Spotted Lanternflies (SLF), *Lycorma delicatula*, are a crop pest native to China, Taiwan, and Vietnam. They were introduced to Japan and Korea as early as 2000. Since their introduction to the United States in 2014, populations have been established in 14 northeastern states. Their main distribution method is human transportation of their inconspicuous egg masses, each containing about 40 individuals. Like many Hemiptera, SLF use their beak to suck the sugar-rich phloem from plants. The Tree of Heaven (Ailanthus altissima), present in their native range, is their preferred host, and is also invasive and is found in 44 states. SLF can attack and reduce the yield of fruit trees including apple, peach, and especially grape. Their preference for congregating in large numbers results in damage to their host in two ways: First, they simultaneously wound the plant and reduce its nutrient supply. Second, the sheer volume of their sticky excreta coats host plants, reducing their photosynthetic ability and introducing fungal pathogens. In this paper I survey a variety of studies that offer insight into SLF biology and behavior with the intention of using that information to develop strategies to control their populations and mitigate the damage they inflict.

Given the propensity for SLF to gather in high densities, using entomopathogenic fungi to manage populations is a promising strategy. There are 4 known species of fungi that are deadly pathogens to SLF. Following outbreaks of epizootic disease in Spotted Lanternfly populations in southern Pennsylvania in 2018, Clifton et al. (2019) identified two species of fungi that contributed to the local population collapse: *Batkoa major* and *Beauveria bassiana*. Of 180 cadavers collected, 73% were afflicted with *B. major*, and 27% with *B. bassiana*. Clifton found a mere 12 egg masses at the site, probably because gravid females were dying before egg deposition. Hajek et al. (2022) demonstrated *B. major*'s potential for killing SLF in the lab: with a sample size of 336, 67% of subjects died within 10 days after exposure to *B. major* spores with varying levels of effectiveness depending on life stage. Clifton et al. (2021) discovered two other species of fungi known to harm Spotted Lanternflies: *Ophiocordyceps delicatula*, a species previously undescribed in the literature, and *Metarhizium pemphigi*. There have yet to be bioassays for either species to assess potential to be used as a biopesticide.

Parasitoid wasps, natural enemies of SLF, contribute to regulating SLF populations in their native range. After Liu and Mottern (2017) collected SLF eggs in Pennsylvania in the field and incubated them in the lab for two months they found adult parasitoid wasps emerging from the masses. They collected the aforementioned wasps in addition to wasps they found directly on top of egg masses in the field while they were collecting eggs. After sequencing the DNA and analyzing the morphology of these wasps, they concluded that it was *Ooencyrtus kuvanae*. Coincidentally, In a historical twist, *O. kuvanae* is one of two parasitoid wasps that was intentionally introduced to the US over a century ago in order to control populations of Gypsy Moth. Since then, there have been a couple of studies on the efficacy of *O. kuvanae* as a biological control for SLF, alongside a few studies on Asian wasps not found in the US.

Because insects have a long history of coevolution with plants, researchers often study the effects various plant-based compounds have on the behavior of pest insects. Of the 10 essential oils Yoon et al. (2011) tested using a Y tube olfactometer, only lavender oil solicited significant avoidant activity in SLF with a P-value of 0.0037. After separating lavender oil into its components and testing SLF reaction to those, Yoon et al. (2011) identified linalool as the only component that had a repellent effect. They also found that sticky traps treated with lavender oil captured fewer SLF than untreated traps. In that same year, Moon et al. used the same methods to conclude that mint oil was an attractant for SLF. On the other hand, when Cooperband et al. (2019) treated sticky traps with either linalool, spearmint oil or other plant-based kairomones, their results reflected an insignificant difference between the untreated control traps and the traps treated with linalool and spearmint oil. The Cooperband study ultimately identified three different kairomones that captured more SLF in sticky traps than the untreated traps. Methyl salicylate was the most notable compound because it was the only one that was consistently capturing SLF of all life stages. Branching out from plant kairomones to plant volatiles, Derstine et al. (2020) tested 18 plant volatiles in both the lab and field and identified 11 that were significantly attractive. One of which, sulcatone, was more attractive than methyl salicylate.

SLF, like other Hemipterans, use sound to communicate with each other. Studies show that using sound to control SLF behavior can be a viable strategy for population management. Rohde et al. (2022) placed a SLF in the middle of a paper circle and played a 60 Hz sound for 30 seconds. They observed that movement of all 20 adults and 16 nymphs was, on average, directly towards the sound. Polajnar et al.'s (2016) examination of a close SLF relative, the American Grapevine Leafhopper (*Scaphoideus titanus*) offers valuable insights given their shared classification within the suborder Auchenorrhyncha. Their study, similar to Rohde's, measured behavior as they alter sound frequency in addition to sound duration. In 20 minutes, no leafhopper pairs mated in the lab when they played a noise with an amplitude of 2.5 μm/s. After playing the same sound in a vineyard for 21 hours straight, they observed that mating rates dropped from 71% to 5%.

The potential economic impact of SLF feeding behavior is the driving force behind research into its physiology and behavior. There is still much more to learn about the mortality rates of the two newest fungal parasites of SLF, *Ophiocordyceps delicatula* and *Metarhizium pemphigi*. Parasitoid life cycle and potential host range needs to be thoroughly researched before any biological control strategy is implemented in order to minimize potential unforeseen consequences. Contradictory findings between studies in 2011 Korea and 2019 US express a need for more studies to be done in order to confirm effective repellant or attractant chemicals, if any. I suspect the temporal and geographical difference between those studies might account for the difference in results due to working with different populations of SLF. A molecular analysis of differences in each population's genome might confirm or deny this hypothesis. Regardless, an effective repellent would ideally be applied to the perimeter of a farm whereas treated lures on the property would attract straggler SLF. Lastly, I believe SLF acoustic communication is under-researched given how promising of a strategy it demonstrates.

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