
# ACTION PLAN

# for

# Spotted lanternfly (*Lycorma delicatula*)

California Department of Food and Agriculture

Plant Health and Pest Prevention Services Division

4/07/2023

# Table of Contents

# Preface

The California Department of Food and Agriculture (CDFA) develops action plans to facilitate responses for quarantine pests of concern for California. Action plans describe the activities CDFA is likely to take in response to the finding of such pests in the state. An action plan typically includes procedures for detection, delimitation, treatment, and quarantine with a goal of eradication. An action plan document is a dynamic document that may be modified as new or more efficacious methods, procedures, or technologies become available and there is a need to incorporate them into the existing regulatory framework for a given pest.

Science advisory panels and ad hoc science advisory panels are sometimes convened to fill in gaps in knowledge regarding actionable pests, and recommendations from such advisory panels are often considered in developing new or modifying existing action plans. In the case of spotted lanternfly (SLF), an ad hoc science advisory panel meeting was held from September 21st to 23rd, 2021. The panel was composed of 11 people with expert-level knowledge of SLF and pest issues in California. Many of these scientists and researchers were living and working in states that were infested with this pest. CDFA-PHPPS asked the panel 50 questions relating to SLF detection, eradication, quarantine, management, and general biology. Their responses were considered in the development of this action plan.

The Department evaluates all possible treatment methods for any plant pest or disease in accordance with integrated pest management (IPM) principles. According to the United States Environmental Protection Agency, “Integrated Pest Management (IPM) is an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. IPM programs use current, comprehensive information on the life cycles of pests and their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage by the most economical means, and with the least possible hazard to people, property, and the environment.” (Integrated pest management (IPM) principles)

A work plan involving physical and/or chemical control of a pest may be necessary to prevent loss and damage to California’s natural environment, fruit and vegetable industry, native wildlife, private and public property, and food supplies. This action plan provides a background on the targeted pest, its biology, and its preferred host. It also describes some of the methods that will be considered by the state of California for the detection, eradication, quarantine, and management of SLF once a SLF introduction is detected. The methods described herein may be added upon, revised, or otherwise amended based on new information and necessary site specific approaches.

# Abbreviations and Acronyms

| Abbreviation | Definition |
|---|---|
| ADM | Asian Defoliating Moth traps |
| APHIS | Animal and Plant Health Inspection Service |
| BPS | California Border Protection Stations |
| CACASA | California Agricultural Commissioners and Sealers Association |
| CDFA | California Department of Food and Agriculture |
| CDFW | California Department of Fish and Wildlife |
| CEQA | California Environmental Quality Act |
| CNDDB | California Natural Diversity Database |
| ECOPERS | Environmental Compliance Permits and Regulations |
| EPA | Environmental Protection Agency |
| GPS | Global Positioning System |
| ICS | Incident Command System |
| IPC | Integrated Pest Control |
| IPM | Integrated Pest Management |
| NOT | Notice of Treatment |
| OEHHA | Office of Environmental Health Hazard Assessment |
| PDAS | Plant Data Analysis Services |
| PDCP | Pierce's Disease Control Program |
| PDEP | Pest Detection and Emergency Projects |
| PDR | Pest Damage Record |
| PE | Pest Exclusion |
| PEIR | Programmatic Environmental Impact Report |
| PEP | Proclamation of an Emergency Program |
| PHPPS | Plant Health and Pest Prevention Services Division |
| PPDC | Plant Pest Diagnostics Center |
| PPQ | Plant Protection and Quarantine |
| SLF | Spotted Lanternfly |
| USDA | United States Department of Agriculture |
| USFWS | United States Fish and Wildlife Service Department |
| 008A | A hold at destination notice issued when certain commodities enter CA |

# Glossary

**Assessment:** Identifying, marking and recording the extent of the area of treatment on an individual property for the purposes of applying pesticides to target host trees for the control of spotted lanternfly, as established by program or contracted treatment guidelines.

**Compliance Agreement:** Agreements used by the Department and cooperating pest exclusion programs to ensure that regulated and quarantined businesses and individuals comply with regulatory restrictions during their conduct of business and reduce the risk of spreading the regulated pests or diseases.

**Delimitation Survey:** Intensive visual or trap surveillance of the immediate region surrounding a site that has been confirmed as containing live spotted lanternfly life stages with the express purpose of identifying the extent and scale of a population of spotted lanternflies.

**Detection Survey:** Visual or trap surveillance designed to identify previously unknown populations spotted lanternfly.

**High Risk:** An area, location, or site determined to have a high likelihood of further spreading spotted lanternfly or posing economic risk. This may include but is not limited to ports of entry, maritime ports, airports, rail intermodal sites, and rest stops on major interstate corridors.

**High-risk Pathway:** A network of routes that meet the following risk factors when connected via transportation to SLF-infested areas: High-traffic rail and transit pathways (rail, intermodal, trucking industries), high-volume shipping operations and cooperators (air or ground cargo facilities), high-risk industries (green industries, stone or building materials), and high-value agricultural commodities.

**Host:** Plant species determined to be utilized by any life stage of spotted lanternfly for feeding and/or reproduction.

**Inspection:** Active visual searching of trees and other surfaces/objects at the targeted survey site or location for the purpose of detecting the presence of spotted lanternfly in any of its life stages.

**Pest Damage Record (PDR):** Sample submission form required for diagnosis/identification by the Plant Pest Diagnostics Center (PPDC) and record-keeping.

**Sentinel Trees:** Tree-of-heaven trees maintained as passive traps at sites with no confirmed spotted lanternfly population, along the edge of a known infested area or outside of a known infested area.

**Site:** A geographic point or area where surveillance or treatment activities occur.

**Target Host:** Trees identified by the spotted lanternfly program as suitable for treatment to control spotted lanternfly, including **tree-of-heaven.**

# Introduction

The spotted lanternfly (SLF), *Lycorma delicatula* (White) (Hemiptera: Fulgoridae) is an invasive planthopper known to feed on over 100 species of plants from 33 botanical families, including commercial grapevines. SLF is native to China, India, and Vietnam (Kim et al., 2021). It was not considered a widespread invasive agricultural insect pest until after it spread from its native range to South Korea in 2004, Japan in 2008, and the United States (Pennsylvania) in 2014 (Barringer et al., 2015; Kim et al. 2021). Since its arrival in the United States, SLF has become established in at least eleven eastern states. These states are carrying out various treatment and control activities in coordination with the United States Department of Agriculture (USDA) (StopSLF.org). Live, viable SLF life stages have not been found in the environment in California, but multiple dead life stages and a few live adults have been intercepted by the Department staff in airplane shipments from 2019 to 2022 and a dead adult, dead nymph, and several live egg masses have been intercepted at border stations from 2019 to 2022. As SLF is likely to have significant economic and environmental impacts if it were to establish in California, it has been assigned an "A" pest rating by the Department. The A pest rating designation places a target pest in the highest risk regulatory category. In addition, California has instituted a state exterior quarantine against SLF (Title 3 California Code of Regulations (CCR) §3287).

In the eastern United States, SLF has one generation per year and overwinters in the egg stage as part of an egg mass. Overwintering SLF eggs start to hatch around April or May and nymphs begin sucking sap from young stems and foliage of suitable host plants. Nymphs do not fly and are more polyphagous than adults, feeding on a wide variety of plants. Their feeding produces large quantities of fluid (honeydew) that often coats stems and leaves. This can result in the growth of sooty mold, which, if it grows on leaves, can reduce photosynthesis by obscuring sunlight. Through loss of carbohydrates via the phloem from the host plant and decreased photosynthesis resulting from sooty mold, SLF infestations can severely weaken susceptible plants and eventually kill them. Nymphs go through four instars and adults start to appear around July. Adult SLF can fly but can also disperse by walking. They start to lay eggs around September. The strongly preferred hosts for adult feeding are tree-of-heaven (*Ailanthus altissima*), an Asian tree widely introduced throughout North America, and grapevines (*Vitis* spp.). The insect will also feed on a wide variety of other agricultural commodities.

Egg clusters are typically deposited on trees with a smooth surface structure. The most likely pathway for long-distance spread of SLF is the movement of egg clusters on infested nursery stock, moveable storage containers (including pods), and conveyances (including cars, trucks, and train cars). During the flight season in late summer and early fall, SLF from infested areas often "hitchhike" in airplane shipments to California, but most such hitchhikers arrive in California dead.

SLF has many host plants (see Section 4, Table 1), but they strongly prefer tree-of-heaven and grapevines. Other documented host plants include birch (e.g., Japanese white birch [*Betula platyphylla]*), dogwoods (e.g., wedding cake tree *[Cornus controversa]*, Japanese dogwood [*C. kousa]*, and Japanese cornel [*C. officinalis*]), Japanese silverberry (*Elaeagnus umbellata*), Manchurian walnut (*Juglans mandshurica*), cigar box tree (*Cedrela fissilis*), Chinese mahogany (*Toona sinensis*), lilac (*Syringa vulgaris*), ash (e.g., white ash [*Fraxinus americana*]), cherries (e.g., Japanese cherry [*Prunus serrulata*] and yoshino cherry [*P. yedoensis*]), poplars and cottonwoods (e.g., white poplar [*Populus alba]*), maples (e.g., Japanese

maple *[Acer palmatum*] and silver maple [*A. saccharinum*]), bitterwood (*Picrasma quassioides*), zelkova (*Zelkova serrata*), and Virginia creeper (*Parthenocissus quinquefolia*).

Niche modeling with Maximum Entropy (Maxent) suggests that SLF is likely to establish in large parts of California if introduced (Wakie et al., 2020). This model used bioclimatic variables and the known (at the time of the study) distribution of SLF. The most important factor in predicting SLF likelihood of occurrence was found to be the mean temperature of the driest quarter of the year; the viable temperature ranges from about 0°C plus or minus 7°C (a temperature range between 19°F and 45°F). Although it was not included in the Maxent niche modeling study, a factor that would obviously be significant in predicting SLF's possible range is the presence of hosts, especially tree-of-heaven. The influence of hosts on the potential distribution of SLF in California is not completely understood at this time, because there are many tree species on the west coast that are not present or not present in large numbers where SLF is currently known to occur. The potential host range of SLF is likely quite broad; therefore, it is not known which, if any, of these trees may be hosts of SLF.

As known (and likely unknown) host plants are widely grown in California, SLF is likely to establish wherever it is introduced, except possibly in desert or high mountain regions. The hosts of SLF include multiple agriculturally important crops and common ornamentals (e.g. grapes, liquidambar, peaches, maples, and walnuts) in California. Infestations of SLF may lower crop yields and increase production costs of economically important crops such as grape, stone fruit, and woody nursery stock. Upon entering Korea and Pennsylvania, the insect caused considerable, often catastrophic, damage in vineyards.

SLF attacks many large and small forest trees (e.g. oaks, dogwoods, and ash) in its introduced range in the eastern United States. California forests are differently structured than the deciduous forests of the East, with many forests and woodlands in the state dominated by evergreen hardwoods and conifers. Nevertheless, many of the known host tree generally are represented in California forests as understory trees or trees in riparian zones. If SLF were to invade the wildlands of California, it may have a negative impact on forest structure by weakening or killing certain woody species. This would be expected to lower biodiversity, disrupt natural communities, and change ecosystem processes. In addition, infestations would trigger new treatments in vineyards, orchards, managed natural land, forests, and by residents who find infested plants unsightly or suffering reduced fruit production.

Apart from agricultural or environmental effects, SLF has had significant impacts to residents in the infested areas of the eastern United States. Large numbers of SLF in yards result in a “rain” of honeydew droplets falling onto people and surfaces. Sooty mold on plants and other surfaces can result. These impacts could occur in California if this pest becomes established here. Businesses that rely on tourism, such as vineyards, may suffer loses because of the nuisances associated with SLF. In addition, residents are likely to use chemical insecticides to control SLF infestations, which will increase costs to homeowners and chemicals in the environment.

Existing law obligates the Secretary to investigate and determine the feasibility of controlling or eradicating pests of limited distribution but establishes discretion with regard to the establishment and maintenance of regulations to achieve this goal. In addition, the Department is the only agency which can implement plant quarantines. The California Food and Agricultural Code (FAC) Section 401.5 states “the department shall seek to protect the general welfare and economy of the state and seek to maintain the economic well-being of agriculturally dependent rural communities in this state.”

Existing law, FAC Section 407, provides that the Secretary may adopt such regulations as are reasonably necessary to carry out the provisions of this code that the Secretary is directed or authorized to administer or enforce. FAC Section 5322, provides that the Secretary may establish, maintain, and enforce quarantine, eradication, and such other regulations as are in her opinion necessary to circumscribe and exterminate or prevent the spread of any pest that is described in FAC Section 5321. FAC Section 5761, provides that the Secretary may proclaim any portion of the state to be an eradication area with respect to the pest, prescribe the boundaries of such area, and name the pest and the hosts of the pest which are known to exist within the area, together with the means or methods which are to be used in the eradication or control of such pest. FAC Section 5762, provides that the Secretary may proclaim any pest with respect to which an eradication area has been proclaimed, and any stages of the pest, its hosts and carriers, and any premises, plants, and things infested or infected or exposed to infestation or infection with such pest or its hosts or carriers, within such area, are public nuisances, which are subject to all laws and remedies which relate to the prevention and abatement of public nuisances. FAC Section 5763, provides that the Secretary, or the commissioner acting under the supervision and direction of the director, in a summary manner, may disinfect or take such other action, including removal or destruction, with reference to any such public nuisance, which she thinks is necessary.

# Program Contacts and Areas of Responsibility

- Director, Plant Health and Pest Prevention Services Division
    - Administrative Oversight and Outreach Activities

- Assistant Director, Plant Health and Pest Prevention Services Division
    - Administrative Oversight and Outreach Activities
    - Plant Data Analysis Services (PDAS) oversight
        - Data Capture, Analysis, Storage, Sharing
        - Mapping Detections, Quarantine Boundaries
    - Environmental Compliance Permits & Regulations (ECOPERS) oversight
        - Regulations Development
        - Environmental Compliance
        - Permitting

- Branch Chief, Pest Exclusion (PE)
    - State Exterior Quarantine Development and Enforcement
    - State Interior Quarantine Development and Enforcement
    - Emergency Quarantine Response Activities

- Branch Chief, Pest Detection and Emergency Projects (PDEP)
    - Detection Survey, Trapping
    - Delimitation Survey, Trapping
    - Treatment and Control Activities

- Branch Chief, Plant Pest Diagnostics Center (PPDC)
    - Establishing Sample Submission Protocols
        - Sample Photography
        - Sample Handling
        - Sample Shipping Guidelines
    - Sample Processing and Identification
    - Initiating Communication Plan Distribution

- Branch Chief, Integrated Pest Control (IPC)
    - Biological Control

- Statewide Coordinator, Pierce's Disease Control Program (PDCP)
    - Outreach Activities
    - Coordination with Pierce's Disease and Glassy-Winged Sharpshooter Board and Pierce's Disease Advisory Task Force

# Target Pest

SLF adults are approximately 2.5 cm (1 inch) in length. The forewings are grayish brown with black spots, with the wing tips having a darker, brick-and-mortar pattern. The hindwings are mainly red with black spots, followed by a white band and a black tip. When SLF is at rest, a faint red color can be observed through the forewings, but the color is most noticeable when it is in flight. The body is mainly black, but the abdomen appears to be mostly yellow with black bands along its length. In the eastern United States, adults can be found as early as July, and they remain active until the onset of winter. In late fall, the adults mate, and females begin laying eggs. SLF females prefer to lay eggs on tree-of-heaven, but will lay eggs on any flat vertical surface, including other trees, stones, vehicles, and outdoor furniture. The eggs are laid 30 to 50 at a time in a single mass that is coated with a waxy gray film. When this film has dried, the egg mass looks similar to a splash of mud, which can make them difficult to notice. Individual reproductive SLF females are reported to produce one ore two egg masses in their life time. On the east coast, eggs hatch in spring, usually in late April or early May; hatching time may differ in California. The nymphs are small and black with white spots when they first hatch. When the nymphs reach the fourth (last) instar, they have red coloring, especially around the head, abdomen, and wing pads. One habit observed in nymphs is a tendency to crawl up a tree in the morning, and then back down the tree in the evening. As the nymphs often do this in large groups, it can be very noticeable.

**Pest Profile:** California Pest Rating for *Lycorma delicatula*, spotted lanternfly.

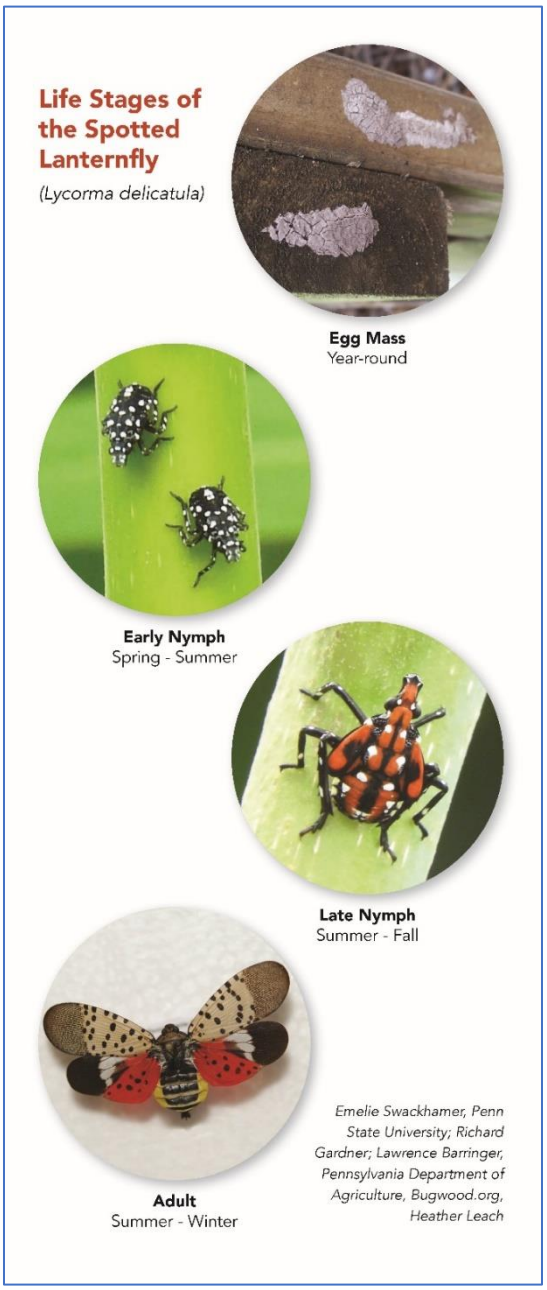


*Figure 1 SLF life cycle*

# Known Host List

Table 1 depicts a preliminary list of SLF host (feeding) plants. SLF is reported to feed on all of the plants on this list, either in the field or in the laboratory (Barringer and Ciafre, 2020).

| Genus | Species | Genus | Species | Genus | Species |
|---|---|---|---|---|---|
| *Acer* | *negundo* | *Juglans* | *cinerea* | *Quercus* | *acutissima* |
| *Acer* | *palmatum* | *Juglans* | *hindsii* | *Quercus* | *aliena* |
| *Acer* | *platanoides* | *Juglans* | *major* | *Quercus* | *rubra* |
| *Acer* | *pseudoplatanus* | *Juglans* | *mandshurica* | *Rhus* | *chinensis* |
| *Acer* | *rubrum* | *Juglans* | *microcarpa* | *Rhus* | *typhina* |
| *Acer* | *saccharinum* | *Juglans* | *nigra* | *Robinia* | *pseudoacacia* |
| *Acer* | *saccharum* | *Juglans* | *x sinensis* | *Rosa* | *cvs.* |
| *Actinidia* | *chinensis* | *Juniperus* | *chinensis* | *Rosa* | *multiflora* |
| *Ailanthus* | *altissima* | *Liriodendron* | *tulipifera* | *Rosa* | *rugosa* |
| *Alnus* | *incana* | *Lonicera* | *spp.* | *Rosa* | *spp.* |
| *Amelanchier* | *spp.* | *Luffa* | *spp.* | *Rubus* | *crataegifolius* |
| *Angelica* | *dahurica* | *Maackia* | *amurensis* | *Rubus* | *spp.* |
| *Aralia* | *cordata* | *Magnolia* | *kobus* | *Salix* | *babylonica* |
| *Aralia* | *Elata* | *Magnolia* | *obovata* | *Salix* | *koreensis* |
| *Arctium* | *lappa* | *Mallotus* | *japonicus* | *Salix* | *matsudana* |
| *Armoracia* | *rusticana* | *Malus* | *pumila* | *Salix* | *udensis* |
| *Betula* | *lenta* | *Malus* | *spp.* | *Salvia* | *spp.* |
| *Betula* | *pendula* | *Melia* | *azedarach* | *Sassafras* | *albidum* |
| *Betula* | *platyphylla* | *Metaplexis* | *japonica* | *Sorbaria* | *sorbifolia* |
| *Cedrela* | *fissilis* | *Monarda* | *spp.* | *Sorbus* | *conmixta* |
| *Celastrus* | *orbiculatus* | *Morus* | *alba* | *Styrax* | *japonicus* |
| *Cornus* | *controversa* | *Morus* | *bombycis* | *Styrax* | *obassia* |
| *Cornus* | *kousa* | *Nyssa* | *sylvatica* | *Tetradium* | *daniellii* |
| *Cornus* | *officinalis* | *Ocimum* | *basilicum* | *Tetradium* | *spp.* |
| *Corylus* | *americana* | *Parthenocissus* | *quinquefolia* | *Thuja* | *occidentalis* |
| *Diospyros* | *kaki* | *Phellodendron* | *amurense* | *Toona* | *sinensis* |
| *Elaeagnus* | *umbellata* | *Philadelphus* | *schrenkii* | *Toxicodendron* | *radicans* |
| *Euphorbia* | *pulcherrima* | *Picrasma* | *quassioides* | *Toxicodendron* | *vernicifluum* |
| *Fagus* | *grandifolia* | *Populus* | *koreana* | *Vaccinium* | *angustifolium* |
| *Firmiana* | *simplex* | *Prunus* | *mume* | *Vitis* | *amurensis* |
| *Forsythia* | *spp.* | *Prunus* | *pPersica* | *Vitis* | *riparia* |
| *Fraxinus* | *spp.* | *Prunus* | *salicina* | *Vitis* | *spp.* |
| *Hibiscus* | *spp.* | *Prunus* | *serotina* | *Vitis* | *vinifera* |
| *Humulus* | *japonicus* | *Pterocarya* | *stenoptera* | *Xanthoxylum* | *simulans* |
| *Humulus* | *lupulus* | *Pyrus* | *spp.* | | |

*Table 1 Preliminary list of known host (feeding) plants for SLF.*

# Environmental and Regulatory Compliance

## Establishing a 'Proclamation of Emergency Program' (PEP)

Public notification is a necessary and important component of the Department's Pest Detection and Response System. A protocol for public notification is established for every Department programmatic response. In the event of a SLF infestation, the Department will communicate a Proclamation of an Emergency Program to notify the public, governing boards of affected cities and counties, including county agricultural commissioners and health officers. Although technical assistance from sister agencies is not solicited during an Emergency Program, standard best management practices to avoid or minimize human and environmental impacts are always followed in treatment activities.

## Environmental Compliance

Since California is not known to possess any populations of SLF, any finds of SLF in this state would elicit an emergency response. However, a programmatic response may not be needed if it is determined to be an incursion rather than an introduction (i.e., an SLF found in a situation, for example, on an incoming vehicle, that does not indicate an infestation in the environment). Such cases would be classified as regulatory incidents not eliciting a programmatic response. If an emergency response is deemed necessary, it would entail promulgation of an emergency regulation to establish eradication authority in the appropriate county or counties and issuing a PEP before initiating any on-the-ground programmatic actions.

## Eradication Authority

If a live SLF triggers a treatment as defined in section 15, then eradication authority would be established for SLF in all counties in which any infestation is found, and all counties in which delimitation activities would occur. Eradication authority would be initiated via the emergency regulation process to allow expeditious initiation of mission-critical eradication activities (FAC §5322).

# California Department of Food and Agriculture Permitting

The Department issues different permit types depending on the type of activity a permitee is requesting to perform. Relevant permits for SLF activities include a quarantined commodity permit, a plant pest permit, and an SLF master permit issued to the shipper's state of origin department of agriculture. The master permit would allow CDFA to issue compliance agreements under a master permit to shippers to expedite shipments from quarantined areas.

## Plant Pest Permit

Under California Code of Regulations (CCR) 3 CCR § 3154, California plant pest permits may be issued for entities who want to conduct diagnostics or research on plant pests or diseases in California. This permit is required for the movement of live SLF into or within California. The applicants must complete Pest Exclusion Fill-in Form 66-026, which is provided to the public on the Department 's website. The movement conditions outlined in the permit request are reviewed and approved or denied by the primary state entomologist. If the application has been approved, a permit is produced and sent to the applicant as well as to any applicable county agricultural commissioners' offices and the Department 's Pest Exclusion branch, including the program manager of the Department border stations. An electronic copy of the permit is made available on the Department 's Interior Pest Exclusion Program extranet site, which is accessible only by the Department and county staff. The Regulatory Procedures for State Pest Movement Permits and are also available on the PHPPS extranet. For movement into the state from another state or country, a federal plant pest permit (PPQ 526) will likely be required, in which case the primary state entomologist will provide state review and a state permit would typically not be required to avoid duplication of effort.

## Quarantined Commodity Permit

As per 3 CCR § 3154, a quarantined commodity (QC) permit can be issued with conditions allowing the movement of articles regulated by California's Spotted Lanternfly Exterior Quarantine (3 CCR § 3287) into California for commercial purposes (3 CCR § 3154, Director May Issue Special Permits). Unless exempted by a QC Permit, materials meeting the criteria set out in the exterior quarantine would normally not be allowed entry into California from areas within the United States known to be infested with SLF.

QC Permit applicants will use the Fill-in Form 66-045, which is provided to the public on CDFA's website. They will also be required to review the SLF training material provided by the Department. If a master permit is not already in place for the state of origin, the Department contacts the origin state department of agriculture to develop a master permit. The type of commodity and the movement conditions outlined in the permit request are reviewed and approved or denied by the primary state entomologist. If the application has been approved, the applicant is added to the master permit shipper list and a permit is produced and is sent to the applicant, as well as any applicable county agricultural commissioners' offices and the Department 's Pest Exclusion branch, including the program manager of the Department border stations. In addition, an electronic copy of the permit is made available on the

CDFA's Interior Pest Exclusion Program extranet site, which is accessible for use by the Department and county staff. The Regulatory Procedures for Quarantine Commodity Permits is also available on the PHPPS extranet for the Department and county staff.

The following is a sample of some of the conditions that may be required for a quarantine commodity master permit; in the case of such a master permit, the shipping state department of agriculture has ultimate responsibility for ensuring that these conditions are met:

1. Shippers may only be approved if under a compliance agreement with the state department of agriculture to ship only articles that have been authorized under this permit and to adhere to the requirements of this permit.
2. One or more employees ("designated employees") of the shipping entity shall review the training provided by the Department and train all employees of the entity involved in inspecting the articles (see condition 3, below) at least once per year.
3. The designated employee(s) shall record, preserve, and maintain for two years and provide to the CDFA or origin state department of agriculture as needed the following information:
    a. Name, telephone number, and email address of the designated employee(s).
    b. A log of all employees trained by the designated employee(s), including the names of employees trained, name of trainer (designated employee), and date of training.
    c. The legal name, address, telephone number, and email address of the primary business location of the permit holder.
    d. Records, including type and quantity, of all regulated articles shipped into California.
    e. Records of all inspections including any spotted lanternflies of any life stages found and action taken.
4. All articles (including conveyances) shall be inspected by an employee trained by the designated employee prior to leaving the regulated area for any life stages of spotted lanternfly. Any spotted lanternflies of any life stage found must be removed and destroyed.
5. All regulated articles, other than the vehicles or other conveyances themselves, must be packaged and safeguarded, such as within a closed container, shrink wrap, tight tarp, or similar covering to maintain isolation from the environment during storage or transportation.
6. The permit shall be displayed in a visible and conspicuous place at each business entity or individual location to which it was issued.
7. The Department shall not issue the QC Master Permit until it receives an annual email from the origin state department of agriculture confirming by a list of approved shippers. The email shall be directed to the Department's Permits and Regulations Unit at permits@cdfa.ca.gov.
8. The origin state department of agriculture shall monitor shippers to ensure that the conditions of this permit are met.
9. The Department reserves the right to amend this permit, based on additional information. Amendments shall not be effective until both the Department and affected shipper have signed the amended permit.

10. Each shipment shall be accompanied by a certificate issued by an authorized representative of the state department of agriculture affirming that the shipment meets the requirements of California Permit No. QC XXXX for spotted lanternfly. In lieu of a paper certificate, a sticker or stamp-type certificate may be used with the following format:

    (origin state) Origin. Shipments from (origin state) are valid until Month Day, Year
    Under Authority of Permit No. QC XXXX for spotted lanternfly.
    Approved by the (origin state department of agriculture).
    (signature) Authorized Representative

11. Should any federal regulations be applicable, all articles must also be in compliance with those regulations.
12. All articles shipped to California under this permit are subject to inspection upon arrival in California.
13. Any shipment found to be infested with spotted lanternfly or improperly certified may be rejected in accordance with California laws (e.g., FAC section 403) and the shipper may be suspended until the Department, in consultation with the origin state department of agriculture, determines the nature of the violations involved and is satisfied with the resolution of the violation(s).
14. The origin state department of agriculture shall notify CDFA permits and regulations via email (permits@cdfa.ca.gov) of any violations, suspected or known, of this permit brought to the attention of the (origin state department of agriculture) by any party to enable a cooperative investigation or other appropriate action.

# Overview of Program Operational Approach

The SLF program within the Pest Detection/Emergency Projects Branch will focus on the following activities to detect and respond to any future incursions of SLF. More detailed descriptions of each of these broad activities can be found in subsequent sections.

## A. Prioritize and Inventory High-Risk Pathways to Prioritize Surveys

Early detection of SLF is critical to control a population before it becomes established. It is not practical to survey every square mile in California for SLF. In addition, due to factors such as population, presence of favored hosts, and movement of vehicles and articles from SLF-infested states, the risk of SLF introduction is uneven across the state. USDA-APHIS-PPQ and state cooperators have observed a strong correlation between major transportation (such as rail and trucking) and commodity pathways with the introduction of SLF into new areas.

Several tools exist to prioritize high-risk pathways and properties, such as predictive modeling (see Temple SLF dashboard, decision support tools), Department program data, and field observation to forecast pathways and areas of high risk as targets for survey and treatment operations. Additionally, the Department and California Agricultural Commissioners and Sealers Association (CACASA) have funded research on pathway analysis, risk of introduction, and risk of establishment for SLF. Currently, these approaches have been used to identify likely areas of SLF incursion into California. Statewide detection surveys began in 2020 and will be continued annually, with further refinement, into the future.

Annually, high risk areas will be identified based on current information; then, the Department and county cooperators will, in cooperation from the rail, air cargo, maritime, and trucking industries, conduct detection surveys and respond as necessary.

## B. Perform Detection Surveys for Spotted Lanternfly Populations

Survey and detection activities are critical and allow the program to determine the presence and delimit the geographic extent of SLF infestation, determine the future, likely incursions of SLF, determine where to conduct treatments to control SLF, and provide data to inform predictive and risk-based spread models, if indicated (see Section 11, below).

## C. Treatment and Control

Chemical, cultural, and/or biological treatments will be performed as appropriate with coordination from the USDA, county agricultural commissioners, and the grape industry. For more details on possible treatment and control scenarios, see Section 14 and 15, below.

## D. Collect, Analyze and Report Spotted Lanternfly Operational Data

The SLF program uses the ArcGIS Survey123 application for mobile data collection of survey activities. Each survey records the address and spatial location of the host, the host type, suspect SLF life stage, and any associated Pest and Damage Records (PDR) that have been submitted to the Department 's Plant Pest Diagnostics Center (PPDC) for a suspect. Survey123 allows for efficient spatial data collection, which allows the Department Geographic Information System (GIS) units to rapidly transform survey data into spatial distribution maps regarding suspects and host types.

If SLF is detected within the state, a PDR will be entered into the Department 's Plant Health and Pest Prevention Services (PHPPS) PDR database and must include 1) geographic coordinates (decimal degrees) of the trap location and where on the property the trap is placed, 2) the physical address or location description of the property (e.g. "123 Main Steet, Sacramento, CA" or "1/2 mile south of Main Street, 1 mile east of Dry Creek Rd"), 3) sample information including life stage, sex, and counts, 4) host plant species, 5) identification information stating the species has been rated, dated, and signed by an entomologist in the PPDC. The Plant Data Analysis Services (PDAS) unit will be notified of the PDR and will review the PDR for discrepancies. PDAS will contact field staff and/or laboratory staff if PDR discrepancies in the spatial location and/or identification are discovered. Once the PDR is reviewed, PDAS will prepare an internal CDFA "bullseye" map in the GIS application ESRI ArcGIS Pro with the following spatial layers: 1) the point location of the SLF detection and any previous detections; 2) a geographic buffer surrounding the detection to be used as a spatial distance reference, for example, a treatment or quarantine buffer; 3) locations of nurseries within the area; 4) crop boundaries as reported in the Pesticide Use Reporting and County Agricultural Commissioners' crop datasets; and 5) California counties. All spatial layers included in the bullseye map will overlay a basemap layer that displays city names, major streets, and landmarks for reference. The bullseye map and completed PDR will be sent to the Department staff who are included in an internal pest communication plan (see Section 17) and to USDA APHIS staff leads (as of 9/13/2021, this includes State Operations Coordinator, State Plant Health Director, and Assistant State Plant Health Director). Upon request, follow-up maps such as a map of the detection at a closer magnification and/or of the detection overlaid with a labeled crop layer will be produced and distributed internally to management. The Department considers the property address in the completed PDR to be personally identifying information and held in confidence by the Department

In the event the Department identifies enough SLF detections to trigger a quarantine, PDAS will draw a proposed quarantine boundary and will distribute the map for internal review. PDAS will work with Pest Exclusion (PE) staff and request review from the County Agricultural Commissioner(s) (CAC) involved. Upon approval, PDAS will update the CDFA SLF web page with "static" (i.e., non-interactive) maps of the quarantine boundary to be included in the Plant Quarantine Manual, a downloadable Google Earth KML file of the quarantine boundary, and a web map application of the approved quarantine boundary.

## E. Perform Outreach to the Public Regarding Management Activities

If treatment is triggered, the Department will issue a PEP and hold an online meeting with a presentation from the Public Information Officer, the primary state entomologist, and County Agricultural Commissioner. The Department of Pesticide Regulation and Office of Environmental Health Hazard Assessment will be present to answer questions from the public. Invitations to the meeting will be sent by USPS post cards to residents within the treatment area and a 100m buffer. Alternatively, if there are few residents in the area, they will be notified using door to door communication protocols and provided information on the treatment in writing. If funding is available, lenticulars may be used in quarantine areas (see Section 19 below).

# Sample Submission

For PDR preparation and SLF sample submission, please follow the general guidelines provided at https://www.cdfa.ca.gov/plant/ppd/PDF/Submission_guidelines_Entomology.pdf. For suspect SLF, the nymph and adult stages can be killed directly in 70-95% alcohol and sent to the lab (make sure to indicate if they were alive or dead when collected), but the egg stage will require special preparation. The eggs of SLF are encased in a strong cement-like covering. The undisturbed appearance of this egg mass is critical to positively identify them as SLF. For egg masses, please photograph the undisturbed egg mass prior to killing in alcohol. After killing in alcohol and dissolving the cement covering, please rinse and put the eggs back into clean alcohol for shipping to the lab and attach a printout of the egg mass photograph with the PDR. Do not ship live/dry eggs to the lab. Freezing will not necessarily kill the eggs. The lab will make identifications using morphology and will use DNA-based methods when necessary in cases of ambiguity (e.g., if eggs come to the lab without a photograph). The Department protocol will be followed for all SLF submissions, regardless of activity or situation. The CDFA will work with the USDA to facilitate official federal confirmation of SLF found in California.

# Survey and Detection

Survey and detection activities provide a baseline for all pest mitigation operations, allowing the program to detect the presence of SLF, delimit the incursion, determine where to conduct treatments to eradicate SLF populations, and generate data that can be used to inform predictive and risk-based spread models. The primary detection tactics for SLF are visual survey and public reporting. Visual survey is, in general, more effective than trapping for early detection, especially at low densities. However, traps can be useful for detecting early-instar nymphs. Trapping has the advantage that the trap is present for a given length of time in the field, whereas a visual survey is a "snapshot" of the surveyed trees. SLF tend to move through the environment and may be missed on the trees that happen to be surveyed.

Detection survey determines the presence or absence of SLF in previously undetected locations. The discovery of SLF may establish a new center of infestation, and, in turn, may lead to suppression efforts (or other subsequent actions) depending on the level of infestation, risk, and circumstances surrounding the infestation.

At any time of year, one or more SLF life stages can be found in an infested area. The efficiency of survey effort varies over the course of a year because of differences in visibility and the spatial distribution of different life stages. The most visible life stages are 4$^{th}$ instar nymphs and adults. In addition, later-instar nymphs and adults have more specific feeding preferences (tree-of-heaven and grapevines), and therefore tend to be more clustered in distribution. Lastly, egg masses are difficult to find in the field. For all of these reasons, late-instar nymphs and adults are the prime target for detection surveys. In the eastern United States, these life stages are present July through November. This may differ in California, given the warmer climate in some areas compared to the area currently infested by SLF in the eastern United States. Surveys in California are carried out when or after the SAFARIS PestCAST model predicts adult emergence in a given survey area. This model is based on "degree days" (i.e., the model accounts for different rates of development according to temperature). The degree day threshold for adult emergence will be reached at different times throughout the state, but the survey will take place between July and August.

Currently in California, high-risk surveys are conducted from the early summer into fall. The survey is focused on a list of areas of high risk of introduction, both from the infected eastern states as well as Asia. Typical sites surveyed include railyards receiving a high volume of railcars from the eastern United States, sites receiving a high volume of goods from eastern states based on *Lymantria dispar* hold notices (Form 008A), and importers of stone and other goods from infested regions of Asia. Form 008A sites are used because the majority of the SLF-infested area in the eastern United States is also included in the *L. dispar* quarantine, the articles of concern (primarily, those that can carry egg masses of either species) are essentially the same, and the Form 008A information is already collected and available for use. The sites surveyed can change year by year to account for new information. While it is desirable for any potential host to be surveyed, tree-of-heaven of at least 6-inch diameter at breast height (DBH) is the primary target host for detection survey. Based on the direction of local SLF program managers, alternative hosts may be used to supplement primary target hosts in detection survey if appropriate tree-of-heaven is not present within a survey area.

Identifying symptoms of feeding damage (honeydew, sooty mold, sap flux, flying insects attracted to honeydew or sap, etc.) may be useful to direct closer inspection in areas of low density, but suspected

feeding damage cannot be used as confirmation of SLF presence. Thus, potential SLF feeding damage will be immediately examined when observed during survey.

## Detection Protocol:

1. Specific protocols have been developed for identifying survey sites within each of three general types of detection survey locations, as follows:

    - Railyards:
      See Figure 2, below, for an example of a possible inspection plan for a railyard. A quota of survey sites will be determined for the area surrounding the perimeter of a railyard. Using aerial imagery or provided maps, determine a primary axis of the railyard where the tracks converge on either side, such that there will be a general north-south or east-west split of the surrounding area. Using this axial division, divide the quota of sites in half for each side of the railyard to help locate an even distribution of hosts surrounding the railyard perimeter. Choose a starting point where the rails converge, begin traveling along the railyard perimeter and pick the first site with tree-of-heaven. Continue traveling along the perimeter and survey the next tree-of-heaven if it is at least 0.25 mi away from the prior site. If a large tree or stand of trees is encountered, this may be recorded as an extra site. If tree-of-heaven is common in the area, choose the largest trees or sites with stands of multiple trees. If tree-of-heaven is uncommon in the area, grapevines (wild or maintained) may be used instead. Continue along perimeter surveying sites every 0.25+ mile until the other end of the railyard is reached along that side of the perimeter. If enough hosts are not found, begin traveling back towards the starting point, expanding your search radius out from the perimeter to 0.25 mi of the perimeter line. Any hosts located within this expanded radius should be surveyed if they are at least 0.25 mi away from any prior located sites. If the starting point is reached without meeting the desired quota, begin traveling away from the starting point as before, but expanding the search radius out to 0.5 mi from the perimeter line. This process will be repeated on the opposite side of the railyard axis. If the initial side of the railyard survey possessed an unmet quota of host sites, add the quota to the second side of the railyard survey. Boundaries and buffers will be illustrated on provided maps to assist with survey efforts.

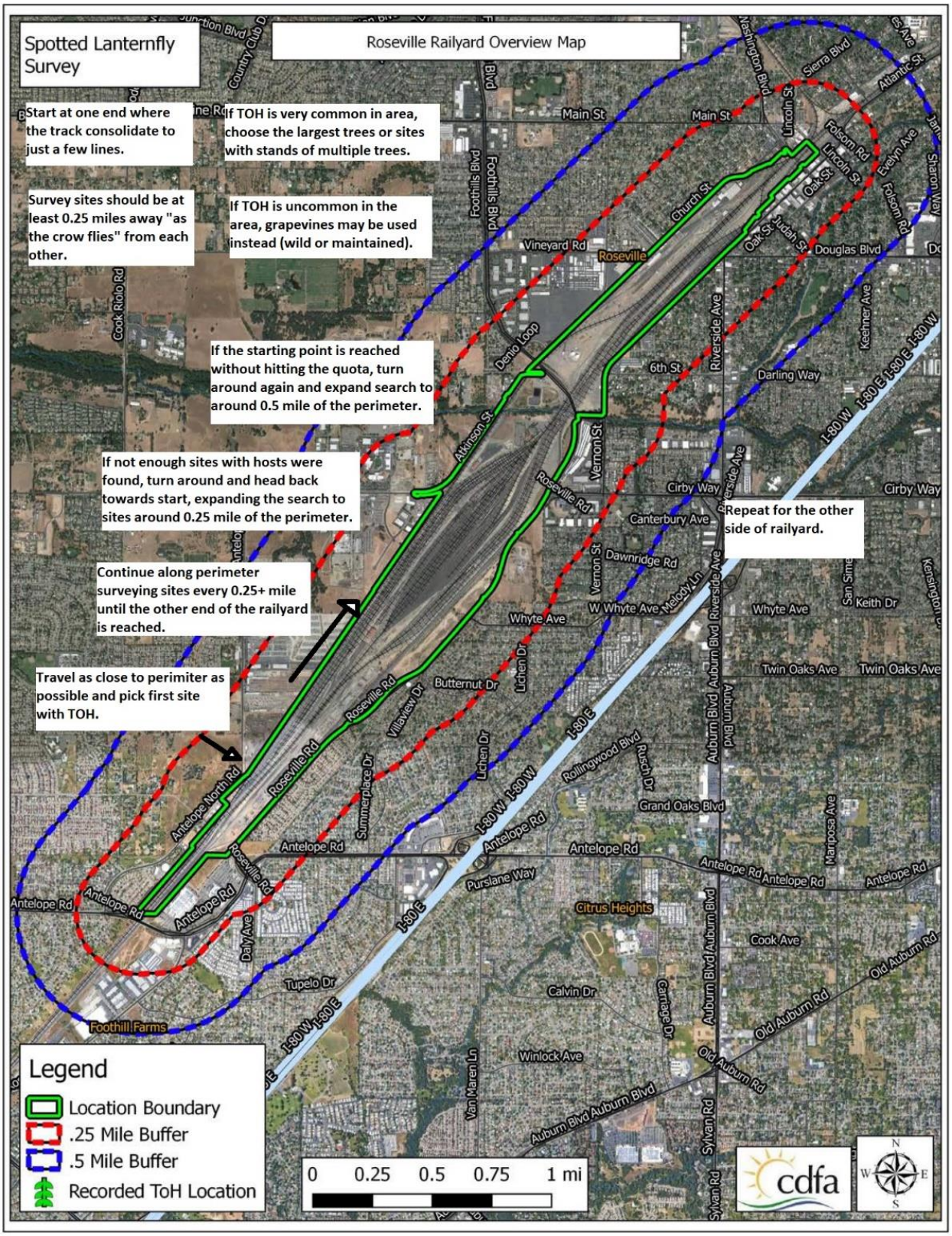


*Figure 2 Example of railyard inspection plan.*

- Ports:
  In order to maximize efficiency of the Department survey efforts, Asian defoliating moth (ADM; this is a general term used to refer to multiple species of Asian moths that defoliate trees and is not one species of pest) trapping sites, which are located at ports receiving ships from Asia, will also be surveyed for SLF. As is the case with 008A form data (described above), ADM trapping sites can reasonably be assumed to be higher-risk sites for potential introduction of SLF (in this case, from Asia, where SLF is native) via transport of egg masses on articles and storage containers. When servicing ADM traps, scout for tree-of-heaven and grapevines (wild or maintained). Choose a site within or on the direct perimeter of the port property with tree-of-heaven if possible. If tree-of-heaven is abundant, choose largest tree or stand of multiple trees. If tree-of-heaven is very uncommon in the area, grapevines may be used instead (wild or domestic). If no hosts found, expand to include 0.25 mile buffer around the port. If no hosts are found, expand to include 0.5 mile buffer around the port. Two sites per port should be surveyed, at least 0.25 mile apart, except the Port of Los Angeles/Long Beach (LA/LB), which has a target of 12 sites due to the port's large size and high traffic volume. Boundaries and buffers will be illustrated on maps to assist with survey effects.

- Point locations:
  Examples of point locations include *Lymantria dispar* hold notice (Form 008A) locations, campgrounds, and stone importers. Look for tree-of-heaven on or around the perimeter of the property. If tree-of-heaven is abundant, choose largest tree or stand of multiple trees nearest to the target location, as described above. If tree-of-heaven is very uncommon in the area, grapevines (wild or maintained) may be used instead. If no hosts are found, expand search to within 0.25 mile of the property. If no hosts are found, expand search to within 0.5 mile of the property. If no hosts are found, record as such and go to next location. For example, for "Stone City" in Anaheim, five survey sites would be optimal, at least 0.25 miles apart from each other, along and South of E Ball Rd., West of State Route 57 (Orange Freeway), North of E Orangewood Ave, and East of Interstate 5. Attempt one site within 0.25 mile of the intersection of E Cerritos Ave and S State College Blvd, with remaining sites scattered throughout area. Boundaries and buffers will be illustrated on maps to assist with survey effects.

2. At each site, thoroughly visually scan a tree (or grapevine) and surrounding vegetation for signs of SLF nymphs, adults, egg masses and honeydew. Start by looking for signs of the pests (weeping wounds, sap on trunks, honeydew, sooty mold and fungal mats at the base of the tree). Inspect the trunk and large branches of the tree closely for SLF nymphs and adults. Inspect the shaded areas of the tree bark (on the trunk and branches) closely for SLF egg masses. Check the outer edge of the tree canopy along leaves and branches working your way towards the center of tree. Use binoculars to survey as needed. Inspect surrounding vegetation and undergrowth as SLF can be found on less preferred and non-host material. Record GPS of the host. If multiple tree-of-heaven are present, choose largest tree or stand of multiple trees. If there is a large stand of tree-of-heaven or tree-of-heaven bordering a forested area inspect trees on the border/edge. On the

SLF Survey Data Sheet, record date, surveyor name, site name (for example, "Roseville Railyard #7" or the address of one of the high risk shipment receivers), host presence (Yes or No), host information (e.g., genus, single or multiple tree, > or < 6" diameter), lat/long of host, number of suspect adults/nymphs/egg masses (and egg mass substrate; if it is a plant, please identify), and any relevant comments like “wild grapevine” or "I think I saw one but it got away" or "additional hosts behind locked fence and unable to get permission" or “lots of honeydew and sooty mold but no suspects found” or “tree-of-heaven very abundant in survey area” or “tree-of-heaven non-existent in survey area”. On accompanying target location map, mark with pen or sharpie location of host site(s).

3. If spotted lanternfly is not detected:
    a. Record absence data.
    b. Select another survey site at location, if applicable.

4. If one or more suspect SLF are detected:
    a. If live suspect adults or nymphs are found, use a net if possible to collect the insect and then carefully transfer the specimen to a vial with alcohol. If dead and dry suspect adults or nymphs are found, collect in dry vials. If suspect egg masses are found, first take a picture of the suspect egg masses. Collect the egg masses by scraping the complete egg mass into alcohol. Take pictures of any suspects if possible, especially egg masses prior to collection. Enter SLF detection survey results for the site in the appropriate data collection app. Record a survey point whether SLF has been found or not.
    b. Conduct a thorough search of the work vehicles to ensure there are no SLF or egg masses in or on the vehicle before leaving the site.
    c. Complete PDR.
    d. Submit specimen(s) and PDR to the PPDC.
    e. Continue with survey to completion.

5. If SLF is confirmed by the PPDC:
    a. Designate the site as POSITIVE.
    b. Issue hold notice on site
    c. Initiate the SLF Delimitation Protocol.

## Trapping:

Trapping can be effective in some situations for detecting SLF, both in detection as well as delimitation situations. Types of traps that have been reported to be effective include the bug barrier trap, the circle

trap, and the sentinel tree method. All of these techniques work best when used on tree-of-heaven. The bug barrier trap consists of a inward-facing sticky band that is placed on a tree trunk. The circle trap has mesh that funnels SLF into an attached collecting receptacle. Both of these traps catch SLF as they crawl up the tree trunk. In the sentinel tree method, a tree-of-heaven is treated with a systemic insecticide, such as dinotefuran, and a collecting receptable is placed below the tree to catch SLF that have fed on the tree and died.

# Delimitation Protocol

If SLF is found, a delimitation survey will establish the extent of the infestation and help to inform next steps (i.e., eradication and quarantine activities). This survey establishes the population boundaries. The delimitation survey should begin as soon as possible after an initial detection of SLF and, at the discretion of the Department, additional times as well. For example, if nymphs are found in the early summer, the site may be surveyed the following August to September to account for decreased efficiency of survey outside of August to September. The delimitation area is two miles from each detection site. Delimitation surveys will continue at a rate of at least one survey per year after the initial year of the find for the duration of the delimitation period.

### Delimitation Procedure:

1. Select one of the identified properties containing delimitation sites to be inspected.
2. Inspect the site according to the SLF Detection Procedure.
3. If SLF is not detected, record negative data and move to the next identified delimitation site to be inspected. Repeat until all identified delimitation sites have been inspected. At the discretion of the Department, some properties/areas may not be surveyed for various reasons.
4. If SLF is detected outside of the initial find site, extend the delimitation area to two miles from each additional find.
5. At the discretion of the department, the delimitation area may be enlarged if conditions warrant it. For example, if a road or railroad cross the delimitation area, search may be expanded along that corridor.

# Regulatory Actions

A state interior quarantine shall be triggered by the official detection and confirmation of a total of two or more living SLF adults found in the environment within one mile of each other and during the timeframe of one lifecycle, or by one or more living SLF nymphs, visibly mated female, or egg masses in the environment. Additional detections of adult or immature spotted lanternflies in the quarantine area will further expand the quarantine area from those find sites. Quarantine boundaries shall be a one-mile radius from each adult or immature detection site. The quarantine shall persist until eradication activities have ceased as defined in section 15 for the duration of treatment and control and follow-up activities

All regulated commercial entities, such as nurseries, landscapers, fruit harvesters, green waste handlers, host fruit processors, shipping and storage facilities, movers, quarries, RV campgrounds and any other entity identified as a potential carrier of SLF shall be identified, staff informed of the quarantine restrictions; conditions for low risk movement of regulated materials, if any, must be identified and specified in the interior quarantine regulation. Quarantine compliance inspections shall be conducted as necessary in all quarantine areas to ensure ongoing compliance with quarantine restrictions.

Inspections of host nursery stock and other establishments under compliance inside the quarantine areas shall be conducted to assess the status of SLF. Trace-back investigations and inspections shall be conducted to determine potential sources of infestation. Trace-forward investigations and inspections may also be conducted to determine potential new areas of infestation.

Quarantine certification protocols shall be developed and/or amended in association with USDA, industry representatives, researchers, and local regulatory authorities.

<u>The following compliance agreement documents have been developed and are available from the Regulatory Program in PE:</u>

1. Support Documents
    a. Checklist Guide for Moving Non-Commercial Items into California
    b. Exhibit HL: Host List
    c. Exhibit OS: Oviposition Substrates
2. Compliance Agreement w/exhibits
    a. Exhibit A: Lumber/Timber Production, Storage and Transport
    b. Exhibit B: Building and Landscape Materials, Storage and Transport
    c. Exhibit N: Nursery
    d. Exhibit PH: Packing Houses
    e. Exhibit R: Recreational and Commercial Equipment Rental and Storage
    f. Exhibit YM: Yard Maintenance

3. QC Compliance Agreement w/exhibits to be used with Master permit
    a. Exhibit G: Grower
    b. Exhibit H: Harvester
    c. Exhibit L: Landscaper/Tree Services
    d. Exhibit P: Processor
    e. Exhibit T: Transporter/Hauler
    f. Exhibit X1: Program Management Practices for Aerial Spray Treatments
    g. Exhibit X2: Program Management Practices for Ground Spray and Drench Treatments
    h. Exhibit X3: Program Management Practices for Hazardous Materials Spills
4. Green Waste QC Compliance Agreement w/exhibits to be used with Master Permit
    a. Exhibit GW2: Green Waste Receiver – Biomass/Cogeneration
    b. Exhibit GW4: Green Waste Receiver – Composting
    c. Exhibit GW6: Green Waste Receiver – Landfill
    d. Exhibit GW10: Green Waste – Transporter/Hauler
    e. Exhibit GW12: Green Waste Receiver – Processor or Transfer Station

# Biological Control

Currently there is ongoing research to identify potential biological control agents of SLF. Certain parasitoids are known to attack SLF, but most do not seem to be specific to SLF. Fungal pathogens of SLF are also being explored. The preferred host plant of SLF, tree-of-heaven, is also a target for biocontrol research. A species of fungal wilt, *Verticillium non-alfalfae*, may have potential as a biocontrol agent of tree-of-heaven. The Department will favor, as much as is compatible or beneficial with current programs, research on effective biological control of SLF and tree-of-heaven.

# Treatment

The methods used to treat an infestation of SLF in California will be situationally dependent. Time of year, land use, population density, vegetation type and density, and other site specific factors will all be considered. Treatment methods may include contact insecticide spray treatments, herbicide and systemic insecticide tree treatments (for hosts), egg mass treatments, egg scraping, and border treatments with insecticides. Treatments will primarily be conducted by the Department personnel, contractors or county personnel. In some cases, contractors may be preferred due to their specialized training and equipment and unique access to properties, such as along rail lines and in high traffic areas at air and seaports.

The finding of any living life stage of SLF in the environment may trigger an SLF treatment project, which will be conducted within a 400-meters radius from each find site. To be effective, treatment methods must be used to match the life stages present at the time of use. The procedure used will be as follows:

If only live egg masses are found:

1. As time allows (unless approaching hatch time), use a combination of egg mass scraping and egg mass treatment (vegetable oil spray, such as Golden Pest Spray Oil or equivalent) on all accessible egg masses found during survey.

   And,

2. Conduct a follow-up survey in spring or summer with same protocol as used for initial delimitation (see Section 10).

   And,

3. Treat area as soon as possible (considering predicted SLF hatch time and seasonal limitations on insecticide use) with methods 5 and 6, below.

If SLF nymphs or adults are found:

4. As soon as possible, treat all living plants within 400 meters of the find site(s) with bifenthrin (spray). This is a contact insecticide that will provide rapid kill of active SLF life stages. Verify effectiveness of treatment seven or more days post-treatment and, if needed, repeat treatment according to pesticide guidelines (see below). If bifenthrin cannot be applied to an area for any reason (for example, environmental concerns or objection of residents), the Department may select an alternative effective insecticide.

   And,

5. If treating May-August, treat all (or only those with a DBH of 6” or greater) tree-of-heaven within 400 meters of the find site(s) with dinotefuran once per year. This is a systemic insecticide and will provide longer-lasting control of feeding SLF nymphs and adults. In order to be effective, it should be applied May-August to ensure uptake by the plant. Use of both contact and systemic insecticides will provide maximum control of SLF.

In addition, in any SLF treatment project, tree-of-heaven (and possibly other host plants) may be removed from the treatment area with any method, including manual removal, herbicide, and/or biological control.

Follow-up surveys, using visual survey and/or trapping (trapping may be especially effective for nymphs), will be done to monitor effectiveness of treatments targeting nymphs and adults. If practical, and if the numbers of SLF initially observed warrant it, the first follow-up survey may be done seven days after such treatments. Follow-up surveys may be done weekly thereafter for a month and then monthly for the remainder of the year. For the next two years, at least one survey, preferably targeting adult SLF, should be done. Follow-up surveys should be done for a total of three years. If there is evidence that treatment has failed, it will be repeated as soon as possible in accordance with pesticide use requirements.

An infestation of SLF shall be considered eradicated after the equivalent time period of three life-cycles have passed with no further detections. SLF is generally known to have one life-cycle per year. Therefore, unless information becomes available indicating the duration of the SLF life-cycle is significantly different in California, the infestation will be considered eradicated three years to the day after the last find. If the last find occurs during a leap year on February 29$^{th}$, the three years will be considered to end on March 1$^{st}$.

If SLF adults are found late in the year and it is likely that egg masses have already been laid, the Department may proceed with spring treatment (5 and 6 above). Egg masses are difficult to find in the field and it may be necessary to assume that eggs may have been laid.

Alternatively, treatment and control projects will end in a County when the Primary State Entomologist and County Agricultural Commissioner concur that eradication is no longer feasible and local control is ineffective. Alternatively, once 100,000+ properties are in the combined treatment area, the Department may be required to reduce or eliminate treatment due to logistical constraints. Once treatment and control projects end, it will be up to growers to manage SLF populations in the County. For this reason, growers should be encouraged to develop Pest Control Districts and Integrated Pest Management (IPM) strategies for SLF before it is found in California.

# Host Control: Tree-of-heaven

Much of the information in this section is taken directly from a Penn State Extension webpage prepared by PennState Extension Scientists, David R. Jackson, Forest Resources Educator, Art Gover, Research Support Associate in the Wildland Weed Management Program, and Sarah Wurzbacher, Forest Resources Educator.

Tree-of-heaven, or ailanthus (*Ailanthus altissima*), is an invasive tree and noxious weed in California. By far the most preferred host of SLF, tree-of-heaven is a rapidly growing deciduous tree native to both northeast and central China, as well as Taiwan. Tree-of-heaven was introduced into the West Coast in the 1850s. The emerging consensus is that controlling tree-of-heaven is crucial to controlling or preventing the establishment and spread of SLF.

*Figure 3 Tree-of-heaven leaves. Credit: Bigstock*

The tree was initially valued as a unique, fast-growing ornamental shade tree with the ability to grow in a wide range of conditions, tolerating poor soils and air quality. It was widely planted in California during the post-goldrush years, but lost popularity by the early 1900s due to its "weedy" nature, prolific root sprouting, and foul odor. Tree-of-heaven has become a common invasive plant in urban, agricultural, and riparian areas. It is common and conspicuous along transportation corridors and near old homesteads. Tree-of-heaven has not invaded remote wild areas. This is because, unlike in the eastern United States, tree-of-heaven rarely spreads by seed in California. Most populations consist of one to a few clones that have continued to spread for decades since planting via prolific root sprouting.

## Identification:

### Size

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

### Bark

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

*Figure 4 Bark. Photo: Dave Jackson.*

## 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 distinctive, rancid odor.


*Figure 5 Leaf. Photo Dave Jackson*

*Figure 6 Leaf Margin. Photo: Dave Jackson.*

## 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.

*Figure 7 Leaf scar. Photo: Dave Jackson*


*Figure 8 Brown spongy pith. Photo: Dave Jackson*

## 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.

*Figure 9 Close up of seeds (samaras). Photo: Dave Jackson.*

## Look-alikes

This species is easily confused with some of our native or commonly planted trees that have compound leaves and numerous leaflets, such as Chinese pistache, black walnut, and pecan. The leaves tend to be much larger than superficially similar leaves of common trees, such as black walnut. The leaflet edges of these similar trees all have teeth, while tree-of-heaven are smooth. The rancid smell produced by the crushed foliage and broken twigs is unique to tree-of-heaven.

*Figure 10 Clonal patches growing along highway. Photo: Dave Jackson.*

## 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. Established trees continually spread by sending up root suckers that may emerge as far as 50 feet from the parent tree. A cut or injured tree-of-heaven may send up dozens of stump and root sprouts. Tree-of-heaven produces allelopathic chemicals in its leaves, roots, and bark that can limit or prevent establishment of other plants.

## Control

Tree-of-heaven is widespread in California (see CalWeedMapper) and is a preferred host for SLF. In some situations, the presence of tree-of-heaven may be critical to establishment of SLF. In these situations, removal of tree-of-heaven may be the most effective means of preventing establishment of SLF. In addition, SLF has no effective lure or trap, so detection efforts must rely on visual survey. Focusing detection surveys on Tree-of-heaven increases the chances of detecting SLF early in establishment; this may allow early and effective action to control incipient populations. As tree-of-heaven rarely reproduces from seed in California, leaving sentinel trees poses little risk of spread of tree-of-heaven. Therefore, management tactics in California should balance lowering the chance of SLF establishment by removing Tree-of-heaven and preserving sentinel trees to ensure early detection of SLF. Control may be achieved by removing as many tree-of-heaven as feasible from margins of shipping/transportation corridors. From 1-3 sentinel tree-of-heaven of over 6” dbh can be preserved in each trapping grid at locations that lend themselves to easy detection survey access. These trees should be located more than 100 meters from major transportation corridors (e.g., railways and highways).

Due to its extensive root system and resprouting ability, tree-of-heaven is difficult to control. Treatment timing and follow up activities during 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, wait for symptoms to develop (approximately 30 days), and then cut.

Seedlings are unlikely in California. If they do occur, 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 roots with systemic herbicides applied in mid- to late summer (July to onset of fall color). An effective systemic herbicide with the lowest risk of environmental impacts should be chosen. 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. An effective herbicide with the least harmful, potential non-target impacts should be chosen.

Herbicides applied to foliage, bark, or cuts on the stem are effective at controlling tree-of-heaven. Cut stump herbicide applications do not prevent root suckering and should not be utilized. There are many effective herbicides available for use on tree-of-heaven, including dicamba, glyphosate, imazapyr, metsulfuron methyl, and triclopyr. For most treatments, herbicides containing the active ingredients glyphosate or triclopyr are documented as effective and they have little soil activity and pose minimal risk to nontarget plants.

Foliar herbicide sprays may be 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 hack-and-squirt 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 are generally less than 6 inches in basal 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.

Hack-and-squirt herbicide applications are highly selective with a concentrated herbicide solution applied to downward-angled cuts in the main stem or stems between ankle and breast height. For effective hack-and-squirt applications, apply the herbicide solution to cuts spaced evenly around the stem. Leaving uncut living tissue between the hacks 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, and follow-up measures are necessary.

## Management Calendar

The management calendar for tree-of-heaven emphasizes late-season treatment to maximize control of roots (See Table 2, below).

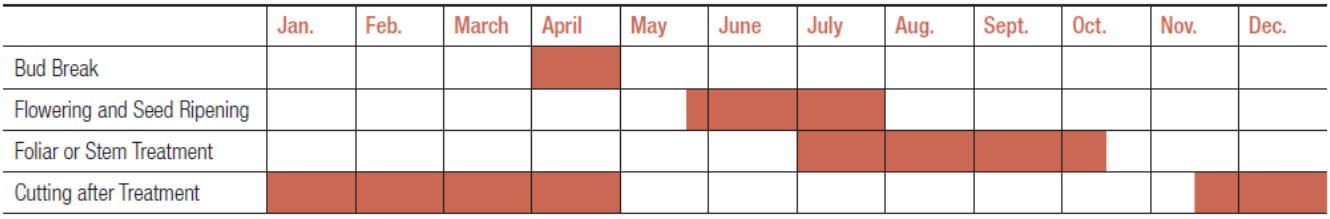


*Table 2 Tree-of-heaven management calendar*

## Treatment and Timing

Prescriptions for controlling tree-of-heaven stress timing to maximize injury to roots. Improper timing will result in treatments that provide "top kill" (shoot injury) but little control of roots.

*Table 3 Tree-of-heaven treatment (continued on next page).*

| Treatment | Timing | Herbicide | Product Rate | Comments |
|---|---|---|---|---|
| Foliar Application | July 1 to onset of fall color | Rodeo (glyphosate)<br>plus<br>Garlon 3A (triclopyr 3 lb/gal)<br>or<br>Vastlan (triclopyr 4 lb/gal) | 3 quarts/acre<br>plus<br>2 quarts/acre<br>or<br>1.5 quarts/acre | The combination of glyphosate and triclopyr provides a broad-spectrum treatment that is effective against tree-of-heaven to be targeted during the operation. This is a broad spectrum herbicide, but it has little soil activity and poses little risk to nontarget organisms through root uptake. Garlon 3A and Vastlan are both triclopyr formulations but have different active ingredient concentrations (44.4% and 54.72%, respectively). 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). |

| Treatment | Timing | Herbicide | Product Rate | Comments |
|---|---|---|---|---|
| Basal Bark | July 1 to onset of fall color | Pathfinder II<br>or<br>Garlon 4 Ultra (triclopyr ester) | Ready-to-use<br>or<br>20%, 1:4 in basal oil | Pathfinder II is a ready-to-use oil-based formulation of triclopyr used for basal bark applications. Treat main stems up to 6 inches in basal 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 basal diameter use hack-and-squirt. |
| Hack and Squirt | July 1 to onset of fall color | Rodeo (glyphosate)<br>or<br>Garlon 3A (triclopyr 3 lb/gal)<br>or<br>Vastlan (triclopyr 4 lb/gal) | 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 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 within 1 foot of the ground. |
| Cut Stump | N/A | | | If cutting tree-of-heaven for immediate safety reasons due to poor tree structure with an imminent threat of branch or trunk collapse, do so and treat the stump. However, cut stump herbicide applications are not recommended because they do not provide effective control of roots. Stump treatments will keep the stump free of sprouts, but they will not prevent root suckering. When tree removal is necessary, it is best to treat with one of the above-mentioned herbicide applications first, wait for symptoms to develop (generally 30 days), and then cut. |

### Human Health Concerns

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

# Outreach Partners

- California County Agricultural Commissioners – Both statewide and impacted counties
- California County Board of Supervisors – impacted counties
- California Department of Forestry and Fire Protection (Cal Fire)
- California Department of Pesticide Regulation (DPR)
- California Invasive Plant Council (Cal-IPC)
- California Table Grape Industry
    - California Table Grape Commission; Consolidated Central Valley Table Grape Pest & Disease Control District
- California Raisin Industry
    - National Grape Research Alliance
    - California Fresh Fruit Association
- California Wine Grape Industry
    - California Association of Winegrape Growers
    - Wine Institute
    - Family Winemakers of California
- iNaturalist
- National Plant Board
- National Plant Diagnostic Network (NPDN)
- Impacted Incorporated California City
- Master Gardeners
- The Office of Environmental Health Hazard Assessment (OEHHA)
- Pierce's Disease Control Program and Pierce's Disease and Glassy-Winged Sharpshooter Board
- SLF Impacted States
- University of California Cooperative Extension and Agriculture and Natural Resources
- United States Department of Agriculture
- United States Forest Service
- Western States Invasive Species Councils
- Western Plant Board
- Western Plant Diagnostics Network (WPDN)

# Internal and External Communication Plan

Currently, the Department has focused outreach efforts on detecting and reporting SLF via our pest hotline (1-800-491-1899) or our report-a-pest electronic application (http://reportapest.cdfa.ca.gov/). Additionally, the Department has pro-actively taken the following communication actions:

- Provided training for county regulatory staff from Plant Health Division and Pierce's Disease Control Program through the Department 's Pest Prevention University on what the pest looks like as well as potential conveyances
- Communicating the risk of artificially moving SLF egg masses via a conveyance such as motorhomes or trucks to travelers at our California Border Protection Stations.
- Continue to participate and contribute to the national SLF Summit as well as National Plant Board and Western Plant Board SLF meetings.
- Development and deployment of a SLF specific training module to educate and familiarize UC Master Gardeners about SLF and how to report suspect detections including a photograph and GPS coordinates of the suspect detection.
- Developed communication tools and advertising materials such as a SLF brochure, postcard, rack card, video, and pest alert (see attachment A). Printed copies of the communication toolkit have been sent to County Agricultural Commissioner and University of California extension offices throughout the state.
- Communicating with iNaturalist, citizen scientists, and community-based science outreach about SLF and how to report it through presentations and outreach booths at different functions throughout California.
- Outreach and presentations with stakeholders including California Grape Industry, California Nursery Industry, California County Agricultural Commissioners, and other interested parties.
- Coordinating with other states including a unified western states outreach effort through the Western Plant Board.

Upon initial confirmation from the Department 's Plant Pest Diagnostics Center of an official SLF detection in California, the Department will initiate the following activities:

- Initiate an Incident Command System (ICS) conference call/meeting/webinar with USDA, CalEPA's Office of Environmental Health Hazard Assessment (OEHHA) and the impacted County Agricultural Commissioner to coordinate, engage, and report out on detections, regulations, lab updates, next steps, and other updates. The ICS is an action planning process that ensures that all SLF-related activities are coordinated and communicated to all partners involved and that all activities support identified objectives. The ICS process ensures integration of all program elements, from planning, operations, communication, and outreach, to equipment needs and financial management. Using the ICS process facilitates a standardized system of communication, collaborative decision-making, and cost effective resource utilization. Representatives from the

Department , USDA, and affected CACs convene regularly (daily, weekly, or other frequency as determined necessary) to plan, communicate, and act on the SLF response in California.

- Work in cooperation with the impacted County Agricultural Commissioner and their staff and notify the County Board of Supervisors of the initial detection and next steps. Additionally, if the detection was within a California incorporated city, we will notify the city of the initial detection and next steps as well.
- Work in cooperation with the impacted County Agricultural Commissioner to develop and write a public press release either sharing the detection and what steps the public can do to help, declaring a quarantine, if triggered, and/or describe delimitation or treatment activities. All communication will urge the public to report sightings of the pest.
- Identify languages needed for the specific impacted community and translate outreach materials tailored to those communities.
- A Proclamation of an Emergency Program (PEP) will be developed and released on our public website and sent to impacted state, county, city, school district and public health officials.
- A PEP may be printed in the local paper to alert the public of proposed activities.
- Impacted residents in the treatment area will receive either a hand delivered or mailed public notice alerting them of any upcoming public meetings to cover program activities. the Department and partners will hold a public meeting(s) or virtual public meeting(s), which will highlight the pest, detection(s), how to report sightings, next steps and what is at stake if no action is taken. The meetings will also inform of the public of any chemical, physical, or biological treatments that will occur in response to the detections, including necessary measures to protect non-target plants, animals, and public health before, during, and after treatment. This will include a question-and-answer session. Following the public meeting, depending on the specific treatment, the impacted residents will individually receive a hand delivered treatment notice detailing the treatments, date and time, materials to be used, precautions that may be taken, and a toll-free pest hotline (currently 1-800-491-1899) to communicate any specific needs or concerns. Following treatment, the impacted residents are left a letter detailing precautions the residents may choose to take to limit their exposure and states the Department's appreciation for their cooperation with the treatments to eradicate SLF.
- Hold outreach meetings/briefings on SLF activities, as requested, with state, county, city, other elected bodies, or community organizations.
- Share outreach language/content with county and city staff as requested so they can help inform the impacted communities about SLF activities.
- Consideration of an SLF information booth at any public events held in the impacted communities to share information about the SLF and related treatments.

# References

Barringer, L. and Ciafre, C. M. 2020. Worldwide feeding host plants of spotted lanternfly, with significant additions from North America. Environmental Entomology 49:999-1011.

Barringer, L. E., Donovall, L. R., Spichiger, S. -E. 2015. The first New World record of *Lycorma delicatula* (Insecta: Hemiptera: Fulgoridae). Entomological News. 125:20-23.

Integrated pest management (IPM) principles. Accessed March 9, 2022:

https://www.epa.gov/safepestcontrol/integrated-pest-management-ipm-principles#what

Kim, H., Kim, S., Lee, Y., Lee, H. -S., Lee, S. -J., and Lee, J. -H. 2021. Tracing the origin of Korean invasive populations of the spotted lanternfly, *Lycorma delicatula* (Hemiptera: Fulgoridae). Insects 12:1-18.

StopSLF.org. Accessed March 9, 2022:

https://www.stopslf.org/

Wakie, T. T., Neven, L. G., Yee, W. L., and Lu, Z. 2020. The establishment risk of *Lycorma delicatula* (Hemiptera: Fulgoridae) in the United States and globally. Journal of Economic Entomology 113:306-314.