

Preparedness in biological control of priority biosecurity threats

Spotted lanternfly, *Lycorma delicatula* (White)

Introduction

Lycorma delicatula (Hemiptera: Fulgoridae), the spotted lanternfly (SLF), is a plant hopper native to China, and southeast Asia (Taiwan and Vietnam). Since mid-2000s, this species has been introduced into South Korea and Japan, and more recently, the USA (Lee et al. 2019). In North America, the species was first observed in Pennsylvania but then spread rapidly and is currently reported in nine states, from Indiana to Connecticut. SLF is a serious plant pest, causing severe economic damage to agricultural and forest systems. SLF feeds on the phloem in leaves and stems from over 100 host plants such as cherries (*Prunus*), grapevines (*Vitis*) or black walnut (*Juglans nigra*). Feeding causes sap exudation from plants resulting in mold growth. SLF is also considered a nuisance pest due to its aggregating behaviour on trees, shrubs, and human-made objects, affecting the quality of life by their presence and the presence of sooty mold promoted by SLF. Studies on the global risk of establishment of SLF predicted highly suitable areas in Asia, Oceania, South America, North America, Africa, and Europe (Wakie et al. 2020). Due to the high dispersion, the tremendous damages SLF is causing to commercial crops and the environment many government agencies consider SLF as a priority/ high risk pest.

History of classical biological control against pest

Recently, diverse research on natural enemies against the SLF is carried out. In China, a number of promising natural enemies have been identified, especially the egg parasitoid *Anastatus orientalis* (Hymenoptera: Eupelmidae) and the nymphal parasitoid, *Dryinus sinicus* (Hymenoptera: Dryinidae) (Xin et al 2021; CABI 2022). Field surveys conducted in Pennsylvania showed that *Ooencyrtus kuvanae* (Hymenoptera: Encyrtidae) parasitized eggs of SLF (Liu and Mottern, 2017). In California, it is tested if species of *Anastatus*, native to California and Arizona, have potential to parasitize eggs of SLF (CDFA 2022).

Knowledge on the majority of potential BCAs is limited and ongoing work is focusing on their life cycle and host range.

Most promising natural enemies for classical biological control

- *Dryinus sinicus* is a nymphal parasitoid that usually parasitizes second- and third-instar SLF nymphs. As observed for *A. orientalis*, parasitism of nymphs in the native range is highly variable among sites but may reach up to 48% (CABI 2022). However, further research is necessary to proof whether parasitism of nymphs is really caused by *D. sinicus* or several (cryptic) species (Xin et al. 2021). Furthermore, female *D. sinicus* can kill several SLF nymphs by host-feeding before laying their eggs (Xin et al. 2021). So far, knowledge on *D. sinicus* and other related species are very limited. Before *D. sinicus* can be fully considered for a biological control program, further research needs to be done, especially on its host specificity, its impact on SLF populations and its potential for mass-rearing.

Other natural enemies for classical biological control

Preparedness in biological control of priority biosecurity threats

- *Anastatus orientalis* has a high potential to parasitize SLF. In China, where the SLF is native, high levels of parasitism (30-40% and up to 69%) have been reported for *A. orientalis* (Choi et al. 2014; Broadley et al. 2020). However, parasitism rates are highly variable from sites to sites and may also vary among host plants within a given site (Xin et al 2021). Host range testing showed that *A. orientalis* is not highly specific to SLF and can parasitize other North American Fulgoridae and Acanaloniidae but also more distant taxa of Heteroptera or Lepidoptera. However, a careful host screening with choice tests has not yet been performed. Likewise, further studies are needed to clearly state on its life history and its host search behaviour. The mass-rearing of this egg parasitoid is promising as the species can complete 7–8 generations over 8 months under laboratory conditions.
- *Ooencyrtus kuvanae* (Hymenoptera: Encyrtidae) was detected in SLF egg masses collected in 2016 in Pennsylvania (Liu and Mottern, 2017). This egg parasitoid was initially introduced to North America in early 1900's for the biological control of spongy moth *Lymantria dispar*. In field surveys conducted in China, this parasitoid has not been found to parasitize egg masses of SLF, even though Asian spongy moth populations (*L. dispar asiatica*) were present in the surveyed sites (Xin et al 2021). Before the discovery of *O. kuvanae* in SLF egg masses, the host range of the wasp was considered to be restricted to Lepidoptera with preferences for spongy moth. This observation can suggest either a broader host range of the species or it raises questions about the identity of the observed parasitoids; as cryptic species complexes are common among parasitoids (Liu and Mottern, 2017). Moreover, *O. kuvanae* is known as a hyper-parasitoid parasitizing some *Anastatus* species which may potentially interfere with other BCAs and reduce their impacts. Consequently, *O. kuvanae* may not be the best option for the biocontrol of SLF.

References

1. Broadley HJ, Gould JR, Sullivan LT, et al. 2021. Life history and rearing of *Anastatus orientalis* (Hymenoptera: Eupelmidae), an egg parasitoid of the spotted lanternfly (Hemiptera: Fulgoridae). *Environmental Entomology* 50, 28-35.
2. CABI. 2022. Pro-active biocontrol of Spotted lanternfly.
3. Lee D-H, Park Y-L & Leskey TC. 2019. A review of biology and management of *Lycorma delicatula* (Hemiptera: Fulgoridae), an emerging global invasive species. *Journal of Asia-Pacific Entomology* 22, 589-596.
4. Liu H & Mottern J. 2017. An old remedy for a new problem? Identification of *Ooencyrtus kuvanae* (Hymenoptera: Encyrtidae), an egg parasitoid of *Lycorma delicatula* (Hemiptera: Fulgoridae) in North America. *Journal of Insect Science* 17.
5. Wakie TT, Neven LG, Yee WL & Lu Z. 2020. The establishment risk of *Lycorma delicatula* (Hemiptera: Fulgoridae) in the United States and globally. *Journal of Economic Entomology* 113, 306-314.
6. Xin B, Zhang Y-I, Wang X-y, et al. 2021. Exploratory survey of spotted lanternfly (Hemiptera: Fulgoridae) and its natural enemies in China. *Environmental Entomology* 50, 36-45.