E. Smyers

Spotted Lanternfly Management for Homeowners

Introduction

Spotted lanternfly (SLF), *Lycorma delicatula*, is an invasive planthopper, native to China, that was first detected in 2014 in southeastern Pennsylvania. It feeds voraciously on many plants, including economically important crops like fruit trees, grapevines, hops, hardwoods, and ornamentals. If you think you have SLF, do not panic! First, make sure the insect you are seeing is the spotted lanternfly. Second, learn about its life cycle and habits. Third, determine what plants it is infesting and what it is not. Fourth, employ management strategies at the proper time of the year.

Quick Facts

- SLF is a **destructive invasive pest**, threatening agricultural, timber, and ornamental industries, and the plants in your backyard.
- SLF is currently under **quarantine** in 13 counties in Pennsylvania.
- SLF **does not bite or sting.**
- **Stop the spread** of SLF by checking your car and any outdoor equipment (grills, mowers, firewood, etc.) when going in and out of the quarantine zone.
- Manage SLF on your property by **scraping eggs, banding trees,** removing the favored host **(tree-of-heaven),** and using **chemical control** when appropriate.

Identification and Life Cycle

There is one generation of SLF per year. The eggs are laid in late fall and hatch in the spring. Egg masses are laid on hard surfaces (trees, decks, houses, outdoor equipment, rocks, etc.) and protected with a mud-like covering. Each egg mass contains 30–50 eggs. After hatching and before reaching adulthood, SLF goes through four nymph stages. Nymphs are small (¼ to ½ inch) and hard to find. The first three stages (instars) are all black with white spots, and the last instar is red with white dots and black stripes (Figure 1). SLF adults emerge in July and are active until winter. This is the most obvious and easily detectable stage because they are large (~1 inch) and highly mobile. Adults have black bodies with brightly colored wings. Only the adults can fly. Because SLF adults jump more than fly, their wings often remain closed. SLF wings are gray with black spots, and the tips of the wings are black with gray veins.

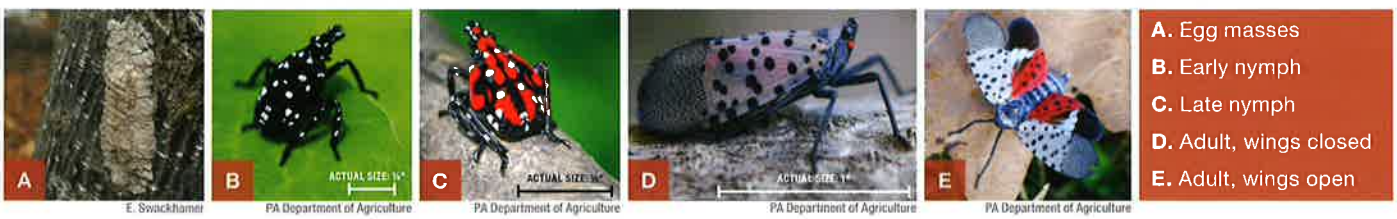

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Figure 1. The life stages of SLF, including an egg mass on a tree.

Current Distribution and Reporting

An SLF quarantine is currently in effect for 13 counties in Pennsylvania (Figure 2). If you are located outside the quarantine zone and find a spotted lanternfly, collect and report it immediately with our online reporting system at **extension.psu.edu/spotted-lanternfly** or by calling 1-888-4BAD-FLY. SLF found within the quarantine zone does not need to be reported.

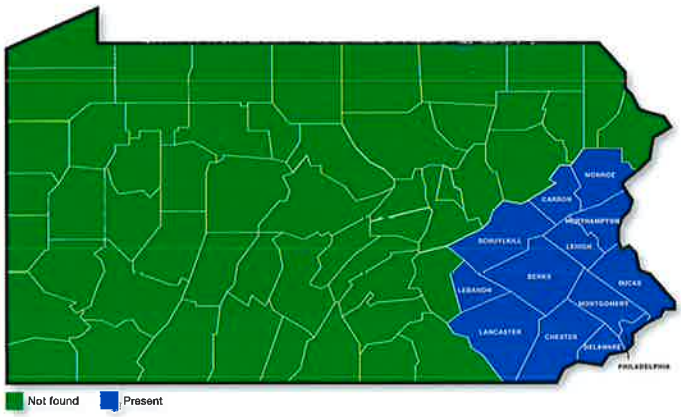

Figure 2. The distribution as of June 20, 2018, of SLF in Pennsylvania, indicated in blue. Check the Pennsylvania Department of Agriculture's website for updated distribution information.

Feeding Damage

SLF is capable of causing serious damage to its host, including oozing sap from the trees, wilting, leaf curling, and even death. SLF feeds using a piercing-sucking mouthpart tapped into the plant like a straw. When SLF feeds, it also excretes honeydew, or sugary water. This creates a sticky surface on and around plants that encourages the growth of black sooty mold. This mold is harmless to people but can cause damage to the plant. If you see black sooty mold or sticky areas on a plant or tree, it may be infested by SLF, but it could also be aphids, leafhoppers, planthoppers, or scale insects. Therefore, it is important to identify the cause of the mold, as control measures may differ for pests other than SLF. There is no way to prevent SLF from moving onto your property. Be aware that SLF is very mobile and management actions must be continuous to keep them off your property.

Management

Stop the Spread

When you travel in and out of the quarantine zone, check your car and outdoor equipment (grills, outdoor furniture, landscaping supplies, mowers, etc.). Check for SLF egg masses from late fall to early spring. Remember that egg masses may be underneath your car or in your wheel well. During all other times of the year, check for nymphs and adults, and keep your windows rolled up when you park. Don't store things or park under infested trees, and don't move firewood.

Steps of Spotted Lanternfly Management

1	Stop the spread
2	Scrape eggs
3	Band trees to catch nymphs
4	Remove tree-of-heaven
5	Apply insecticides

Egg Scraping

Walk around your property to check for egg masses on trees, cement blocks, rocks, and any other hard surface. If you find egg masses on your property from September to June, you can scrape them off using a plastic card or putty knife (Figure 3). Scrape them into a bag or container filled with isopropyl alcohol or hand sanitizer. This is the most effective way to kill the eggs, but they can also be smashed or burned. Remember that some eggs will be laid at the tops of trees and may not be possible to reach.

Figure 3. Scraping SLF egg masses from a tree.

Tree Banding

When the nymphs first hatch, they will walk up the trees to feed on the softer new growth of the plant. Take advantage of this behavior by wrapping tree trunks in sticky tape and trapping the nymphs. Any tree can be banded, but we recommend specifically banding tree-of-heaven, the preferred host, or trees where you see a lot of egg masses or nymphs (Figure 4). Special tape for this purpose can be purchased, though duct tape wrapped backward and tight to the tree also works well. Push pins can be used to secure the band. Adult SLF will avoid tape, so it is essential to band trees in the spring when there are nymphs. Be advised that birds and small mammals stuck to the tape, while rare, have been reported. Check and change traps every other week.

Figure 4. A banded tree with SLF nymphs stuck at the bottom.

Host Removal

Tree-of-heaven (*Ailanthus altissima*) is an invasive plant, but it is common in landscape plantings, agricultural areas, and along the sides of roads. This is the preferred host for SLF and current management efforts are focused on removing this tree. This involves applying an herbicide to the tree and cutting it down from July to September. Failure to apply herbicide will result in new growth from the stump; even when treated, multiple applications may be necessary over time to completely kill the tree. These trees can get very tall, so seek the help of a tree care service if necessary. Tree-of-heaven is named because of its rapid growth, which can reach up to 100 feet tall and 6 feet in diameter. The bark of tree-of-heaven is similar to the outside of a cantaloupe. When crushed, the leaves put off a foul odor that many describe as rotten peanut butter. There are both male and female trees, and only female trees produce seed. They spread by seed and will also produce "clones" by their roots. This tree can be mistaken for other native species, including black walnut, hickory, and staghorn sumac. For help identifying and treating this plant, visit **extension.psu.edu/spotted-lanternfly**. While tree-of-heaven is a preferred host, SLF feeds on a large variety of plants, including many of the trees in your backyard. Removing these may not be preferred; refer to the next section for further guidance.

Chemical Control

Insecticides can be contact, systemic, or both, and may vary greatly in the length of control after application (i.e., residual activity). Contact insecticides kill SLF when the chemical contacts the insect as a direct spray to the adult or nymph, or when the pest walks over a surface with pesticide residue on it. Systemic insecticides are absorbed by the tree through sprayed leaves, roots, and or woody tissue and are moved by its vascular system to other parts of the tree. SLF is killed as it feeds on any part of the tree, even if it was not sprayed directly (e.g., spraying the lower part of the tree will protect the tree tops). Systemic insecticides work best when applied in the spring and early summer, before the more mobile adults emerge. However, they can protect the tree and kill adults depending on the application timing and type. Systemic products will often give contact activity when sprayed directly to live SLF, but contact activity from surface residues is often relatively short as the product is absorbed into the tree.

There are four main methods to apply insecticides: **tree injection** and **bark sprays** (applied by professional applicators), and **soil drench** and **foliar sprays** (can be applied by homeowners). The Pennsylvania Department of Agriculture and the United States Department of Agriculture are currently using the systemic insecticide dinotefuran as injections or

Active Ingredient	Mode of Exposure	Example Products
acetamiprid (neonicotinoid)	systemic/contact	Ortho Flower Fruit & Vegetable Insect Killer
azadirachtin* (botanical)	contact	Neemix 4.5 Insect Growth Regulator
bifenthrin (pyrethroid)	contact	Ortho Bug-B-Gon Insect Killer for Lawns & Gardens, The Anderson's Turf Products Duocide Insect Control, Bug Blaster II Turf Ornamental Insect Control
carbaryl (carbamate)	contact	The Anderson's Turf Products Duocide Insect Control, Sevin Bug Killer, Bayer Complete Insect Killer for Gardens, Ortho Bug-Geta Plus Snail Slug & Insect Killer
dinotefuran (neonicotinoid)	systemic/contact	Ortho Tree & Shrub Insect Control, Zylam Insecticide, Safari Insecticide, Transtect Insecticide
imidacloprid (neonicotinoid)	systemic/contact	Ortho MAX Tree & Shrub Insect Control, Ferti-Lome Tree & Shrub Systemic Insect Drench, Bayer Tree and Shrub Insect Control, Bonide Annual Tree & Shrub Insect Control with SYSTEMAXX
thiamethoxam (neonicotinoid)	systemic/contact	Ambrands AMDRO Quick Kill Lawn & Landscape Insect Killer
soaps*	contact	Concern Insect Killing Soap C, Ortho Elementals Insecticidal Soap, Safer Insect-Killing-Soap

*Organic product

Note: This product list provides an example of products with these active ingredients. It is not an endorsement or specific recommendation.

bark sprays on tree-of-heaven to kill SLF. Both methods work well and have residual activity that lasts from several weeks to several months. These application types, however, can only be applied by certified pesticide applicators, including tree care professionals, and can be costly.

Some insecticides available at your local garden or hardware store can be used as either soil drenches or foliar sprays. Be sure the product is meant for this type of application by reading the product label. Foliar sprays with contact insecticides are applied to surfaces where SLF feeds and walks, which includes the base of a tree, such as tree-of-heaven, where spotted lanternflies are abundant. They can also be applied directly to SLF nymphs and adults. Foliar sprays with systemic insecticides are best applied to leaves and green tissue of trees. This does not need to be the entire tree and can be leaves within your reach. While systemic insecticides can be applied to the bark of trees (bark sprays), they require special penetrants (only available to certified pesticide applicators) to effectively move them into the tree and kill SLF. Systemic insecticides on the leaves of trees will readily move throughout the rest of the tree. Systemic insecticides applied to foliage will be taken up by the tree quicker than systemic insecticides applied with soil drenches.

Soil drenches with systemic insecticides and water are applied into the soil around the trunk of the tree. The insecticide is taken up by the roots and moved into the rest of the tree. Ideally, soil drenches are best applied in the spring to trees such as tree-of-heaven or other favored hosts that have had high SLF populations in the past and are likely to have them again. Soil drenches may take several days or weeks to move into the tree. They should not be used to kill high numbers of SLF as you see them. Depending on the product and rates used, soil drenches have the advantage of longer residual activity (several weeks to several months) over foliar applications.

Currently suggested active ingredients for homeowners, their mode of exposure, and example products are provided in the table. Please note that most products currently available are not registered for use on SLF. These products and their companies are not liable for results when used on SLF. Research is ongoing to find the insecticides that are most effective on SLF, but that are safe to humans, pets, beneficial insects, and the environment. More detailed field trials are being conducted with a wider range of insecticides on SLF in summer 2018 to better understand direct efficacy and the residual activity of various products available to homeowners. We have not yet evaluated nontarget effects of listed products on beneficial insects, including pollinators. We do not recommend treating your entire property because these products are not specific to SLF and beneficial insects may be affected as well. Only treat areas where SLF is abundant.

These recommendations are current as of June 20, 2018, and may change as we learn more. We encourage you to stay up to date by visiting our website. Check the version of this fact sheet (listed below following the publication code number) and always look for the most up-to-date information. When using any pesticide, follow the pesticide label for directions, application rates, methods, and appropriate protective equipment.

Summary

Spotted lanternfly is a destructive invasive pest, threatening agricultural, timber, and ornamental industries, and the plants in your backyard. Together, we can take action to limit the spread and damage from this pest.

- If you find SLF outside the quarantine zone, report it! **extension.psu.edu/spotted-lanternfly** or 1-888-4BAD-FLY
- Don't let SLF spread. Check your car, outdoor equipment, etc., for SLF eggs, nymphs, and adults when moving in and out of the quarantine zone. Don't move firewood.
- Help us reduce SLF populations by scraping egg masses from trees, houses, and anywhere else you find them.
- Band trees to trap and kill nymphs in the early spring.
- Remove tree-of-heaven, the preferred host for SLF.
- If needed, protect your trees by applying insecticides using foliar or soil drench methods or consult a local tree care service. Always follow label instructions when applying any pesticide.
- Keep in touch and stay up to date! Sign up for our newsletter and find new information on SLF at **extension.psu.edu/spotted-lanternfly**.

Prepared by Heather Leach, spotted lanternfly extension associate; David Biddinger, tree fruit research entomologist and research associate professor; and Greg Krawczyk, extension tree fruit entomologist and research associate professor.

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Where trade names appear, no discrimination is intended, and no endorsement by Penn State Extension is implied.

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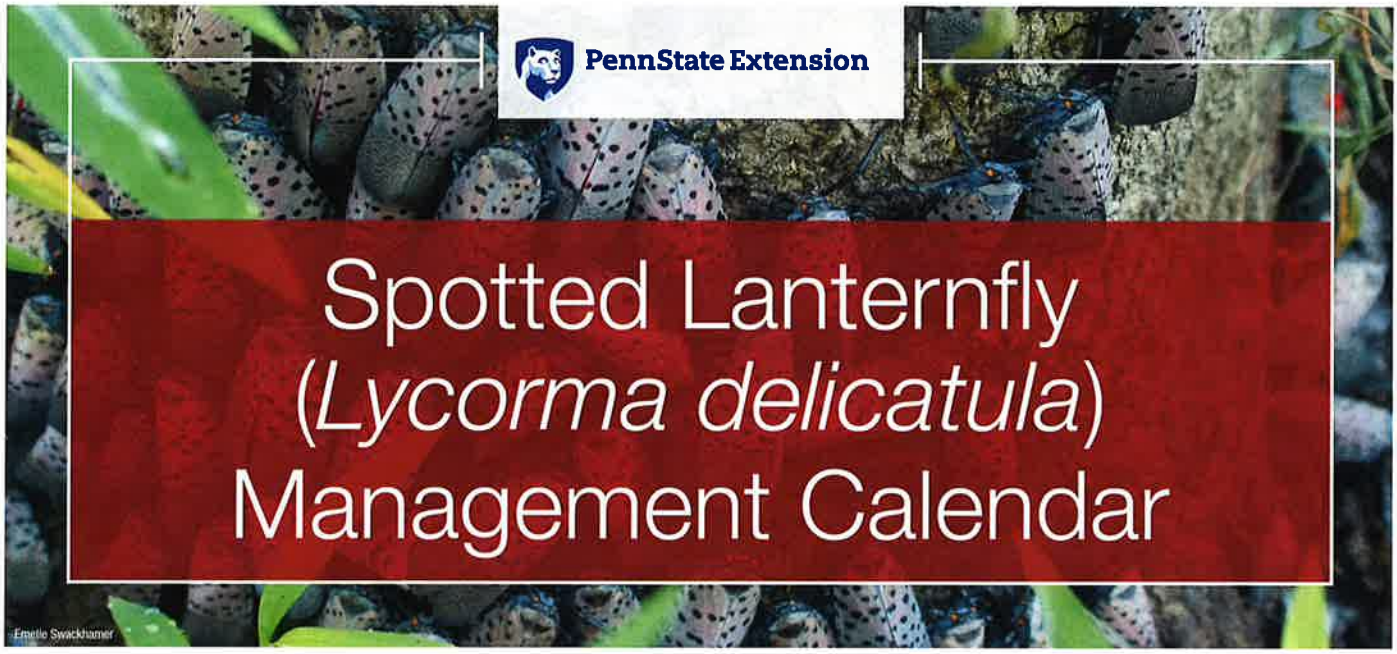

Best Time to Use Management Practices

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Destroy egg masses												
Use sticky bands to capture spotted lanternfly												
Registered insecticides can be effective[1]												
Avoid moving gravid (fertilized) females[2]												
Avoid moving viable egg masses[2]												
Treat most tree-of-heaven (*Ailanthus altissima*) trees with herbicide[1,3]												
Treat tree-of-heaven "trap" trees with systemic insecticides[1,4]												

1 **ALWAYS READ PESTICIDE LABELS AND FOLLOW THE DIRECTIONS.**

2 Before you move outdoor items from the quarantine area, check for spotted lanternfly egg masses, nymphs, and adults and destroy them. To be in compliance with the quarantine order, use the checklist at **www.agriculture.pa.gov/Plants_Land_Water/PlantIndustry/Entomology/spotted_lanternfly/Documents/SLF%20Checklist%2011-12-2014.pdf** when you have to move items from inside the quarantine to outside.

3 Tree-of-heaven is an exotic invasive tree introduced from China. It is dioecious, meaning a tree is either male or female. It grows in colonies that consist of groups of stems all growing from one root system. All of the trees growing from one root system are the same sex. It is best to use male trees as "trap" trees because they do not produce seed. Tree-of-heaven trees will resprout vigorously from their roots after cutting, even if stumps are treated with an herbicide. To control tree-of-heaven trees, treat using foliar, basal bark, or hack-and-squirt herbicide applications from July through September. If tree-of-heaven stems need to be removed, wait 30 days after treatment to cut the trees down. Repeat herbicide applications may be necessary to completely control tree-of-heaven roots. Killing all tree-of-heaven trees may result in spotted lanternflies moving to surrounding plants, increasing pest damage on them.

4 About 15 percent of tree-of-heaven trees should be left alive to serve as trap trees to attract spotted lanternflies. Leave only male, non-seed-bearing trees if possible to limit seed production.

Life Stage Present (one generation per year in Pennsylvania)

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Eggs												
Nymphs												
Adults												

There are several ways to reduce populations of the spotted lanternfly (SLF). Professional pest managers use an integrated approach called integrated pest management (IPM) to eliminate as many SLF as possible while minimizing potential risks to the environment. One IPM method for destroying SLF is using "trap" trees. Thousands of SLF can be killed by one trap tree. The Pennsylvania Department of Agriculture (PDA) is establishing many trap trees in the infested area to kill as many SLF as possible while minimizing pesticide use. Property owners can also establish trap trees on their land or hire a professional service to help them.

How do trap trees work?

Tree-of-heaven (*Ailanthus altissima*) is a preferred host for SLF. In the fall, many SLF adults relocate to feed on tree-of-heaven. To set up trap trees, most tree-of-heaven trees are killed. The remaining tree-of-heaven trees are treated with an insecticide that is moved throughout the entire tree. When the SLF adults feed on the treated trap trees, they ingest the systemic insecticide and die. As additional SLF relocate to feed on the trap trees, they also die.

Steps to establish a trap tree to kill SLF:

1. Identify all tree-of-heaven trees on the site. Spotted lanternflies seem to prefer certain tree-of-heaven trees over others. Locate specific trees that are most attractive to the spotted lanternfly based on the number of insects feeding on them. For information on how to identify tree-of-heaven, see these fact sheets at **extension.psu.edu/tree-of-heaven** or **extension.psu.edu/spotted-lanternfly-identifying-tree-of-heaven-and-some-native-look-a-like**.

2. Treat approximately 85 percent of the tree-of-heaven trees with a properly labeled herbicide. Kill all female tree-of-heaven trees if possible; they produce seed and contribute to the spread of this invasive tree. Leave only a few male tree-of-heaven trees that appear to be more attractive to the insect to serve as trap trees.

   Herbicides recommended to kill tree-of-heaven trees contain the active ingredient triclopyr, which comes in two formulations: water based (amine) and oil based (ester). Both formulations are effective for controlling tree-of-heaven. Other herbicides are effective; but to prevent herbicide injury to trap trees through common root systems, limit herbicide selection to triclopyr. Herbicide application methods effective for controlling tree-of-heaven include foliar sprays, basal bark, and spaced-cut hack-and-squirt applications. Treating cut stumps is ineffective at controlling the tree-of-heaven; it will *not* control the roots. For more information about herbicide application methods, go to **extension.psu.edu/publications/uh174**.

   Herbicide applications made to control tree-of-heaven are most effective when applied from July 1 to September 30, when the plant is exporting sugars to the roots. Applications made outside this window are not effective at controlling the roots and may only injure aboveground growth.

   Cutting tree-of-heaven is often necessary to remove potentially hazardous trees, but it is not useful as a stand-alone control measure. They will resprout vigorously from stumps and roots. In situations where tree-of-heaven stems need to be removed, it is best to treat them with herbicide first and then cut. Allow 30 days for the herbicide to take effect before cutting. For information on how to control tree-of-heaven, see **plantscience.psu.edu/research/labs/weed-ecology/research/wildland-weed-management/publications/invasive-species-quicksheets/ailanthus**.

3. Treat the remaining tree-of-heaven trap trees with an insecticide that will move throughout the tree. For best results, apply the insecticide according to the label in June through August. When spotted lanternflies feed on treated trees, they will die. Systemic insecticides known to be effective and labeled to treat ornamental trees, including tree-of-heaven, contain the active ingredients dinotefuran or imidacloprid. PDA is using dinotefuran to establish trap trees. Treating only trap trees reduces the total amount of insecticide used in comparison to large-scale contact insecticide applications.

Prepared by Emelie Swackhamer, horticulture educator; David Jackson, forest resources educator; and Art Gover, wildland weed management specialist.

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PennState Extension

Spotted Lanternfly: Tips for Handling Yard Waste in Quarantined Areas

The invasive spotted lanternfly has been found in counties in southeastern Pennsylvania. We are trying to contain and control this pest with the goal of future eradication. A quarantine order is in place that prohibits the movement of any living life stage of this insect to areas outside the quarantined area. For information about identifying the spotted lanternfly, where it is known to exist, the quarantine order, and compliance, go to **extension.psu.edu/spotted-lanternfly**.

Learn how to identify spotted lanternfly and report it. Report any capture, photos, or sightings of this insect to **extension.psu.edu/spotted-lanternfly** or 1-888-4BAD-FLY (1-888-422-3359).

Know which counties are included in the quarantine order. Additional counties will be added if new discoveries occur. Check **extension.psu.edu/spotted-lanternfly** for the current quarantine map.

Avoid moving this insect on woody plant debris (e.g., fallen trees or branches and tree trimmings) and any living plants, equipment, building materials, or other objects. Businesses may avoid possible fines by obtaining a spotted lanternfly permit through the Pennsylvania Department of Agriculture (PDA). To obtain a permit, complete the training online at **extension.psu.edu/spotted-lanternfly**. This is a "train the trainer" course to **train designated employees (usually an owner, manager, or supervisor) within a company** on how to comply with the quarantine regulations. The designated employee **must then train fellow employees.** Plant nurseries, nursery stock dealers, and mulch producers should contact their plant inspector for compliance information. In-person training and questions may be directed to SLFPermit@PA.gov.

Inspect yard waste and other items and destroy egg masses. Destroy egg masses by scraping and covering them in alcohol, crushing them, or burning them.

Noncommercial residents should use the compliance checklist when moving items from within the quarantined area to outside areas (see **extension.psu.edu/spotted-lanternfly**).

When working in the quarantined area, if possible chip all woody debris on-site to no larger than 1-inch pieces in each of two dimensions. Even within the quarantined area, moving chips is a better practice than moving larger woody debris. Movement of fallen leaves is not regulated under the spotted lanternfly quarantine, but please check for and destroy any egg masses on leaf bags and containers.

If you can, leave all chips or woody debris on-site. The next best option is to take chips or debris to an organic materials recycler within the quarantined area.

To kill viable insects or eggs in chipped material, the composting procedure below must be followed before moving material out of the quarantined area:

1. Compost piles must be a minimum of 200 cubic yards.
2. Internal temperature at a depth of 18 inches must reach 140°F (60°C) for four continuous days.
3. After the interior of the pile is successfully heat treated, the exterior of the pile needs to be rotated to the center. Using a front-end loader or a bulldozer, remove the outer layer of the compost pile to a depth of 3 feet.
4. Start a second compost pile using the recently removed cover material as a core.
5. Cover this second compost pile by moving the core material from the first compost pile as a cover at least 3 feet deep.
6. Allow the second compost pile to remain undisturbed until the temperature reaches 140°F (60°C) for at least four continuous days.
7. After the chips have been successfully composted according to these directions, the resulting composted material meets compliance requirements.
8. Mulch being offered for sale and moved out of the quarantined area must be certified by PDA. Contact your regional plant inspector for information.

Prepared by Emelie Swackhamer, horticulture extension educator.

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Checklist for Residents
Living in Spotted Lanternfly Quarantine Areas

IMPORTANT: Before you move outdoor items from the quarantine area, check for spotted lanternfly egg masses, adults, and nymphs. Make sure all items are pest free before you move them. Help keep this pest from spreading.

If you find any of these life stages of the Spotted Lanternfly, remove, devitalize, place in a sealed bag, and dispose of bag in the garbage.

Adult Spotted Lanternfly, present in autumn months.

Spotted Lanternfly nymphs, present in spring and summer months. (Images from Park et al. 2009)

Fresh Spotted Lanternfly egg mass (outlined in red). Egg masses are present in autumn and winter months, blending in with their surroundings.

By signing this checklist, I am confirming that I have inspected my vehicle and those items I am moving from the Spotted Lanternfly quarantine area, and do not see any egg masses or insects in or on anything I am moving.

Signature _____ Address _____ Date _____

Please sign, date, and keep this checklist in your vehicle with you – use it each time you need it.

For more information, visit the Pennsylvania Department of Agriculture website:
www.pda.state.pa.us/spottedlanternfly

pennsylvania
DEPARTMENT OF AGRICULTURE

Checklist for Residents Living in Spotted Lanternfly Quarantine Areas

IMPORTANT: Before you move outdoor items from the quarantine area, check for spotted lanternfly egg masses, adults, and nymphs. Make sure all items are pest free before you move them. Help keep this pest from spreading.

Check before you move

Recreational or Camping Items

- ☐ Backpacks
- ☐ Basketball backboards
- ☐ Bicycles
- ☐ Boats/Boat trailers
- ☐ Campers
- ☐ Ice chests
- ☐ Motorcycles
- ☐ Motor homes
- ☐ Recreational vehicles
- ☐ Snowmobiles
- ☐ Tarps
- ☐ Tents
- ☐ Other

Outdoor Household Items

- ☐ Barrels
- ☐ Cardboard or wooden boxes
- ☐ Outdoor poles
- ☐ Plant containers
- ☐ Firewood
- ☐ Propane or oil tanks
- ☐ Trash cans
- ☐ Refrigerators/Freezers
- ☐ Storage sheds
- ☐ Shutters
- ☐ Storm/Screen doors and windows
- ☐ Window awnings
- ☐ Outdoor furniture
- ☐ Other

Building Materials

- ☐ Bricks/Cinder blocks
- ☐ Cement mixing tubs
- ☐ Lumber
- ☐ Roofing materials
- ☐ Tools and toolboxes
- ☐ Workbenches
- ☐ Skidsters/Forklifts
- ☐ Pipes
- ☐ Other

Yard and Garden Items

- ☐ Dog houses, rabbit sheds, chicken coops, etc
- ☐ Barbecue grills
- ☐ Carts
- ☐ Cold frames
- ☐ Fencing
- ☐ Garden tillers
- ☐ Yard decorations
- ☐ Garden tools
- ☐ Backhoes
- ☐ Lawnmowers
- ☐ Signs and posts
- ☐ Storage sheds
- ☐ Tractors and trailers
- ☐ Trees, shrubs and plants
- ☐ Other

Children's Playthings

- ☐ Play houses
- ☐ Kiddie pools
- ☐ Bicycles, scooters
- ☐ Sandboxes
- ☐ Other

PennState Extension

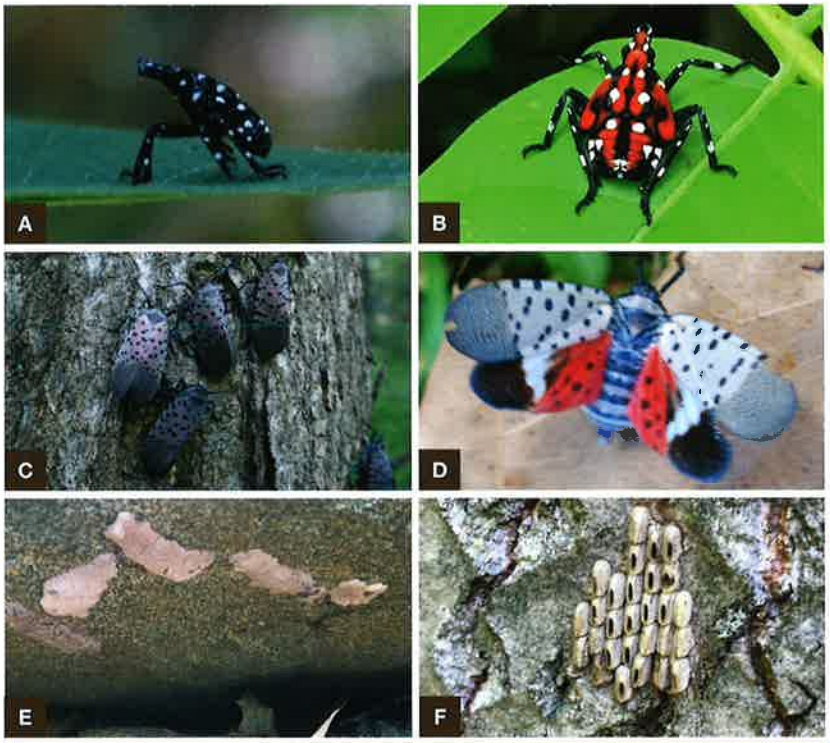
How You Can Comply with the Spotted Lanternfly Quarantine Regulations

There is a new invasive insect in southeastern Pennsylvania, *Lycorma delicatula*, commonly known as the spotted lanternfly (SLF). This insect has the potential to be harmful to grapevines, hops, tree fruit, and trees. To try to limit the spread of SLF, the Pennsylvania Department of Agriculture (PDA) has established a quarantine order in counties where SLF already exists. All residents and businesses must comply with the regulations. PDA has the authority to fine anyone who willfully violates the quarantine order.

Here are some tips to help you avoid spreading SLF and be in compliance with the regulations.

1. Learn about which counties are included in the quarantine order. The area of the quarantine will continue to change as new discoveries are made. As you move within and out of the quarantined area, you must make sure that you are not transporting any living life stages of the SLF to new areas. If you believe you have discovered SLF, report your discovery online at **extension.psu.edu/spotted-lanternfly** or call 1-888-4BAD-FLY (1-888-422-3359). The most recent quarantine map can always be found at **extension.psu.edu/spotted-lanternfly**.

2. Learn about what SLF looks like in every stage of its development throughout the year.



A. The young nymphs are black with white spots and can be present from April through July.

B. The older nymphs are black and red with white spots and can be present from July through September.

C. The adults (shown at rest) can be present from July until late December. The adults are 1 to 1¼ inches long.

D. Adults will show their red underwings when disturbed.

E. The egg masses can be on trees, rocks, or any other solid object and can be present from September through June.

F. The empty remains of the eggs that have hatched can be found at any time of the year.

To see additional pictures of SLF, go to **extension.psu.edu/spotted-lanternfly-what-to-look-for**

3. Avoid parking or storing things under trees in infested areas. The female SLF often lays eggs on objects that are under the trees she is feeding on. You should try to change your habits about where you park. Park vehicles in open fields, away from tree lines, or in a closed garage if possible. You should not store things that you might need to move to outside of the quarantined area under infested trees. These things include firewood, tools, construction supplies, equipment, or any other solid object.

4. Inspect all items that you need to move from within the quarantined area to areas outside the quarantined area. You should remove and destroy any SLF that you find before you move the item. Also check all vehicles, trailers, campers, and equipment, including around windshield wipers, grills, wheel wells, and truck beds. Inspect plant material, woody debris, lawn furniture, construction supplies, tools, and all solid objects. Destroy mobile stages of SLF by crushing them. Destroy eggs by smashing them or scraping them into a container of rubbing alcohol.

5. All businesses should get a permit issued through PDA. A permit provides evidence that you have completed training about how to follow the rules of the quarantine order and you agree to do all you can to ensure the items you transport are not carrying SLF. You will receive documentation for your vehicles to show that you have obtained the SLF permit from PDA. To obtain a permit, take the training online at **extension.psu.edu/spotted-lanternfly**. This is a "train the trainer" course to train designated employees (usually an owner, manager, or supervisor) within a company on how to comply with the quarantine regulations. The designated employee must then train fellow employees. In-person training and questions may be directed to **SLFPermit@PA.gov**.

6. Use the checklist for residents if you need to move items that are not included in a permit through a business. This checklist is a legal document to show that you have inspected the item, removed and destroyed any living life stages of SLF, and are in compliance. You can print the checklist, fill it out, sign it, and take it with you when you move the item(s). The checklist is available at **extension.psu.edu/spotted-lanternfly**.

7. If you sell plants, have them inspected by PDA to receive a phytosanitary certificate. Pennsylvania law requires horticultural businesses that produce and/or sell plants to have either a Nursery/Greenhouse License or a Nursery Dealer's License. When you have a license, plant inspectors will check your plants. For more information, see **www.agriculture.pa.gov/Plants_Land_Water/PlantIndustry/plant-health/Phytosanitary/Pages/default.aspx**.

8. If you sell and/or produce mulch, you must use specific practices to ensure it does not harbor SLF. The specific practices are outlined at **extension.psu.edu/spotted-lanternfly** under Spotted Lanternfly Management. You will need to enter into a compliance agreement with PDA.

These regulations do not apply to grass clippings or autumn leaf collection. We believe that the spotted lanternfly does not lay eggs on these lightweight objects. Clippings and leaves may be moved from the quarantined area if necessary, as long as the truck and/or trailer you are hauling them with has been checked.

The regulations of the quarantine order are in place to prevent the spotted lanternfly from being spread by people. This pest is not just a concern to agricultural and horticultural professionals, it is a community concern. To protect the agriculture industry, we need everyone to be aware of the best practices to avoid spreading the spotted lanternfly and use these practices in their daily activities.

You can find the official quarantine order, a summary in plain language, and more information at **www.agriculture.pa.gov/Plants_Land_Water/PlantIndustry/Entomology/spotted_lanternfly/quarantine/Pages/default.aspx**.

If you do not have access to the Internet, contact the Penn State Extension office in your county to receive copies of the checklist for residents or to access the online permit training.

Prepared by Emelie Swackhamer, horticulture extension educator.

Photo D: PA Department of Agriculture; all other photos: Emelie Swackhamer.

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Background

Tree-of-heaven, commonly referred to as ailanthus, is a rapidly growing deciduous tree native to a region extending from China south to Australia. It was first introduced into the United States in the Philadelphia area in 1784. Immigrants later introduced tree-of-heaven to the West Coast in the 1850s. It was initially valued as an urban street tree and was widely planted in the Baltimore and Washington, D.C., area. From these areas, tree-of-heaven has spread and become a common invasive plant in urban, agricultural, and forested areas.

Description

Size: Tree-of-heaven has rapid growth and can grow into a very large tree, reaching heights of 80 to 100 feet and up to 6 feet in diameter.

Bark: The bark of tree-of-heaven is smooth and green when young, eventually turning light brown to gray, resembling the skin of a cantaloupe.

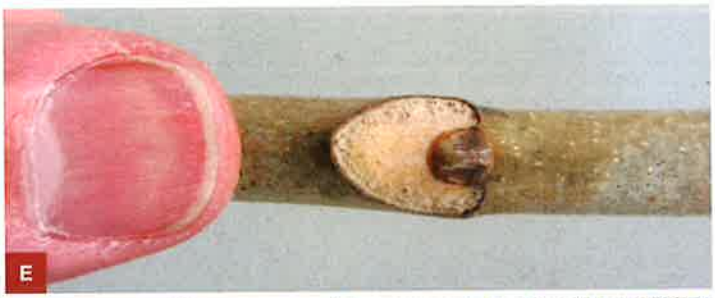
Leaves: Tree-of-heaven leaves are pinnately compound, meaning they have a central stem in which leaflets are attached on each side. One leaf can range in length from 1 to 4 feet with anywhere from 10 to 40 leaflets. The leaflets are "lance" shaped with smooth or "entire" margins. At the base of each leaflet are one to two protruding bumps called glandular teeth. When crushed, the leaves and all plant parts give off a strong, offensive odor.

Twigs: The twigs of tree-of-heaven are alternate on the tree, stout, greenish to brown in color, and lack a terminal bud. They have large V- or heart-shaped leaf scars. The twigs easily break to expose the large, spongy, brown center, or pith.

Seeds: Seeds on female trees are a 1-to-2-inch-long twisted samara, or wing. There is one seed per samara. The samaras are found in clusters, which often hang on the tree through winter.

Dispersal

Tree-of-heaven is dioecious, meaning a tree is either male or female, and typically grows in dense colonies, or "clones." All trees in a single clone are the same sex. Female trees are prolific seeders with the potential to produce more than 300,000 seeds annually. The single-seeded samaras are wind dispersed. Established trees continually spread by sending up root suckers that may emerge as far as 50 feet from the parent tree. A cut



A. Bark
B. Leaf
C. Leaf margin
D. Brown spongy pith
E. Leaf scar
F. Seeds (samaras)
G. Close up of seeds (samaras)

Photos by Dave Jackson

or injured ailanthus tree may send up dozens of root sprouts. Sprouts as young as two years are capable of producing seed. Tree-of-heaven produces allelopathic chemicals in its leaves, roots, and bark that can limit or prevent the establishment of other plants.

Site

Tree-of-heaven grows almost anywhere, from mine spoil in full sun to fertile, partly shaded, alluvial soils along rivers and streams. Besides urban areas, tree-of-heaven is now found growing along woodland edges, roadsides, railways, fencerows, and in forest openings. Tree-of-heaven is intolerant of shade and cannot compete under a closed forest canopy but will quickly colonize disturbed areas, taking advantage of forests defoliated by insects or impacted by wind and other disturbances.

Management Calendar

The management calendar for tree-of-heaven emphasizes late season treatment to maximize control of the roots.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Bud Break				■								
Flowering and Seed Ripening						■	■					
Foliar or Stem Treatment							■	■	■	■		
Cutting after Treatment	■	■	■	■							■	■

Treatment and Timing

Prescriptions for controlling tree-of-heaven stress proper timing of operations to maximize injury to the roots. Improper timing will result in treatments that provide "top kill" (shoot injury) but little control of the roots. Product names reflect the current Pennsylvania state herbicide contract; additional brands with the same active ingredients are available.

Treatment	Timing	Herbicide	Product Rate	Comments
Foliar Application	July 1 to onset of fall color	AquaNeat (glyphosate) plus Garlon 3A or Vastlan (triclopyr amine)	3 quarts/acre plus 2 quarts/acre or 1.5 quarts/acre	The combination of glyphosate and triclopyr provides a broad-spectrum treatment that is effective against tree-of-heaven and other woody species that should also be targeted during the operation. This is a nonselective mixture, but it has little soil activity and poses little risk to nontarget organisms, and both products have aquatic labeling. A surfactant (e.g., Alligare 90) needs to be added. If using a different glyphosate product, be sure to check the product label to see if a surfactant is needed (some come premixed).
Basal Bark	July 1 to onset of fall color	Pathfinder II or Garlon 4 Ultra (triclopyr ester)	Ready-to-use or 20%, 1:4 in basal oil	Pathfinder II is a ready-to-use oil-based formulation of triclopyr used for basal bark applications. Treat stems up to 6 inches in diameter by wetting the entire circumference of the lower 12 to 18 inches, without runoff; apply a shorter band to small-diameter stems. This technique is best suited for treating small infestations or as a follow-up to treat surviving stems after a foliar application. If stems are larger than 6 inches in diameter, use hack-and-squirt.
Hack and Squirt	July 1 to onset of fall color	AquaNeat (glyphosate) or Garlon 3A or Vastlan (triclopyr amine)	Use either product undiluted or 1:1 with water	Glyphosate or triclopyr in water are effective for hack-and-squirt treatments. It is essential to space the cuts, leaving intact bark between them. If the stem is completely girdled, the herbicide cannot translocate to the roots. A simple guideline for the number of hacks is one per inch of diameter, with a minimum of two. Spray herbicide solution into hacks immediately using a squirt bottle, filling the cuts. This treatment is best suited for low stem numbers and stems at least 1 inch in diameter.

Look-alikes

This species is easily confused with some of our native species that have compound leaves and numerous leaflets, such as staghorn sumac, black walnut, and hickory. The leaf edges of these native trees all have teeth, called serrations, while those of tree-of-heaven are smooth. The foul odor produced by the crushed foliage and broken twigs is also unique to tree-of-heaven.

Control

Due to its extensive root system and resprouting ability, tree-of-heaven is difficult to control. Treatment timing and following up the second year are critical to success. Mechanical methods, such as cutting or mowing, are ineffective, as the tree responds by producing large numbers of stump sprouts and root suckers. When cutting tree-of-heaven is necessary to remove potentially hazardous trees, it is best to treat with an herbicide first, allow 30 days for it to take effect, and then cut.

Hand pulling young seedlings is effective when the soil is moist and the entire root system is removed. Small root fragments are capable of generating new shoots. Seedlings can be easily confused with root suckers, which are nearly impossible to pull by hand.

To control tree-of-heaven, target the roots with systemic herbicides applied in mid- to late summer (July to onset of fall color) when the tree is moving carbohydrates to the roots. Herbicide applications made outside this late growing season window will only injure aboveground growth. Following treatment, repeated site monitoring for signs of regrowth is critical to prevent reinfestation.

Herbicides applied to foliage, bark, or frill cuts on the stem are effective at controlling tree-of-heaven. Cut stump herbicide applications encourage root suckering and should not be utilized. Apply all treatments no earlier than July 1 up until the tree begins to show fall colors. There are many effective herbicides available for use on tree-of-heaven, including dicamba, glyphosate, imazapyr, metsulfuron methyl, and triclopyr. For most treatments we recommend using herbicides containing the active ingredients glyphosate or triclopyr.

Foliar herbicide sprays are used where tree height and distribution allow effective coverage without unacceptable contact with nearby desirable plants. Treatments are applied in mid- to late growing season with equipment ranging from high-volume truck-mounted sprayers to low-volume backpack sprayers.

For dense or extensive infestations, treat initially with a foliar application to eliminate the small, low growth. Then follow up with a bark or frill application on the remaining larger stems. The initial foliar application will control most of the stems, while the follow-up stem treatment controls missed stems or those too tall for adequate coverage.

Basal bark applications provide a target-specific method for treating tree-of-heaven that in general is less than 6 inches in diameter. Using a low-volume backpack sprayer, a concentrated mixture of herbicide containing the ester formulation of triclopyr in oil is applied from the ground line to a height of 12 to 18 inches, completely around the stem. To maximize translocation to the roots, apply herbicides from mid- to late summer.

Frill herbicide applications, called hack-and-squirt, are highly selective with a concentrated herbicide solution applied directly into the stem. For effective hack-and-squirt applications, apply the herbicide solution to spaced cuts around the circumference of the stem. Leaving uncut living tissue between the frill cuts allows the herbicide to move to the roots. Again, make applications in mid- to late summer.

Well-established tree-of-heaven stands are only eliminated through repeated efforts and monitoring. Initial treatments often only reduce the root systems, making follow-up measures necessary. Persistence is the key to success.

Human Health Concerns

Tree-of-heaven can affect human health. The tree is a very high pollen producer and a moderate source of allergy in some people. In addition, a few cases of skin irritation or dermatitis have been reported from contact with plant parts (leaves, branches, seeds, and bark) and products. Symptoms often vary and depend on several factors, including the sensitivity of the individual, the extent of contact, and the condition of the plant or plant product. There are rare reports of myocarditis (inflammation of the heart muscle) from exposure to sap through broken skin, blisters, or cuts. People who have extensive contact with the tree should wear protective clothing and gloves and be careful to avoid contact with the sap.

Prepared by David R. Jackson, forest resources educator, and Art Gover, research support associate, Wildland Weed Management Program.

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