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Effect of the insecticide spray timing during the day on *Halyomorpha halys* mortality in field condition

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Extended abstract: *Halyomorpha halys* (Hemiptera: Pentatomidae), commonly known as the brown marmorated stink bug, is an invasive pest that can cause severe economic losses in several agricultural crops, including tree fruit crops. Emilia-Romagna, where *H. halys* was firstly detected in 2012, was the first Italian region where important damages were recorded, and since almost 7 years, this alien species has become a key pest in numerous horticultural crops (Bariselli et al., 2016). The greatest threat is in the orchards, where *H. halys* impacted the crop protection programs, increasing the number of insecticide sprays per season, including broad-spectrum active ingredients that disrupted the Integrated Pest Management (IPM) approach (Kuhar and Kamminga, 2017). In Emilia-Romagna the need to re-establish an IPM approach in tree fruit crops with the reduction of active ingredients authorized pushed for an optimization of insecticide treatments to maximize the impact of the available insecticides on *H. halys*. In this context, a specific activity of 'Alien.Stop' project focused on different aspects related to the sustainability of the insecticides usage, including evaluating the effect of spray timing during the day on the mortality of the target pest.

A field study was carried out during 2020-2021 to investigate the effect of an insecticide spray against *H. halys* applied in field conditions in three moments of the day – at 6:00 AM, at 12:00 PM and 6:00 PM, considering both the knock-down effect and the insect mortality after 24 hours. The performance of the insecticide spray on a natural *H. halys* infestation was evaluated following the approach described in Preti et al. (2018) and reported as EPPO guideline (EPPO PP1/313(2), 2022). One trial per year was conducted by selecting a peach orchard with a consistent target pest infestation and baiting the plants with aggregation pheromones for 5-7 days before the trial began. Therefore, a white sheet was deployed along rows and below the plant canopy to collect any insects falling from the treated plants. The experimental design was a randomized complete block with 4 replicates of 3-5 plants per treatment. A deltamethrin-based insecticide was applied using a backpack sprayer at 5-fold the maximum label rate (first experimental application, referred as treatment A) and followed after 24 hours by a second intervention at 10-fold the maximum label rate (second experimental application, referred as treatment B or 'inventory' application). The insects impacted by treatment A (day 1) were classified, counted and removed by the net below the treated plants at 24 hours after each first experimental application (namely at 6:00 AM, at 12:00 PM and 6:00 PM of day 2), just before the inventory application. Then a second data collection was carried out at 24 hours after each inventory application (day 3) to record what was impacted by treatment B that was not counted previously. The proportion of insects recorded after treatment A over the total amount counted during the trial (recorded after A + after B) allowed to measure the impact of the first experimental application carried out at different timing. The knock-down effect was calculated considering for the first assessment all the living status (alive, moribund

and dead insects) affected by treatment A, while the insect mortality regarded only the insects dead after treatment A over the total amount present in that given plot. In 2020 the trial was carried out on September 8-10, while in 2021, on July 20-22. All data were analysed with GLM followed by Tukey's test (using SAS program).

In 2020 and in 2021, a total of more than 5000 and 1800 *H. halys* individuals were recorded during the 48 hours of study, respectively. More than 75 % were adults during the first year, while in the second year, the adults represented less than 15 %. In both years, the results were consistent, showing that the insecticide application at 12.00 PM obtained the lowest knock-down effect. The best time for insecticide application was at 6:00 PM, which resulted in a high knock-down effect on both *H. halys* adults and juveniles. Also, considering the insect mortality, the best results were achieved by applying the insecticide at 6:00 PM. Likely, on the one hand, *H. halys* stays in the crop and may be less mobile during the evening and night and on the other hand, the insecticide product may be more persistent on the crop across the nighttime due to the lower impact of climatic conditions (e. g., UV light, temperature and evaporation). The chemical control of *H. halys* can not be considered a stand-alone method, especially using non-selective products such as pyrethroids. In addition, considering the extreme mobility, high polyphagy, and wide distribution of this target pest, it is clear that the insecticides are not a sustainable solution to face the problem. Nevertheless, to date the rational use of insecticides against *H. halys* remains crucial to limit crop damages, especially in tree fruits. This study will provide important information to maximize insecticide efficacy.

Key words: brown marmorated stink bug, pest control, crop protection, deltamethrin, knock-down effect

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