Neotropical Entomology
ISSN: 1519-566X
journal homepage: www.scielo.br/ne

SCIENTIFIC NOTE

Neochrysocharis formosa (Westwood) (Hymenoptera: Eulophidae), a Newly Recorded Parasitoid of the Tomato Moth, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae), in Argentina

MG Luna[1], VI Wada[1], J La Salle[2], NE Sánchez[1]

[1]Centro de Estudios Parasitológicos y de Vectores CEPAVE, La Plata, Argentina
[2]CSIRO Entomology, Black Mountain Laboratories, Canberra, Australia

Keywords
Lycopersicum esculentum, biological control

Correspondence
M Gabriela Luna, Centro de Estudios Parasitológicos y de Vectores – CEPAVE (CCT La Plata CONICET y UNLP); Calle 2 nº 584 (1900), La Plata, Argentina; lunam@cepave.edu.ar

Edited by José R P Parra – ESALQ/USP

Received 21 May 2010 and accepted 05 October 2010

Abstract

We report the first record of *Neochrysocharis formosa* (Westwood) parasitizing larvae of the tomato moth, *Tuta absoluta* (Meyrick), in tomato crops in Northern Buenos Aires Province, Argentina. Tomato moth larvae were sampled during four consecutive growing cycles, between 2003 and 2005, in 10 sites. *Neochrysocharis formosa* was present only in organic outdoor and protected crops, and predominantly during the late season. Parasitism rates varied from 1.5% to 5%. The finding of this species is a new record for Argentina and South America, and *T. absoluta* is a new host record.

The tomato moth, *Tuta absoluta* (Meyrick), is a main pest of greenhouse and outdoor tomato crops in South America (Siqueira *et al* 2000, Vargas 1970). Recently, it has spread to Europe and North African countries, where significant damage was reported (Urbaneja *et al* 2009, Viggiani *et al* 2009).

The use of chemical pesticides is a common practice to control the pest. However, due to its concealed habit, it requires several treatments per growing season, which in turn can result in a decrease of efficacy by the development of insecticide resistance by this pest (Ecole *et al* 2000, Siqueira *et al* 2000, Lietti *et al* 2005, Strassera 2009). In the search for other pest management practices, biological control is a reliable alternative to be considered (Altieri & Nicholllls 1999, van Lenteren & Manzaroli 2000).

In this paper we report the first record of *Neochrysocharis formosa* (Westwood), an eulophid parasitoid, parasitizing *T. absoluta* larvae in tomato crops in Northern Buenos Aires Province, Argentina. This finding is a new record for Argentina and South America, and *T. absoluta* is a new host record.

Tomato moth larvae were sampled during four consecutive growing cycles (two in spring, early season, and two in summer, late season), from 2003 to 2005, in an important horticultural region located in the surroundings of La Plata (Buenos Aires province, Argentina, 34º 58´ S, 57º 59´ W). Ten tomato fields (referred to as 'sites') were chosen, of which six were under organic and four conventionalpest control (i.e. *Bt* and / or purines *vs*. synthetic insecticide use by calendar applications, respectively). All of the conventional and half of the organic crops were protected (open-sided plastic greenhouses) and the remaining were outdoor-cultivated. Each sample consisted of 100 leaves with apparent *T. absoluta* damage randomly picked. Samples were taken once per cropping cycle, exceptionally twice. Leaves were placed in sealed plastic bags and transported to the laboratory. Mines were dissected under a stereoscope to determine the presence of *T. absoluta* larvae and parasitoids. Parasitized hosts were kept individually in glass vials (5 ml), provided with a piece of wet paper, in

a walk-in rearing chamber (25 ± 2ºC; 70 % RH, 14:10 L:D photoperiod) until parasitoid pupation.

We recorded the number of preimaginal individuals of *T. absoluta* and the number of larvae and pupae of *N. formosa*. At each sample site, the percentage parasitism was calculated as the number of parasitized hosts/ total number of hosts collected × 100. Voucher parasitoid specimens were deposited in the Museo de La Plata (La Plata, Argentina) and in the Australian National Insect Collection (Australia).

Approximately 2,403 *T. absoluta* larvae were collected and reared from early crops and another 3,208 from late crops. *Neochrysocharis formosa* was only present in organic outdoor and protected crops, and predominantly in late season (Table 1). Thus, it was found in five out of six sites, at 1.5% to 5% percentage of parasitism. Exceptionally, *N. formosa* was registered in one early organic site, where it reached approximately 11% of parasitism (Table 1). Interestingly, it was found coexisting in most sites with the native eulophid *Dineulophus phtorimaeae* de Santis. However, when *N. formosa* was found at early season, the proportion of parasitism was much higher (92%) than that of *D. phtorimaeae,* but closer to equal rates (46%) in late crops. *Neochrysocharis formosa* could develop earlier during the cropping cycle, probably due to its wider host range that would allow to use alternative hosts and crops (both outdoor and greenhouse) throughout the year (Bene *et al* 1985, Cabello *et al* 1994), and also because one of its competitors, *D. phtorimaeae*, apparently finds better habitat conditions in late non-protected crops (Luna *et al* 2010).

Neochrysocharis formosa is now known from all continents except Australia, and has an extremely varied biology (Noyes 2003). It is currently considered cosmopolitan after several introductions for biological control. In Argentina, there are no reports of any intentional introduction of this species; however, lack of previous records may be more an indication of a poor knowledge of its distribution than its absence (Hansson 1995).

Neochrysocharis formosa is a quite polyphagous species known to attack a wide variety of leafmining and gall forming insects. It has been recorded as a primary parasitoid from well over 100 species of hosts in four different orders (Coleoptera, Diptera, Hymenoptera, Lepidoptera) and it is also known to practice non-concurrent host feeding and acts as a hyperparasitoid. It has been reported in horticultural crops as tomato, eggplant, celery, several Fabaceae and Brassicaceae, and melon, and in floral as chrysantemum and gerbera. It is present in cultivated and non-cultivated plant species and, in total, it has been recorded from over 60 different plant species in 25 families (Noyes 2003). *Neochrysocharis formosa* is an endoparasitoid, which usually emerges from its host in its last larval stage and pupates externally. There are reports describing high natural levels of control (> 50%) of of *Liriomyza* spp. larvae by *N. formosa* (Tryon & Poe 1981, Bene *et al* 1985, Cabello *et al* 1994).

Considering its spontaneous presence in tomato crops in the region and its proved efficacy as a biological control agent, it would be worth continuing studies to assess the potential of *N. formosa* against *T. absoluta*. This fits in well with the strategy proposed to control generalist herbivore species (like leafminers), which recommends conservation biological control of indigenous natural enemies as a starting point rather than the introduction of exotic natural enemies (Murphy & La Salle 1999). A pest management programme that includes regular monitoring and use of selective pesticides was previously demonstrated to be suitable to preserve *N. formosa* in

Table 1 Total percentages of parasitism of *Tuta absoluta* by *Neochrysocharis formosa* in tomato crops in Argentina collected during growing seasons 2003-2004 and 2004-2005. In parentheses: total number of hosts collected per site; ^two samples in a same month.

	Sampling sites	Early crops	%	Late crops	%
Organic	La Nueva Anunciación			Mar 2004	2.38 (210)
greenhouses	López			Feb 2004	2.23 (224)
	Parrillo	Nov 2003, Dec 2004, Jan 2005	11.2 (323)	Feb 2005[1]	5 (100)
Organic	Moyano	Dec 2003	0 (121)		
open-field	Peralta			Apr, May 2004	4.72 (424)
	Senattori	Nov 2003	0 (150)	Feb 2004	1.5 (199)
Conventional	EEA Gorina			Feb 2005	0 (726)
greenhouses	Maita			Feb, Mar 2005	0 (1325)
	Mazza	Nov, Dec 2004, Jan 2005	0 (1246)		
	Quinta Fresca	Dec 2004, Jan 2005	0 (564)		

In parentheses: total number of hosts collected per site; [1]two samples in a same month.

tomato crops (Schuster *et al* 1979). Further biological studies on *N*. *formosa*, as well as another *T*. *absoluta* parasitoid species, would establish a foundation for such a conservation biological control program.

Acknowledgments

We thank the tomato producers I. Abán, M. Del Pino, M. Maita, R. López, S. Parrillo, P. Peralta and M.E. Senattori. To M.E Strassera (AER-INTA Gran Buenos Aires) and E. Nieves (CEPAVE) for technical assistance. A. Salvo (UNCor, Argentina) kindly provided useful suggestions and bibliography. This research was funded by ANPCyT (IM 40-2000), CONICET (PIP 2000), and UNLP (Nº 396, 01/01/2002-2006).

References

Altieri MA, Nichols CI (1999) Classical biological control in Latin America: past, present and future, p.975-992. In Bellows TS, Fisher TW (eds) Handbook of biological control. Academic Press, 1046p.

Bene GD, Rumine P, del Bene G (1985) Use of chromotropic traps for the monitoring of *Liriomyza trifolii* (Burgess) (Diptera: Agromyzidae) and its biological behaviour in cold greenhouses. Redia 68: 177-188.

Cabello T, Jaimez R, Pascual F (1994) Spatial and temporal distribution of *Liriomyza* spp. and their parasitoids on horticultural crops in greenhouses of Southern Spain (Diptera: Agromyzidae). Bol Sanid Veg Plagas 20: 445-455.

Ecole CC, Picanco M, Moreira MD, Magalhaes STV (2000) Chemical components associated with resistance of *Lycopersicon hirsutum* f. *typicum* to *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae). An Soc Entomol Brasil 29: 327-337.

Hansson C (1995) Revision of the Neartic species of *Neochrysocharis* Kurdjumov (Hymenoptera: Eulophidae). Entomol Scand 26: 27-46.

Lietti MM, Botto E, Alzogaray RA (2005) Insecticide resistance in argentine populations of *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae). Neotrop Entomol 34: 113-119.

Luna MG, Wada VI, Sánchez NE (2010) Biology of *Dineulophus phtorimaeae* (Hymenoptera: Eulophidae), and field interaction with *Pseudapanteles dignus* (Hymenoptera: Braconidae), larval parasitoids of *Tuta absoluta* (Lepidoptera: Gelechiidae) in tomato. Ann Entomol Soc Am 103: 936-942.

Murphy S, LaSalle J (1999) Balancing biological control strategies in the IPM of New World invasive *Liriomyza* leafminers in field vegetable crops. Biocontrol News Inf 20: 91-104.

Noyes JS (2003) Universal Chalcidoidea database. www.nhm.ac.uk/entomology/chalcidoids/index.html. Accessed on 16-April-2010.

Schuster DJ, Musgrave CA, Jones JP (1979) Vegetable leafminer and parasite emergence from tomato foliage sprayed with oxamyl. J Econ Entomol 72: 208-210.

Siqueira HAA, Guedes RNC, Picanco MC (2000) Cartap resistance and synergism in populations of *Tuta absoluta* (Lep., Gelechiidae). J Appl Entomol 124: 233-238.

Strassera ME (2009) Análisis de la sustentabilidad de tres alternativas de manejo de plagas de tomate bajo cubierta en el Cinturón Hortícola Platense. Trabajo de tesis M Sc, FCAyF, UNLP, La Plata, 172p.

Tryon EH, Poe SL (1981) Developmental stages and emergence of vegetable leafminer pupae and their parasites reared from celery foliage. Fla Entomol 64: 477-483.

Urbaneja A, Monto H, Molla O (2009) Suitability of the tomato borer *Tuta absoluta* as prey for *Macrolophus pygmaeus* and *Nesidiocoris tenuis*. J Appl Entomol 133: 292-296.

van Lenteren JC, Manzaroli G (2000) Evaluation and use of predators and parasitoids for biological control of pests in greenhouses, p.183-201. In Albajes R, Gullino M L, Van Lenteren J C, Elad Y (eds) Integrated pest and disease management in greenhouse crops. Dordrecht, Kluwer Academic Publishers, 568p.

Vargas H (1970) Observaciones sobre la biología y enemigos naturales de la polilla del tomate, *Gnorimoschema absoluta* (Meyrick) (Lep., Geleciidae). Idesia1: 75-110.

Viggiani G, Filella F, Delrio G, Ramasini W, Foxi C (2009) *Tuta absoluta*, nuovo lepidottero segnalato anche in Italia. L'informatore Agrario 2: 66-68.