

FIVE YEARS AFTER THE FIRST RECORD OF *TUTA ABSOLUTA* (MEYRICK) IN ALGERIA, WHAT DO WE EXPECT FROM ITS NATIVE NATURAL ENEMIES?

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Abstract

Since its first record in the vicinity of Mostaganem (Northwestern Algeria) in spring 2008, the tomato leaf miner *Tuta absoluta* Meyrick (Lepidoptera: Gelechiidae) has established as a key pest of tomato crops. It is the most important pest devastating tomato crop throughout the year. The development of approaches to manage *T. absoluta* in Mediterranean countries is depending of several factors. Many works were initiated on its control and much still remains to be done.

With the aim of gathering more information about practices, we monitored *T. absoluta* infestation in greenhouses. The list of its native enemies is in expansion, reaching nowadays over 10 native species. The mainly species of predators belong to the Miridae family (*Macrolophus pygmaeus*, *Nesidiocoris tenuis* and *Dyciphus tamanii*) and the most important parasitoid species belong to the Eulophidae family with three dominant species (*Necremnus arthynes*, *Stenomesus* sp and *Neochrysocharis formosa*). The first parasitoid species is found through the country while the second was more recorded in the South part of Algeria. When farmers adopt spontaneously chemical control because not having enough understanding about side effects of pesticides on beneficial organisms there are difficulties in doing available work on biological control. On the other hand unfortunately some native enemies are recorded under a misidentification. Indirect interactions were found have been neglected to explain the parasitism rate.

We are trying to explain what we have to do encouraging acceptable results in greenhouses and open fields. This way seems to us to be necessary because we are in constant suspense between enthusiasm and discouragement.

Keywords: *Tuta absoluta*, biological control, native natural enemies, integrated pest management

Introduction

The tomato leafminer, *Tuta absoluta* (Meyrick) (Lep: Gelechiidae) is known to be native from South America where it remained confined until 2007. (EPPO, 2007; Desneux et al., 2010). Its initial detection in the Mediterranean basin occurred in Spain in winter 2006/2007 (Urbaneja et al., 2007) likely following the importation of tomatoes from Argentina (Garcia Mari F., personal com.) at the end of 2006. The pest has expanded quickly over all the tomato cropping causing serious damage (Urbaneja et al., 2008). Since it was reported in many Mediterranean countries of Europe, North Africa and Middle East (Desneux et al. 2010; Garcia Mari- et Vercher, 2010). Despite the presence of a well-organized plant protection throughout Europe, no measure has been capable to halt the spread of *T. absoluta* throughout the continent (Desneux et al., 2010).

In Algeria the first sightings of *T. absoluta* occurred in spring 2008 in a tomato greenhouse located in the vicinity of Mostaganem (Northwestern Algeria) (Guenaoui, 2008). In July 2008 the pest was recorded under official control (INPV, 2008; EPPO, 2008). The initial invasion of the pest happened suddenly, requiring a rapid response. The success of its spread in term of distribution and abundance is related to the favourable climatic conditions, wide distribution of its host plants (Solanaceous family) and to a low efficacy of native natural enemies in the new territory because tomato growers applied large quantities of insecticides which affected parasitoid abundance in the vegetable agro-ecosystems and probably promoted the development of pesticide resistance within

the pest. The development of approaches to manage the pest would be facilitated through more knowledge including the data that may help the implementation of efficient biological control programs (Desneux et al. 2010).

The tomato production system in Algerian greenhouses differs from that in Europe. Tomatoes for the fresh market are mainly produced in plastic greenhouses without heating. The economic damage level of tomato fruits is very high, because bad measures are applied against the pest that could lead to more difficulties in pest management in the future. Damage to tomato crops will be limited since the pest is controlled by several methods in greenhouses or outdoors in a strategy IPM but before an effective IPM system could be developed for *T. absoluta* it is necessary to identify the key native natural enemies to know the species composition and abundance predators and parasitoids that will be recognized for their potential contribution to the integrated pest management of *T. absoluta*.

The aim of this work is to give a picture of the composition of the species that spontaneously provide biological control services in Algeria. The first step was to identify native predators and parasitoids, their hosts (leaf miners) and plant hosts. The research project focused on the occurrence of indigenous natural enemies in two tomato growing areas at Mostaganem (Northwestern) and at Touggourt-Biskra- (Southwestern) where the climate is diverse with dry periods and temperatures higher than in the North. The work began in 2009.

Materials and Methods

Parasitoids

During cropping seasons (from 2009 to 2012) samples tomato leaves infested by *T. absoluta* were randomly collected from two sites in Mostaganem (greenhouse and open field) with 250 leaves/week and 2 other sites (100 leaves each) in the South. The samples were placed in plastic bags labeled with the name of the crop, date, location. Infested leaves were examined under a stereomicroscope and larval mines were broken open and all larvae were examined for parasitism. Larvae were recorded as parasitized and kept in vials in the laboratory conditions until emergence of parasitoids. The parasitoids were put in vials with alcohol until identification.

Predators

Tomato plants were observed in several sites on untreated crops for detecting predators preying on *Tuta absoluta*. The predators were taken with a small aspirator, put in plastic vials labeled with the name of the crop, date, location and brought to the laboratory where individuals were frozen and kept in alcohol until identification.

Results and discussion

Parasitoids

Only six species of parasitoids (all Hymenoptera) belonging to the Eulophidae family were identified during the investigated period: *Necremnus artynes*, *Neochrysocharis formosa*, *Stenomesus* sp, *Hemiptarsenus zilahisebessi*, *Diglyphus isaea*, *Pnigalio* sp.

N. artynes is the most frequent species in Algeria. It was also reported by Boualem et al. (2012), Kolaï et al. 2012 in the vicinity of Mostaganem and by Dahliz in the Southeastern (unpublished data). The parasitoid has been reported over all Mediterranean countries, in Spain (Gabarra et al., 2010), in France (Desneux et al. 2012) and in Italy (Zappala et al., 2011).

N. artynes paralyze the larva before laying the egg adjacent to it. A study on its potential to reduce population of *T. absoluta* in Algerian conditions is achieving.

Neochrysocharis formosa was lowly recorded in both sites since 2010. It is likely distributed in almost all of the world. It is a very common parasitoid, recorded from more than 100 host species in many orders (Diptera, Lepidoptera, Coleoptera, Hemiptera.) (Noyes, 2013). It was also reported as an hyperparasitoid of the primary parasitoid *Diglyphus isaea* (Hym: Eulophidae) (Akihito, 2002). In

Japan an asexual strain of *Neochrysocharis formosa* was registered as a biological control agent for agromyzid leaf miner pests. The native strain recorded on *T. absoluta* is arrhenotokous.

Stenomesus sp was recorded only in the Southeastern. It is adapted to high temperatures (Dahliz and Guenaoui , unpublished data). *Stenomesus* species and mainly *S.japonicus* (Ashmed) have a wide host range, recorded from Gelechiidae, Pyralidae, and Gracillariidae (David and Stevens, 1992).

H. zilahisebessi, *D. isaea* (1 specimen) and *Pnigalio* (2 specimens) were recorded on *T. absoluta* only at Mostaganem. *H. zilahisebessi* was recorded in Spain (Gabarra and Arno, 2010).

D. isaea could not be candidate because the parasitism failed on *T. absoluta*.

The rate of each species varied according to the site, the season and the year .

The larval ectoparasitoid *Dineulophus phthorimaeae* (Hym: Eulophidae) that is described as native to Argentine and Chile by Savino et al. (2012) was reported in Algeria by Benmoussa et al. (2009) but we never found it in our samples.

All species recorded are idiobiont species that halt host development after attacking it by the injection of venom. They feed on their host and prefer the third instar larval host to oviposit , grow protected inside the leaf mines and pupate *in situ* (Dahliz et Guenaoui unpublished data).

Predators

In the Northwestern until June 2012, only five species of predators had been seen preying on *T. absoluta* .There are three Miridae, one Formicidae and recently one Chrysopidae. The Miridae *Macrolophus pygmaeus* (Rambur) *Nesidiocoris tenuis* (Reuter) and *Dicyphus tamaninii* (Wagner) have been observed to prey on *T. absoluta* in the vicinity of Mostaganem. *M. pygmaeus* is sometimes confused with *M. caliginosus* (synonym of *M. melanotoma*) (Martinez-Cascales et al. 2006).The most important of them is *N. tenuis* more active and tolerant to high temperatures. During 2011, *Tapinoma nigerrimu* (Hym:Formicidae) a common ant in Algeria,was seen preying on infested tomato fruits playing a major rôle. Recently larvae of *Chrysopa carnea* (Neuroptera: Chrysopidae) were found preying actively on larvae of *T. absoluta* on the hedge of the tomato greenhouse (Pers. Observation).

As a first step for evaluating the efficacy of the native predatory mirids on *T. absoluta* laboratory experiments were conducted in 2010/2011 at 25°C.The results showed that both bugs preyed actively on eggs and first larval instars (Guenaoui et al. 2010; Guenaoui et al., 2011). In Spain, Urbaneja et al. (2008) showed the prey suitability of the tomato borer *Tuta absoluta* for the Spanish strain of *M. pygmaeus* and *N.tenuis*. The last species is a commercial product known under NESIBUG name and sealed by Koppert Biological System.This commercial strain has been first imported in 2010 by the Algerian Ministry of Agriculture for releasing in tomato greenhouses throughout different sites . In 2013 several releases occurred (INPV, 2013) In Algeria, in despite of a large use of chemical control little is known on the evaluation of effects of pesticides on released predators .In Spain several studies had been conducted to test the toxicity of different products used in greenhouses (Arno and Gabbara, 2011). More prospects are need in Mediterranean countries for biological control of *T. absoluta* (Urbaneja et al., 2012).

Conclusion

In conclusion, this work provides some data on natural enemies associated with *T. absoluta* in fields during the past five years. The spread of this invasive pest may provide an opportunity to learn more about the pest (a possible parthenogenetic reproduction) and its natural enemies. Concerning predatory bugs the importation of *N. tenuis* for releasing in specific sites to encourage the use of biological control, we have a critical regard because this could lead to interactions of competition with the native strains for the same resource. The releases will be too expensive for the tomato grower when he should pay himself the treatment at cost price. In this case, biological control that is the main tactic inducing a reduction of insecticides use will be neglected. We have to learn to

vegetable growers they should preserve safety of the beneficial with selective pesticides. The efficacy of Emamectine against larvae of *T. absoluta* was tested (Gasmi and Guenaoui, 2012) Its toxicity towards natural enemies studies have been shown only towards Coccinellidae (Youn et al. 2003).

The most abundant parasitoid is *Necremnus artynes* which has a large distribution over the Mediterranean basin. In Algeria its ability to affect strongly the populations of *T. absoluta* is not yet proved because we expect that the parasitism rate will be very low when pest populations are high. Native entomophagous need time to be adapted to *T. absoluta* and to control it effectively by adjusting their behavior and physiology to the new pest. So, it is essential to gain more knowledge to understand the relations between host plants, the pest and its natural enemies for a real national program of biological control. For this, we need well-trained agents and growers who can help researchers to obtain the biologic information needed to evaluate different approaches and separate effective methods from ineffective ones.

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