

Survey on Natural Enemies of Diaspididae (Hemiptera: Coccoidea) Species in Citrus Orchards in Antalya, Turkey and Record of A New Species for Turkey

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ABSTRACT---- *Species of the family of Diaspididae and their natural enemies in citrus orchards in Antalya province were surveyed in the years 2011 and 2012. The survey revealed 3 species of predators and 5 species of parasitoids associated with 6 species of scale insect. The parasitoid species *Zaomma lambinus* (Walker) on Diaspididae species in citrus orchards is recorded for the first time in Turkey. Two scale insect species, *Lepidosaphes beckii* (Newman) and *L. gloverii* (Packard), two predators species, *Chilocorus bipustulatus* (L.) and *Rhyzobius lophanthae* (Blaisdell), two parasitoid species, *Comperiella bifasciata* Howardon *Aonidiella aurantii* and *Encarsia citrina* (Craw) on *Aonidiella citrina* (Craw) in citrus orchards are recorded for the first time in Antalya.*

Keywords— Scale insects, predators, parasitoids, citrus orchards, Antalya, Turkey

1. INTRODUCTION

Citrus is one of the most important fruit crops all over the world. According to FAO data of the year 2010, the citrus production in the world is approximately 123 million tons on 8 645 339 hectares. The countries that have the largest share of this amount of production are China with 23 million tons, Brazil with 21 million tons, USA with 9 million tons. Turkey is in 9th place in world production with approximately 3.5 million tons and 11,123 hectares (FAO, 2012). In Turkey, 87.6% of citrus production is made in the Mediterranean region in 5 provinces, being Mersin, Adana, Hatay, Antalya and Kahramanmaraş. Due to the ecological conditions, Antalya province has a significant potential and has a portion of 1/7 for the citrus production in Turkey (TUİK, 2012). Since the *Citrus* genus has different species and varieties, the maturation of the fruits is spread for a long period and the matured fruits can be kept on the tree. These characteristics increase the importance of these crops. With their rich content of vitamin C, they are extremely important for the human health. They are also used as raw materials in the cosmetic industry. So there is always large demand on citrus in world markets (Şimşek, 2009).

A large number of pests are found on citrus (Uygun et al., 1992). The coccids among these pests causes important losses of production. Diaspididae family, which has the maximum species number with approximately 2,400 species belonging to 380 genera, cause important damage by feeding on plants (Miller and Davidson, 2005). In Turkey, it is the most extended family with 96 species and 40 genera (Kaydan et al., 2007).

The aim of this study was to determine the species of Diaspididae which cause damage on different species of citrus and also to determine their natural enemies in Antalya province.

2. MATERIAL AND METHODS

The study was carried out in Antalya province in the years 2011 and 2012. Samplings were performed by irregular surveys for determination of the members of Diaspididae and their natural enemies on the citrus trees in the parks, home gardens, the urban roadsides, and in the orchards established for commercial purposes in the mentioned area. The samplings were made in the months between June and September.

The fruits, leaves and branches of the citrus trees at different directions and heights were taken and put in paper bags. The samples infested with scale insects were brought to laboratory and preparations were made according to the method of Wilkey (1962) which was suggested by Kosztarab and Kozár (1988). The identification of the scale insects were made by the second author.

In order to collect the predators, the Steiner method was used (Steiner, 1984). Random branches from four directions of the trees in each orchard were selected and a total of 50 branches were hit two times by a stick. The numbers of predators which were fallen in the Steiner hopper were counted and later on the predator species were identified by Dr. Nedim UYGUN (Çukurova University, Agricultural Faculty, Plant Protection Department, Adana).

For the purpose of determining the parasitoides, the samples of the leaves, fruits and the shoots that were heavily contaminated with scale insects, were brought to laboratory by putting separately in polyethylene bags. The samples were put in plastic boxes

covered in a light impervious way. In order to collect the parasitoids, a tube was located on the box with the bottom standing out of the box. The parasitoids were drawn to the light and could easily be collected from the tube. The parasitoid species were identified by Dr. George JAPOSHVILI (Entomology and Biocontrol Research Centre, Agricultural University of Georgia, Tbilisi, Georgia).

Population fluctuations were carried out in the mandarin, grapefruit, orange and lemon orchards of BATEM (West Mediterranean Agricultural Research Institute) 15-30 days period with in 2011-2012 years.

3. RESULTS AND DISCUSSION

Three species of predators and 5 species of parasitoids were found to be associated with 6 scale insect species from host citrus orchards in the surveys carried out in Antalya in the years 2011 and 2012. Diaspididae species found on host citrus orchards in Antalya province are given in Table 1. Predator species *Chilocorus bipustulatus* and *Oenopia conglobata* were found at all locations given in Table 1. Parasitoids associated with Diaspididae species on host *Citrus* spp. in Antalya province are given in Table 2.

***Aonidiella aurantii* (Maskell, 1879)**

The presence of *A. aurantii* is described for citrus orchards of the following regions of Turkey: South Eastern Anatolia and the Black Sea Region (Alkan, 1953); Aegean Region (Soydanbay-Tunçyürek and Erkin, 1981); Eastern Mediterranean Region (Karaca, 1990).

***Aonidiella citrina* (Craw, 1890)**

The presence of *A. citrina* is described for citrus orchards of the following regions of Turkey: Giresun, Ordu, Rize, (Düzgüneş, 1952); Aegean Region (Soydanbay-Tunçyürek and Erkin, 1981); Eastern Mediterranean Region (Karaca, 1990).

***Chrysomphalus dictyospermi* (Morgan, 1889)**

The presence of *C. dictyospermi* is described for citrus orchards of the following regions of Turkey: Adana, Aydın, Mersin, İstanbul, İzmir and Rize (Bodenheimer, 1949; 1952).

***Lepidosaphes beckii* (Newman, 1869)**

This species is recorded for the first time in citrus orchards in Antalya. The presence of *L. beckii* is described for citrus orchards of the following regions of Turkey: Adana, Hatay, Mersin (Soylu and Ürel 1977); Artvin and Rize (Bozan et al., 1979).

***Lepidosaphes gloverii* (Packard, 1869)**

This species is recorded for the first time in citrus orchards in Antalya. The presence of *L. gloverii* is described for citrus orchards of the following regions of Turkey: Rize (Gül-Zümreoğlu, 1972); Artvin and Rize (Bozan et al., 1979).

***Parlatoria pergandii* Comstock, 1881 (Chaff scale)**

The presence of *P. pergandii* is described for citrus orchards of the following regions of Turkey: Antalya, (Gül-Zümreoğlu, 1972); Eastern Mediterranean Region (Soylu and Ürel, 1977).

***Chilocorus bipustulatus* (Linnaeus, 1758)**

This species is recorded for the first time in citrus orchards in Antalya. The presence of *C. bipustulatus* is described for citrus orchards of the following regions of Turkey: Eastern Mediterranean Region (Uygun and Şekeroğlu, 1988; Karaca, 1990).

***Oenopia conglobata* (Linnaeus, 1758)**

The presence of *O. conglobata* is described for citrus orchards of the following regions of Turkey: Aydın, Balıkesir, Muğla (Öncüler, 1977); Antalya (Keleş, 1979), Adana (Uygun, 1981).

***Rhyzobius lophanthae* (Blaisdell, 1892)**

This species is recorded for the first time in citrus orchards in Antalya. *Rhyzobius lophanthae* was found Alanya, 16m, 36°33'N 31°58'E, *Citrus reticulata*, *C. limon*, 26.vii.2012. The presence of *R. lophanthae* is described for citrus orchards of the following regions of Turkey: Eastern Mediterranean Region (Karaca, 1990; Önder 1982).

***Aphytis melinus* DeBach, 1959**

The presence of *A. melinus* is described for citrus orchards of the following regions of Turkey: Aegean Region (Soydanbay-Tunçyürek and Erkin, 1981); İzmir (Önder, 1982); Antalya (Erler and Tunç, 2001); Adana and Mersin (Yarpuzlu et al., 2008).

***Comperiella bifasciata* Howard, 1906**

This species is recorded for the first time in citrus orchards on *Aonidiella aurantii* in Antalya. The presence of *C. bifasciata* is described for citrus orchards of the following regions of Turkey: Adana, Hatay, İçel (Soylu and Ürel, 1977); Eastern Mediterranean Region (Sengonca et al., 1998).

***Encarsia citrina* (Craw, 1891)**

This species is recorded for the first time in citrus orchards on *Aonidiella citrina* in Antalya. The presence of *E. citrina* is described for citrus orchards of the following regions of Turkey: Aegean Region (Soydanbay-Tunçyürek and Erkin, 1979).

***Zaomma lambinus* (Walker, 1838)**

This species is recorded for the first time in citrus orchards on Diaspididae species in Turkey. This species was found on *Lepidosaphes* and reported by Japoshvili & Karaca (2002) for Gürcistan and Turkey; by Atlıhan and Özgökçe (2004) for Van; and by Özgen and Karsavuran (2005) for Siirt and Mardin.

***Metaphycus* sp.**

The presence of *Metaphycus* sp. is described for citrus orchards of the following regions of Turkey: Aydın, Balıkesir, İzmir, Muğla (Öncüer, 1977); Adana, Hatay, İçel (Soylu and Ürel, 1977); Antalya (Keleş, 1979).

4. ACKNOWLEDGMENT

Thanks for supporting this study are due to Süleyman Demirel University, Scientific Research Projects Coordinatorship, (Project number: 2486-D-10).

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Table 1. Diaspididae species on host *Citrus* spp. in Antalya, Turkey

Scale insect	Localities	Alt (m)	Coordinates	Host <i>Citrus</i> spp.	Dates
<i>Aonidiella aurantii</i>	Alanya	45	36°33'N 31°59'E	<i>C. reticulata</i> , <i>C. sinensis</i>	03.09.2011
		32	36°33'N 31°57'E	<i>C. sinensis</i>	26.07.2012
		16	36°33'N 31°58'E	<i>C. reticulata</i>	26.07.2012
	Aksu	63	36°55'N 30°51'E	<i>C. reticulata</i>	17.08.2011
					26.07.2012
	Finike	2	36°18'N 30°08'E	<i>C. limon</i> , <i>C. sinensis</i>	17.08.2011
	Gazipaşa	69	36°17'N 32°19'E	<i>C. sinensis</i>	26.07.2012
		26	36°16'N 32°19'E	<i>C. reticulata</i> , <i>C. sinensis</i>	26.07.2012
	Kemer	6	36°43'N 30°33'E	<i>C. reticulata</i> <i>C. sinensis</i>	17.08.2011
		328	36°36'N 30°28'E	<i>C. reticulata</i> <i>C. sinensis</i>	30.06.2012
		36	36°42'N 30°33'E	<i>C. paradisi</i> , <i>C. reticulata</i>	17.08.2011
		543	36°36'N 30°28'E	<i>C. reticulata</i> <i>C. sinensis</i>	03.09.2011
	Kumluca	26	36°22'N 30°16'E	<i>C. sinensis</i>	03.09.2011
		1289	36°31'N 30°21'E	<i>C. reticulata</i>	17.08.2011
	Manavgat	7	36°47'N 31°26'E	<i>C. reticulata</i> , <i>C. sinensis</i>	03.09.2011
					26.07.2012
	Muratpaşa Serik	46	36°52'N 30°48'E	<i>C. paradisi</i> , <i>C. sinensis</i>	03.09.2011
		8	36°55'N 31°00'E	<i>C. limon</i>	26.07.2012
					03.09.2011
<i>Aonidiella citrina</i>	Alanya	16	36°33'N 31°58'E	<i>C. reticulata</i> , <i>C. limon</i>	26.07.2012
		45	36°33'N 31°59'E	<i>C. paradisi</i>	17.08.2011
	Finike	2	36°18'N 30°08'E	<i>C. sinensis</i>	17.08.2011
	Manavgat	7	36°47'N 31°27'E	<i>C. paradisi</i>	26.07.2012
	Muratpaşa	46	36°52'N 30°48'E	<i>C. paradisi</i>	17.08.2011
<i>Chrysomphalus dictyospermi</i>	Alanya	49	36°33'N 31°59'E	<i>C. sinensis</i>	26.07.2012
		19	36°33'N 31°58'E	<i>C. limon</i> , <i>C. sinensis</i>	26.07.2012
		78	36°33'N 32°2'E	<i>C. sinensis</i>	03.09.2011
* <i>Lepidosaphes beckii</i>	Gazipaşa	11	36°17'N 32°17'E	<i>C. sinensis</i>	26.07.2012
	Kemer	19	36°43'N 30°33'E	<i>C. sinensis</i>	17.08.2011
	Kumluca	1276	36°31'N 30°21'E	<i>C. sinensis</i>	03.09.2011
* <i>Lepidosaphes gloverii</i>	Muratpaşa	50	36°51'N 30°44'E	<i>C. sinensis</i>	03.09.2011
<i>Parlatoria pergandii</i>	Alanya	45	36°33'N 31°59'E	<i>C. sinensis</i>	03.09.2011
		78	36°33'N 32°2'E	<i>C. sinensis</i>	26.07.2011
	Aksu	63	36°55'N 30°51'E	<i>C. reticulata</i>	03.09.2011
		16	36°16'N 32°19'E	<i>C. sinensis</i>	26.07.2011
	Gazipaşa	69	36°17'N 32°19'E	<i>C. sinensis</i>	26.07.2011
		543	36°36'N 30°28'E	<i>C. reticulata</i> , <i>C. sinensis</i>	03.09.2011
	Kemer	117	36°43'N 30°33'E	<i>C. reticulata</i>	17.08.2011
		54	36°36'N 30°32'E	<i>C. reticulata</i>	17.08.2011
		283	36°42'N 30°33'E	<i>C. reticulata</i>	17.08.2011
		397	36°36'N 30°28'E	<i>C. reticulata</i> , <i>C. sinensis</i>	30.06.2012
	Kumluca	24	36°22'N 30°16'E	<i>C. reticulata</i>	17.08.2011
		7	36°47'N 31°26'E	<i>C. sinensis</i>	30.06.2012
	Manavgat	7	36°47'N 31°27'E	<i>C. reticulata</i> , <i>C. sinensis</i>	30.06.2012
		46	36°52'N 30°48'E	<i>C. sinensis</i>	17.08.2011
	Muratpaşa Serik	12	36°59'N 30°56'E	<i>C. reticulata</i>	30.06.2012

The first record of species for Antalya is shown with one asterisk*' (Table 1).

Table 2. Parasitoids associated with Diaspididae species on host *Citrus* spp. in Antalya, Turkey

Parasitoids	Localities	Alt. (m)	Coordinates	Host insect	scale	Host Citrus spp.	Date
Aphelinidae							
<i>Aphytis melinus</i>	Aksu	63	36°55'N 30°51'E	<i>A. aurantii</i>		<i>C. limon</i>	26.07.2012
						<i>C. reticulata</i>	30.06.2012
	Muratpaşa	46	36°52'N 30°48'E	<i>A. aurantii</i>		<i>C. paradisi</i>	03.09.2011
						<i>C. sinensis</i>	17.08.2011
<i>*Encarsia citrina</i>	Serik	8	36°52'N 31°00'E	<i>A. aurantii</i>		<i>C. paradisi</i>	03.09.2011
						<i>C. sinensis</i>	03.09.2011
	Muratpaşa	46	36°52'N 30°48'E	<i>A. aurantii</i>		<i>C. limon</i>	26.07.2012
						<i>C. paradisi,</i>	26.07.2012
<i>C. sinensis</i>	30.06.2012						
Encyrtidae							
<i>*Comperiella bifasciata</i>	Muratpaşa	46	36°52'N 30°48'E	<i>A. aurantii</i>		<i>C. paradisi,</i>	26.07.2012
						<i>C. sinensis</i>	30.06.2012
<i>Metaphycus</i> sp.	Muratpaşa	46	36°52'N 30°48'E	<i>A. aurantii</i>		<i>C. sinensis</i>	17.08.2011
<i>**Zaomma lambinus</i>	Alanya	19	36°33'N 31°58'E	Diaspididae species		<i>C. limon</i>	26.07.2012
						<i>C. sinensis</i>	

The first record of species for Turkey are symbolised with two asterisk '**', the first time record of species for Antalya are shown with one asterisk '*' (Table 2).