Proceedings of the
95th Annual
Cumberland-Shenandoah Fruit Workers Conference

December 5th-6th, 2019

Holiday Inn Winchester SE-Historic Gateway
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FIELD OBSERVATIONS ON SPOTTED LANTERNFLY BEHAVIOR AND HOST SUITABILITY

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Introduction:

The spotted lanternfly (SLF), *Lycorma delicatula*, is an invasive planthopper native to East Asia. First discovered in Berks County, PA, in 2014 (Barringer et al., 2015), the SLF has spread to multiple states and counties. SLF are phloem-feeding insects, which results in copious amounts of liquid waste, or honeydew (Dara et al., 2015). This honeydew effectively stops photosynthesis of contaminated vegetation (Dara et al., 2015), which can ultimately result in financial losses in many different economic sectors. The USDA-APHIS implemented a trade quarantine to help limit the SLF spread. It has been shown that SLF nymphs have a wide range of hosts, while the adult host range narrows (Lee et al., 2009). SLF preferred host is commonly known as the tree-of-heaven, *Ailanthus altissima* (Lee et al., 2009). Although the preferred host for SLF is tree-of-heaven, SLF can feed on over twenty families of plants in North America (Lee et al., 2009).

The objective of this project was to review field techniques employed by LABServices over the past two years to evaluate SLF control products in the field. The objective had three goals: 1) Identify a practical method for conducting field efficacy trials on SLF. 2) Investigate adult SLF survivability on various host, tree-of-heaven (TOH), red maple (Acer rubrum) (RM), black walnut (BW), and native grapevine (GV). TOH, RM, BW, and GV were selected because those species are common in woodlots and the perimeter of agricultural fields within the current distribution. 3) Demonstrate techniques effective for conducting pesticide efficacy with adult SLF in field trials.

Materials and Methods:

For field trials, TOH, RM, and BW were selected to be within 6-10" diameters at breast height (DBH). GV was chosen to be within 2-3" DBH. Trees/or vines. Replicates were clustered into a group, and each replicate group was separated by at least 50' from each other. Tree cages were constructed that were durable and restrictive to maintain SLF on a treatment regimen. Tree cages were installed at breast height (4.5' from the base of the trunk). The cages took an average of fifteen minutes to install and were effective all summer unless excessive sooty mold developed and replacement with clean cages was necessary. All SLF adults were hand collected from Kaercher Creek Park, Hamburg, PA. All collections were done from Kaercher Creek exclusively to ensure limited pesticide exposure. After collection, SLF adults were held in plastic containers lined with paper towels to absorb excess honeydew and stored in coolers with refrigerated chill packs. SLF were then brought to our field site in Hamburg, PA, sexed, and five males and five females were placed directly into each cage by hand. Mortality data was collected daily or as needed.

A pyrethroid bark spray and a neonicotinoid systemic bark spray were used only on TOH test trees to demonstrate efficacy in the field. Untreated TOH was used to demonstrate the natural mortality in the cages compared to pesticide treatments. A pyrethroid bark spray (beta-cyfluthrin 2.5%) was used to represent a common homeowner product known to provide quick knockdown with limited residual activity (Table 1). A systemic neonicotinoid bark spray (dinotefuran 70%) was used to simulate an SLF control measure with extended residual properties (Table 1). Applications were made with a backpack sprayer using a TeeJet TX8003VK Full Cone nozzle held 4" from tree bark until spray run-off (60-80 DBH"/gallon solution).

Results:

A total of 5044 SLF were collected Sept 23rd – Nov 7th for use in this project. Overall the collections show that 59% of the adult SLF collected were males, while 41% were female.

To determine if collection and caging of adult SLF influenced the survivability of SLF in the cages, we compared survival at one day after infestation (1DAI) and 7DAI for average percent mortality on untreated plots. The average percent mortality was 0.40% ± 0.89% for all adult SLF on untreated TOH 1DAI (Figure 1). Similarly, there was low percent mortality for all adult SLF on BW and GV untreated treatments 1DAI, 0.67% ± 1.15%, and 0.00% ± 0.00%, respectively (Figure 1). Adult SLF on untreated RM 1DAI resulted in a high average percent mortality of 24.33% ± 18.57% (Figure 1). At 7 DAI, adult SLF on untreated TOH and GV had an average percent mortality not significantly different from each other, 16.11% ± 12.09%, and 21.50% ± 17.68%, respectively (Figure 1). Adult SLF on RM and BW untreated treatments 7DAI had a high average percent mortality that was not significantly different between the two species, 85.33% ± 16.48%, and 100% ± 0.00%, respectively (Figure 1). The average percent mortality for adult SLF at 14DAI follows the same trend as the 7DAI mortality. The BW average percent mortality remained at 100%, while the RM mortality increased to 96.94% ± 6.41% (Figure 1). Adult SLF mortality on untreated TOH and GV continued to increase at 14DAI, 28.67% ± 21.21%, and 40.50% ± 4.95% (Figure 1). As a general observation, average percent mortality tended to increase later in the season as the test trees entered abscission, and mortality increased were related to rising temperatures.

Adult SLF were capable of surviving on GV and TOH untreated treatment trees/vines in this cage design with reasonably low average percent mortality. Therefore, to quantify the duration of adult SLF survival with this caging technique, adult SLF contained in specific cages until 90% mortality occurred. Adult SLF survived 17 days and 24 days on GV and TOH, respectively, until 50% mortality (Figure 2). It took 35 and 44 days for adult SLF to then reach 90% mortality in the GV and TOH, respectively (Figure 2).

A pyrethroid bark spray and a neonicotinoid systemic bark spray were evaluated only on TOH test trees to demonstrate pesticide efficacy in the field. The pyrethroid treatment provided rapid knockdown, resulting in 100% ± 0.00% mortality on adult SLF in less than two hours after infestation (Figure 3). Similarly, at 1DAI, the average percent mortality during the entire trial period for the neonicotinoid bark spray was 82.00% ± 22.98%, and after 4DAI average percent mortality was 100% ± 0.00% (Figure 3). The average percent mortality for adult SLF on untreated TOH at 1DAI and 4 DAI was 0.40% ± 0.89% and 8.12% ± 6.29%, respectively (Figure 3). The adult SLF in these evaluations were changed with newly field-collected insects every fourteen days for the duration of the trial. Evaluation of the systemic neonicotinoid bark spray continued for three months while the pyrethroid bark sprays were terminated after the second group of fresh SLF failed to differ from the untreated controls. The neonicotinoid bark spray provided 100% ± 0.00% mortality of adult SLF at 1DAI until the 8WAT introduction of new SLF adults (Figure 4). By 8WAT, the initial mortality of adult SLF on neonicotinoid bark sprayed trees was significantly reduced from earlier introductions. However, by 4DAI, the average percent mortality was 100% (Figure 4). After three months, introduction of SLF adults on the neonicotinoid bark spray TOH treatments resulted in approximately 40% mortality at 1DAI but ultimately resulted in 100% ± 0.00% mortality by 4DAI (Figure 4).

Discussion:

The male population, at the Kaercher Creek collection site, was significantly higher than the female SLF populations. However, about Oct 31st, when oviposition was ending, male numbers declined relative to female numbers. Lack of male SLF precluded efficacy evaluations of the neonicotinoid bark sprays after October 31. The higher mortality data for adult SLF on RM untreated treatments 1DAI suggests that the collection and caging methods influenced mortality. The high average percent mortality of adult SLF on RM and BW untreated treatments 7DAI suggest that neither species is a suitable long-term exclusive host for adult SLF. Low average percent mortality 1DAI and high average percent mortality 2DAI suggest that untreated BW may be a capable intermediate host for adult SLF. Overall, it was observed that adult SLF were not capable of surviving exclusively on RM and BW with this caged method. None the less, on TOH and GV, adult SLF were capable of surviving for extended periods of longer than one month. Adult SLF survived 20% longer on TOH compared to GV to reach 90% mortality. The neonicotinoid bark spray provided excellent control of adult SLF, up to 3 months using this caging technique.

The cage design implemented in this study could be modified to accommodate for studies on multiple host species, life stage analysis, and even biological agent related trials. Further cage modifications in the future would target smaller trees or use branches with thinner bark to create a more suitable environment for the SLF. Additionally, the cages use adult trees or vines with an established root system, mimicking what would generally be available to SLF in the field. Data collection and analysis were easily manageable because a consistent number of adult SLF used in each cage, allowing for hourly or daily data to be collected. The cages were custom made, easy to install, clean, and manage. A shortcoming observed during evaluations was the lack of available space for SLF in the cages. This presentation only represents one year of data. Therefore, additional replications should be performed.

Video evidence demonstrating a courtship behavior observed in SLF adult males in natural settings was never observed in the cages during this conduct of this research. The observed male courtship behavior involved performing a mating dance for the female SLF. The male is fluttering his hindwings to expose the brightly colored underwing in a circular motion pattern around the female.

Lastly, the presence of *Beauveria bassiana* in the field was observed. No adult SLF in our cages was observed with sporulation masses of *B. bassiana* though the confirmation of mortality due *to B. bassiana* cannot be confirmed.

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Lee, J. E., Moon, S.R., Ahn, H.G., Cho, S.R., Yang, J.O., Yoon, C., Kim, J.H.,2009. Feeding behavior of Lycorma delicatula (Hemiptera: Fulgoridae) and response on feeding stimulants of some plants. Korean J. Appl. Entomol. 48, 467–477.

Figures and Tables:

Table 1. Pesticide efficacy treatment list and application methods

Treatment Type	Chemical Name	% WT	Application Rate (fl. oz./gal)	Application Rate Unit	Application method
Control (no treatment)	n/a	n/a	n/a	n/a	n/a
Pyrethroid Bark Spray	Beta - Cyfluthrin	2.5	2.0	fl. oz./gal	Bark Spray 60 - 80" DBH/ gal. solution
Neonicotinoid Bark Spray	Dinotefuran	70	3.5	fl. oz./gal	Bark Spray 60 - 80" DBH/ gal. solution
	Adjuvant	96	2.5	fl. oz./gal	Bark Spray 60 - 80" DBH/ gal. solution

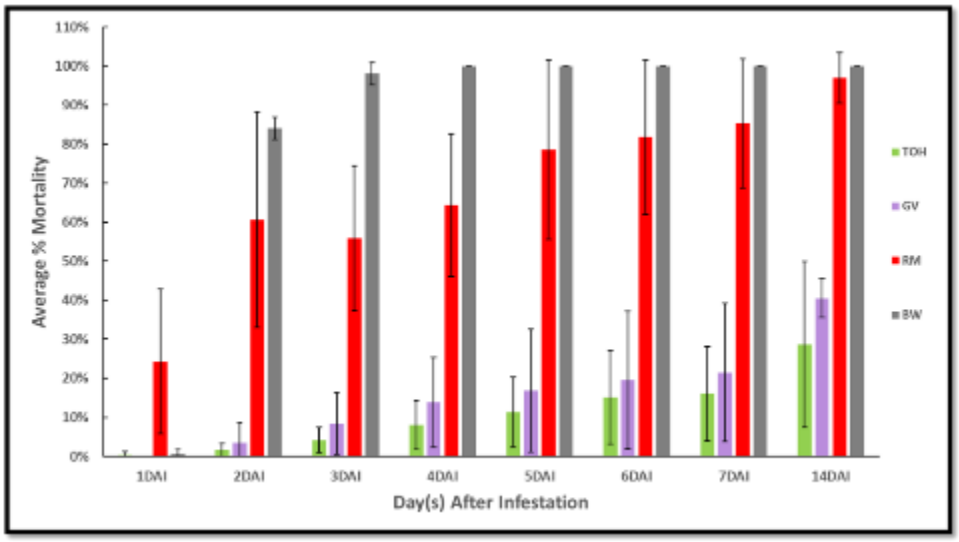

Figure 1. Adult SLF average percent mortality on TOH, GV, RM, and BW untreated treatments until 14 days after infestation.

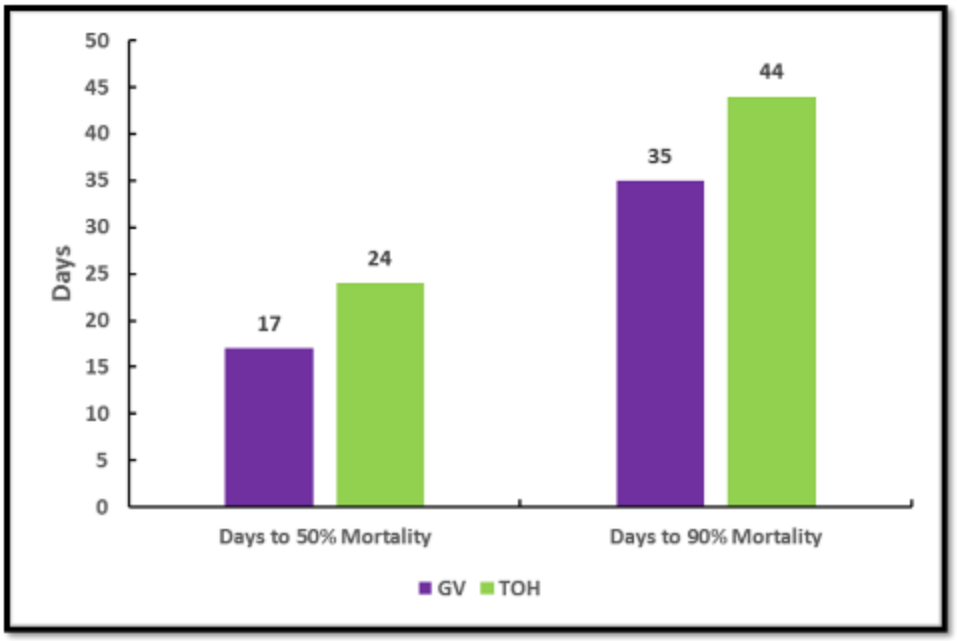

Figure 2. Days adult SLF could survive on GV and TOH exclusively in the custom cages.

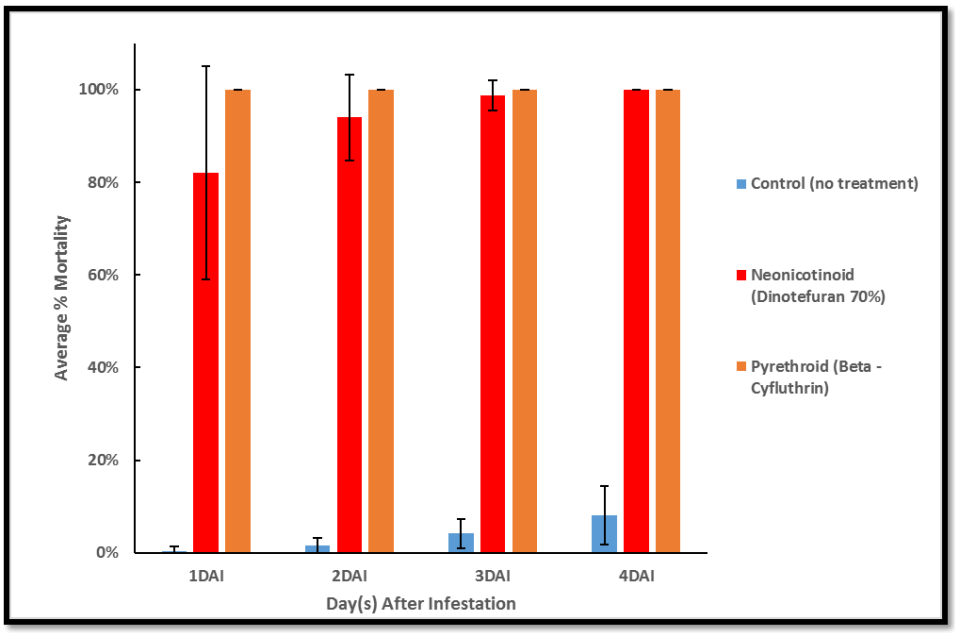

Figure 3. Average percent mortality for adult SLF on TOH treated with various pesticides.

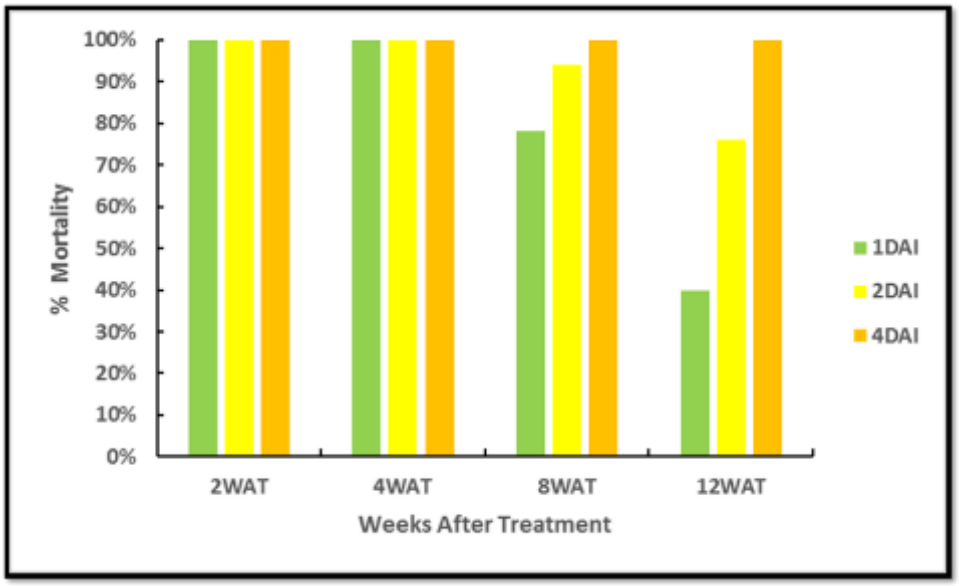

Figure 4. Percent mortality for adult SLF on TOH treated with neonicotinoid bark spray over a three-month period.