Relationship between two natural enemies of brown marmorated stink bug pest

January 24 2022

The brown marmorated stink bug feeding on a cherry. Credit: CABI

A new CABI-led study has examined the relationship between two closely-related natural enemies of the brown marmorated stink bug in respect of how they interact when trying to attack the fruit and nut pest's egg masses.

The brown marmorated stink bug is a global pest which in 2016 caused $60m worth of damage to Georgia's hazelnut (a third of its crop) and in 2010, $37m worth of apples were destroyed in parts of the U.S..

Dr. Tim Haye, an expert on the brown marmorated stink bug (Halyomorpha halys) based at CABI's center in Switzerland, teamed up with researchers from the MARA-CABI Joint Laboratory for Bio-safety and Agriculture and Agri-Food Canada, to understand how competition between two scelionid parasitoids on the stink bug's eggs may provide insight into how they may coexist to fight the devastating crop pest.

Leading the fight

CABI is leading the fight to see if the Asian Samurai Wasp (Trissolcus japonicus) can be used as a natural enemy to control the pest. The latest research, published in the journal *Ecology and Evolution*, examined larval and adult competition between two Asian natural enemies of the pest, Trissolcus japonicus and T. cultratus (Hymenoptera: Scelionidae) associated and coevolved with the brown marmorated stink bug in its native range.

Competition of the two species was assessed by providing parasitized egg masses to each species at various intervals post-parasitism, and measuring host acceptance, developmental suitability, and guarding behavior.

Trissolcus cultratus on brown marmorated sting bug egg mass. Credit: CABI

Dr. Haye, and colleagues Dr. Jinping Zhang, MSc Marion Risse and Dr. Tara Gariepy, found that adult Samurai Wasp showed high acceptance of parasitized eggs up to 72 hours following oviposition (the process of laying eggs) by T. cultratus, despite a very poor developmental outcome.

T. cultratus generally avoided oviposition

In contrast, the scientists found, T. cultratus generally avoided oviposition in H. halys eggs containing early-instar larvae of Samurai

Wasps but did not avoid parasitizing in eggs that contained eggs and third instar larvae wasp.

The researchers argue that the adaptive value of this behavior was supported by the developmental outcome of larval competition inside eggs that had been parasitized by both species. T.cultratus outcompetedSamurai Waspeggs but not early-instar larvae, and a trophic shift occurred whereinT.cultratusdeveloped as a facultative hyperparasitoid (thereby demonstrating extreme survival behavior) on third instar larvae of the Samurai Wasplarvae. This ability to develop as a facultative hyperparasitoid provides a competitive niche for Asian T. cultratus and confirms its competitive superiority in the larval stage. This also occurs, the researchers say, in a biologically distinct European population of T. cultratus, suggesting that facultative hyperparasitism as a competitive strategy is retained in geographically separated populations that have not coevolved with the brown marmorated stink bug or the Asian Samurai Wasp.

Superior competitor in the adult stage

In contrast, T. japonicus—being a poor competitor in the larval stage—was a superior competitor in the adult stage, and accordingly females invested more resources in guarding egg masses parasitized by themselves (8–12 times longer than T. cultratus) and more aggressive attempts to oviposit egg mass guarded by their competitors.

The new study is a unique example for counterbalance competition, wherein coexistence is possible if an inferior larval competitor evolves superior host exploitation abilities as an adult.

More information: Tim Haye et al, A temporal trophic shift from primary parasitism to facultative hyperparasitism during interspecific competition between two coevolved scelionid egg parasitoids, *Ecology*

and Evolution (2021). DOI: 10.1002/ece3.8483

Provided by CABI