Emerging Insect Pests in the Pacific Northwest

Michael R. Bush, Christopher Adams, and Sven Spichiger

Latest revision—March 2025

Non-native insect pests are species that have extended their range from their native habitat to new areas. This movement may be between continents, or within a continent. While non-native species may move on their own, they sometimes arrive via commercial transportation activities. Most non-native insects adapt to new habitats or geographic areas without drawing attention and cause no significant economic harm. Other newly arriving insects do cause damage to plants, structures, or to human health and are therefore recognized as "emerging pests". In this section we will describe existing and emerging non-native insect pests.

While the damage caused by non-native insect pests may have obvious impacts, costs associated with these species can be much harder to calculate. The economic impact of non-native pests may include any of the following costs: increased use of pesticides and their non-target impacts; new rules and regulations; loss of overseas markets; education campaigns; monitoring efforts; management of quarantine areas; containment and eradication efforts; property damage and lost property taxes. These impacts can have further ramifications for agriculture, communities, the environment, and taxpayers. Science News (2011) reports that "non-native, wood-boring insects such as the emerald ash borer and the Asian long horned beetle exact an estimated $1.7 billion in local government expenditures, and approximately $830 million in lost residential property values each year."

In the Pacific Northwest (PNW), most of our worst pests are non-native species introduced from other areas of the world, or in some cases, other areas of the United States. Examples include spongy moth, Japanese beetle, black vine weevil, European crane fly, apple maggot, and San Jose scale. Resources to eradicate these emerging, non-native pests are limited and ongoing eradication programs must be directed to those that most impact the PNW. The priority list varies between States in the PNW, so the best listing can be found on the website of your state department of agriculture:

Washington: https://agr.wa.gov/departments/insects-pests-and-weeds
Oregon: https://www.invasivespeciesinfo.gov/us/oregon
Idaho: https://agri.idaho.gov/main/tag/invasive-species/

This section of the Handbook includes information on new and existing insect pests in the PNW. World trade has increased the number of new invasive species in our gardens, crops, and natural environment. If you find unfamiliar species, or pests causing damage to landscape plants, crops, structures, etc., please contact your state department of agriculture, your state invasive species council (see below) or your local county extension office. In Washington, you can capture a series of digital images and send the best photos to PestProgram@agr.wa.gov for identification.

For further information:

Rosetta, R. L. 2017. An Update on New and Emerging Pests in the Pacific Northwest. https://www.publicgardens.org/resources/update-new-and-emerging-pests-pacific-northwest

Washington Invasive Species Council. 2019. Priority Species. https://invasivespecies.wa.gov/find-a-priority-species/

Oregon Invasive Species Council. https://www.oregoninvasivespeciescouncil.org/

Idaho Invasive Species Council. http://invasivespecies.idaho.gov/idaho-invasive-species-council

Aukema J. E., B. Leung, K. Kovacs, C. Chivers, K. O. Britton, J. Englin, S. J. Frankel, R. G. Haight, T. P. Holmes, A. M. Liebhold, D. G. McCullough, B. Von Holle. Economic Impacts of Non-Native Forest Insects in the Continental United States. PLoS ONE, 2011; 6 (9): e24587 DOI: 10.1371/journal.pone.0024587

Ongoing Eradication Programs

Spongy moth

Latest revision—March 2025

The spongy moth (*Lymantria dispar dispar*) was first detected in Washington in 1974. Since the early 1990s, another variety of spongy moth, the Asian spongy moth *(L. dispar asiatica*), has been intercepted multiple times by the Washington State Department of Agriculture (WSDA), often as egg masses attached to cargo on ships originating from Asian ports. Over the past 40 years, trapping and rapid response efforts have been successful in preventing permanent populations of either variety of spongy moth in the PNW. In 2019, a closely related moth species known as the Hokkaido moth (*L. umbrosa*) was detected in Washington. In response, WSDA initiated an eradication program for the Hokkaido moth in the spring of 2020.

Pest description and damage The wings of male spongy moths are tan with a series of dark-brown wavy lines and relatively large, feathery antennae. The wingspan of the male moth is about 1.5 inches long. The female moths are larger, about 2-inch wingspan, but sport wings of a much lighter color—cream to white. The female moths of the spongy moth cannot fly, but the female Asian spongy moth can and readily disperse. The moths are most active in summer. The mature larvae have five pairs of distinctive blue dots followed by red dots along their back and can be found late spring to early summer. The larvae of spongy moths feed on over 500 trees, shrubs, and plants including most hardwood and conifer trees found in the PNW. In parts of northeastern US, this species defoliates entire forests. Homeowners should be on the lookout for the spongy moth egg masses from late autumn to early spring as these are, by far, the most inadvertently transported stage of this pest. Each egg mass contains hundreds of round eggs covered with a dense mat of light tan hairs and is sponge-like in appearance. These masses are usually laid on the bark of the host trees, but may be found on automobiles, RVs, firewood, doorframes, windowsills, furniture, or just about any sheltered surface.

Pest monitoring Traps that rely on lures which release a sex pheromone to attract and monitor male moths are commercially available. WSDA places up to 25,000 green or orange delta traps on host trees throughout the state each summer.

Management This is a quarantined pest species. If you suspect you have found any stage of this insect, please report the finding to the State Department of Agriculture or local university Extension office. When confirmed as a spongy moth, these state agencies will respond and work to eradicate this pest as soon as possible.

For further information:

Crabo, L., R. Zach & M. Peterson. 2019. Pacific Northwest Moths. https://pnwmoths.biol.wwu.edu

Japanese beetle

Latest revision—March 2025

Japanese beetle (*Popilia japonica*) has been established in the eastern United States since the early 1900s. Slow the Spread (STS) efforts coordinated by state and federal agencies have helped to keep several western states, including Washington and Oregon, free from Japanese beetle. The Departments of Agriculture in Oregon and Washington have surveyed adult Japanese beetle for over 30 years. Isolated infestations of this beetle were eradicated in the past. In 2016, hundreds of adults trapped near Portland initiated another eradication response effort. Quarantine areas are in place and this eradication program will continue. Multiple finds of Japanese beetle were detected in Washington, and efforts are in play to eradicate these beetle populations.

Pest description and damage The adult beetle is a colorful flower beetle with iridescent copper-colored wings and a metallic green thorax with a series of tufts of white hair along the perimeter of the abdomen. The adult measures about 0.375 inch long. In the summer months, these adults congregate and skeletonize the leaves of a wide range of ornamental plants including rose, phlox, mallow, aster, maple, oak, willow, linden, and rhododendron, as well as crops including peach, caneberry, grape, hop, potato, and tomato. In late summer, adults mate and lay eggs in the soil beneath host plants. The mature larvae are C-shaped white grubs that tunnel under the ground surface, feed on the roots of grasses and can be found in lawns during the spring. Japanese beetle larvae are serious turf pests. The Japanese beetle overwinters as larvae in the soil and pupates in soil chambers in the spring. There is one generation each season. Nevertheless, this insect can build up large populations in a short period of time.

Pest monitoring Traps that rely on an aggregation pheromone and/or a floral lure to attract and monitor both male and female beetles are commercially available. WSDA traps Japanese beetles every year. Most Japanese beetle detections are associated with air cargo.

Management This is a quarantined pest species. If you suspect you have found turf damage, the C-shaped larvae, or the adult beetle, report the finding to your state Department of Agriculture or local university Extension office. For the larvae, a trained specialist looking at a physical sample under a microscope must do species identification (physical specimen required). When confirmed as a Japanese beetle, these state agencies will respond and work to eradicate this pest as soon as possible. Several pesticide products, both organic and conventional, that target the adult and larval stages of the Japanese beetle are available.

For further information:

Suits, R., H. Stoven, G. Langellotto-Rhodaback & C. Burfitt. 2017. Japanese Beetles in Oregon. https://catalog.extension.oregonstate.edu/em9158

Spotted-wing Drosophila: An Emerging Berry and Stone Fruit Pest

Vaughn Walton

Latest revision—March 2025

Spotted-wing drosophila (SWD; *Drosophila suzukii*; Family: Drosophilidae) is a key pest that targets a wide variety of susceptible fruits including tree stone fruits (e.g., cherry) and berries (e.g., strawberry, blueberry, raspberry, blackberry, and wine grape). SWD is widespread throughout all the important production regions in the U.S., Europe, and South America and originates from Asia.

Pest description, fruit damage, and life cycle Adult SWD flies resemble common vinegar (pomace) flies and sometimes are referred to as fruit flies. SWD can damage ripe-to-overripe fruit by depositing eggs directly beneath the surface. Larvae develop from these eggs, resulting in unmarketable fruit. *Drosophila suzukii* can survive on a range of non-crop hosts in surrounding vegetation, which makes control more difficult.

Identification SWD have red eyes and a yellowish-brown amber colored body measuring 0.125 inch (2-3 mm) in length. Two key characteristics

distinguish SWD from other common fruit flies: 1) a black spot (sometimes dark, sometimes faded) near the leading top edge of adult male wings (females do not have wing spots); 2) the prominent saw-like ovipositor (used to insert eggs into fruit) on the female's posterior end; and 3) the pupae of both sexes have two respiratory horns sticking out of the anterior end; each horn with a complete whorl of 6-8 fingers/points. Several dark, continuous bands are visible around the abdomen of both the male and female. A hand lens and good lighting are useful for seeing these characteristics. Note: if the female gets caught in a liquid bait (e.g., apple cider vinegar or yeast) within a monitoring trap, her ovipositor may extrude from the body (because of the liquid), thus aiding in the identification of female SWD. See references below.

Symptoms from damage To recognize SWD damage, look very closely for scarring or spotting on the fruit surface; liquid exuding (when squeezed) out of scar/hole where eggs were laid; softening, collapsing and/or bruising of fruit at damage site; small white larvae and pupae that can be seen with naked eye if fruit is opened; and, under a microscope, two hair-like filaments sticking out of fruit where they are connected to a white egg within the fruit can sometimes be seen. See OSU Extension Bulletin EM 9021, Recognize Fruit Damage from Spotted Wing Drosophila (https://catalog.extension.oregonstate.edu/em9021).

Life cycle A single female can lay several hundred eggs. Adults can live 3 to 4 weeks in summer and several months in winter. Larvae feed inside the fruit for about 5 to 7 days, until they are ready to pupate. Most larvae pupate outside of the fruit. Non-feeding pupae are brownish yellow with star-like (6 to 8 points) respiratory horns at one end. Pupation lasts for 3 to 10 days and emerging adult flies will mate, producing additional offspring. Adult SWD use alternative hosts in surrounding vegetation to survive the winter period. Several generations commonly occur in Oregon, depending on environmental conditions during the cropping season.

Sampling

Like most fruit flies, SWD are attracted to the odors of rotting fruit, i.e., fermentation, vinegar, and alcohols. To construct simple homemade traps, use any plastic container (18- to 32-ounce size) with a removable lid. Drill small holes around the middle of the cup to allow flies to enter. Holes should be small to limit the ability of larger insects to enter (3/16 in or 4.76 mm). Leave an undrilled space on one side of the cup to make it easier to pour out the liquid bait solution when checking the trap and changing the solution. Add a couple of inches of liquid bait such as apple cider vinegar and white wine to the cup. Adding a drop of liquid soap to the solution will break the surface tension of the liquid so that captured flies sink more easily. An alternative bait that catches even more flies can be made from a mixture of yeast, sugar, and water (2 teaspoons of dry baker's yeast, 4 teaspoons of sugar, and 1.5 cups of warm water). The yeast and sugar solution makes identification of SWD, from all the other flies, more difficult. Commercial traps and lures are available from Scentry Biologicals Inc. and Tréce Inc. and can be easily purchased through Great Lakes IPM (greatlakesipm.com).

Traps should be hung within the canopy of the crop or close to the fruit level when possible. Avoid placing traps in direct sun as midday heat inside the trap can reduce catch. For strawberries, secure the trap on the ground within the plants and construct a roof structure to provide shade (red plastic plates work well). Traps can also be placed in locations where flies are likely to be intercepted while moving through the landscape, for example fence lines near adjacent non-crop plants and borders shared with other fruit growers.

In most commercial settings protective (prophylactic) sprays are applied, regardless of catch data from traps, because damage thresholds are zero. In organic production and backyard fruit, more traps can help with early detection and improve pest management decisions. Check and refresh traps once a week. While mass trapping has not been shown to be an effective control tactic, traps sometimes catch thousands of SWD, so multiple traps can help reduce populations.

Male SWD can sometimes be identified with the unaided eye by looking for the dark spots on the male's wings. It is difficult to confirm SWD and see the female's ovipositor without a magnifying glass or microscope. Traps sometimes catch so many insects that it is difficult to make out what was caught. For a closer look, filter the contents of your traps using a strainer, and place insect in a pan with a solid white background. Spread the insects out (using a small paintbrush or tweezers) and examine contents with a magnifying lens or under a microscope. Numerous species of *Drosophila* and other insects will also be attracted to these traps, especially if the yeast bait is used. Damage thresholds have not yet been established for this pest.

Fruit inspection

Several methods have shown positive results for recovering larvae by using a salt or sugar solution over crushed fruit. Collect ripening fruits suspected to be infested with SWD in a plastic bag. See "A quick, 7-step guide for detecting larvae in fruit" (OSU Extension Bulletin, EM 9097) and "A Detailed Guide for Testing Fruit for the Presence of Spotted Wing Drosophila (SWD) Larvae" (OSU Extension Bulletin, EM 9096).

Preparation of extraction solution: Dissolve 1 cup of plain salt in 1 gal warm water (10 BRIX); –or– 2.5 cups of brown sugar in 1 gal water (16 BRIX). Solutions must be thoroughly dissolved to help larvae float on top of the solution for easy viewing. Prepare the solution in advance, if possible.

Extraction method: Place a layer of crushed fruit in a shallow white pan. Pour solution (salt or sugar) over crushed fruit. A good proportion of larvae will exit the fruit after a few minutes, looking for air at the top of the liquid. A majority will float to the surface, unless stuck in or under pulp. Wait for at least 15 minutes to get a majority of larvae out of infested fruit. Look for moving white larvae on the surface of the liquid. Eventually, however, they will die and sink to the bottom of the pan. The sugar solution will keep them alive longer than salt solution. Do not mistake SWD larvae for plant parts, fruitworm, thrips, aphid skins, other *Drosophila* larvae, etc.

Fruit dunk bag method: Place suspect fruit in a large sealable plastic bag. Crush fruit by using a rolling pin over bag or squeeze/crush fruit with hands through bag. Add solution to the bag of crushed fruit. Shake bag lightly to promote penetration of solution into the fruit. If fruits are infested, white SWD larvae will float to the top, and fruit should settle on the bottom (note: some fruit floats, depending on fruit weight/amount and sugar

levels in fruit). It may take over 15 minutes or so for larvae to float and fruit to separate. If larvae are small, a hand lens or scope and good lighting are useful to see their presence. Hold the clear bag in light and small larvae may be seen moving and floating among fruit.

Management—cultural and physical methods

Harvest in a timely manner—Pick fruit at regular intervals to prevent egg-laying opportunities and SWD infestations. Avoid leaving overripe fruit to hang on host plant.

Clean up infested fruit—To avoid SWD populations from increasing, clean up overripe hanging, fallen, and SWD-infested fruit.

Create a barrier—If a monitoring program detects SWD, cover fruiting clusters (e.g., blueberry) or entire fruiting plants (e.g., caneberry) with a fine netting (less than 1 mm in size if feasible) to reduce egg-laying. Use weed fabric, and control weeds as they provide a more suitable habitat for SWD. Weed fabric reduces the survival of pupating larvae.

Protect fruit from damage—Protect fruit from rain and sun to reduce fruit splitting and to improve fruit quality. SWD can be attracted to damaged fruit.

Select early season fruit cultivars to reduce SWD pressure.

Non-crop hosts from areas surrounding your fruiting crop may be an issue—Potential perimeter, wildland and backyard uncultivated plants used by SWD may include berries from: dogwood, elderberry, Himalayan blackberry, laurel, sweet box (*Sarcococca* spp.), flowering cherry, honeysuckle, and dozens of other fruiting species. See OSU Extension publication EM9096: Noncrop Host Plants of Spotted Wing Drosophila in North America. (https://catalog.extension.oregonstate.edu/em9096). Some of these fruits may not be affected by SWD under certain environmental conditions or because of specific management practices being used.

Canopy and irrigation management— SWD prefer shady and humid habitats. Maintain an open and aerated plant canopy that is less attractive to SWD adults and minimize leaky irrigation lines and overhead irrigation. Use drip irrigation, as it increases temperature and reduces water availability to adult flies. Drip irrigation also results in increased host feeding of pupal parasitoids, ultimately resulting in higher mortality of SWD.

Cooling fruit—Chill fruit (less than 34°F) immediately after harvest for extended time periods (greater than 4 to 8 days) but retaining fruit quality to slow or kill eggs and young larvae.

Management—biological control

Research is underway to determine the specific predators and parasitoids (wasps) that attack SWD larvae and pupae. Field observations suggest that ants, spiders, predaceous bugs (e.g., minute pirate bugs, big-eyed bugs), yellow jackets, lacewing larvae, and parasitoid wasps may be important biological control agents.

Management—chemical control

Chemical controls should be coupled with monitoring efforts. Rotate chemical families to avoid resistance and follow the label for each crop. See specific fruit for recommended chemicals.

Pesticide families that help control SWD include: spinosyns, pyrethroids, carbamates, and organophosphates. These chemicals kill SWD adults, and some may have an effect on larvae that are developing within and are protected by the fruit. Follow the label for appropriate rates and risks. Do not apply when bees and other pollinators are present, such as when plants are flowering or when pollinators are active.

For further information:

Mermer, S., L. Brewer, D. Dalton, R. Nieri, K. Park, F. Pfab, M. V. Rossi-Stacconi, and V. Walton. 2019. Improved Chemical Control Strategies for Spotted-wing Drosophila. Oregon State University Extension Service EM 9265.

Mermer, S., G. A. Hoheisel, H. Y. Bahlol, L. Khot, D. Rendon, L. Brewer, D. Dalton, R. Nieri, K. Park, F. Pfab, M. V. Rossi-Stacconi, and V. Walton. 2019. Optimizing Chemical Control of Spotted-wing Drosophila. Oregon State University Extension Service EM 9266.

Rendon, D., S. Mermer, L. Brewer, D. Dalton, C. B. D. Silva, J. Lee, R. Nieri, K. Park, F. Pfab, G. Tait, N. Wiman, and V. Walton. 2019. Cultural Control Strategies to Manage Spotted-wing Drosophila. Oregon State University Extension Service EM 9262.

Rossi-Stacconi, M. V., L. Brewer, D. Dalton, J. Lee, R. Nieri, K. Park, F. Pfab, G. Tait, and V. Walton. 2019. Host Range and Characteristics Affecting Fruit Susceptibility to Spotted-wing Drosophila. Oregon State University Extension Service EM 9263.

Rossi-Stacconi, M. V., L. Brewer, B. Miller, D. Dalton, J. Lee, K. Park, F. Pfab, V. Walton, and C. B. D. Silva. 2019. Biocontrol of Spotted-wing Drosophila. Oregon State University Extension Service EM 9229.

Silva, C. B. D., B. E. Price, D. Dalton, D. Rendon, K. Park, L. Brewer, V. Walton, and M. V. Rossi-Stacconi. 2019. Potential Impacts of Irrigation and Biocontrol on Spotted-wing Drosophila Populations. Oregon State University Extension Service EM 9268.

Tait, G., D. Rendon, L. Brewer, D. Dalton, J. Lee, R. Nieri, K. Park, F. Pfab, M. V. Rossi-Stacconi, and V. Walton. 2019. Noncrop Host Plants Used By Spotted-wing Drosophila. 3.

Tait, G., M. V. Rossi-Stacconi, B. Miller, D. Dalton, J. Lee, K. Park, V. Walton, T. Peerbolt, and L. Brewer. n.d. Monitoring Techniques for Spotted-wing Drosophila. Oregon State University Extension Service EM 9267.

Walton, V., L. Brewer, D. Dalton, S. Tochen, R. Nieri, K. Park, F. Pfab, D. Rendon, G. Tait, N. Wiman, and M. V. Rossi. 2019. How Seasons Affect

Population Structure, Behavior and Risk on Spotted-wing Drosophila. Oregon State University Extension Service EM 9261.

Brown Marmorated Stink Bug: An Emerging Threat to Pacific Northwest Agriculture

Nik G. Wiman

Latest revision—March 2025

The brown marmorated stink bug (*Halyomorpha halys*) (Hemiptera: Pentatomidae) is a highly damaging invasive crop pest that feeds on a wide range of plants (more than 170 species), has a strong capacity for dispersal and population increase, and until recently had no major natural enemies in the PNW. Brown marmorated stink bug (BMSB) was first observed in the United States in Allentown, Pennsylvania, in 1996, and is now found in most U.S. states, southern Canada and Europe. In the PNW, BMSB was discovered in Portland in 2004, and in Vancouver, WA in 2010. There have been multiple introductions of the pest from Asia into the region, as well as introductions of BMSB inadvertently brought from the eastern U.S in vehicles and freight. At this point in time, this pest has become widely distributed across the region, and it should not be surprising to encounter BMSB anywhere in the PNW in urban environments. Its distribution tends to be more limited to cities and towns in more arid environments east of the Cascades where there are concentrations of suitable ornamental and other trees and plants that can be used as a food source. West of the Cascades, BMSB is widely naturalized in forest environments where it can subsist on wild host plant species, particularly maples and ash. The agricultural problems have been most severe in the Columbia Gorge, Willamette Valley, and in the Umpqua and Rogue Valleys. Commercial crops that have sustained damage from BMSB include hazelnut, apple, pear, peach, blueberry, and cherry. Wine grapes may also be attacked throughout the pest's established range, but grapes are typically not as susceptible to damage. Vegetable crops are susceptible to BMSB, but damage to commercial vegetable crops has been minimal to date. Nuisance problems can be severe anywhere BMSB is established. Nuisance problems encompass damage to noncommercial crops such as backyard orchards and vegetable gardens, aggregation on homes and other structures in the fall, and infestation of homes during winter. Nuisance problems are particularly severe in the greater Portland-Vancouver area and outlying communities, and more recently severe nuisance problems have been reported in the Eugene area.

Pest description and life cycle

Adult BMSB are approximately 0.7 inch long, generally a mottled ("marmorated") brown in color on the back, but coloration on the ventral (bottom) abdomen is variable, and can be gray, yellow, green, or red. The distinct white bands on the otherwise darkly colored antennae are a key character for identification. They also have alternating dark and light bands on the dorsal (top) part of the abdomen that protrudes out beyond the folded wings and dark bands on the tips of the membranous sections of the wings. Male BMSB are smaller than females and have a small notch in the distal end (tip) of their abdomen. Adult BMSB look most similar to two other genera of stink bugs common in the PNW, brown stink bugs *(Euschistus* spp.) and rough stink bugs (*Brochymena* spp.) but can be distinguished by the antennal bands and by having a smooth anterior (forward) margin of the thorax (shoulder), while the other species have drab antennae and/or rough or spined anterior margins on their thorax. The five immature stages of BMSB initially have a unique red abdomen and black thorax, but become darker as they grow and look more like the adult after each molt. The first instar is the smallest immature motile stage at about 0.1 inch in length. The fifth instar is approximately 0.5 inch in length. Stink bugs have glands that emit a pungent aroma that resembles cilantro when they are disturbed or crushed.

Adult BMSB overwinter in protected areas such as houses, outbuildings, and outdoors in sheltered locations such as logs and rock outcrops. When the weather warms up in the spring, BMSB exit their overwintering sites and disperse to vegetation to feed and reproduce. Many ornamental and naturalized plant species are important host plants, such as catalpa (*Catalpa speciosa*), tree-of-heaven (*Ailanthus altissima*), female English holly *(Ilex aquifolium*), Oregon grape (*Mahonia aquifolium*), lilac (*Syringa* spp.), dogwood (*Cornus* spp.) mountain ash (*Sorbus aucuparia*), Oregon ash *(Fraxinus latifolia*), empress tree (*Paulownia tomentosa*), various maples, particularly big leaf maple (*Acer macrophyllum*). BMSB will feed on developing buds, fruit, and trunks of thin-barked trees, such as maple and peach. BMSB also feeds on corn, pepper, tomato, green beans, peas, and a wide range of other vegetable plants. The eggs are laid in clusters ranging in number from 25-30 eggs per egg mass (28 on average), are typically blue-green, and are attached to the underside of leaves. Eggs are most easily detected on broad-leaf hosts (e.g., *Catalpa*, *Paulownia*). After the eggs hatch, immature BMSB will molt five times as they mature into adults. Two generations per season can occur in Oregon.

The BMSB, like other plant-feeding stink bugs, damages plants during feeding. All nymphal stages and adults can cause damage except for the first instar nymphs, which feed on the egg mass. Stink bugs feed by inserting their piercing-sucking mouthparts (stylets) into plant tissue, secreting digestive saliva, and then extracting the digested plant fluids. The extraction of plant fluids following the injection of the saliva results in deformed plant parts, loss of turgor, and occasionally aborted plant ovaries (which can cause empty shells or blanks in hazelnuts). It is frequently observed that BMSB feeding on fruit and vegetables results in pithy, loose-cell textured tissue surrounding the feeding site (corky tissue). BMSB feeding on apples and pears close to harvest may not readily show apparent damage. However, damage worsens during storage so that apparently undamaged fruit comes out of storage full of brown spots. Damage to fruits and nuts may not be apparent without cutting away the skin of the fruit or shelling the nut. BMSB damage can sometimes be difficult to distinguish from fruit physiological problems or nutrient deficiencies such as cork spot and bitter pit. However, pithy corking damage from BMSB is typically only located within 0.4 inch of the fruit surface, whereas the disorders generally have corky tissue throughout the fruit. See https://extension.oregonstate.edu/catalog/pub/em9054-s for a printed BMSB identification guide with images of damage.

Sampling and Management

During the summer and fall months, BMSB can be sampled by visual observation of adults, nymphs, and egg masses on the crop or by use of beating

trays to collect them from plants. Timed visual observations or other metrics of effort can help standardize samples. Typically, chances of successfully sampling BMSB on host plants decrease during hot weather when the insects become very active and beat sampling will be most effective early in the morning when the insects are cool. Pheromone traps are available commercially and can be used for monitoring but captures of BMSB on traps may not correlate well with crop damage. However, particularly early in the season, any capture of BMSB on traps near the crop is reason for concern. Traps work best in the late summer and fall months in areas where BMSB are present in higher numbers and more receptive to the aggregation pheromone. Traps or pheromone lures should not be placed in the crop as an aggregation of BMSB around the trap can cause more damage than would naturally occur. Rather, place monitoring traps along crop perimeters to better understand the immigration of BMSB.

There are no established treatment thresholds for BMSB in the PNW but given the severity of damage that occurs when populations are noticeable, growers readily spray insecticides. Current insecticide programs are based on pyrethroid, carbamate, organophosphate, and neonicotinoid insecticides. All of these insecticides are disruptive to various natural enemies and have the potential to cause secondary pest outbreaks. Gardeners and growers with small plots may be able to exclude BMSB with fine netting, but this approach is not feasible for larger farms. Alternate row or perimeter treatments can give control without being as disruptive as cover sprays. Vegetation along farm borders can provide a refuge for BMSB and may need to be managed to reduce pressure on a crop. Treatment of crop plants with particle films is an alternative to broad-spectrum insecticides to deter BMSB, and kaolin clay is available as a tool for both home and commercial use ("Surround" and "Surround at Home").

Biological control of BMSB was initiated with the discovery of the samurai wasp (*Trissolcus japonicus*) in the PNW. This parasitoid wasp attacks and parasitizes BMSB eggs and has a parasitism rate of approximately 60-70% of BMSB egg masses in its native range of China, with observed rates as high as 90%. Wild populations of the wasp were first recorded in Vancouver, WA in 2015, in Portland, OR in 2016, and in Beaverton, OR and Walla Walla, WA in 2017. Since 2016, samurai wasps have been widely redistributed around the region and are becoming established. Urban or riparian areas appear to be the ideal habitats for samurai wasp establishment. As the current range of the samurai wasp continues to expand through both assisted and unassisted means, it is expected that the wasps will reduce BMSB populations locally. Several northeastern and mid-Atlantic states also have wild samurai wasp populations. Adults are 1.5 mm, black, prefer shaded areas, and have been spotted on BMSB egg masses laid on ornamental trees including maple, hawthorn (*Crataegus* spp.), and boxelder, as well as catalpa and hazelnuts trees. Although the wasp's small size makes it difficult to detect, several signs indicate the presence of the samurai wasp or other parasitoids. Wasps can be recognized by their "guarding behavior" – walking on and laying eggs in BMSB egg masses. Parasitized egg masses will turn a dark black color 3-5 days after being attacked. After adult parasitoids emerge from the eggs by using their mandibles to chew their way out, the eggs are left with uneven circular holes. For further details on recognizing parasitized egg masses, see EM 9164 (link below). Generalist arthropod predators can also feed on BMSB egg masses and nymphs. A predatory wasp in the genus *Astata* has been widely observed in Willamette Valley. The female will sting and carry off late instar nymphs from the host plants to a nest in the soil where she uses the dead BMSB to feed her offspring. Nests are less commonly observed than adults.

BMSB will overwinter in homes, sometimes in extraordinary numbers. This can be a good opportunity to reduce the local population that will disperse to nearby crops the following spring. From late August through November, BMSB aggregate on the sides of houses and buildings. They then work their way into the buildings through cracks and other openings. They can be in a semi-dormant state during most of the winter, but warm spells cause them to move around and become more noticeable. They often appear in the home interior after working their way in from unfinished spaces entered from the outside. The best way to prevent them from entering homes is to seal all the openings with caulking or other material to exclude them. Once they are on or in a structure, vacuuming them is the best way to capture and remove BMSB. A rigid extension hose for a shop-vac can be an effective way to remove BMSB from the eaves and walls of houses. Crushing them can cause them to release their defensive aroma, which is disagreeable and lingers for a time. Note that vacuuming BMSB can permanently impart this defensive odor to the machine.

For further information and to report BMSB or Samurai Wasp:

Report sightings and nuisance or agricultural problems from brown marmorated stink bug. Oregon State University.

https://agsci.oregonstate.edu/bmsb/brown-marmorated-stink-bug

Management of brown marmorated stink bug in US specialty crops and information for homeowners. https://www.stopbmsb.org

Samurai wasp: promising egg parasitoid for management of brown marmorated stink bug (BMSB). EM 9164: https://extension.oregonstate.edu/catalog/pub/em9164-s

Spotted lanternfly

The spotted lanternfly (*Lycorma delicatula*) is an invasive planthopper first documented in Pennsylvania in 2014 and has since spread to several other states. This insect feeds on important crops such as grape, hop, and fruit trees as well as many hardwood trees and nursery stock. Dead specimens were intercepted at cargo ports in California in 2019 and in Oregon in 2020. Agricultural Departments in Washington and Oregon have surveyed for live lanternflies in crops over the past couple years without finding them. We call on readers of this handbook to stay vigilant for the spotted lanternfly and immediately contact agricultural departments, invasive species councils, or university Extension in your state.

Description and damage When in flight, this brightly colored planthopper has wingspan of about 2 inches and is easy to spot due to the flashing red coloration on the hind wings. When at rest, these hind wings are hidden under light grey, spotted forewings. The newly emerged nymphs are black with white spots while the older nymphs develop a red body color with white and black spots. While the adults are mobile, we suspect that the greatest risk of the spread of this insect is due to the egg masses camouflaged to look like a smudge of mud found on various surfaces. At high densities, the adult female may lay the egg masses on just about any hard, smooth surface including vehicles, cargo crates, and much more. At high

population densities, the spotted lanternfly reduces host plant vigor and productivity, but a primary problem is that this insect ejects large quantities of honeydew on surfaces beneath the infested plant including fruit and leaves. The honeydew feeds and promotes fungal growth that further stresses the host and discolors surfaces beneath the infested host including manmade surfaces like cars, decks, and the exterior of homes.

Biology and life cycle In the United States, the colorful adult planthopper is active from July to December. The nymphs are found on host plants between May and July. The egg stage is the overwintering stage for this species. While the adults and the nymphs can feed on the phloem of a wide range of plant species, the spotted lanternfly prefers to feed on tree-of-heaven (*Ailanthus altissima*), which is considered an invasive pest (weed) of its own throughout the PNW.

Pest monitoring Since the spotted lanternfly is not established in the PNW, early detection is the best defense against this pest. Shipments of plant material or cargo from in and around the quarantine area should be closely inspected. The easiest way to notice this pest is by scouting the base of host trees, plants, and crops for adult activity (when in flight, the adults display those red hind wings) and looking for signs of honeydew on surfaces beneath infested crops. While tree-of-heaven may be a good host plant to look for spotted lanternfly, removing this invasive plant from home landscapes and borders of host crops is strongly encouraged in any case.

For further information:

Wakie, T. T., L. G. Neven, W. L. Yee and Z. Lu. 2020. The Establishment Risk of *Lycorma delicatula* (Hemiptera: Fulgoridae) in the United States and Globally. Journal of Economic Entomology, Vol 113 (1) February 2020, Pages 306–314. https://doi.org/10.1093/jee/toz259

Oregon Department of Agriculture Fact Sheets and Pest Alerts. 2020 Spotted lanternfly 1113 - State of Oregon. https://www.oregon.gov/oda/shared/Documents/Publications/IPPM/SpottedLanternflyPestAlert.pdf

Northern giant hornet (2019)

Several invasive hornets, including the northern giant hornet (*Vespa mandarinia*), have been intercepted in ports throughout the PNW. In 2019, NGH was confirmed in and eradicated from British Columbia, Canada. In December 2019, WSDA responded to a public sighting and captured this hornet near the border of Washington State and British Columbia. During the 2020 season, citizen scientists, together with WSDA/WSU staff, placed over 2,500 hornet traps in northwestern Washington. In October of 2020, these traps helped WSDA locate and destroy the first NGH nest in the United States. Three additional nests were located and eliminated in 2021. WSDA continues to investigate any reports of the Northern giant hornet in Washington. No detections or confirmed reports of NGH have been reported in Washington since 2022.

Description and damage This hornet resembles our native yellowjacket wasps, but adults can be nearly 2 inches long. Adults have a distinctly yellow-orange head with prominent black eyes, black thorax and black/yellow striped abdomen. This hornet preys on other insects, gathers tree sap and raids the colonies of other bees and wasps for protein spoils. In late summer and throughout autumn, this hornet will invade honey bee colonies and hives, decapitate bee workers and then feed on the colony brood and provisions. These hornets can sting humans and animals, but only when their nests are disturbed. If you suspect that you have a colony, do NOT attempt to remove or eradicate it. NGH will aggressively defend its own nest. Furthermore, this species of hornet will sting in self-defense, so do not handle any live specimen! The sting of NGH is more dangerous than that of other stinging insects in Washington since it can sting multiple times and deliver a larger dose of venom. Seek medical attention immediately if stung multiple times.

Biology and life cycle In its native range, this hornet nests and forms colonies often in underground chambers early in the spring. In Washington, all of the nests detected were inside of the voids of alder trees. During the summer, the nest expands in size and number. Between July to October homeowners are most likely to encounter foraging adults.

Pest monitoring If you suspect you have found a honeybee colony damaged by this species, or suspect you have encountered this large hornet, please report the finding to the State Department of Agriculture or local university Extension office. If safe, attempt to photograph the specimen and note what direction the hornet flies when it leaves. When confirmed as an invasive hornet of concern, these state agencies will respond and work with you to eradicate this pest as soon as possible.

For further information:

McGann, C. 2019. Pest Alert: Asian giant hornet. WA State Department of Agriculture Ag Briefs. https://wastatedeptag.blogspot.com/2019/12/pest-alert-asian-giant-hornet.html

Emerging Insect Pests

(Dates in parentheses are when each pest was reported in the Pacific Northwest.)

Latest revision—March 2025

Cabbage whitefly (2016)

While cabbage whitefly (*Aleyrodes proletella*) is primarily a new pest of brassica crops (*i.e*., cabbage, mustard, cruciferous vegetables). It also attacks other brassicas that are bedding plants and ornamentals.

Pest description and damage Cabbage whitefly adults and nymphs are likely to infest the outer or exposed leaves of brassicas. Damage is often limited to leaf curling, yellowing, and the presence of sooty mold growing on the honeydew. Cabbage whitefly damage is limited to outer leaves and to ornamental brassicas, especially ornamental leafy kale. When the problem is persistent, check nearby brassica weeds for whiteflies. As these weeds mature or die off, whiteflies will fly to more valuable plants. Adults are small (less than 0.05 inch), white, moth-like, and have white wings and a waxy, white thorax. When abundant, they fly up in great clouds from host plants. The nymphs are whitish green, flattened, and oval with dense waxy exudate covering them. Different species of whitefly look very similar but can be differentiated by comparing digital images or physical specimens. Cabbage whitefly might be mistaken for the greenhouse whitefly, but GHW has long wings, a yellow thorax, and a much wider host range. Adults and nymphs are vectors of a great number of viruses.

Biology and life cycle Adults overwinter on the host plants, including nearby related weeds. Nevertheless, cabbage whitefly can spend the entire year on one host plant.

Pest monitoring The presence of paper wasps and yellowjackets cruising through ornamental beds should cause the gardener to check plants more closely. These wasps are great predators and when abundant may be feeding on whitefly prey and whitefly honeydew. Monitor for whitefly with yellow sticky traps placed next to suspect plants.

Management—cultural control

Isolate all incoming plants in a separate area until you can inspect them for the presence of eggs, nymphs or pupae. Unfortunately, the more visible adults may not be present at the time your shipment arrives.

Management—biological control

There are several effective biological control organisms such as the parasitic wasp, *Encarsia formosa* and predatory *Delphastis* beetles. A good biocontrol consultant can match host whitefly to an effective predator or parasitoid and then guide you on proper timing releases.

For biology, life history, monitoring and management

See "Whitefly" in:

Common Landscape Pests

Management—chemical

See "Whitefly" in Table 1:

Chemical Control of Landscape Pests

For further information:

Oregon Department of Agriculture. 2016. Pest Alert: Cabbage Whitefly, *Aleyrodes proletella*. https://www.oregon.gov/ODA/shared/Documents/Publications/IPPM/CabbageWhiteflyAlert.pdf

Ash whitefly (2015)

Ash whitefly (*Siphoninus phillyreae*) was detected in California in 1988 and continues to spread to neighboring states to the south. By 2014, it was found in Oregon. Clouds of whiteflies are seen in the late summer and autumn in the Willamette Valley. This whitefly has a wide range of ornamental, native, and fruit tree hosts. For now, it is limited in its distribution. Early detection in new locations presents an opportunity to introduce natural enemies so that they increase along with the pest.

Pest description and damage Ash whitefly adults are small (about 0.05 inches long) and have translucent white wings through which the yellow body may be visible. The pale-yellow eggs are covered by waxy deposits. Translucent nymphs are covered with tufts of white wax and become more opaque as they mature. The puparia are covered with white wax and surrounded by tubercles that exude sticky honeydew. Infested leaves have a sticky mess of eggs, waxy nymphs, puparia, and honeydew. Both adults and nymphs feed on the host plants. Excessive whitefly feeding can defoliate trees, cause premature fruit drop, and may lead to the death of the host plant in severe whitefly infestations.

Biology and life cycle Female whiteflies lay eggs on the undersides of the leaves on host plants. Nymphs emerge from the eggs and settle onto the leaves where they remain and feed on the plant sap. They then pupate and later emerge as winged adults. Adults live 30-60 days with several generations in a year. Adults leave preferred summer hosts such as ash, pear, and hawthorn to overwinter and breed on evergreen hosts. It is not uncommon for whiteflies to linger on evergreens without developing other life stages. However, for the nursery industry, they may be a contaminant, the customer does not want any whitefly species introduced into their landscape.

Pest monitoring Watch for clouds of tiny whiteflies, or sticky honeydew and sooty mold under infested leaves.

Management—cultural and physical control

There are no lists of resistant cultivars of plants currently. Strong streams of water directed to the undersides of plants may dislodge or injure the

various life stages. Sticky traps and screening provide some protection.

Management—biological control

In other states, several biological control agents were released to manage populations of ash whitefly including a parasitic wasp *Encarsia inaron* and a lady beetle, *Clitostethus arcuatus*. In California and in Florida, *E. inaron* was the most successful agent limiting the populations of ash whitefly. In California, between 80 to 98% of ash whitefly nymphs were parasitized by this wasp. This parasitic wasp is so effective in parasitizing ash whitefly that pesticide use was avoided to allow the natural enemy to build up to effective numbers.

For biology, life history, monitoring and management

See "Whitefly" in:

Common Landscape Pests

Management—chemical control

See "Whitefly" in Table 1:

Chemical Control of Landscape Pests

For further information:

Paine, T., Bellows, T. and M. Hoddle. 2016. Ash whitefly. Center for Invasive Species Research. https://cisr.ucr.edu/ash_whitefly.html

Rosetta, R. 2016. Ash whitefly. Oregon State University Extension. https://agsci.oregonstate.edu/nurspest/insects/ash-whitefly

Banded-winged whitefly (2015)

The banded-winged whitefly (*Trialeurodes abutiloneus*) is relatively new to the PNW. It has been detected near the gorge in eastern Oregon, and a cloud of whiteflies with bands on their wings. BWW was reported near the same area of the gorge on the Washington side.

Pest description and damage The banded-winged whitefly is a native of North, Central, and South America. The size of the adult whitefly is between 0.6 to 0.1 inches long. The nymphs are similar in appearance to the greenhouse whitefly (GHW), but the adults and eggs are strikingly different. Adult BWW have two jagged bands across their wings; GHW does not. The cream-colored-to-yellow eggs of BWW are laid singly or in small groups with the peduncle inserted into the leaf so they lay parallel to the leaf surface; while the gray to black GHW eggs are laid in partial to full circles standing on end. The pupal case of BWW has a dark marking that is absent in the greenhouse whitefly nymph. BWW feed on many herbaceous garden plants and weeds as does the greenhouse whitefly. Known host plants include 33 families of herbaceous ornamentals, weeds, and the occasional shrub, with a preference for Malvaceae and Solanaceae. There are three kinds of BWW damage: 1) wilting, chlorotic spotting, leaf drop and dieback of heavily infested twigs; 2) copious honeydew and accompanying sooty mold that builds up and blocks photosynthesis; and 3) the transmission of viruses like abutilon yellows virus, diodia vein chlorosis virus, sweet potato chlorotic stunt virus and tomato chlorosis virus. Plants may look sickly due to the removal of sap through whitefly feeding.

Biology and life cycle BWW reproduces about as quickly as GHW. Eggs will hatch in about twelve days in greenhouse temperatures in April. The time to complete a generation is less at higher temperatures, so populations can increase quickly. Many BWW overwinter as adults, but often all stages will be present through the winter.

Pest scouting Watch for honeydew, cast skins or adults caught in yellow sticky traps to develop an aesthetic or tolerance or economic threshold and management. Use pre- and post-treatment numbers to evaluate the effectiveness of management actions. Check traps for signs of parasitoids and withhold all but drastic sprays to give natural enemies a chance to build up.

Management—cultural and physical control

Hose off adult whiteflies with water and use yellow sticky cards to reduce numbers.

Management—biological control

The following predators and parasitoids are known to attack this pest in its native states: a wasp parasite *Eretmocerus staufferi*, an entomopathogenic fungus *Orthomyces aleyrodes*, the predatory bug *Orius insidiosus*, and a variety of coccinellid beetles. Other species/biotypes of *Eretmocerus* and *Orius* spp. are available, but their efficacy against *T. abutiloneus* is unclear.

For biology, life history, monitoring and management

See "Whitefly" in:

Common Landscape Pests

Management—chemical control

See "Whitefly" in Table 1:

Chemical Control of Landscape Pests

For further information:

UC IPM Statewide Integrated Pest Management Program. 2016. Identifying Whiteflies.

http://www.ipm.ucdavis.edu/PMG/C783/m783bpwhitefly.html

Southern green stink bug (2015)

In 2015, the southern green stink bug (*Nezara viridula*) was reported south of Seattle, WA near Seattle University and Seward Park. This stink bug was abundant and already reached populations damaging to cherries and raspberries. Their abundance suggests that they may have been in the area for several years.

Pest description and damage Southern green stink bug (SGSB) adults are green, usually with three light dots along the front edge of the triangular pronotum. There are several color variations of this species and sometimes the overwintering adult will change to brown, then back to green in spring. Usually among the adult stink bugs, there will be distinctive patterned nymphs sporting black and white or green and white spots. SGSB can be confused with the more common green stink bug (GSB), but GSB nymphs do not have distinctive spots. Eggs are laid in clusters of about 20-30 eggs each. If you are not sure of the ID, samples can be photographed and submitted to the mapping website [see insert] or taken to county Master Gardener clinics or local Extension offices. Damage depends on the plant part attacked and can include wilting buds, tar spots on fruit or leaves, honeydew or sooty mold, fruit with cat-facing, sunken areas, or dark corky areas within. These stink bugs can become a nuisance when they overwinter in homes, but they do not reproduce in households, nor do they bite people. All stages emit a repugnant odor, which smells a bit like bleach.

Biology and life cycle The southern green stink bug adults overwinter under bark, in leaf litter, or more notably in house walls, attics, and other protected areas. As soon as the spring weather warms, they emerge and start laying eggs. Eggs hatch in five days to three weeks depending on temperature. The first nymphs look like small dark dots and cluster on the eggs for protection. They do not feed until they molt to the second instar a few days later. There are five instars, each taking about 5-7 days to develop. Each instar is distinctly colored with black and white spots. The fifth and final instar will have visible wing buds, a warning that the next stage will be green egg-laying adults. In warmer climates, there are up to four generations a year.

Pest monitoring Several traps are available on the market for commercial growers and homeowners. For small-scale trapping, an aluminum turkey pan with a half-gallon of water and a small amount of detergent soap placed under an incandescent light at night is effective. A variety of pheromone traps can be used to monitor this stink bug species. Sweeping with a net may be useful in shrubbery and low-hanging tree branches. Beating vegetation (including perimeter weeds), bushes, or branches to dislodge both adults and nymphs over a large tray or light-colored sheet. When autumn arrives, check the south and west sides of the home for aggregating stink bug adults. They will work their way inside the home as it gets colder.

Management—cultural control

During late autumn, remove landscape weeds and plant debris where stink bugs will overwinter. Trap crops, such as beans, can attract stink bugs. Consider planting perimeter rows of a trap crop in early spring. Later in the spring, destroy the trap crop when stink bugs are found.

Management—physical control

Remove home-invading stink bugs by hand or with a shop vac. In late autumn or early spring, vacuum aggregating masses from the house siding. Captured bugs should be killed (freezing is recommended) otherwise they may find their way back to host plants. Keep stink bugs out of the home by caulking and sealing all cracks and crevices around doors, windows, faucets, and wires. Screen attic, soffit, and crawl space vents and windows. Remove, or screen window air conditioners where they get in most easily. Use a well-sealed floating row cover to prevent stink bugs from settling on shorter crops.

Management—biological control

There are 71 parasitoids and many predators that are known worldwide to attack stink bugs. As with any invasive pest, it is likely that outbreak conditions will exist for a few years before natural enemies will begin to take their toll and pest numbers will drop to manageable levels.

For Management—chemical control

See "True bug" in Table 1:

Chemical Control of Landscape Pests

For further information:

See "Stink bug" in:

Common Landscape Pests

CABI (Centre for Agriculture and Biosciences). 2016. *Nezara viridula* (green stink bug). https://www.cabidigitallibrary.org/doi/10.1079/cabicompendium.36282

Looney C., M. Tilbury, B. Carman, T. Murray and M. R. Bush. 2019. An Established Population of the Southern Green Stink Bug, *Nezara viridula* (Linnaeus), in Washington State. Proceedings of the Entomological Society of Washington 16, December 2019.

Rose stem girdler (2014)

Justin O'Dea

Latest revision-March 2025

Pest description and crop damage Rose stem girdler (*Agrilus cuprescens*) is a small copper-green-colored beetle in the family Buprestidae. It is a pest of caneberry crops and ornamental brambles (*Rosa* and *Rubus* spp.). RSG is relatively new to the PNW and damage is increasingly being reported throughout the south Puget Sound basin to the Willamette Valley region of western Oregon. It has also been confirmed in the inland PNW. Infestations can reduce berry yield or kill canes. Damage patterns in infested regions or within fields may be highly variable and confined to certain "hotspots" where infestation is particularly heavy, and damage may be severe. Economic loss is most reported in young plantings that are not yet well-established, and/or on primocane varieties grown for fall harvest. Damage to established floricane plantings can be a relatively inconspicuous yield decline, partially due to the infestation going unnoticed. If substantial girdling does not occur before harvest, RSG damage may superficially resemble typical cane senescence after harvest or wilting from Phytophthora root rot. Canes with feeding damage are also more susceptible to winter injury. RSG may commonly begin to infest an area through infested nursery stock/transplants or move incrementally through corridors where wild hosts are abundant. The abundance of wild *Rosa* and *Rubus* species in the western PNW can lead to persistent RSG corridors along roadsides, railroad tracks, fields, and waterways, making eradication impractical.

Adult beetle emergence is dependent on average humidity and temperature thresholds: 1) Pupation requires average daytime temps >50°F and >60% average daily relative humidity, and 2) development into an adult requires average daytime temps >55°F and >70% average daily relative humidity. Therefore, cool and/or dry spring conditions can delay RSG emergence. Once adults have developed, they may stay in canes for 1 to 3 weeks until average daytime temps are >65°F. After this latent period (most commonly early June in the PNW), adults will emerge from the stem, leaving behind a D-shaped emergence hole.

Peak adult emergence and activity may occur over a 2- to 3-week period, but residual activity has been observed to last for up to 8 weeks or longer in the PNW. Individual adults live for ~1 week once they emerge and have been estimated to move up to 300 ft from their emergence location within a season. Prior to egg-laying, adults feed on leaves, which can result in a tattered appearance. Once reproductively mature, females most commonly lay eggs on the basal 1/3 of primocanes or multiple points higher up on older canes. Eggs hatch within two weeks and flat-headed larvae bore directly beneath their eggshells into the canes. Larvae are cream-colored and during early summer feed within the vascular tissue resulting in a characteristic spiral and/or gall-like swelling on canes. Spiral damage patterns may be more prominent on infested second-year canes, whereas prominent galling may be particularly apparent on first-year and/or soft and tender canes. Damage from larvae can eventually have a girdling effect on the cane leading to wilted top-growth beginning in mid-summer through fall. Weakened canes may easily snap, particularly if weighted by ripening berries or during cane-tying/trellising operations. By early fall, most larvae will have moved into the cane pith where they remain until the following year. Larvae do not always remain viable in the cane, which may be partially due to buildups of naturally occurring parasitoid wasps that follow an infestation and reduce RSG activity in the following year. When this happens, infestation symptoms may be apparent, but damage to cane vitality may appear negligible.

Management-chemical control—HOME and COMMERCIAL USE

Diligent, thorough pruning and destroying of RSG-damaged canes can help reduce field populations considerably (up to 80%). Insufficient field cleanup has been observed to lead to buildups of pest populations even when insecticides are used. Larvae are unlikely to survive in canes if pruned out before late summer but can remain viable in canes pruned after they reach their overwintering stage inside the cane pith. If these later-pruned canes are left in the field, they should be thoroughly destroyed and/or tilled below 2 inches to prevent emergence the following year. Generally, any production system where canes are absent when adults are active and/or where canes are mowed after infestation may lessen the risk of in-field RSG issues in a given year. Integrating effective insecticides with pruning practices may provide near-full control of in-field populations, though RSG may still enter fields annually from infested wild hosts on the edges. There are no insecticides specifically labeled for RSG control but a list of caneberry insecticides that are effective on RSG has been published in the Utah State University Extension guide, ENT-178-15. Sprays need to be targeted at the adult beetles to prevent egg-laying. Insecticide applications made before adults emerge are ineffective. Growers may choose to prioritize new/young caneberry plantings and/or fall-harvest primocane varieties for chemical management if necessary. Scouting for RSG can be difficult because beetles are often not abundant enough to be easily spotted but are most likely to be seen on caneberry leaves between late May and mid-June in the western PNW. Once adults have emerged, weekly applications should be applied as full cover sprays, including the basal area of the canes, beginning immediately at adult emergence, and continued while adults are present. Because adults can emerge around bloom, follow all pollinator guidelines that may appear on the pesticide labels.

European chafer (2012)

European chafer (*Rhizotrogus majalis*) is destructive to lawns in the larval stage and feeds on leaves and flowers in the adult stage. This beetle was first found in British Columbia in 2001. It naturally disperses at a rate of about 10 miles per year. In 2012, this species was detected near the Portland airport in Japanese beetle traps and found infesting a lawn near Sea-Tac Airport by a homeowner in 2015.

Description and damage The adult beetle is a plain brown scarab beetle that measures about 0.5 inch long. Males have an array of antenna that fan out like plates, but females have tiny antennae. Adults feed on a variety of leaves although this damage is not significant. Significant damage is

caused by immature beetle, a C-shaped white grub, as it feeds on the root systems under turf. The European chafer grubs feed on the roots, severing the blades from the roots. The grub is white with three distinct and gangly true legs and a bulbous bag at the hind end. It has a good set of mandibles for feeding on roots. Of secondary concern is the damage to a yard caused by raccoons or skunks that dig up and feed on the grubs.

Biology and life cycle European chafer has a single generation in a year. Adults mate and begin laying 20-30 eggs at dusk. The eggs hatch and larvae begin feeding on small roots and work their way up to larger roots. The larvae feed underground all winter. In May, they create a little crater to pupate in and after two to three weeks, the adults emerge.

Pest Scouting Adults begin buzzing about in May-June, sounding like a swarm of bees as they feed and seek mates. Sometimes exhausted beetles are found near porch lights. To monitor for larvae, dig out a patch of sod and look for the C-shaped white grubs in the root zone of the grass. Five to 10 larvae per square foot is the trigger to act.

Management—cultural

Keeping turf healthy with a good root system is likely to slow the damage to the turf. With more roots to feed on, there are also more roots to keep growing while they feed. Compact, drought-struggling lawns will have a tougher time surviving.

Management—biological

Parasitic nematodes hold some promise for management.

Management—chemical control

See "Beetles" in Table 5:

Chemical Control of Landscape Pests

For more information

Murray, T., G. Stahnke, and E. LaGasa. 2012. Pest Watch: European Chafer. WSU Extension. FS071E. https://s3.wp.wsu.edu/uploads/sites/2070/2013/12/European-Chafer.pdf

Red lily leaf beetle (2012)

The red lily leaf beetle (*Lilioceris lilii*) is a European and Mediterranean beetle that feeds primarily on plants in the lily family. Known hosts are true lilies (excluding daylilies) and particularly the Asiatic lilies and fritillaries. RLLB feeds on other plants in the Liliaceae family such as *Polygonatum* spp. (Solomon's seal), *Smilax* spp.; and on *Nicotiana* spp. as well as *Solanum* spp., such as bittersweet nightshade and potatoes. They feed on all the above ground plant parts: leaves, stems, buds and flowers, contaminate hosts with unsightly black frass, and can cause rapid death of plants.

RLLB entered North America via Montreal in 1945. In 1992, it was found in Cambridge, MA and since then has spread to seven east coast states. In 2012, RLLB was found in Bellevue, WA. This pest is most likely to have a substantial impact on the economics, markets, and pesticide use for lily bulb producers, cut flower growers, lily enthusiasts, and for the native host plants.

Pest description and damage The RLLB is bright red and shiny—like red lacquer jewelry. It is 0.25 to 0.375 inch in length with black head, legs, underside, and antennae. Adult beetles can stridulate (squeak) when disturbed. The eggs are initially bright orange when laid, then turn to reddish-brown. Larvae are initially reddish, but later turn to a slimy black as they cover themselves with excrement. Adult RLLB damage consists of chewed leaf edges and holes in the center of the leaf. Young larval RLLB feed by scraping the tissue from the leaf surface and turning the leaf to a slimy mush. More mature larvae chew larger holes in the leaf surface.

Biology and life cycle The RLLB in Bellevue overwintered as an adult in ground litter and emerged with warm weather in late March. Female beetles can lay more than 400 eggs in small groups. In Bellevue, RLLB began laying their red eggs as soon as they emerged in the spring. Eggs are laid in small clusters on the leaf surface. Eggs hatch into larvae that begin feeding on the leaf surface. When mature (3 to 4 weeks), larvae drop to the soil and form a cell in which they pupate. The next generation of adults emerges about 2 to 3 weeks after that.

Pest monitoring Begin watching for holes or specks of black frass on the leaves, or the RLLB adults as soon as the weather warms from mid-March, or when lilies begin to emerge from the soil. In Bellevue in 2013, beetles were found on March 25th when host lilies were barely two inches out of the ground. The beetles may also hide underneath the leaves. If there are several lily plants of high value and early damage is severe, pesticides may be necessary. The best time for control is when larvae are small and vulnerable. Be sure to check less favored, but acceptable, hosts such as other lily relatives, nightshade, nicotiana, or potato.

Management—cultural and physical control

Minimize planting lilies in contiguous plantings. Mixed plantings make it more difficult for beetles to find new host plants. Asiatic hybrid varieties of lilies are most susceptible. Oriental varieties as well as *Lilium henryi* 'Madame Butterfly,' *L. speciosum* 'Uchida,' *L.* 'Black Beauty,*' L. regale*, and *L.* 'Golden Joy' are reported to be resistant varieties to this pest. Hand-pick and kill any beetles, eggs, or larvae.

Management—biological control

There are no parasitoids for this insect that are native to North America. However, parasitoids in the families Ichneumonidae and Eulophidae are known from the beetle's native lands. Several parasitoids of the red lily leaf beetle from Europe have been imported and released in the east coast states with some success.

Management—chemical control

See "Leaf feeding beetles" in Table 2:

Chemical Control of Landscape Pests

Resources

Murray, T.A., E. LaGasa and J. Glass. 2012. Pest Alert: Red Lily Leaf Beetle. WSU Extension. https://pubs.extension.wsu.edu/pest-watch-lily-leaf-beetle-home-garden-series

Mountain ash sawfly (2009)

Mountain ash sawfly (*Pristiphora geniculate*) is a recent addition to pests of American and European mountain ash, (*Sorbus americana* and *S. aucuparia*, respectively), which are commonly planted as ornamental landscape trees and naturalized in parks and woodlands. The insect arrived in the U.S. from Europe in the 1920s. It was found north of Seattle in 2009 and has spread to several counties since.

Description and damage The mountain ash sawfly larvae are gregarious caterpillar-like larvae that feed on the leaves of its hosts. They characteristically consume all but the rachis and midveins of leaflets leaving only a skeleton. The young larvae are yellowish and somewhat translucent. As they mature, they become orange-yellow with distinct black spots. The larvae feed gregariously, lining up along the edge of the leaflets nearly head-to-head, and swing their tail end away from the leaf. In this position, they eat their way to the midrib, then move on to new leaves. Full-grown larvae are between 0.6 to 0.75 inch long. The larvae spin a brownish tan capsule and remain as a prepupa during the winter. When conditions are optimal, they become pupae and then transform into the adult stage. Adults look like small dark flies (but with four wings, they are in the order Hymenoptera: bees, ants, and wasps).

Biology and life cycle Winter is spent in the pupal stage in the soil. In late spring, the adults emerge, mate, and insert eggs into slits in the leaf. These hatch and the tiny first instar larvae line up along the leaf edge and feed. They molt several times until they are fully mature, then pupate in mid-summer. There are two and possibly three generations per year. Pupae are reported to be able to delay emergence for two or three years.

Pest monitoring Scouting should include a periodic visual scan for larvae on leaves. Sticky traps hung from branches can provide evidence of adult emergence. Assess the severity of the infestation. A few bunches of larvae might be ignored early in the spring, but re-evaluate the abundance and damage caused by the second generation. Scouting is encouraged each year as heavily infested trees one year may be free of sawfly larvae the next year.

Management—cultural control

Prune off the clusters of sawflies as soon as they are noticed and remove them to minimize damage to the tree. Early removal reduces the potential for defoliation in mid-summer by the second generation. If the tree is defoliated, provide water and light fertilizer to stimulate new growth.

Management—chemical control

See "Sawfly" in Table 2:

Chemical Control of Landscape Pests

For further information:

Granger, B. 2016. Mountain Ash Sawfly Persists in the Pacific Northwest. Pacific Northwest ISA. https://agsci.oregonstate.edu/nurspest/insects/mountain-ash-sawfly

Elm seed bug (2009)

The elm seed bug (*Arocatus melanocephalus*) has limited distribution in Oregon, Washington, and Idaho. It has also been found in Utah. The elm seed bug is native to southcentral Europe. While we do not know how it arrived, there have been interceptions of the elm seed bug at eastern seaports on imported tile from Italy. Like most introduced insects, numbers are initially low, and the pest is rarely seen until numbers build over several years then it becomes epidemic.

Pest description and damage The elm seed bug is a small (0.33 inch) true bug with rusty red markings on the thorax, wings, and legs, an orange underbelly, and alternating dark and white marks along the edge of the abdomen. The nymphs are brighter and reddish with a black head, similar to the related boxelder bug. Adults and nymphs thrive on the abundant seeds of elms and other trees such as oak or linden. Since they feed on seeds in the trees, they are not a major landscape pest. However, they cause concern when adults and nymphs drop onto decks, congregate on building siding, and then enter homes in large numbers. This occurs in July and August as they seek relief from the heat, in the autumn when they are seeking winter shelter, and again in spring when they leave their sheltered overwintering sites. Both adults and nymphs emit an unpleasant odor.

Pest biology and life cycle The adults emerge from overwintering sites in spring, mate, and lay eggs. While there is only one generation per year, the adults have an extended egg-laying period and both young and adults are present throughout the summer and fall. Eggs hatch and young nymphs go through a series of molts. After each molt, their wing buds become more visible until the final molt when they have fully developed adult wings.

Pest monitoring Watch for adults on house siding, on seeds in the trees, on the ground, or on the siding of buildings during hot periods and in fall.

Management—cultural and physical control

Pest-proof your home including caulking of all cracks and crevices around siding, windows, doorways, faucets, electrical fixtures, etc. Remove adults and nymphs with a shop vac (remember that the vacuum can become odorous from the bugs) when they are congregating. If the problem persists, consider removing elms from your home landscape. Rake or vacuum elm seeds in the fall from siding, walkways, and areas where seed bugs congregate, such as firewood. Inspect boxes, pots, and firewood logs before bringing them inside.

Management—chemical control

See "True bug" in Table 1:

Chemical Control of Landscape Pests

For further information:

Ellis, J. 2013. Elm seed bug, *Arocatus melanocephalus*: an exotic invasive pest new to the U.S. Idaho Department of Agriculture. https://www.landcan.org/pdfs/Spring_2013_ESB_Fact_Sheet_update.pdf

Stokes, B. S., E. Bechinski, & P. Castrovillo. 2016. Managing Elm Seed Bugs around Your Home. University of Idaho Extension CIS 1223. https://www.uidaho.edu/-/media/UIdaho-Responsive/Files/Extension/publications/cis/cis1223.pdf

Seed bugs (2001- 2005)

There are several native seed bugs in the PNW. Examples include the boxelder bug (Heteroptera: Rhopolidae*; Boisia trivittata*), the western conifer seed bug (Heteroptera: Coreidae; *Leptoglosus occidentalis*), some stink bugs (Heteroptera: Pentatomidae) and many others. Between 2001 to 2005, three new seed bugs in the family Rhyparochromidae, or the dirt-colored seed bugs, have been found for the first time in the PNW. The three new bugs are the tuxedo bug (*Raglius alboacuminatus*), the bright-spotted ground bug or common smoke bug (*Rhyparochromus vulgaris*), and the Mediterranean seed bug (*Xanthochilus* saturnius). Little is known about these bugs, possibly because they are not major economic pests. They do cause anxiety among homeowners and often result in costly eradication. Exotic seed bugs are frequently intercepted at port, primarily on pallets of tile and other ceramic products. Italy represents the origin of many of these interceptions.

Pest description and damage To a gardener, these three seed bugs would look rather similar. They are very small (between 0.25 to 0.3 inch long) and flat and are rapid runners. They all have gray heads with bulging compound eyes. When present in the home landscape, they tend to become very abundant.

The tuxedo bug (*R. alboacuminatus*) was reported from Utah in 1999. This bug species has two to three white spots, two light bands around the thorax that are visible when viewed from the side or below, banded legs, and a dark abdomen.

The bright-spotted ground bug (*R. vulgaris*) is found in California and Oregon. It is like a tuxedo bug but has no white rings around the thorax. The legs are uniform in color and the abdomen is light colored.

The Mediterranean seed bug (*X. saturnius*) is larger than the previous seed bugs with even more distinctive markings of black-on-tan. Behind the head is the thorax with a jet black band followed by a band of stippled brown. The large triangle between the wings (scutellum) is also jet black. A light stripe outlines the scutellum, and the posterior edge of the leathery portion of the wing, forming a distinct X. There are also three other jet black blotch markings on the wings. It can be very abundant in grass seed fields in southern Oregon, indicating that it does feed on grass seed. For that reason, it continues to be regulated in foreign trade. Even though they do not cause damage to houses or harm humans or pets, these seed bugs become a huge annoyance and costly to exterminate when they migrate into households.

Biology and life cycle All the seed bugs overwinter as adults in gregarious clusters in protected places such as under bark or tucked in firewood, or walls of buildings. The adults emerge in spring (April or May) as the weather warms, mate, and lay eggs. Small nymphs look like adults without wings. Adults and larvae feed together on the same plant or on seeds that have fallen to the ground.

The seed bugs are found among tall grasses and weeds, fallow fields, and edges of woodlands, especially those areas with bare ground, where they feed on fallen seeds. Hosts listed include Stachys and other Lamiaceae, and Scrophulariaceae (*Verbascum lychnitis*). They also feed on seeds of landscape plants such as elm and poplar, as well as nettle, sage, and raspberry. Eggs are laid in the ground litter, on the soil, or on leafy or woody litter. These bugs are seen running about on the ground, litter, or woody debris; there are few direct observations of them feeding on the plants. It is likely they simply feed on grass and weed seeds lying on the ground. The nymphs become mature adults by July and the new adults begin a second generation. These insects become a major nuisance when they move to irrigated grasses from dry pastures. They are an even greater nuisance when they migrate into houses in prodigious numbers. Their impact on seed production, and survival for plants and grasses is unknown. As regulated insects, they can have economic impacts on trade. They create a nuisance, anxiety, and expense for homeowners. Their impact on fragile ecosystems is unknown.

Pest monitoring Their abundance in landscapes generates calls to nurseries and Extension offices when they are encountered by gardeners or the landscape maintenance crews, or when they become more visible on the foundation and siding of houses as they move into homes for the winter.

Management—cultural control

Management strategies are not needed. If the bugs become objectionable, reduce the amount of bare ground (adding groundcovers) among plantings and pull weeds before they set seed. In houses, seal up all cracks and crevices where they might enter and place screens over windows and doors. A

vacuum or shop vacuum is very effective in removing bugs.

Management—biological control

There is no mention of natural enemies in their country of origin or here in the PNW. Likely small insectivores like salamanders, frogs, lizards and some birds are potential predators. However, these generalist predators are lacking in urban environments. Given the reports of large numbers of seed bugs entering buildings, predators, that are present, do not consume enough prey.

Management—chemical control

See "True Bugs" in Table 1:

Chemical Control of Landscape Pests

For further information:

LaGasa, Eric. 2006. New Pest Alert and Update; Introduced Exotic Seed-Bugs are New and Increasing Nuisance Problems in Areas of Western Washington - *Rhyparochromis vulgaris* and *Raglius alboacuminatus*. https://cms.agr.wa.gov/WSDAKentico/Imported/158-RhyparochromisAndRagliusAlertAndUpdate06.pdf?/158-RhyparochromisAndRagliusAlertAndUpdate06.pdf

Mediterranean seed bug. http://nathistoc.bio.uci.edu/hemipt/Xanthochilus.htm

Viburnum leaf beetle (2001)

The first record of the viburnum leaf beetle (*Pyrrhalta viburni*) in North America was from Ontario, Canada in 1947, although it may have arrived in the early 1900s on nursery stock from Europe. In the U.S., this beetle was found in New York State in 1996. The beetle rapidly spread to neighboring states of Maine, New Hampshire, Vermont, and some of Pennsylvania and Ohio. In 2001, it reached British Columbia. The WSU Master Gardeners found the first Washington specimens in Whatcom County a few years later. In 2015, there were reports of gardeners removing viburnums killed by this beetle. With good scouting and timing of pesticides, or winter shearing to remove eggs deposited at the tips of branches, it should be possible to retain viburnums in our home landscapes.

Pest description and damage The eggs of the viburnum leaf beetle (VLB) are tucked into depressions chewed in the stem at the tips of the new growth. Eggs are covered with a mix of chewed plant tissue and excrement, highlighting the scars on twigs. The tiny larvae are greenish-yellow, becoming more yellow with rows of tiny black blister-like protrusions as they mature. The pupa is small, yellowish with black eyes. The adults are drab brown and quite small (0.2 to 0.25 inches long), but numerous on leaves. Damage to leaves is extensive and varies from brown skeletonized areas, areas of small holes between veins chewed by the older larvae, to oblong holes chewed by the adult. Trees and shrubs can be entirely defoliated. The greatest impact will be for nurseries, growers, arboreta collections, and mature landscapes.

Biology and life cycle VLB overwinters as eggs in the stems of the current season's growth. In spring, they hatch and begin to scrape tissue from the underside of the leaf surface between the veins. As they grow, they can chew through the smaller veins leaving a network of holes. The mature larvae chew larger holes. Mature larvae crawl down the stem to pupate in the soil. The adults emerge and chew oblong holes in the remaining leaf tissue, leaving only the midrib and secondary veins. From egg to adult may take only two months. Adults mate and the females can lay up to 500 eggs. Adults continue feeding until the first hard frost.

Pest monitoring Look for, and remove, the distinctive egg scars on the most current stems during the winter when stems are bare. When infestations are heavy, it may take shearing to remove the branch tips. As the weather warms, check leaves near the tips of twigs for the first small larvae on the undersides of leaves. Next, small holes will appear in leaves. If you wait too long, the leaves will become ratty.

Management – cultural and physical

The VLB feeds on many *Viburnum* species: most susceptible include *Viburnum dentatum* (arrowood viburnums), *V. opulus* (European cranberry bush), *V. opulus* var. *americana* (American cranberry bush), *V. rainesquianum* (Rafinesque viburnum) and *V. sargentii* (Sargent viburnum). However, there are a number of viburnum cultivars that are resistant to VLB. These include resistant species such as *V. plicatum* var. *tomentosum* (doublefile viburnum), *V. carlesii* (Koreanspice viburnum), *V. burkwoodii* (Burkwood viburnum), *V.* x *juddii* (Judd viburnum), *V.* x *rhytidiophylloides* (lantanaphyllum viburnum) and *V. rhytidiophylum* (leatherleaf viburnum). For a complete list of resistant, moderately resistant, moderately susceptible to very susceptible viburnums see http://www.hort.cornell.edu/vlb/suscept.html.

Since larvae crawl down the stem (rather than drop) to pupate, a sticky barrier or up-facing V-shaped tape collar around the trunk may provide some control. Hand-remove the larvae and adults in the morning hours before they warm up and become more active. Striking bushes with a stick over a paper box lid may dislodge beetles and larvae more quickly than handpicking. Populations may be reduced in warm winters when the eggs do not get their required prolonged chilling period.

Management – biological

While natural enemies specific to VLB are unknown in the U.S., generalist predators such as some birds, lady beetle adults and larvae, lacewing larvae and spined soldier bugs nymphs are known feed on larvae. The lady beetle adults and spined soldier bug adults also eat the adult viburnum leaf beetles. Ground beetles and insectivores also could feed on pupae in the soil and litter.

Management—chemical control

See "Leaf feeding beetles" in Table 2:

Chemical Control of Landscape Pests

For further information:

Department of Horticulture Cornell University. 2018. Managing Viburnum Leaf Beetles. www.hort.cornell.edu/vlb/manage.html

Murray, T., E. LaGasa, C. Looney, N. Aflitto. 2016. Pest Watch: Viburnum Leaf Beetle. WSU Extension Publication FS202E. https://pubs.extension.wsu.edu/pest-watch-viburnum-leaf-beetle-home-garden-series