (first sustained catch), then use degree days (base 45^{o} F) for treatment timing. 150-200 degree days for first generation; 1150-1200 degree days for second generation; 2100-2200 degree days for third generation. See http://pubs.cas.psu.edu/FreePubs/PDFs/agrs045.pdf
- Use mating disruption for second and later generations. Ideally, blocks should be 5-10 acres in size for mating disruption to be effective. Choose insecticides for post-bloom control of plum curculio that will also have efficacy on first generation OFM. See efficacy charts in the New England Tree Fruit Management Guide or other recommendation guides for your state. Then install OFM mating disruption ties before second generation in mid-June. Mating disruption dispensers lasting 90 days should also provide control for third generation. If mating disruption is used, all stone fruits in the orchard must be treated with pheromone ties.
- For more information and photos see, http://www.nysipm.cornell.edu/factsheets/treefruit/pests/ofm/ofm.asp

Peachtree Borers – Peachtree Borer (PTB) and Lesser Peachtree Borers (LPTB)

- Monitor for adults 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 in conjunction with mating disruption.

- Monitor for larvae or pupae to determine borer infestation levels. 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 (as indicated by 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. See http://www.virginiafruit.ento.vt.edu/lptb.html and http://virginiafruit.ento.vt.edu/ptb.html
- Use mating disruption for management of both borer species. Use Isomate PTB-Dual at a rate of 150 pheromone ties per acre. These should be installed at shuck split 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 more than 30% of trees infested with PTB, 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 1) root dips for new plantings and 2) sprays for trunk (PTB) and scaffold limbs (LPTB). 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. Also, although adult moths are not specifically targeted, insecticides used for other stone fruit pests during the season may also provide some control.
- For more information including photos see, http://nysipm.cornell.edu/factsheets/treefruit/pests/ptb/ptb.asp

Plum Curculio (PC)

- Monitor to determine when PC has arrived in the orchard by direct examination of the fruit for injury (minimum of 200 fruit per block) or by the use of 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 migration of PC adults into the orchard. This timing is when there is 308 degree days (base 50^0 F) from **apple** petal fall.
- Insecticide treatments should begin at shuck split stage if adults are present and causing fruit injury. No economic threshold has been established, however treatment is suggested if there is 1-2% of new damage.
- For more information and photos see, http://www.virginiafruit.ento.vt.edu/PCPeach.html

Spotted Wing Drosophila (SWD)

- Monitor for adult SWD using baited traps. In 2013, the trap design included a two part trap with apple cider and yeast baits. For the latest trap design, consult your state Extension recommendations. The 2013 trap design is at http://ipm.uconn.edu/documents/view.php?id=376
- Monitor fruit for SWD larvae as larvae may be present before adults are captured in traps. Inspect fruit or use a salt water extraction method as described in http://bugs.osu.edu/Welty/pdf/ProtocolSWD_larvae24April.pdf
- Treatments are suggested if larvae are found infesting fruit and/or if adults are being captured in traps.
- Sanitation is a key component of SWD management. Where possible, try to remove and destroy infected fruit, over ripe fruit and infected fruit that has dropped. Do not compost.
- Remove alternate hosts such as wild brambles, autumn olive and wild grapes.
- SWD is primarily a pest of small fruits. Stone fruits may be attacked but they are not a preferred host.
- For more information see, http://www.northeastipm.org/about-us/publications/ipm-insights/spotted-wing-drosophila-in-the-northeast/ and http://ipm.uconn.edu/documents/raw2/spotted%20wing%20drosophila/Spotted%20Wing%20Drosophila.php?aid=275

DISEASE MANAGEMENT

Bacterial Spot

- Select resistant cultivars to minimize losses from this disease
- Use a copper application during the fall and/or spring to reduce bacterial spot inoculum. Peaches are very susceptible to copper injury, especially after bud-break.
- On susceptible varieties, begin monitoring at shuck split and continue weekly through late season by examining 50 fruit and 25 of the oldest leaves on each sample tree. Once initial lesions are detected, make weekly examinations of 100 of the most recently developed, fully expanded leaves for lesions to determine if disease spread is occurring. The three week period following petal fall is critical for early season fruit infection and establishment of inoculum on new foliage.
- Base treatment decisions on:1) if the disease has affected quality of more than 5% of fruit; 2) if the incidence of initial lesions in the current season is “common”, (i.e 20 % or more leaves show lesions); 3) whether new lesions have developed since previous week.
- For more information and photos, see http://www.caf.wvu.edu/kearneysville/disease_descriptions/ombactsp.html

Black Knot (plums)

- Monitor for black knots on a susceptible cultivar such as "Stanley", from dormant period through bloom. Presence of any black knots represents high risk.
- Prune infected shoots and limbs during dormancy, at least 6 inches below any visible symptoms. Bury or burn them before bud break.
- Chemical controls may be applied between white bud and shuck split stage based on monitoring results. However, fungicide applications are likely to be ineffective unless proper pruning and sanitation are also used.
- Remove wild plum and cherry seedlings from fence rows, woodlots and along orchard perimeters.
- For more information and photos, see http://www.caf.wvu.edu/kearneysville/disease_descriptions/omplumbk.html

Brown Rot (blossom blight)

- Before pink stage, monitor a minimum of 20 sample trees per block for the presence of fruit mummies and cankers. A total of one to ten mummies and/or cankers, and more than ten mummies and/or cankers represent levels of moderate and high risk, respectively, for blossom infection under the appropriate environmental conditions.
- At shuck fall, examine ten shoots on each sample tree for the presence of blossom infection. A total of one to ten blossom infections and greater than ten blossom infections represent moderate and high risk, respectively, for fruit infection during the preharvest and harvest periods.
- Fruits become more susceptible to brown rot as they begin to color, about 3 weeks before harvest. Monitor 10 fruit on each tree for disease incidence. Greater than 2 infected fruit per 10 acres (eight trees sampled) represents a high risk for brown rot outbreak.
- Fungicide treatments are especially critical during bloom and starting again 3 weeks before harvest, especially if rainy periods occur during these times.
- Cultural practices are very important to minimize brown rot. Practices include:
    - Remove overwintering brown rot mummies that are a source of disease inoculum.
    - Prune out cankers and blossom infections in the spring.
    - Prune to avoid excessive overcrowding of branches to increase air circulation, promote rapid drying and increase light and spray penetration.
    - Remove all remaining fruit from trees after final picking.
    - Fertilize to maintain optimal nitrogen/potassium balance.
    - Pick and handle fruit carefully to avoid injuries.
- For more and information and photos, see http://www.caf.wvu.edu/kearneysville/disease_descriptions/ombrownr.html

Peach Leaf Curl

- Leaf curl can be controlled with one well-timed fungicide application either in the fall or spring before bud swell. Treatments for leaf curl are not effective after infections occur or after symptoms appear.
- Monitor during bloom to assess the effectiveness of the control program to plan for the following season.
- For more information and photos, see http://www.caf.wvu.edu/kearneysville/disease_descriptions/omplfcrl.html

Peach Scab

- When pruning, monitor for twig lesions. Regular pruning helps with air movement, reduces length of wet periods and improves spray penetration into trees.
- Fungicide treatments are best if timed between petal fall and 40 days before harvest. By the time the disease symptoms appear, it is too late to control for the current growing season.
- Beginning in mid to late season, monitor 25 fruit on each sample tree for lesions which are most common on the shoulders of the fruit. A total of 10-20 fruit infections represent a moderate risk; greater than 20 represent a high risk. These damage levels indicate that improvements in disease management are needed for the following season.
- For more information and photos, see http://www.caf.wvu.edu/kearneysville/disease_descriptions/ompscab.html

Perennial Canker (also called Valsa, Cytospora, Leucostoma Canker)

- After shuck fall, monitor trees for cankers. Cankers should be removed from the tree and burned, buried or moved out of the orchard.
- Management of cankers is based on preventive measures designed to decrease winter injury; control insects (e.g peach tree borers, Oriental fruit moth) and other diseases (e.g. brown rot) and promote optimal plant health.
- Cultural practices are very important to minimize this disease. Practices include
    - Establish new plantings at a distance from old, cankered blocks
    - Proper site selection with deep, well-drained soil and good air drainage
    - Train to promote wide crotch angles for reduced breakage and winter injury
    - Delay annual pruning until bloom or later to allow pruning cuts to “heal” quickly
    - Use standard practices to reduce winter injury such as the application of white trunk paint.
- For more information and photos, see http://www.caf.wvu.edu/kearneysville/disease_descriptions/omleuco.html

Powdery Mildew

- Select resistant cultivars to minimize losses from this disease.
- Avoid planting susceptible peaches adjacent to mildew susceptible apple cultivars.
- Monitor ten terminals per tree for presence of white, mycelial growth on young leaves. A total of one to ten infections and greater than 10 infections represent moderate and high risk, respectively.
- Monitor 25 fruit on each sample tree, two to four weeks after shuck fall for the presence of round, whitish, powdery spots on the fruit surface. A total of ten to 20 fruit infections and greater than 20 fruit infections represent moderate and high risk, respectively.
- Fungicide treatments are most effective between petal fall and pit hardening stages. Fruit of susceptible cultivars become resistant at pit hardening stage.
- For more information and photos, see http://www.caf.wvu.edu/kearneysville/disease_descriptions/omppowml.html

X Disease

- Control broadleaf weeds through herbicide or cultural controls such as mowing, mulching, weed badgering, etc. Broadleaf weeds harbor leafhoppers that are X-Disease vectors
- Remove choke cherries and wild sweet cherries within a 500 ft. radius of the orchard as they are hosts for X-Disease. Infected chokecherries are most obvious when they start turning yellow by late July.
- For more information and photos to help identify choke cherry, see http://extension.unh.edu/resources/files/Resource001720_Rep2400.pdf
- For more information and photos of X-Disease, see http://www.caf.wvu.edu/kearneysville/disease_descriptions/ompxdis.html

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