

Keeping an Eye Out for the Invasive Spotted Lanternfly

By Sarah Phipps, *State Survey Coordinator, Missouri Department of Agriculture*

If one thing has been learned about invasive pests, it's that the first detection is not by a wary entomologist, but instead the watchful eye of a homeowner, park goer, business owner, or a camping enthusiast. It often entails going about your normal workday or taking a stroll in the park and running across something that stands out because you have not seen it before – something so strikingly beautiful it does not seem to belong. This year, the Missouri Department of Agriculture (MDA) has received several phone calls and e-mails from concerned homeowners and businesses in our state whose watchful eyes have found the spotted lanternfly (SLF).

The spotted lanternfly (*Lycorma delicatula*), is a large planthopper native to Asia and was first detected in the United States in Pennsylvania in 2014. It feeds on the sap of more than 100 plant species, including grape, tree of heaven, apple, oak, walnut, maple and ornamental plants. This bad bug not only has the potential to damage our forests and food supply by feeding on trees and crop plants, but SLF also is a threat to recreation and tourism in our state. The SLF is now found in 14 states, with the most recent find being in Michigan. New infestations are being found hundreds of miles away from the next nearest-known infestation, indicating the pest is hitchhiking with humans. No active populations have been found in Missouri, but the examples provided below demonstrate the risk of SLF entering our state.

In one occurrence, a company contacted MDA at the end of July, after dead SLF nymphs were found in the shrink-wrap surrounding the boxes and pallets of a shipment received from Pennsylvania. Initially, four dead SLF nymphs were found on the shipment, but to date, a total of 15 dead SLF have been spotted. An inspection of the warehouse and vegetation in the surrounding area was completed and no egg masses or live SLF were detected at the facility.

In another occurrence, an e-mail from a trucking company alerted MDA of an adult SLF near the end of September – the first adult SLF specimen for our state. Yikes! Thankfully, it was dead when found. The truck hauling the SLF had traveled



Trucking company from St. Louis County reported a dead spotted lanternfly, which was found under the hood of a truck after returning from Pennsylvania.

to Pennsylvania, Ohio, Indiana and Illinois during September. The SLF was found under the hood of the truck upon return. When evaluated, it was determined the SLF was in the adult stage of its lifecycle when the truck traveled through Pennsylvania, where it was likely picked up.

These occurrences have prompted an inspection of the vegetation on the premises and surrounding the facilities where the dead SLF was found. The MDA team specifically inspects to see if there are any tree of heaven or other host plants located around the businesses. No signs or symptoms of any SLF life stage have been found at this time.



Ben Quisenberry, MDA Plant Protection Specialist, inspects pallets for spotted lanternfly egg masses at one of the reported sites.

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In the reports MDA has received thus far, the SLF was found dead on the premises or no active population was found upon inspection. The Department is thankful Missouri companies are open to SLF inspections and honest about potential sightings.

Our team is proud of companies that have been proactive in educating their drivers, maintenance staff, and office employees on the SLF. Training more eyes to spot SLF can help slow the spread of this pest. Please continue to keep an eye out for the invasive spotted lanternfly!

Lifecycle Description

Spotted lanternflies go through five stages of growth after hatching from eggs. The first four stages are called nymphs. The tiny nymphs are initially black with white spots, but eventually develop red areas on their bodies. Adults are about an inch long, gray and black in color, and have hind wings with bright red patches. Adult spotted lanternflies are present from July through December. Egg masses of 30-50 eggs overwinter and hatch in the spring.



How can you help?

Early detection is key. Inspect your trees and plants for signs of this pest, particularly at dusk and at night when the insects tend to gather in large groups on the trunks or stems of plants. Inspect trees (in particular, tree of heaven), logs, lumber, bricks, stone or other smooth surfaces for egg masses.

If you think you have found spotted lanternfly, follow these steps:*



**You can also report your sighting to the Missouri Department of Agriculture by calling (573) 751-9334 or mail a letter to Missouri Department of Agriculture, PO Box 630, Jefferson City, Missouri 65102.*

Spotted Lanternfly and Its Look-a-likes

Some insects resemble the spotted lanternfly. Check out some of its look-a-likes here:



Additional Resources: Spotted Lanternfly Brochure & Poster: <https://agriculture.mo.gov/plants/pests/spotted-lanternfly-brochure.pdf>



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Mycorrhizae: Nature's Gift to Plant Health

By Dr. David Trinklein

Late in the 19th century, a Polish scientist by the name of Franciszek Kamienski made a remarkable discovery. He found there were soil-borne fungi that formed a mutually beneficial (symbiotic) relationships with the root systems of plants. Today, those fungi carry the common name of mycorrhizae which, literally interpreted, means “fungus-roots”. Nearly 150 years later, scientists continue to make novel discoveries about these unique micro-organisms, and the benefits they bring to modern agriculture.

A symbiotic relationship can be defined as two living organisms living in close physical association, most often to the benefit of both. It is estimated that nearly 80 percent of all plant species on earth form mycorrhizal associations of one type or another. Mycorrhizal classification is based on the relationship of the hyphae (branching filamentous structure that form the main body of the fungus) and the roots of plants.

Ectomycorrhizae, commonly found on the roots of woody plant species, produce hyphae primarily on the exterior of plant roots. The result is a hyphal sheath known as a mantel. In contrast, endomycorrhizae (a.k.a. arbuscular mycorrhizae) grow inside the roots both between and within root cells. The relationship between fungus and plant of endomycorrhizae is a more invasive than that of ectomycorrhizae. Endomycorrhizae colonize a wide array of plants species.

At one time skeptical about the importance of mycorrhizae, the scientific community now acknowledges their benefits as both numerous and important to plant growth. For example, because of an improved “connection” of a plant’s root system and the soil that surrounds it, mycorrhizae allow for increased uptake of both water and essential mineral elements, especially phosphorus. These benefits lead to improved drought tolerance, a reduction in the amount of fertilizer need to be applied to soil and increased disease resistance.

The benefit of increased disease resistance imparted by mycorrhizae has been the result of much research. It has long been theorized that a healthy, vigorous plant is better able to withstand disease pressure when compared with a malnourished, stressed plant. Causing a plant’s root system to be able to take in additional nutrients and water, undoubtedly makes for a healthier plant. However, there are additional reasons why mycorrhizae help plants to resist diseases.

Since some mycorrhizae form a mantel enveloping roots, their presence represents a physical shield against invasion by other soil-borne microbes. In short, they compete with microbial pathogens for both space and root exudates. Additionally, they cause cell walls to thicken, making pathogen invasion more difficult.

Additional to the above, it has been demonstrated that mycorrhizae excrete enzymes that are toxic to soil-borne pathogens such as nematodes. Disease suppressive effects against soil-borne fungi such as *Fusarium*, *Verticillium* and *Phytophthora* also have been documented.

Of great curiosity is the defense response plants exhibit when mycorrhizal affiliations are present. In short, plants respond with countermeasures when under the attack of disease organisms. For example, certain chemical compounds with anti-microbial actions (e.g. alkaloids) are released by plants when disease organisms attack. Again, these responses appear to be stronger in plants having mycorrhizal associations compared with those that do not.

Although most mineral soils contain mycorrhizae, there numbers often are insufficient for adequate root colonization. Additionally, soilless media used in container production lack mycorrhizae unless blended into the mix as an additive.

In light of the many benefits of mycorrhizae, supplements of the latter are available to make certain sufficient populations are present in the root zone area. Brand names* include but are not limited to Asperello® (*Trichoderma asperellum*, strain T34), Obtego® (*Trichoderma asperellum*, strain ICC 012 + *Trichoderma gamsii*, strain ICC 080), PreStop® (*Gliocladium catenulatum*), RootShield® (*Trichoderma harzianum*), RootShield Plus® (*Trichoderma harzianum* + *Trichoderma virens*) and SoilGard® (*Gliocladium virens*). All are OMRI listed and labeled for use on both vegetable and ornamental crops. Although natural, the above products are considered (bio)pesticides and should be handled with care. Always read and follow label directions.

Additional biofungicides labeled for vegetable crops include Actinovate® (*Streptomyces lydicus*) and Cease® (*Bacillus subtilis*). However, the latter two contain beneficial bacteria rather than mycorrhizae.

In most cases, the above products are applied both before and after transplanting crops such as vegetables. Typically, the first application is made as a drench to transplants (e.g. tomato) growing in a greenhouse. Additional applications normally are made after setting plants in the field (or production greenhouse/high tunnel) via “chemigation”, using drip irrigation equipment. Frequency of repeated field application depends both upon product and disease pressure.

***Mention of brand names does not imply endorsement by the author or University of Missouri Extension.**

Preventing Yield Loss - Soil Testing for Soluble Salts in High Tunnels

By Justin Keay



Photo by Maya Horvath

Soil testing provides valuable insights into pH and the levels of nutrients, guiding fertilizer application as well as recommendations of materials to adjust soil pH, such as lime or sulfur. Soil testing in a high value production space, such as a high tunnel, is even more critical to ensure revenues cover construction and maintenance costs.

Most growers are familiar with testing soil for macronutrients (nitrogen, phosphorous, potassium, calcium and magnesium) and pH, but might be less familiar with testing for soluble salts. Soluble salts are measured by electrical conductivity testing and reported in units of mmhos/cm. High levels of soluble salts in soil can reduce yields and damage crops. Sodium is not the only soluble salt that can cause yield loss, excess fertilizer salts such as magnesium, calcium, and potassium can also contribute to this problem. Plant nutrients should always be applied based on soil test recommendations. Excess nutrients (organic or synthetic) applied in dry forms or through fertigation, shallow irrigation, and high levels of salts in irrigation water, can all over time raise soluble salt levels in the soil to damaging levels.

Soils with high levels of soluble salts are categorized in a range from very slightly saline, to very strongly saline, depending on the concentration of soluble salts in a tested volume of soil. As soluble salts accumulate to high levels in the rootzone, plants have a much harder time withdrawing water from the surrounding soil. Certain crops are more sensitive to high salt levels than others. For example, beets can thrive in moderately saline soils, while other crops such as tomatoes and peppers might suffer yield losses of 25% or greater in similar soils. In field production systems in Missouri, salt accumulation in soils is generally not a concern, due to high levels of precipitation from rainfall and snow that leach soluble salts downward out of the rootzone.

However, in high tunnel production systems rainfall is completely excluded, and accumulation of high levels of soluble salts in the rootzone is much more common. Higher rates of fertilizer are often applied to high tunnel soils to maximize crop yields, additionally, drip irrigation does not supply enough water to leach salts downward into the soil profile. In a high tunnel, as water evaporates and moves upward in the soil profile, salts can accumulate to damaging levels in shallow layers of the soil. In a survey of high tunnel growers in Pennsylvania (Penn State), soils in conventional high tunnels on average had strongly saline soils, while soils in organic high tunnels on average had moderately saline soils. Whether organic or conventional, salt levels in high tunnel soils were shown to be capable of reducing yields of non-salt tolerant crops.

There are multiple options high tunnel growers can use to manage this problem. One option would be to move the high tunnel to a new location with fresh soil, the added benefit of this practice is to reduce soil-borne disease issues that tend to accumulate in high tunnels. This practice however might not be feasible, as most growers treat high tunnels as fixed stationary structures. The second option is to remove the plastic from a high tunnel after crop harvest in the fall and leave the high tunnel open until the following spring. Annual or semi-annual removal of plastic has proven successful for some growers, who are able to maintain soluble salts below damaging levels in their high tunnels. This process involves a high amount of labor and might not be possible for growers who use their high tunnels for winter production of crops such as spinach and greens. Using high amounts of irrigation in high tunnels can also leach soluble salts out of the rootzone. General guidance for this practice is to apply six inches of water to leach 50% of salts from the rootzone, 12 inches to leach 80%, and 24 inches to leach 90%. Leaching can be accomplished with drip irrigation or sprinklers.

The only way to know whether soil has high levels of soluble salts is to test. It is recommended to collect a dozen subsamples taken throughout the tunnel, to a depth of 6 inches. If growing on fixed beds, it is recommended to sample only from the beds and not from the alleys or walk-ways. Thoroughly mix the subsamples together and drop off two cups at the local MU Extension office or send samples directly to the MU Extension Soil Testing Laboratory. University of Missouri Extension Soil Testing Lab offers soluble salt testing (as measured by electrical conductivity) for \$6. Make sure to request an electrical conductivity test, or E.C. test, when submitting the sample. Salinity tolerances and potential yield losses of common vegetables are listed in the table below. Tomato yield losses of 10% can occur at electrical conductivity values as low as 3.5 mmhos/cm, and 50% at values of 7.6 mmhos/cm. See the table below for soluble salts levels capable of reducing yield in other commonly grown high tunnel crops. If the soil test indicates high levels of soluble salts and a grower chooses to take action to address this problem, it is important to retest the soil to ensure the practice was successful in lowering soluble salts to desired levels.

Salinity tolerance of common vegetables

Crop	Threshold Value	Yield Loss		
		10%	25%	50%
-----EC _e (mmhos/cm)-----				
Beets	5.3	8.0	10.0	12.0
Broccoli	2.7	3.5	5.5	8.2
Cabbage	1.8	2.8	4.4	7.0
Carrot	1.0	1.7	2.8	4.6
Cauliflower	2.7	3.5	4.7	5.9
Cucumber	2.5	3.3	4.4	6.3
Lettuce	1.3	2.1	3.2	5.2
Pepper, Bell	1.3	2.2	3.3	5.1
Spinach	3.7	5.5	7.0	8.0
Squash/Pumpkins	3.9	4.9	5.9	7.9
Tomato	2.5	3.5	5.0	7.6

Adapted from *Salinity and Plant Tolerance*, Utah State University Extension

Soil samples may be sent directly to the laboratory at the address below, be sure to include a check made payable to “MU Soil Testing” as well as a soil sample form. Sample forms can be obtained at your local MU Extension office or online at: <https://extension.missouri.edu/mp727>.

MU Soil and Plant Testing Laboratory

1100 University Avenue
Mumford Hall Room 23
Columbia, MO 65211

Basics of Ordering Seed for Commercial Growers

By Katie Kammler

There are many seed sources to choose from when ordering seed to plant. You want to choose a reputable source that offers disease free seed, high germination rates, etc. Variety selection and quantities available are also important. There are many seed companies that cater to just home gardeners versus commercial production. Some companies do both. Many companies offer seed treatments with fungicides and insecticides coating the seeds to help prevent problems. Organic seed and untreated seeds options are also available. Compare availability, pricing, shipping rates, and discounts between companies to help determine what works for you farm. Many growers work with multiple seed companies since some desired varieties are proprietary to one company.

Variety selection is an important part of seed selection. What grows best in your climate and soil? What do your markets/buyers demand? If you are looking to try some new varieties, it is always good to start small to learn more about successfully growing a specific variety. Sometimes trying a new variety is also about education for the buyer on the advantages of a specific crop, this is particularly true for farmer's market vendors.

There are differences between what seeds are available for a commercial grower versus what is available for a home gardener. Catalogs or seed company websites for home growers offer small quantities of different varieties. Advantages of seed companies that cater to commercial producers are that they will have the newest varieties and different variety selection, including varieties that have resistance to common disease problems. They will also have quantity pricing, typically either by number of seed or by weight. Seed treatments are typically available to help combat disease and insects. The best part is that they have comparison charts which will list characteristic of each variety. For example, days to maturity, average size, plant habit, resistance to any diseases, and a description. Many also include symbols that indicate whether a particular variety is a hybrid, organic, untreated, treated, pelleted, new addition, exclusive to that company, a favorite of that company, a winner of All-American Selections, ornament, edible, good for storage, plant variety protected, extremely heat tolerant or extremely cold tolerant, or good for container planting.

My final tips are to compare prices and varieties between companies. There are differences between seed catalogs and shopping online or dealing directly with a seed representative, depending on the company. Keep inventory list of seed and figure out how much seed you actually need for the growing season. If you have leftover seed, it can be stored in the refrigerator or a cool dry place for the next growing season. Glass or plastic containers are ideal to keep insects and mice out of stored seed. Germination rates go down the longer seed is stored and the length of time that a seed can be stored depends on what it is. I always look forward to exploring new seed options every year. It makes the winter months go by faster when planning for spring planting!

WHO'S WHO

MU Extension

Justin Keay
Horticulture Field Specialist
Pike County
573-324-5464
justin.keay@missouri.edu

Katie Kammler
Horticulture Field Specialist
Ste. Genevieve County
573-883-3548
kammlerk@missouri.edu

Dave Trinklein
State Floriculture Specialist
573-882-9631
trinkleind@missouri.edu

Juan Cabrera-Garcia
State Vegetable Specialist
573-882-0567
Jcabrera-garcia@missouri.edu

Jared Fogue
MU IPM Program
Media Specialist
ipm@missouri.edu

MU Extension County Specialists

Adair: Jennifer Schutter
660-665-9866

Bates: Ramón Arancibia
660-679-4167

Henry: Travis Harper
660-885-5556

Morgan: Joni Harper
573-378-5358

St. Francois: Kate Kammler
573-883-3548

Vernon: Pat Miller
417-448-2560

Webster: Patrick Byers
417-859-2044

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