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SCIENTIFIC NOTE

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

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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, Strasser 2009). In the search for other pest management practices, biological control is a reliable alternative to be considered (Altieri & Nicholls 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, 34° 58' S, 57° 59' W). Ten tomato fields (referred to as 'sites') were chosen, of which six were under organic and four conventional pest 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 ($25 \pm 2^\circ\text{C}$; 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 \times 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 phthorimaeae* de Santis. However, when *N. formosa* was found at early season, the proportion of parasitism was much higher (92%) than that of *D. phthorimaeae*, 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. phthorimaeae*, 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 chrysanthemum 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 *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 greenhouses	La Nueva Anunciación			Mar 2004	2.38 (210)
	López			Feb 2004	2.23 (224)
	Parrillo	Nov 2003, Dec 2004, Jan 2005	11.2 (323)	Feb 2005 ¹	5 (100)
Organic open-field	Moyano	Dec 2003	0 (121)		
	Peralta			Apr, May 2004	4.72 (424)
	Senattori	Nov 2003	0 (150)	Feb 2004	1.5 (199)
Conventional greenhouses	EEA Gorina			Feb 2005	0 (726)
	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; ¹two 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.

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