

Parasitoid Complex of the Tomato Leaf Miner, *Tuta absoluta* (Meyrick 1917), (Lepidoptera: Gelechiidae) in Hatay, Turkey

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ABSTRACT: In Hatay, Turkey parasitoid complex of the Tomato Leaf Miner, *Tuta absoluta* (Meyrick), (Lepidoptera, Gelechiidae) was studied in 2010. The study was carried out in Samandağ, Yayladağı, Altınözü, Reyhanlı, Kumlu, Kırıkhan and Antakya, mainly in a greenhouse belonging to Mustafa Kemal University, in which organic farming has been conducted without any pesticide applications. Infestation level of the pest was very high on leaves and fruits of tomato in each locality. In the greenhouse of the University, 9 parasitoid species from 4 families of Hymenoptera were obtained. The parasitoids were: *Closterocerus clara* (Szelenyi) (new record for Turkey), *Ratzeburgiola christatus* (Ratzeburg), *R. incompleta* Boucek, *Baryscapus bruchophagi* (Gahan) (Eulophidae); *Brachymeria secundaria* (Ruschka), *Hockeria unicolor* (Walker) (Chalcididae), *Pteromalus intermedius* (Walker) (Pteromalidae), and two species of Braconidae, *Bracon hebetor* Say and *Bracon didemie* Beyarslan. The rates of parasitism for the species were 37.0%, 4.2%, 2.8%, 0.7%, 0.7%, 1.1%, 0.7%, 1.1% and 7.0%, respectively. Distribution and host of the parasitoid species were given.

Key Words: *Tuta absoluta*, parasitoids, Hymenoptera, Hatay, Turkey

Hatay'da Domates Yaprak Güvesi, *Tuta absoluta* (Meyrick 1917), (Lepidoptera: Gelechiidae)'nin Parazitoit Kompleksi

ÖZET: Hatay (Samandağ, Yayladağı, Altınözü, Reyhanlı, Kumlu, Kırıkhan ve Antakya)'da Domates yaprak güvesi, *Tuta absoluta* (Meyrick) (Lepidoptera, Gelechiidae)'nin parazitoit kompleksi 2010 yılında çalışılmıştır. Çalışma özellikle Mustafa Kemal Üniversitesi'ne ait pestisit uygulanmayan (organik tarım yapılan) yarı açık cam serada yürütülmüştür. Zararlının bulaşma düzeyi her yörede domates yaprak ve meyvelerinde çok yüksek düzeyde bulunmuştur. Mustafa Kemal Üniversitesi'ne ait cam serada Hymenoptera takımının 4 familyasına ait 9 parazitoit tür bulunmuştur. Bu parazitoitler, *Closterocerus clarus* (Szelenyi) (Türkiye için yeni kayıt), *Ratzeburgiola christatus* (Ratzeburg), *R. incompleta* Boucek, *Baryscapus bruchophagi* (Gahan) (Eulophidae); *Brachymeria secundaria* (Ruschka), *Hockeria unicolor* Walker (Chalcididae), *Pteromalus intermedius* (Walker) (Pteromalidae), *Bracon hebetor* Say ve *Bracon didemie* Beyarslan (Braconidae)'dir. Bu türlerin parazitlenme oranları sırasıyla %37.0, %4.2, %2.8, %0.7, %0.7, %1.1, %0.7, %1.1 ve %7.0 olarak belirlenmiştir. Parazitoit türlerin dağılım alanları ve konukçuları verilmiştir.

Anahtar Kelimeler: *Tuta absoluta*, parazitoitler, Hymenoptera, Hatay, Türkiye

INTRODUCTION

The Tomato leaf miner, *Tuta absoluta* (Meyrick 1917) (Lepidoptera: Gelechiidae) is an important pest of tomato in many parts of the world. It originated in South America, and is now considered to be a serious pest for tomato production in the Mediterranean region. In this area, it has 10-12 generations per year in greenhouses and at least 5-6 generations in open fields. Each female produces 250-300 eggs in her life span. *Tuta absoluta* attacks leaves, stems and fruits and causes significant damage in tomato crops in greenhouses and also affects some other crops. The hosts of *T. absoluta* are tomato, potato, eggplant, *Lycopersicon hirsutum*, *Solanum* spp. and various wild solanaceous species such as *Datura stramonium*, *D. ferox* and *Nicotiana glauca* (Galarza 1984, Notz 1992).

Currently, *T. absoluta* has been recorded in many countries in South America and Southern Europe; the UK; Holland; the Middle East, including Syria, Israel, Lebanon and Turkey; and many countries in North Africa (EPPO 2009, Seplyarsky et al. 2010). *Tuta*

absoluta is not present at high altitudes (above 1,000 m), and low temperature is a limiting factor for its survival (Notz 1992). Considering the ecological requirements of the pest, it can be estimated that it will be an important destructive pest in Turkey, especially in the Mediterranean and Aegean regions in which warm and humid conditions prevail all year round. It has great potential to cause yield losses in the major tomato-producing areas of these regions (Kiliç 2010). In Turkey *T. absoluta* was first recorded in Urla-Izmir, the Aegean Region in August, 2009 by Kiliç (2010) and later in Antalya by Erler et al. (2010). Currently, it is distributed in nearly all of the tomato growing areas in Turkey.

The recommended control measures of *Tuta absoluta* involves integration of egg parasitoids, *Trichogramma* spp., especially *T. pretiosum* Riley and *T. achaeae* Nagaraja & Nagarkatti; mirid predators, *Nesidiocoris tenuis* Reuter and *Macrolophus caliginosus* (Wagner); application of *Bacillus thuringiensis* (Bt) and selective pesticides; and use of pheromone traps for monitoring and mass-trapping.

Control is extremely difficult if the pest is well established because the larvae are internal feeders. Pest management is further complicated by insecticide resistance (Siqueira et al. 2000; Lietti et al. 2005, Cabello et al. 2009a, Urbaneja et al. 2009).

In the last decade, studies on parasitoids of *T. absoluta* have been conducted in several countries; on egg parasitism by *Trichogramma pretiosum* in Brazil (Faria et al. 2000 a, b; Faria et al. 2008); by *T. achaeae* in Spain (Cabello et al. 2009b, Kabiri et al. 2010); on larval/pupae parasitoids under laboratory conditions by *Pseudapanteles dignus* (Muesebeck) in Argentina (Maria et al. 2004, Luna et al. 2007); and by *Apanteles gelechiidivoris* Marsh. in Colombia (Bajonero 2008). Marchiori et al. (2007) studied the occurrence of parasitoids of *T. absoluta* on tomato plants under greenhouse conditions, in Lavras County, State of Minas Gerais, Brazil. They reared three groups of parasitoids from their larvae, 21 specimens of *Bracon* sp. (Braconidae), one specimen of *Earinus* sp. (Braconidae), and 13 specimens of *Conura* sp. (Chalcididae). The rates of parasitism for the three species were 4.2%, 0.2%, and 2.6%, respectively.

The objective of this study was to determine the parasitoids of *T. absoluta* on the tomato crop in Hatay, Turkey.

MATERIAL and METHODS

The study was carried out in sprayed and unsprayed tomato fields infested by *T. absoluta* in Hatay from May to August 2010. Samplings were carried out in Samandağ, Yayladağı, Altınözü, Reyhanlı, Kumlu, Kırıkhan and Antakya. The levels of *T. absoluta* infestations were calculated from 10 leaves taken from each of 25 plants in every locality. In Antakya, samples were taken mainly from a greenhouse belonging to the Research Institute of Mustafa Kemal University, in which organic farming has been conducted without any pesticide application. From each field, at least 20 leaves of tomato, infested by different stages of larvae and pupae were sampled, placed in polyethylene bags and brought to the laboratory. Samples were maintained at 25-30°C and 60% relative humidity. The leaves were placed in cages covered by fine screen mesh until emergence of moths or parasitoid adults. The specimens of parasitoids obtained from *T. absoluta* larvae and pupae were collected from the cages by aid of a mouth aspirator, and they were preserved in vials with 96% ethanol for identification. The levels of parasitism of the species were calculated from total number of the adults of parasitic species and moths caught in the cages.

For detection of the kind of parasitism of the species, the larval galleries were dissected and the remnants of host larvae and parasitoids were studied and photographed.

Chalcidoidea parasitoids were identified by following several references: (Boucek 1952, Peck 1963, Peck et al. 1964, Graham 1969, 1991, Nikol'skaya 1978, Hansson 1990). The braconid species were identified by Beyarslan (University of Thrace, Science and Education Faculty, Edirne, Turkey). All of the specimens were deposited in the Insect Collection of Mustafa Kemal University, Antakya, Hatay, Turkey.

RESULTS and DISCUSSION

During the study, infestation of *T. absoluta* was observed from all of the tomato fields in the district studied: Samandağ, Yayladağı, Altınözü, Reyhanlı, Kumlu, Kırıkhan and Antakya. Damage levels on the leaves varied from 20-49% in open fields, where several pesticides were sprayed; 35-58% in pesticide-sprayed greenhouses; and 80-95% in unsprayed greenhouses. On the fruits, damage levels were 36-58% in open fields; 27-43% in sprayed greenhouses and 35-60% in unsprayed greenhouses.

In the study none of the parasites were reared from the samples taken from fields and greenhouses where pesticides had been sprayed. All of the parasites were obtained from the samples taken from the semi-open greenhouses in Antakya, belonging to the Research Institute of Mustafa Kemal University, and the samples taken from open fields in Reyhanlı where organic farming has been conducted without any pesticide application. In those plots, the primary mortality factors of the tomato leafminer were determined to be nine species of parasitoids belonging to four families of Hymenoptera. The parasitoids are: *Closterocerus clarus* (Szelenyi) (45 ♀♀, 61 ♂♂) (new record for Turkey); *Ratzeburgiola christatus* (Ratzeburg) (2 ♀♀, 10 ♂♂); *R. incompleta* Boucek (1 ♀, 7 ♂♂); *Baryscapus bruchophagi* (Gahan) (1 ♀, 1 ♂) (Eulophidae); *Brachymeria secundaria* (Ruschka) (1 ♀, 1 ♂); *Hockeria unicolor* (Walker) (3 ♂♂) (Chalcididae); *Pteromalus intermedius* (Walker) (2 ♀♀) (Pteromalidae); and two species of Braconidae: *Bracon (Habrobracon) hebetor* Say. (2 ♀♀, 1 ♂); *Bracon (Habrobracon) didemie* Beyarslan (7 ♀♀, 13 ♂♂). The parasitoids were reared for the first time from mines of *T. absoluta*. The rates of parasitism for the species were 37.0%, 4.2%, 2.8%, 0.7%, 0.7%, 1.1%, 0.7%, 1.1% and 7.0%, respectively and in Reyhanlı the rate of parasitism for *B. (H.) didemie* (4 ♀♀, 8 ♂♂) was 4.2%, which was only found parasitoid in the districts other than Antakya. Distribution and host of the parasitoid species were given in Table 1.

Table 1. Parasitoids of the Tomato Leaf Miner, *Tuta absoluta* (Meyrick 1917), (Lepidoptera: Gelechiidae) and their parasitism levels, based on at least 20 infested leaves in Hatay, Turkey

Localities	Sampling dates	Moth reared		Parasitoids reared																	
				<i>C.clar</i>		<i>R.chri</i>		<i>R.inc.</i>		<i>B.bru</i>		<i>B.sec.</i>		<i>H.uni.</i>		<i>P.int.</i>		<i>B.heb.</i>		<i>B.did.</i>	
		No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Samandağ	16.04	2	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	03.05	1	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	25.05	7	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Yayladağı	16.04	2	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	03.05	1	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	25.05	2	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Altınözü	22.04	3	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07.05	2	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	19.05	3	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reyhanlı	09.04	-	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	13.05	2	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11.06	11	78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	22
Kumlu	09.04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	13.05	2	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11.06	3	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kırıkhan	09.04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	13.05	2	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11.06	3	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Antakya	06.04	8	44	9	50	-	-	1	6	-	-	-	-	-	-	-	-	-	-	-	-
	16.04	10	27	18	48	3	8	-	-	1	2.7	-	-	1	2.7	-	-	1	2.7	3	8
	26.04	11	30	17	47	2	5	3	8	-	-	-	-	-	1	2.7	-	-	2	3.4	
	07.05	14	37	16	42	1	2.7	1	2.7	-	-	1	2.7	1	2.7	-	-	-	-	4	10.8
	17.05	13	40	14	42	-	-	2	6	1	3	-	-	-	-	1	3	1	3	1	3
	27.05	9	36	9	36	4	16	-	-	-	-	-	-	-	-	-	1	4	2	8	
	04.06	11	53	7	33.5	2	9	1	4.5	-	-	-	-	-	-	-	-	-	-	-	-
	12.06	4	28.5	5	43.5	-	-	-	-	-	-	-	1	7	1	7	-	-	-	2	14
18.06	3	18	11	64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	18	
Total	--	128	46	106	37.0	12	4.2	8	2.8	2	0.7	2	0.7	3	1.1	2	0.7	3	1.1	2	0.7

Closterocerus clarus (Szelenyi 1977)

Neochrysocharis clara Szelenyi, 1977: 454. Holotype female, Hungary.

Closterocerus clarus (Szelenyi 1977): Yefremova 2002: 582.

Host: *Tuta absoluta* (new host record)

Distribution: Hungary, Mongolia (Szelenyi 1977); Moscow Oblast (Hansson 1990); Ul'yanovsk Oblast (Yefremova 2002); Turkey (new record for Turkey).

Material studied: Hatay, Antakya, 06. iv. – 18. vi. 2010, 45 ♀♀, 61 ♂♂.

Biological notes: Until now there was no host record for this species. In the present work it was found that *T. absoluta* is a first host record for *C. clarus*, and it was an important mortality factor for this serious pest in Antakya. In the study, 61 males and 45 females were reared as solitary parasitoid from first instars larvae of *T. absoluta* in tomato leaves (Fig. 1a-d), and its parasitism rate was 37.0% which was the highest when compared with the total parasitism by the other parasitoids.

Ratzeburgiola christatus (Ratzeburg 1848)

Entedon cristatus Ratzeburg 1848:163, new species, Germany

Ratzeburgiola cristata (Ratzeburg), Erdős 1958: 206-208, New combination for *Entedon cristatus* Ratzeburg; Efremova. 1994: 31-36. Valid species.

Ratzeburgiola cristatus (Ratzeburg): Vidal, 2001: 65. Valid species

Hosts: Diptera: Agromyzidae: *Liriomyza congesta*; Lepidoptera: Gelechiidae: *Chrysoesthia sexguttella*; Gracillariidae: *Lithocolletis nigrescentella*; Phyllonorycter sp.; Heliozelidae: *Antispila* sp.; Momphidae: *Cosmopterix pulchrimella*; Nepticulidae: *Stigmella aurella*; Noctuidae: *Calymnia trapezina* (Askew 1967, Boucek & Askew 1968, Efremova 1994, Vidal 2001).

Distribution: Europe (Askew 1967; Boucek & Askew 1968); Turkey (Öncüer 1991)

Material studied: Hatay, Antakya, 13.-15.vi.2010, 2♀♀,10♂♂.

Biological notes: Reared from mines of *T. absoluta*, as primary parasitoid.



Figure 1. Pupae of *Closterocerus clavus* (Szelenyi) in larval gallery of tomato leafminer, *Tuta absoluta* Povolny, on tomato leaf. a. leaf with mines; b. pupa of the parasites in a mine; c. pupae with remnant of caterpillar (white arrow stated head of caterpillar); d. remnant of parasite and caterpillar in a mine (white arrow shows body remnant of caterpillar fed by *C. clavus*).

Ratzeburgiola incompleta Boucek 1971

Ratzeburgiola incompleta Boucek 1971:535. New species, ♂♀, figs., Holotype ♀, NMP, Czechoslovakia. *Ratzeburgiola incompleta* Boucek: Efremova, 1994: 34-35.

Hosts: Diptera: Agromyzidae: *Agromyza hiemalis*; *Chromatomyia horticola*; *Liriomyza* sp.; *Liriomyza huidobrensis* Lepidoptera: Gelechiidae: *Chrysoesthia sexguttella*; Gracillariidae: *Phyllocnistis citrella*; *Phyllonorycter corylifoliella*; Heliozelidae: *Antispila rivillei*; *Holocacista rivillei*; Momphidae: *Cosmopterix pulchrimella* (Al-Ghabeish & Allawi 2001, Massa & Riizzo 2000, Riizzo & Masso 2002).

Distribution: Azerbaijan, Bulgaria, Czech Republic, Czechoslovakia, Israel, Italy, Sicily, Jordan, Moldova, Slovakia, Syria, (Boucek 1971; Alkhateeb et al. 1999); Turkey (Uygun et al. 1997).

Material studied: Hatay, Antakya, 15.vi.- 18.vii. 2010, 1♀, 7♂♂.

Biological notes: Reared from mines of *T. absoluta*, as primary parasitoid.

Baryscapus bruchophagi (Gahan 1913)

Tetrastichus bruchophagi Gahan 1913: 439. New species, Lectotype ♀, USNM, United States of America-California, designated by Graham (1991)

Baryscapus bruchophagi (Gahan): LaSalle & Graham 1990:124. New combination for *Tetrastichus bruchophagi* Gahan

Baryscapus bruchophagi (Gahan): Graham 1991:135-136. Valid species.

Hosts: Coleoptera: Apionidae: *Apion seniculus* ; Curculionidae: *Hypera postica* (Mambetova 1975); Diptera: Agromyzidae: *Tropicomyia atomella*; Cecidomyiidae: *Asphondylia websteri* (Husain & Khan 1986, Peck 1963), Hymenoptera: Eurytomidae: *Bruchophagus gibbus*; *Bruchophagus kolobovae*; *Bruchophagus platypterus*; *Bruchophagus roddi*; *Eurytoma onobrychidis*; *Systole* sp.; *Systole geniculata* (Carrillo & Dickason 1963, De Santis 1967, 1979; Trjapitzin 1978).

Distribution: Worldwide, Turkey (Sakaltaş & Gencer 2005).

Material studied: Hatay, Antakya, 13.-15.vi.2010, 1♂, 1♀.

Biological notes: Reared from mines of *T. absoluta*, but it may be primary/ secondary parasitoid.

Brachymeria secundaria (Ruschka 1922)

Chalcis secundaria Ruschka 1922:227. New species, Austria.

Brachymeria tauriensis Masi 1929: 26. New species, Italy.

Brachymeria secundaria (Ruschka): Boucek 1952: 24, New combination for *Chalcis secundaria* Ruschka.

Hosts: Hymenoptera: Braconidae: *Apanteles melitaeorum*; Lepidoptera: Geometridae: *Agriopsis leucophaearia* (Glavendekic 2000); Lymantriidae: *Euproctis chryssorrhoea*; *Euproctis flava*; *Lymantria dispar*; *Notolophus aurolimbatus*; *Nygmia phaeorrhoea*; *Ocneria dispar*; *Orgyia guadarramensis*; *Stilpnotia salicis* Noctuidae: *Helicoverpa armigera*; Notodontidae: *Cerura vinula*; Nymphalidae: *Euphydryas aurinia*; *Mellicta* sp.; Pieridae: *Pieris daplidice*; Tortricidae: *Laspeyresia pomonella*; *Pandemis cerasana*; *Polychrosis botrana*; Yponomeutidae: *Plutella maculipennis* (Narendran 1986, Herting 1976, Thompson 1954, Kotenko 1976).

Parasitoid hosts: Hymenoptera: Braconidae: *Apanteles liparidis*; *Apanteles ordinarius*; *Meteorus pulchricornis*; *Meteorus rubens*; *Meteorus versicolor*; *Rhogas drymoniae*; Ichneumonidae: *Campoletis chlorideae* (Askew 1979, Erdős 1955, Narendran 1986, Vasic & Minic 1979).

Distribution: Europe (Boucek 1952, 1966, 1977, Vidal 2001, Askew et al. 2001); Turkey (Öncüer 1991).

Material studied: Hatay, Antakya, 13.-15.vi.2010, 1♂, 1♀.

Biological notes: Reared from mines of *T. absoluta*, but it may be primary and secondary parasitoid.

Hockeria unicolor Walker 1834

Hockeria unicolor Walker, 1834:37. New species, BMNH, France

Halticella pachycera Förster 1859: 88. New species, Austria. Synonym of *Hockeria unicolor* Walker by Boucek (1952)

Hosts: Coleoptera: Curculionidae: *Lixus scabricollis*; Lepidoptera: Gelechiidae: *Exoteleia dodecella*; Geometridae: *Gymnoscelis pumilata*; Gracillariidae: *Phyllonorycter robiniella*; Momphidae: *Vulcaniella pomposella*; Noctuidae: *Spodoptera litura*; Psychidae: *Apterona helicoidella*; *Cochliotheca crenulella*; Tortricidae: *Evetria* sp.; *Laspeyresia leplastriana*; *Polychrosis* sp.; *Rhyacionia buoliana*; Yponomeutidae: *Prays oleae*; *Yponomeuta malinellus*; Zygaenidae: *Theresimima ampelophaga*; *Zygaena* sp. (Boucek 1952, 1977, Herting 1975, Kalina 1989, Askew 1991, Askew et al. 2001)

Distribution: Europe (Walker 1834 a; Boucek 1952, 1977, Herting 1975, Kalina 1989, Askew 1991, Askew et al. 2001, Lotfalizadeh et al. 2007); Kazakhstan: Tselinograd Obl., Russia, Ukraine, Transcaucasia (Nikol'skaya 1978); Morocco (Boucek 1952); Senegal (Herting 1976); Turkey (Boucek 1952, 1956, Öncüer 1991).

Material studied: Hatay, Antakya, 11.-15.vii. 2010, 3♂♂.

Biological notes: Reared from larvae in mines of *T. absoluta* on tomato.

Pteromalus intermedius (Walker 1834)

Eutelus intermedius Walker, 1834: 366. New species, Lectotype, BMNH, United Kingdom, designated by Graham (1969).

Pteromalus intermedius (Walker), Walker 1846: 38. New combination for *Eutelus intermedius* Walker; Boucek & Graham 1978:228. New combination for *Eutelus intermedius* Walker

Hosts: Diptera: Tephritidae: *Oxyna nebulosa*; *Oxyna parietina*; *Tephritis conura* (Garrido Torres & Nieves-Aldrey 1992, 1999, Graham 1969, Vidal 1997); Lepidoptera: Coleophoridae: *Carpochena ceratoidis* (Dzhanokmen, 2001).

Distribution: Europe, Asia, (Graham 1969, Boucek & Graham 1978; Vidal 2001, Askew et al. 2001, Dzhanokmen 1978, 2005); Turkey (Öncüer, 1991).

Material studied: Hatay, Antakya, 11.-25.vii. 2010, 2♀♀.

Biological notes: Reared from mines of *T. absoluta*, it may be primary parasitoid.

Bracon (Habrobracon) hebetor (Say 1836)

Distribution: India, New England, Mediterranean area (mostly Eastern) (EPPO 2010); Iraq (Hussain & Jafar 1969); Brazil (Silva 1947); Turkey (Beyarslan et al. 2010, Akman (Gündüz) & Gülel 2005).

Hosts: Lepidoptera: Pyralidae: *Plodia interpunctella* (Hübner 1813), *Ephestia kuehniella* Zeller, 1879, *Cadra cautella* (Walker, 1863) (Hussain & Jafar 1969, Benson 1973, 1974, Tobias 1986, Hagstrum & Smittle 1977, Press et al. 1977); Arctiidae: *Utetheisa pulchella*; Blastobasidae- *Pseudohypatopa pulvereana*; Depressariidae- *Agonopterix nervosa*; *Depressaria* sp.; Gelechiidae: *Exoteleia dodecella*; *Pectinophora gossypiella*; *Pexicopia malvella*; *Phthorimaea operculella*; *Sitotroga cerealella*; *Stomopteryx nerteria*; Lymantriidae: *Lymantria dispar*; Noctuidae: *Achaea janata*; *Adisura atkinsoni*; *Busseola fusca*; *Diparopsis castanea*; *Eublemma amabilis*; *Helicoverpa armigera*; *H. zea*; *Heliothis peltigera*; *H. virescens*; *H. virescens*; *H. virescens*; *H. virescens*; *H. virescens*; Hymenoptera: Braconidae: *Apanteles taragamae*; Cynipidae: *Andricus caputmedusae*; Coleoptera:

Curculionidae: *Caryedon serratus*; *Anthonomus grandis* (Yu et al. 2006).

Material studied: Hatay, Antakya, 16. iv.-27.v. 2010, 2♀♀.1♂.

Biological notes: *Bracon (H.) hebetor* has been used as an indoor biocontrol agent against stored product pests worldwide; it parasitizes mainly the late larval stage of pyralid host. In Antakya it was reared from larvae of *T. absoluta* in mines on leaves and fruits of tomato.

***Bracon (Habrobracon) didemie* Beyarslan, 2002**

The species was described from female specimens by Beyarslan (2002) and later it was described again from different localities of Turkey, without any host record (Yu et al. 2006, Beyarslan et al. 2010)

Hosts: *Tuta absoluta* (new host record)

Distribution: Turkey (Yu et al. 2006): Bartın, Elazığ, Erzincan, Eskişehir, Kırklareli, Malatya, Sinop, Sivas, Tunceli, Yozgat (Beyarslan et al. 2010).

Biological notes: The adults (Fig. 2.a) were reared from larvae of *T. absoluta* in mine on leaves and fruits of tomato. After hatching, adults mate and the female stings ovipositor into larva under epidermis of leaf (Fig. 2.b). The female feeds on the hemolymph when it

comes out of the larval body, then it lays eggs into the host larva (Fig. 2). After completing development, larva come out and pupate on the side of mine of caterpillar.

CONCLUSIONS

The parasitoids found in this work are autochthonous natural enemies, and attack *T. absoluta* and/or its primary parasitoids. Of these parasitoids, two species, *C. clarus*, which principally attacks the first instar larvae of *T. absoluta*, and *B. (H.) didemie*, which attacks the last instar larvae, seem to be very important natural enemies that could be adapted to this new host and would admit the development of a biological pest control program. In future work the effectiveness of the parasitoids should be evaluated in experimental and commercial greenhouses as principal biological control agent.

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Figure 2. *Bracon (Habrobracon) didemie* Beyarslan. Female. a. body; b- e. oviposition activities on *Tuta absoluta* larvae; female feeding on hemolymph of larva.

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