

Preparedness in biological control of priority biosecurity threats

Brown marmorated stink bug, *Halyomorpha halys* (Stål)

Introduction

The brown marmorated stink bug, *Halyomorpha halys* Stål is a severe pest of Asian origin causing dramatic losses in production of fruits, vegetables and nuts. This pest is nowadays present in most parts of Europe, in North America (USA and Canada) and in South America (Chile). Severe damages are recorded for the Eastern USA and in North Italy. Broad spectrum insecticide applications are the most adopted control method, but high recovery ability of adults, low residual activity of active ingredients, high mobility and the extreme broad host range, cause several failures in chemical control (Leskey and Nielsen, 2018). Thus, biological control appears the most valid perspective in the long-term period (Zhang *et al.*, 2017).

History of classical biological control against *Halyomorpha halys*

In the native area of the pest, several natural enemies attack *H. halys*. Among these, the egg parasitoid *Trissolcus japonicus* (Ashmead) plays a relevant role and has been indicated as the most promising candidate for classical biocontrol programs (Yang *et al.*, 2009; Zhang *et al.* 2017). In Europe (Italy, Switzerland, Germany), USA and Canada, adventive populations of *T. japonicus* were recently discovered (2015-2021); adventive populations probably were introduced with its host. Field data on such adventive populations in Italy, showed that the current parasitoid impact on eggs of *H. halys* is low, less than approx. 10% (Moraglio *et al.*, 2020), even if locally parasitisation can reach higher rates (>70%, see Milnes and Beers, 2019). In Italy, a second adventive egg parasitoid from Asia was recently detected in 2018: *Trissolcus mitsukurii* (Ashmead) (Sabbatini Peverieri *et al.*, 2018). This species was successively detected also in neighbouring countries (Slovenia and France in 2021). Both egg parasitoids are oligophagous, thus not specific on *H. halys*. However, field observations in China, USA and Italy, and laboratory tests in olfactometer indicate a strong preference towards the target pest, thus suggesting that their occurrence on non-targets in the field can be considered occasional (Zhang *et al.*, 2017; Haye *et al.*, 2023; Milnes and Beers, 2019; Rondoni *et al.*, 2022). Despite the arrival of adventive parasitoids in Italy and USA, their populations appear to need more time to increase and to impact infesting population of *H. halys*. Introductions and or redistribution plans of *T. japonicus* are ongoing in the USA and in Italy. and petitions are under evaluation in other countries (e.g., France).

Most promising natural enemies for classical biological control

Two parasitoid species of Asian origin, *T. japonicus* and *T. mitsukurii* are candidates for classical biological control.

Trissolcus japonicus: Monitoring activities in the pest native area, showed that *T. japonicus* alone represents c.a. 50% of the parasitoids obtained from *H. halys* eggs during the whole season. When attacking egg masses, *T. japonicus* are able to parasitize on average 80-90% of the eggs in the field depending on season timing (Yang *et al.*, 2009; Zhang *et al.*, 2017).

Trissolcus mitsukurii: Information on the role of this species within the *H. halys* parasitoid guild in Asia is scarce. However, field data collected on the adventive population of *T. mitsukurii* in North

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Italy suggest its potential use as a biocontrol agent. Field reports on its parasitisation activity on *H. halys* span from less than 10% to 80-90% (Benvenuto et al. 2020; Mele et al., 2022).

Other natural enemies for classical biological control

No other natural enemies suitable for classical biological control have been reported.

References

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