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Effects of naturally derived products on *Aculops lycopersici* and their effects on a beneficial mite

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Abstract: Tomato russet mite (TRM) *Aculops lycopersici* is one of the most important pests of tomato *Lycopersicon esculentum*. The decreasing availability of acaricides and restrictions in their use in several countries is promoting researches on alternatives to conventional pesticides. The efficacy of products based on entomopathogenic fungi (i.e. *Beauveria bassiana*, *Paecilomyces fumosoroseus* and *Lecanicillium muscarium*) or naturally substances (pyrethrins and azadirachtin A) on *A. lycopersici* was assessed in the laboratory. Mites were exposed to dry residues of products at their maximum rate and a water-treated control was included for comparison. Eriophyoid mite survival evaluated after 72 h was significantly reduced by *B. bassiana*, azadirachtin A and pyrethrins compared to the control. At 168 hours from applications, mite survival was reduced even on *P. fumosoroseus* treatment. *Beauveria bassiana* was associated with the lowest TRM survival rates. Escaping was significantly higher on azadirachtin A, pyrethrins and *P. fumosoroseus* treatments. The effects of these products were also evaluated on *Amblyseius swirskii* employed in biological control programmes in greenhouses.

Large-scale field monitoring on the distribution of *Trissolcus japonicus* and *Trissolcus mitsukurii*, two egg parasitoids of *Halyomorpha halys*, in Italy and Switzerland

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Abstract: In Europe and North America, the invasive alien stink bug *Halyomorpha halys* causes severe damage on agricultural crops, and proposed chemical and physical solutions do not guarantee an acceptable level of long-term pest control. On the other hand, classical biological control using the egg parasitoid *Trissolcus japonicus* has been identified as the most suitable method to sustainably reduce pest populations in the long-term. Adventive populations of *T. japonicus* have been discovered in the USA since 2014 and more recently in southern Switzerland (2017) and in north-western Italy (2016). A second Asian egg parasitoid, *Trissolcus mitsukurii*, was also detected on *H. halys* eggs in northern Italy in 2018. Considering the exceptional findings of both parasitoids and the perspectives for a biological control program in the two European countries, in 2019 a large-scale field survey in northern Italy and Switzerland was performed to define the abundance and distribution of the two species. A collaborative work plan was established, involving 20 research institutions and plant protection organizations from different Italian and Swiss regions. The monitoring activities were performed from May to September 2019 and focused on detecting naturally laid egg masses of *H. halys* and other pentatomids. Collected egg masses were reared under laboratory conditions to allow egg hatching or parasitoid emergence. Overall, more than 4,348 egg masses of *H. halys* and 285 egg masses of other pentatomid species were collected. Results indicate that both *T. japonicus* and *T. mitsukurii* are present in several sites in the investigated area, in all the habitat types where *H. halys* was recorded and southwards from the first Italian records. Both parasitoids were detected on cultivated plants and hedgerows in IPM or organically managed orchards, on tree/shrubs in urban and suburban areas, and in uncultivated landscapes. The distribution of the two parasitoids partially overlapped, and, in a few records, they occurred in the same area or even in the same egg mass. The percentage of parasitized *H. halys* egg masses ranged between 0.45% and 53.85% and between 0.17% and 20.20% for *T. japonicus* and *T. mitsukurii*, respectively, depending on the area of survey (regions, provinces, cantons). The parasitism rate ranged between 71.43% and 100% and between 88.59% up to 97.40% for *T. japonicus* and *T. mitsukurii*, respectively. Parasitization by these two parasitoids on egg masses other than *H. halys* was a rare event: *T. japonicus* emerged from *Palomena prasina* egg masses and *T. mitsukurii* from *P. prasina*, *Dolycoris baccarum*, *Nezara viridula* and from an egg mass ascribed to a pentatomid of the subfamily Asopinae. *Trissolcus japonicus* and *T. mitsukurii* displayed both the ability to establish self-sustaining populations in the Swiss-northern Italian climate with relatively high parasitization success of *H. halys* eggs, suggesting a high potential for the control of the pest in the near future. This study provided key data for the development of the biocontrol program in Europe with the release program of *T. japonicus*.