PennState Extension

Spotted Lanternfly Management Guide

Publication providing comprehensive details on the spotted lanternfly, including identification and life cycle; quarantine and distribution; host range, p damage; and management.

Introduction

Spotted lanternfly (SLF), *Lycorma delicatula*, is an invasive planthopper that was first detected in North America in 2014 in southeastern Pennsylvani other U.S. states. It is native to parts of Asia.

SLF feeds voraciously on many economically important crops like grapevines, hops, ornamental landscape plants, and many tree species. Heavy SLF f contributed to the death of grapevines, the invasive tree *Ailanthus altissima* (tree-of-heaven, or TOH), and black walnut saplings. While SLF feeding c cause localized branch damage, it is not known to directly kill other plants. SLF feeding is considered a plant stressor and may contribute to the long-t established plants and trees. It is currently considered to be primarily a nuisance pest in residential landscapes.

This guide will review important aspects of the biology and behavior of SLF and management options.

Where is SLF Found?

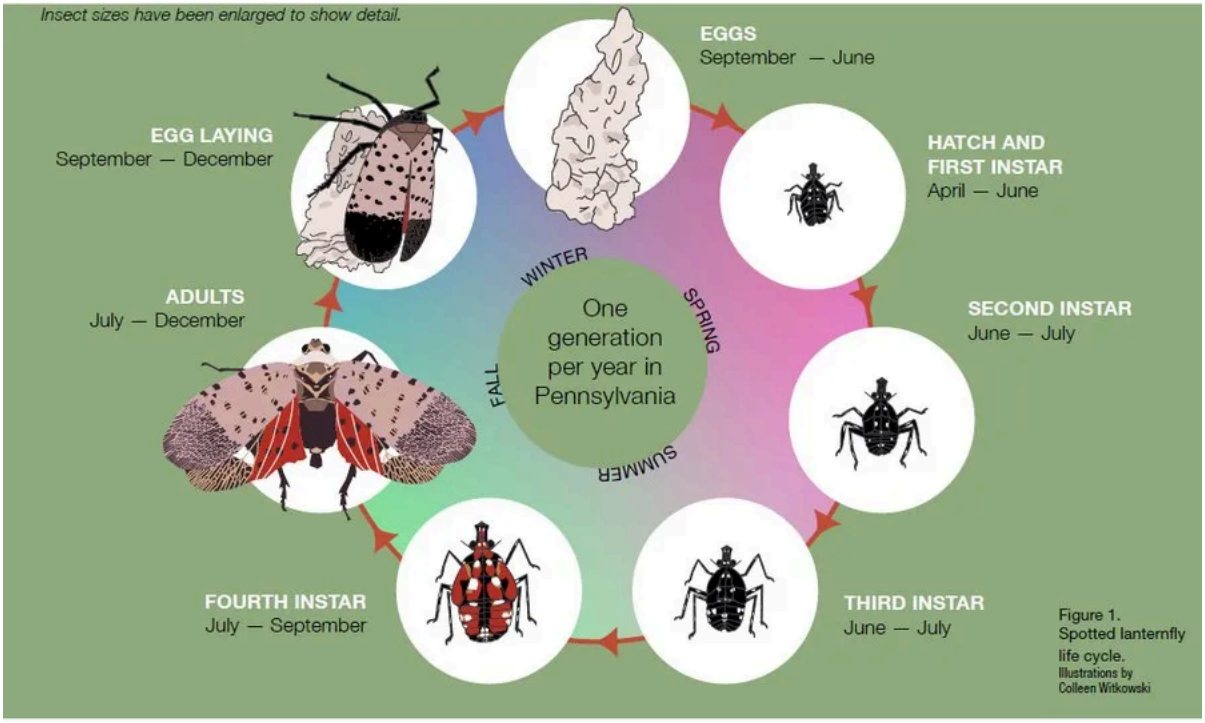
Follow this QR code to the current distribution map(https://cornell.app.box.com/v/slf-distribution-map-detail) from the New York State Integrated Pest Program.

(https://extension.psu.edu/media/wysiwyg//extensions/catalog_product/36203ce3718547c798adbc72de2ee7e0/e/e/ee0524-qr-code-png.png)

(https://extension.psu.edu/media/wysiwyg//extensions/catalog_product/3be9ca0063d74593b592046ee9720135/s/l/slf-adults-on-tree_1.jpg)
Photo credit: Michael Houtz, Penn State

Quick facts

- SLF is an invasive pest that feeds on a large variety of plant species, including those in the agricultural, timber, and ornamental industries, and ba
- SLF is a significant pest of grapes.
- SLF is currently under quarantine in most counties in Pennsylvania, in addition to several other states.
- SLF cannot bite or sting. They feed on plant sap through a tiny, straw-like mouth part.
- SLF is a plant stressor that, in combination with other stressors (e.g., other insects, diseases, weather), can cause significant damage to its host. the tree.
- Slow the spread of SLF by checking your vehicle and any outdoor equipment (furniture, mowers, firewood, etc.) when going in and out of the qu
- Manage SLF on your property by promoting plant health, destroying eggs, using traps, and using chemical control when appropriate. Use the ma section to determine which actions are best to take.



(https://extension.psu.edu/media/wysiwyg//extensions/catalog_product/d3b89e4398ca4bd4b86c8f01a2d833d1/s/l/slf-life-cycle.jpg)
Figure 1. Spotted lanternfly life cycle.

Identification and Life Cycle

There is one generation of SLF per year in Pennsylvania (Figure 1). The eggs are laid in the fall (September to December) and hatch in the spring (late masses are laid on the surfaces of trees, decks, houses, outdoor equipment, rocks, etc., and are protected with a mud-like covering (Figure 2). Each eg average of about 35 individual eggs. After hatching and before reaching adulthood, SLF goes through four nymphal stages (wingless) called instars. N nymphs are small (~1/8 inch) and can be hard to find, and may be mistaken for small ticks or spiders. With each molt to the next instar, the nymphs rc The first three instars are black with white spots. The last (fourth) instar is red with white dots and black stripes and roughly 1/2 inch long. SLF nympl strong jumpers. In Pennsylvania, SLF adults begin to emerge in July and remain active as adults until they are killed by hard freezes later in the fall. Ad obvious and easily detectable stage because they are large (about 1 inch) and highly mobile. Adults have black abdomens with yellow bands that bec mature. Their forewings are gray with black spots, and the tips are black with gray veins, while their hind wings are red, black, and white. Only the ad can fly. However, because SLF adults walk more than fly, their wings often remain closed, leaving only the forewings visible. This makes them more d low numbers, from a distance, or when they are high in a tree. See Table 1 for a comparison of nymph and adult behavior.

Figure 2. Variations in egg mass appearance. Credit: Heather Leach and Emelie Swackhamer, Penn State.

Table 1. Nymphs versus adults: how does behavior differ?

Characteristic	Nymphs	Adults

Characteristic	Nymphs	Adults
Appetite	Nymphs feed on sap from the tender new growth of herbaceous and woody plants.	Adults feed on sap in the twigs, branches, and trunks of woo vines, and shrubs).
Feeding location	Nymphs feed on sap from herbaceous plants, and from the new growth of shrubs and trees (often near the tops of trees, making them difficult to see or reach).	Young adults will feed throughout woody plants; in the fall, t from the trunks/branches.
Movement	Nymphs are in near constant motion when they are not feeding. They climb any trees that they encounter and then launch or "fall" from the crowns and move to the next plants. They often move in groups from plant species to plant species and may only remain on the same plant for a day or two. Group aggregation increases with each life stage.	Adults tend to stay on the same plant longer (except during activity). Adults often choose a favorite or "hot" tree where they gath numbers for several weeks later in the season. This can occu that appear similar (same cultivar, age, growing conditions, a etc.). If you have observed a hot tree that SLF adults preferre there is a good possibility that they will return to that tree in These hot trees are good candidates to target with systemic
Damage	Nymphs ingest less volume of tree sap than the adults, so a population of nymphs is thought to be less damaging than the same number of adults would be. Large numbers of feeding nymphs can damage perennials and annuals and cause dieback of individual tree branches.	Heavy feeding has contributed to the death of grapevines, T walnut saplings. High levels of SLF feeding may increase tre photosynthesis activity and nutrient levels. Damage may be plant is already stressed by other factors.
Management in Landscapes	Contact insecticides may be used to control nymphs. It may be difficult to get a systemic insecticide in place in time to kill young SLF nymphs because nymphs move often. For these reasons, systemic insecticide applications are usually used to target the adult stage rather than the nymphs.	Contact insecticides may be used to control SLF adults beca feed on the lower parts of trees where they are more visible with direct sprays. Properly applied systemic insecticides can provide months o continuing to kill SLF adults as they arrive.
Other considerations	To protect pollinators that visit flowers for nectar, never spray any insecticide on plants that are blooming. Using insecticides to kill SLF nymphs will not prevent SLF from coming onto your property later in the season.	Promoting plant health may help reduce the stress of SLF fe Using insecticides to kill SLF adults will not keep more SLF a onto your property.

The comparisons above are a good rule of thumb, but SLF don't always conform to them! Observe what is happening with the SLF on your property t management decisions.

Quick ID

- Egg masses are covered with a gray-brown substance, flat, and laid on many surfaces, most commonly trees.
- SLF are strong jumpers; both nymphs and adults often jump when prodded or approached.
- Early nymphs have black bodies with bright white spots.
- Fourth instar nymphs are colorful (red, black, and white) and roughly 1/2 inch long.
- Adults have hind wings with red patches, and gray forewings with black spots and veins. When folded, only the forewings are visible and provide camouflage against tree bark.

Current Distribution and Quarantine

Currently, SLF has become established in several U.S. states. The spread of SLF in the current range is most likely due to a combination of (1) natural growth and (2) human-assisted movement (hitchhiking), often along rail lines and highways. To protect vulnerable plants and industries, it is importar SLF to new areas. Many affected states have enacted quarantine orders to try to reduce accidental human-assisted spread of SLF. The quarantine or

being moved from known infested areas be inspected and SLF destroyed before shipment. The quarantines affect all residents and businesses. All bu operations within any quarantined county in Pennsylvania are required to get an SLF permit(http://extension.psu.edu/spotted-lanternfly). Complying v requires businesses to document their inspections and preventive actions. Residents should also check their belongings for all life stages of SLF befor leaving a quarantined county. Use the Checklist for Residents (http://www.agriculture.pa.gov/Plants_Land_Water/PlantIndustry/Entomology/spotted_lanternfly/quarantine/Documents/SLF_Checklist_for_Residents with inspection before traveling.

What You Need to Know

- Everyone should check their belongings, vehicles, etc. for all life stages of SLF before traveling, especially if leaving a quarantined county.
- Businesses and organizations that conduct business within any quarantined county are required to get an SLF permit.
- There is no fee to get an SLF permit and compliance ensures that goods and conveyances have been inspected and are considered free of SLF b
- Plant nurseries and many other businesses may also need a compliance agreement. Contact the Pennsylvania Department of Agriculture (PDA)

(https://extension.psu.edu/media/wysiwyg//extensions/catalog_product/4b257a4f45ff478595ace3724c67de54/s/l/slf-front_1.jpg)
Photo Credit: GH Photos Alamy Stock.

Feeding Damage and Seasonal Variation

Feeding Damage

SLF feed on plant sap using piercing-sucking mouthparts (Figure 3). They acquire nutrients from the plant sap and also rely on associated bacteria in their nutritional requirements. The sap they ingest contains high amounts of sugar, which is not completely digested by the insect. They excrete the e substance called **honeydew**, which can build up below the feeding insects. On sunny days, honeydew can be seen falling from trees, resembling a ligl attractive to ants, wasps, bees, and other sugar-loving insects. As the honeydew accumulates, it is often colonized by sooty mold (fungi). Sooty mold plants or the surfaces on which it grows, but it does physically cover leaves, reducing photosynthesis. With dense groupings of SLF, understory plant the sooty mold buildup on their leaves. Sooty mold frequently stains objects such as tree trunks, decks, patios, and vehicles that are underneath affect can be very difficult to remove.

Consequences of direct feeding damage by nymphs and adults to the host trees vary greatly by host species, numbers of SLF feeding, and environme
SLF feeding can stress plants and cause localized branch damage, **it is not known to kill plants except for grapevines, TOH, and black walnut sapli**
considered a plant stressor and may contribute to the long-term weakening of established plants and trees. SLF feeding has been linked to sugar and
changes in host plants. Plants studied have reacted differently by species, but it is clear that large groups of SLF feeding on host plants manipulate hc
phytochemistry impacting sugar and carbohydrate storage.

(https://extension.psu.edu/media/wysiwyg//extensions/catalog_product/6fd95954d1f24084bfe75454b37bb816/n/y/nymphs-feeding-on-honeydew_
Figure 3. SLF feeding on sap and excreting honeydew, and sooty mold growing on leaves. Credit: Brian Walsh

Seasonal Host Preference

SLF has an extremely broad host range and has been recorded feeding on over seventy different plant species. Conifers are not considered to be gooc
Despite their broad host range, some plants are more favorable to SLF than others. Numerous factors may determine the attractiveness of a particula
plants species are available or absent in the nearby landscape, the health of the plant, time of year, SLF population size, and how long SLF has been p
Nymphs, in particular, have an especially large host range that includes tender plant growth, whereas adults seem to depend more on certain hosts, p
of trees and vines.

Table 2 shows some key plant hosts of SLF and the time at which they are most likely to be found on these hosts; it does not represent a comprehens
feeds on, but rather the patterns of SLF feeding that have been observed through the season. As plants begin to lose their leaves at the end of the gr
are less likely to serve as hosts for SLF. The patterns in host use may change with varying weather conditions, by region, and from other factors as ye

We strongly recommend scouting the area to determine which plants SLF prefer in your landscape throughout the season. These patterns can help
management actions, if any, to take. We emphasize that **not every tree in already-infested areas needs to be treated**. Scout the area first and then c
populations are found and persist.

If you find SLF in new areas where they have not been found before, be sure to report it to your state's agriculture authorities or by calling 1-888-4BA

(https://extension.psu.edu/media/wysiwyg//extensions/catalog_product/b781489cdd5241cfb9b1a66908256258/s/l/slf-nymphs-on-rose-bush_1.jpg)
Credit: Brian Walsh, Penn State

Will SLF Feed on Your Vegetable Garden?

SLF, especially the nymphal stage, will feed on vegetable, fruit, and herb plants. However, damage is seldom reported and only seen when plants are SLF populations. Watch for SLF feeding on cucumber, basil, horseradish, raspberries, asparagus, and other herbaceous plants.

(https://extension.psu.edu/media/wysiwyg//extensions/catalog_product/84567b721b844380b24d3faee82220ad/s/l/slf-adult_1.jpg)
Credit: Amy Korman, Penn State

SLF and Tree of Heaven (TOH)

SLF thrives on TOH

- Learn to identify TOH and look for it on your property
- TOH is also invasive
- Destroying TOH may help reduce the SLF populations that exist at that location
- Herbicides are often needed to eliminate TOH
- SLF does not require TOH to complete its lifecycle

Identification of TOH

- Compound leaf with many leaflets
- Leaflets have smooth margins
- Crushed foliage and twigs have a foul odor

You can find more information about TOH identification and management(https://extension.psu.edu/tree-of-heaven).

Table 2. Common plant hosts for spotted lanternfly feeding throughout the season. As plants begin to lose their leaves at the end of the season, th serve as hosts for SLF. Information in this table is based on observations in Pennsylvania and may vary based on local conditions.

HOST	NYMPHS			ADULTS		
	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
Rose (cultivated, multiflora, etc.)						
Perennials						
Grape (wild and cultivated)						
Tree-of-heaven						
Black walnut, butternut						
River birch						
Willow						
Sumac						
Red/silver maple						

Monitoring

We strongly recommend monitoring high-value plants on a regular basis to observe where SLF is feeding throughout the season. Home gardeners ha nymphs feeding on cucumber, basil, rose, peony, Russian sage, and many more plants. In some cases, damage to these plants has been reported whe high. SLF nymphs generally feed on herbaceous plants for only a short period of time (less than one week) and then move to other plants. If there are and/or high populations of SLF nearby, we recommend you focus monitoring and potential management on high-value plants. You can monitor with t through periodic visual inspection. Don't assume that all plant damage you see is caused by SLF. Remember, other factors can cause plant health dec insects, diseases, and weather conditions.

Seasonal Population Fluctuations

SLF nymphs and adults move from one plant to another throughout the season, which can make assessing the population size difficult. If you have a l plants in your area, you might experience high populations of SLF because they have access to a plentiful food source. We recommend monitoring re

Annual Population Fluctuations

In newly infested areas, SLF populations tend to increase steadily over several seasons, and preferred individual host plants tend to remain consistent to year. Observations in areas that have had SLF for multiple years indicate that population numbers can drastically drop or rebound from season to s that population density, host fitness, natural enemies, and weather conditions play a role in these fluctuations, but further research is needed. **After a population numbers, it is not uncommon to see an increase in the population the following year.**

Management

It is important to understand that **SLF cannot be prevented from coming onto any one property**. SLF is a complex pest problem, and unfortunately, fits all" solution. Each situation is different and deciding on a plan of action requires everyone to assess their situation and decide what makes sense f can experience sudden increases in populations of nymphs, but this occurs more commonly with adults. SLF adults tend to fly to new trees to feed in Additionally, the presence of **low numbers of SLF may not necessitate treatment.**

Deciding If and When to Treat for Spotted Lanternfly

There are many things to consider before deciding to use an insecticide to kill SLF on landscape trees or shrubs. SLF nymphs and adults are both fairl insecticides; even the less-toxic, registered insecticides like soaps and oils can work well. Some things you should take into account are (1) the numbe whether they are on a preferred host plant, where they are likely to remain, or on a plant they will move away from after a shorter visit, (3) the size an (4) the presence or absence of preferred host plants in the landscape, (5) and the life stage of SLF present. If you decide to use an insecticide, use the effective option. Use only insecticides that are registered by the Environmental Protection Agency (EPA) or the PDA and approved for the site. Always label directions.

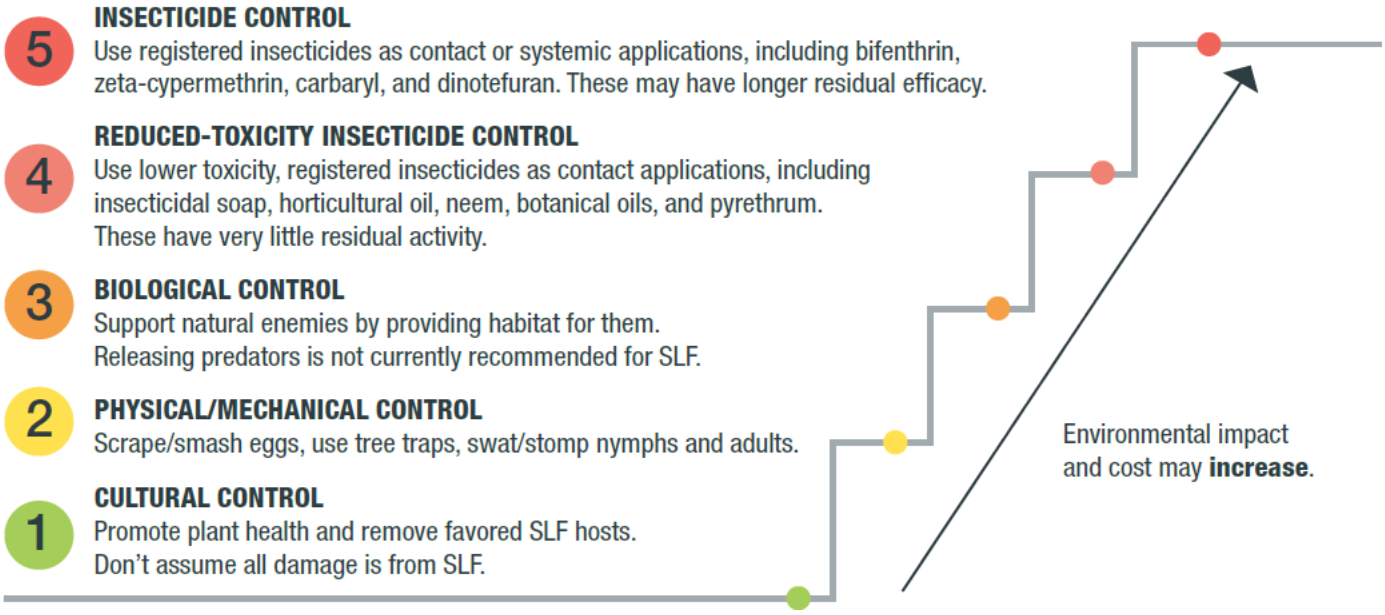
Use the steps below to think about your situation, goals, and the available management options. Continue to remain vigilant and adapt your action pla situation changes.

First, assess your risk by considering SLF population severity and the vulnerability of your plants (Figure 4).

1. Population severity: Monitor your surroundings and watch for patterns in movement and feeding, and the presence of honeydew and sooty mol
2. Vulnerability of plants that may be impacted: This is the likelihood that SLF will feed on existing plants, and the presence (or absence) of other st damaged trees, excessive rain or drought periods, disease, lage, and poor planting sites.

LIKELIHOOD OF IMPACT: what plants are present?	**SEVERITY:** how many SLF are present?			
	Low (occasional egg masses, nymphs, or adults)	**Tolerable** (few egg masses, nymphs, or adults)	**Undesirable** (many egg masses, nymphs, adults, and sooty mold present)	**Intolerable** (heavy levels of adult and nymph feeding, extensive amounts of sooty mold)
Few SLF favorite plants (maples, willow, birch, tree-of-heaven)	**LOW RISK**			
Many SLF favorite plants (maples, willow, birch, tree-of-heaven)				
Plants under **stress** (weather, diseases)				
Proximity to vulnerable plants (young plants, vineyards, etc.)				**HIGH RISK**

Figure 4. Assess the risk to your landscape using SLF population size and plant vulnerability. If you are in an area where SLF has not been previously, captured and destroyed if possible and reported. Also consider proximity to transportation corridors and potential shipping risk.



(https://extension.psu.edu/media/wysiwyg//extensions/catalog_product/2bf312740620490db86dcb89cd600cee/f/i/figure-5.png)

Figure 5. Use options in the lower steps before resorting to the careful use of registered insecticides only when necessary.

After thinking realistically about the risk that SLF poses to your property and trees, the next step is deciding on a course of action that works for you. I many management options that may help. Use options in the lower steps of Figure 5 before resorting to the careful use of insecticides only when nec that if you choose higher steps, environmental impact and cost of the management tactic may increase. The time, effort, and cost of the action plan yc depending on many factors.

You may have the ability, tools, and desire to implement some management options yourself, or you may choose to hire a pest management professio (https://extension.psu.edu/choosing-a-qualified-pest-management-or-lawn-care-company). Table 3 provides a quick reference of roughly when contr employed.

Table 3. Management options for spotted lanternfly throughout the year.

MANAGEMENT OPTIONS	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Don't move any life stage of SLF	■	■	■	■	■	■	■	■	■	■	■	■
Scrape and destroy eggs	■	■	■	■	■				■	■	■	■
Spray eggs with dormant rate of horticultural spray oil		■	■	■								
Use circle traps					■	■	■	■	■	■		
Contact insecticide applications (after hatch and avoid bloom)					■	■	■	■	■	■		
Systemic application of imidacloprid (after bloom, varies by method)					■	■	■	▨	▨			
Systemic application of dinotefuran (after bloom)							■	■	■			

(https://extension.psu.edu/media/wysiwyg//extensions/catalog_product/8b58143ef6bb47b4a7ce2e7a12f18cb6/t/a/table-3.png)

Stop the Spread

If you are in the known range of SLF, do your part to prevent moving them farther. If you find SLF and are outside the known range, you should take a collect some samples for evidence, destroy them if you can, and report your findings on the SLF website(https://extension.psu.edu/spotted-lanternfly) within and out of the quarantine zone, check your vehicle and outdoor items (grills, outdoor furniture, landscaping supplies, mowers, etc.). Check for S fall to summer. Remember, egg masses may be underneath your vehicle or in your wheel well. During the growing season, check for nymphs and adu windows rolled up when you park. Don't store things or park under infested trees, and don't move firewood.

Biological Control

Currently, there are no known natural enemies of SLF that are expected to significantly reduce SLF populations in the United States. Some generalist praying mantises, parasitoids, birds, etc.) will attack and eat SLF. Additionally, two species of fungal pathogens were identified in Pennsylvania that c One species, *Beauveria bassiana*, was the focus of recent research in SLF-infested woodlots. This pathogen is commercially available as a biopesticid results, we do not currently recommend *B. bassiana* for management of SLF; however, continued research may lead to optimizing the use of *B. bassia* future recommendations. Researchers are also exploring the native range of SLF to search for natural enemies for potential release in the United State currently under evaluation in USDA quarantine facilities.

Cultural Control

Removing Preferred Host Plants

Removal of preferred host plants has not been specifically evaluated for success in managing SLF populations. Removing certain infested trees can p sooty mold accumulation on property beneath them. If possible and practical, we recommend removal of tree-of- heaven (TOH). It is invasive in the U negative environmental effects. When removing TOH, you will have best results if you use an herbicide to kill the root system (see the "Tree-of-Heave (https://extension.psu.edu/tree-of-heaven) for more information). More research is needed to determine how removing TOH may impact SLF populatio As an alternative to complete removal, some TOH can be left remaining and treated with a systemic insecticide to attract and kill SLF as they feed. TO meaning there are separate male and female trees. If allowing some TOH to remain, keep only the male trees where possible, in order to prevent fema area.

Mechanical Control

Finding and Destroying SLF Eggs

Female SLF will lay their eggs in a variety of places and on a wide range of surfaces. One common place to find eggs is on or near trees where female the egg-laying period in the fall. Tree hosts preferred by SLF during the fall include red maple, silver maple, and willows— these trees are an excellent for egg masses. SLF will also lay eggs on other trees on which they do not typically feed. They will lay eggs in protected areas under rocks and on law fences, rusty metal, and many other surfaces.

SLF eggs can be destroyed by scraping them from the surface where they were laid into an alcohol solution (e.g., rubbing alcohol or hand sanitizer) w left permanently (Figure 6). Eggs can also be destroyed by thoroughly smashing them.

(https://extension.psu.edu/media/wysiwyg//extensions/catalog_product/46b0240dfcb44ac2864034e9ff73269e/e/e/ee0524-figure-6-jpg.jpg)
Figure 6. Destroy SLF eggs by scraping them from the surface where they were laid into an alcohol solution. Credit: Emelie Swackhamer.

It is important to keep in mind that you will not be able to reach all the egg masses deposited on a tree. Researchers have documented that less than masses laid on trees were at a reachable height (up to 10 feet from the ground), leaving 98 percent of the egg masses above reach (Figure 7). We do ladders or climbing trees to get to the unreachable eggs.

Each destroyed egg mass can remove about 35 SLF from the next year's generation, but you are unlikely to destroy all SLF in an area. Continued man may be necessary the following year.

(https://extension.psu.edu/media/wysiwyg//extensions/catalog_product/a1ad4e28cf56460aa3a9a78d27795a22/s/l/slf-adults-on-a-tree_1.jpg)
Figure 7. Most SLF egg masses on trees are above a reachable height. Credit: Emelie Swackhamer

Using Traps

If you have SLF on your property, you can use traps to kill them and possibly reduce the infestation on your trees. SLF nymphs and adults crawl up th higher on the tree, and traps are used to intercept them. A recommended trap for SLF is a funnel-style trap called a "circle trap." Sticky bands, which material as they move up the tree, have also been used to capture SLF. However, these are not recommended because this sticky material is not selec other animals, including pollinators, butterflies, birds, squirrels, and more. Sticky bands should never be used without a wildlife barrier installed aroun Relatively easy to install, traps are a nonchemical method of killing SLF that can be a good option for residential landscapes.

Installation

Trapping is not possible on bushes or most vines because they don't have trunks that are large enough in diameter for the trap. Traps work best on tr bark with deep grooves may allow SLF to crawl underneath the trap. Place the trap about four feet from the ground and secure it tightly against the t material tightly, stapling it into the tree, or using pushpins. To preserve the health of the tree that you are trying to protect, avoid using nails or wound tissue underneath the bark. Only set up traps on trees on your property or where you have permission to do so. Remember to remove all parts of the season. We suggest using traps as soon as SLF hatch (late April through June). Traps can capture large numbers of nymphs. While adult SLF can also traps, they may avoid them, resulting in less effectiveness later in the season.

Circle Traps

A circle trap is a modified funnel that you can purchase commercially or build yourself (Figure 8). The container used to collect SLF can be a plastic ba detailed guide on how to build your own trap, see "How to Build a New Style Spotted Lanternfly Circle Trap (https://extension.psu.edu/how-to-build-a-spotted-lanternfly-circle-trap)". Some people have built similar traps devising a range of methods that wor

is a good project for anyone who wants to destroy SLF while saving money by using materials they may already have on hand.

(https://extension.psu.edu/media/wysiwyg//extensions/catalog_product/145883017a8d43368d65d26c07e5b6b0/c/i/circle-trap_1.jpg)
Figure 8. A homemade circle trap secured to a tree. Credit: Emelie Swackhamer, Penn State

Sticky Bands

Sticky bands and tree-banding glue are available for purchase online and from your local garden center or hardware store. It is not known how the us
impacts any potential damage from populations of SLF. To date, we have not found any commercially available band to be more effective than anothe
with wildlife screening are not recommended due to the risk of capturing non-target organisms. When banding for SLF using sticky material, you may
animals (bycatch), including beneficial insects, small mammals (bats, squirrels, etc.), small birds, and lizards. Always accompany your sticky band with
reduce bycatch. To do this, you can build a guard over the band using mesh netting (e.g., window screening) to keep animals from the sticky surface (
wire is not effective because it allows small birds and pollinators to pass through. Secure the screening to the tree at the top by pleating it with pushp
bottom open to allow the SLF to enter. It should extend several inches above and below the sticky band and be close to the tree at all points to reduce
larger creatures will fly or climb underneath. There are also commercially available bands that use a fibrous batting material to hold the inward-facing
band away from the trunk of the tree. This creates a protected sticky surface, which reduces the potential of catching birds and other animals. Homem
products like duct tape or petroleum jelly on water-resistant paper are less effective than commercially available sticky bands because they lose their s
can allow SLF to escape.

If you decide to use sticky bands, check them every day. If you capture an animal, do not attempt to free it by yourself. You may put the animal and yo
wish to try to save the animal, cover any exposed sticky material with plastic wrap or tissue paper to reduce additional entanglement, remove the ban
carefully as possible, and take the animal to a wildlife rehabilitation center. To find a center, see the Pennsylvania Association of Wildlife Rehabilitator
website.

(https://extension.psu.edu/media/wysiwyg//extensions/catalog_product/15b0a66a485e4e6ead29be1ad9955d6e/b/a/band-screening_1.jpg)
Figure 9. A sticky band covered with vinyl mesh to prevent bycatch. The screen still allows SLF to crawl up from the base of the tree to come in conta material but prevents mammals, birds, and pollinators from coming into contact with the band. Credit: Elizabeth Finlay, Penn State

Using Insecticides for SLF

Read the label and follow the directions. Insecticides can kill insect pests on contact and/or by being present systemically in a plant that the insect pes 5, and 6). The duration of control that remains after application (i.e., residual activity) varies depending on which type of insecticide is used. Property c consider hiring a certified pesticide applicator to make insecticide applications. Professional applicators have specialized training and equipment to tre professional may reduce your risk of pesticide exposure and save time, but it may cost more than doing the application yourself.

Table 4. Characteristics of contact versus systemic insecticides

Characteristic	Contact Insecticides	Systemic Insecticides
How they kill	SLF are killed when the chemical contacts the body of the insect.	Systemic insecticides are absorbed by roots, bark, or leaves anc vascular system to other parts of the plant, killing the insect wh treated plant.
Application method	Apply with equipment appropriate to the product and spray location. Most products are applied with sprayers.	Systemic insecticides are usually applied by professional, licens There are several methods: trunk injection, trunk spray, soil drer foliar sprays.
Longevity	Residual activity is dependent on the product, but can be from 0 to 14 days; less-toxic contact insecticides require thorough coverage of the insect's body and tend to work for a short period.	This depends on application method and product, but can be se in mind that systemics take time to move into the tree. Systemic only be applied to actively growing trees, so they should not be or winter.

Characteristic	Contact Insecticides	Systemic Insecticides
When is it recommended for SLF?	Target populations of nymphs or adults; to protect pollinators, do not apply insecticides to blooming plants.	Systemic insecticide applications are mostly recommended to ta Apply systemic insecticides only after bloom is finished to prote other beneficial insects. Do not apply systemic insecticides to pl not feed on—they need to feed in order to ingest the insecticide

Table 5. Systemic products for spotted lanternfly adults

Active Ingredient	Activity Against SLF	Residual Activity	Application Method	Recommended Timing	Application Notes
Dinotefuran	Excellent	Excellent	Soil drench, trunk spray, or trunk injection	July to September	Highly soluble; moves rapidly through the bloom. If applied too early in the season, ef before the fall egg-laying period.
Imidacloprid	Variable	Variable	Soil drench	After flowering to July	Low solubility; requires more time for upta
Imidacloprid	Variable	Excellent	Trunk injection	July to September	Faster uptake than soil applications

Dinotefuran and imidacloprid are most often used for their systemic properties; however, some formulations are also labeled for use as foliar sprays.

Always read the entire label of the specific insecticide you intend to use and follow the directions.

This table is based on the experiments we have done to date and should not be considered final or complete.

Table 6. Contact products for nymphs and adults.

Active Ingredient	Activity Against SLF	Residual Activity
Beta-cyfluthrin	Excellent	Excellent
Bifenthrin	Excellent	Excellent
Carbaryl	Excellent	Poor
Zeta-cypermethrin	Excellent	Poor
Malathion	Excellent	Poor
Neem oil[1]	Good	Poor
Natural pyrethrins[1]	Excellent	Poor
Insecticidal soaps[1]	Good	Poor
Parraffinic oil or horticultural spray oil[1]	Good	Poor

Active Ingredient	Activity Against SLF	Residual Activity
Botanical oil[1,2]	Good	Poor

The contact insecticides can include spraying on trunk, branch, and foliage.

[1] Reduced toxicity insecticide option; some products have an organic label.

[2] Two products were tested.

Always read the entire label of the specific insecticide you intend to use and follow the directions.

This table is based on the experiments we have done to date and should not be considered final or complete.

Contact Insecticide Applications

Contact insecticides kill the insect when they contact the insect's body. You can use a contact insecticide to kill SLF within a few hours or days. Less-t insecticides require thorough coverage of the insect's body and tend to work for a short period. Other contact insecticides persist longer in the enviro that move into the area even after the spray has dried. These persistent contact insecticides tend to be more toxic.

Contact insecticides are usually applied as sprays. Sprays of insecticides have the greatest potential to impact nontarget organisms on the site being t made to blooming plants, have a higher potential to drift off target, and also have an increased risk of killing beneficial organisms, which can lead to u flareups.

Systemic Insecticide Applications

Trunk Injection

Trunk injection requires specialized equipment and is usually applied by professionals. Trunk injection can provide the most accurate dosing of a tree, amount of material used, as very little material is lost to the environment outside the tree. Products labeled for trunk injection may not have restriction ingredient permitted per acre per year and can allow for more trees per acre to be treated without violating the label restrictions. Be sure to follow the equipment manufacturer's instructions. SLF death has been observed less than twenty-four hours after injecting a tree with dinotefuran. Injections of been successful but take longer to become effective. As with other application methods, the environmental conditions and health of the tree can grea which the insecticide becomes effective.

Trunk Spray

Trunk sprays (also referred to as "bark banding" or "bole sprays") with dinotefuran have also been successful. Observed death of SLF may take longe with injected applications but is still likely to occur within a few days of treatment. If the label requires a bark penetrant as a spray adjuvant, be sure to application. It is important to properly dose the trees based on size measurement, not simply "spray until runoff." It is often necessary to pause the ap the material to be absorbed so the full dose as dictated by tree diameter at breast height (DBH) may be applied. Large trees with exfoliating bark, suc maples, may be difficult to properly treat with this method because the bark can reduce the penetration of the insecticide into the living tissue. Additio a compromised vascular system (i.e., are wounded) may not be able to translocate the insecticide as well as healthy trees.

Soil Drench and Soil Injection

Soil drenches of systemic insecticides are applied into the soil around the trunk of the tree. The insecticide is taken up by the roots and moved into the Ideally, soil drenches work best when applied in the early summer to trees that had high SLF populations in the past and are likely to have them again pollinators, soil drenches of systemic insecticides should be applied after a tree's flowers have faded. Soil injection by plant health professionals with s can provide more precise application than soil drenching, but it also relies on applying a water-soluble insecticide to the root zone of an individual pla from soil drench or soil injection applications of imidacloprid to control SLF is available. The insecticide needs time to be taken up by the tree roots, giv greatest time delay until it begins to kill SLF. Dinotefuran soil drenches tend to be taken up and provide efficacy much faster and more consistently th

they are less precise than trunk sprays or injection. The amount of water needed to carry the insecticide into the tree is also very important. It is recom drench of imidacloprid be applied in the spring (post bloom) and dinotefuran be applied in midsummer through September to target adult SLF. Read t follow the directions to achieve best results.

Foliar Applications

Foliar applications with appropriately labeled systemic insecticide products can provide rapid contact efficacy for the control of SLF. Generally, this ap provides the lowest dose of systemic active ingredient to individual trees compared to the other methods discussed previously and thus also provides of residual efficacy. In general, foliar applications of systemic insecticides are not recommended for SLF except in specific cases, particularly for nympl

Ovicides to Kill Egg Masses

Experiments have shown that dormant or horticultural oil can kill SLF eggs. Applications made in the fall were not significantly more effective than th February and April. Testing has yielded inconsistent results but generally the higher the concentration of oil that is applied, the more effective the trea were applied directly to the egg masses at a concentration of at least 3 percent, they could be effective in killing up to 75 percent of treated eggs. Lab to prevent plant damage, and not all plants should be sprayed due to phytotoxic damage potential.

Experiments suggest that registered insecticidal oils applied at the highest labeled rates get the best results, if they are applied in high enough volum coverage. Oils offer a lower-toxicity option and may provide some control of egg masses that are not accessible for scraping or smashing. However, f within a reachable area, scraping or smashing will provide greater efficacy than currently available ovicides. Applications of 50 percent soybean oil (sp as an ovicide) can provide more consistent results; however, it must be carefully applied to individual egg masses and should not be sprayed through risk of phytotoxicity. Cost and the low percentage of egg masses that can be reached by hand make this method impractical for most applications.

Pesticide Safety

Avoid overreacting to the situation and teach others not to overreact.

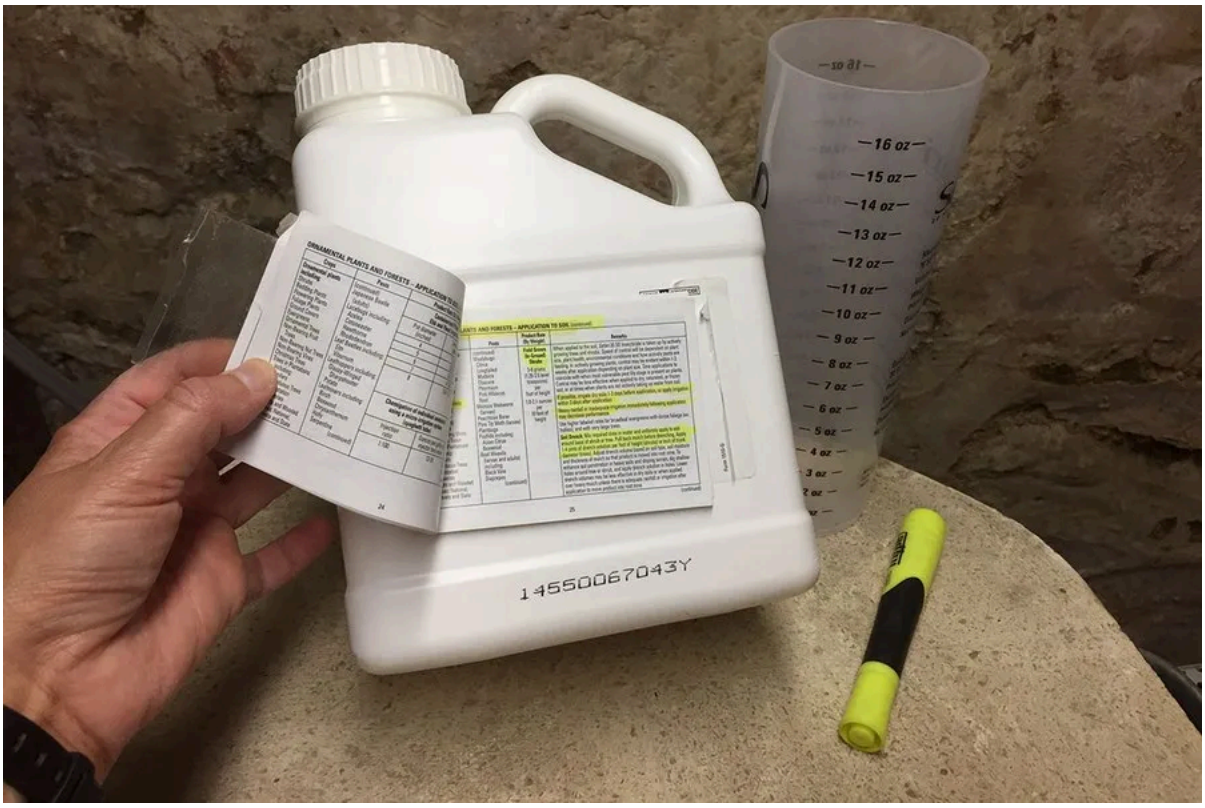
Many people are fearful of SLF and worry that they may affect the health of their trees. From observations, we believe that a few SLF feeding on a lar unlikely to cause permanent damage. On the other hand, thousands of SLF might weaken a tree, but to date, no one has quantified how many will ha the tree will be affected. Consider destroying SLF on individual trees by trapping or swatting them instead of using insecticides. If you decide to use a SLF, there are some important safety measures and pesticide rules to follow. Before using any pesticide product, always read the label and be informe

Only use registered insecticides to kill SLF.

Recipes for homemade sprays made from cleaning, automotive, cooking, or other household products might be more harmful to the environment or y realize. Insecticides that are registered with the EPA or PDA have been tested for safety. The label provides important information, including direction use and precautions to protect pollinators and the environment. Additionally, in Pennsylvania, the site where you plan to use an insecticide (e.g., "orna "vegetable plants") must be listed on the product label. You must use the rate and application method that corresponds with the site use.

Read the label and follow all directions.

Plan to spend time reading the label. You can find labels for insecticides online—read them before you buy anything. Read the label, figure out how m you will need to do the job, and then you will know how much you need to buy. Some labels are formatted as booklets taped onto the side of the proc 10). Peel back the tape and read all the information before using the insecticide. Use a highlighter to mark the specific directions for the way that you This also makes it easier to go back and find the right section the next time you use it.



(https://extension.psu.edu/media/wysiwyg//extensions/catalog_product/38f4d99b078e45979bdee88c79496add/i/n/insecticide-label_1.jpg)
Figure 10. Some product labels are formatted as booklets that are taped onto the side of the product container. Peel back the tape and read all the inf the insecticide. Photo courtesy of Emelie Swackhamer, Penn State

Avoid drift.
Never allow an insecticide to drift into an unintended area. Test your equipment first by using plain water to be sure it is operating properly and make where the spray goes.

Reduce your risk.
When you use an insecticide, the risk depends on (1) the toxicity and (2) how much you are exposed to it. If you use a highly toxic pesticide, you can r limiting your exposure. If you use a less-toxic pesticide but experience a high amount of exposure, your risk increases. Follow the label directions and Use appropriate, properly functioning application equipment. Wear the recommended protective clothing and gear. Wash your protective clothing sep other laundry.

Use the right amount.
Using more than the labeled amount of an insecticide is not a good idea, and it is illegal. The goal is to effectively kill SLF and not release any more ins environment than necessary. Using more than what is listed on the label also wastes money. Certain products and/or applications may have restrictio amount of pesticide applied per designated timeframe or acreage. It is illegal to exceed limits of product use that are specifically written on the label. T adequate control has not been achieved due to the variables noted above

Avoid using the same insecticide all the time.
Some insects have developed resistance to specific insecticides that have been used repeatedly to kill them. When this happens, that insecticide has l insect. We have not seen resistance occur in SLF, but generally it is best to rotate between different groups of insecticides to reduce that risk (see IRA of Action Classification for more information).

Choose the least-toxic insecticide that is effective.

Look for three things on the label to check the toxicity of the product:

1. Designation as an organic insecticide, which can be lower in toxicity and less harmful to the environment. They will include a logo from the Orga Institute (OMRI) on their label.
2. Some insecticides are considered to have so little risk to human health or the environment that they are exempt from some regulations. They are products. Look for products that say they have Section 25B status on the label.
3. The signal word, which is required to be prominently displayed on the front of most insecticide product labels. Most insecticides have one of fou label: (1) "CAUTION" appears on insecticides with lower mammalian toxicity, (2) "WARNING" appears on insecticides that have medium toxicity appears on insecticides with the highest toxicity or greatest risk to eyes or skin, and (4) "DANGER POISON" and a skull and crossbones symbol that are extremely toxic when consumed, inhaled, or absorbed through the skin or eyes (they may also be fatal at very low doses). Section 25B p required to have a signal word on the label because they are classified as a "reduced risk" by the EPA.

Potential Nontarget Effects of Insecticides

Water Contamination

Every precaution should be taken to protect surface water and groundwater from pesticide contamination. Trunk injections pose the smallest risk to c because the insecticide goes directly into the tree. Soil drench applications should only occur directly adjacent to the trunk of the tree, as directed on t should not be applied to sandy soils or where the water table is shallow. Both dinotefuran and imidacloprid and their breakdown degradants can pers extended periods. When exposed to sun, both of these compounds break down readily, but their degradants may persist for much longer. To protect insecticides should not be applied near open water sources (ponds, lakes, streams).

Pollinators and Other Insects

Many of the trees on which SLF has been observed feeding in high densities are also pollinated by bees (e.g., maples). It is possible that trees treated insecticides could have insecticide residue in their flowers and nectar the following spring. Neonicotinoid insecticides, in particular, have been associa decline. Additionally, many native insects (caterpillars, beetles, lacewings, etc.) utilize these trees at the same time as SLF and could be affected by th Pyrethroids can also be damaging to beneficial insect populations and could cause populations of secondary pests, such as mites and scales, to flare insecticides applied by trunk injection, trunk spray, and soil drench are considered to have a reduced impact on natural enemies compared to broad-s insecticides. To be as safe as possible, always read the entire label of the specific insecticide you intend to use and follow the directions.

(https://extension.psu.edu/media/wysiwyg//extensions/catalog_product/4cf2a6858a2a415791dd24e68913a399/s/l/slf_1.jpg)
Photo Credit: GH Photos Alamy Stock

Ongoing Research

Research is ongoing to understand the biology and behavior of SLF and to find better management strategies. Research on tree health impact is focu physiological response of the tree to SLF feeding, which involves the study of sap flow and the nutritional status of the plant over time. Better manag be developed by determining economic injury levels on various hosts, searching for useful biological control options (native and introduced predators, fungal pathogens), and evaluating pesticide efficacy and nontarget effects. Stay up to date with this research by visiting Spotted Lanternfly website (https://extension.psu.edu/spotted-lanternfly).

Summary

- SLF is a major pest of grapes.
- SLF is under quarantine in infested areas in Pennsylvania and some other states.
- Spotted lanternfly is currently considered primarily a nuisance pest in residential landscapes.
- Death of ornamental and shade trees has not been directly linked to SLF to date. SLF is considered a plant stressor. High infestation levels may r activity and energy storage. Don't attribute all plant health decline to SLF.
- Always scout for spotted lanternfly first before deciding to make a treatment. Not every tree on any given property needs to be treated. Be awar populations may fluctuate from year to year; don't assume what happened last year will happen in the coming year.
- The active ingredients, methods, timing, and other treatment suggestions presented here are guidelines based on observation and experience, b will vary based on site conditions. We are conducting research to refine these guidelines.
- Always follow the label for any pesticide application you make.
- Check for updated versions of this fact sheet and other news related to spotted lanternfly by visiting the Penn State Spotted Lanternfly website (https://extension.psu.edu/spotted-lanternfly).

This is a comprehensive guide on spotted lanternfly biology, behavior, plant damage, management, and ongoing research. It is current as of June 202

Authors and Acknowledgments

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Disclaimers

These recommendations are current as of June 2024 and will change as we learn more. We encourage you to stay up to date by visiting the Penn Sta website(https://extension.psu.edu/spotted-lanternfly). Check the online version of this management guide and always look for the most up-to-date in using any pesticide, follow the pesticide label for directions, application rates, methods, and appropriate protective equipment. **Remember, the label i**