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New Record of a Parasitoid (Hymenoptera: Encyrtidae) of the Madeira Mealybug, *Phenacoccus madeirensis* Green (Hemiptera: Pseudococcidae) from Turkey

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ABSTRACT

In this study the presence of *Anagyrus amnestos* Rameshkumar, Noyes and Poorani, 2013 (Hymenoptera: Encyrtidae) as a koinobiont endoparasitoid of *Phenacoccus madeirensis* Green (Hemiptera: Pseudococcidae) is reported for the first time in Turkey.

Key words: Madeira mealybug, first record, biological control, Adana.

INTRODUCTION

The Madeira mealybug, *Phenacoccus madeirensis* Green (Hemiptera: Pseudococcidae) was first described on Madeira Island in 1923 (Green, 1923), but it is believed that it has a Neotropical origin (Kaydan *et al.*, 2012). This species is polyphagous, and has been reported on more than 170 host plant species from 51 families (Garcia *et al.,* 2015), including many agronomic and horticultural crops in both indoor and outdoor productions. So far, it has spread to 69 countries in Southeast Asia, North Africa and the Mediterranean (Garcia *et al.,* 2015). Over the last decades, it has spread to various subtropical islands of Japan (Kondo *et al*., 2001), and many other Asian countries, China, India, Pakistan, Philippines, Taiwan, Thailand and Vietnam (Muniappan, 2011; Shylesha and Joshi, 2012), and to Mediterranean countries, France, Greece, Italy, Portugal and Spain (Beltra and Soto, 2011; Franco *et al.,* 2011; Jansen *et al.,* 2010; Marotta and Tranfaglia, 1990; Matile-Ferrero and Germain, 2004). *Phenacoccus madeirensis* was found for the first time in Turkey in 2012, in Adana, Antalya and Çanakkale provinces (Kaydan *et al.,* 2012).

Phenacoccus madeirensis is an important pest of ornamental plants, like *Pelargonium zonale* (L.) L'Hér. (Geraniaceae), *Hibiscus rosa-sinensis* L., *H. syriacus* L. (Malvaceae), and *Cestrum nocturnum* L. (Solanaceae), as well as vegetables crops such as *Capsicum annuum* L. and *Solanum melongena* L. (Solanaceae) (Kaydan *et*

al., 2012). The Madeira mealybug spread very fast because of the human activities and changes of the environmental conditions, such as temperature and humidity, and the rapid growth of the mealybug population in a very short time, resulting in outbreaks and causing significant damage to ornamental plants in urban landscape (Franco *et al.,* 2011).

Encyrtids (Hymenoptera: Encyrtidae) are regarded as important biological control agents and many species have been used successfully against economically important pests, especially scale insects (Hemiptera: Coccomorpha). About 400 encyrtid species have been used for biological control of many crop pest species (Japoshvili, 2012). There are more than 1755 encyrtid species are known in the Palaearctic Region (Noyes, 2015) of which 148 species belonging to 52 genera have been recorded in Turkey. The genus *Anagyrus* is one of the well-known parasitoid genus used in biological control of mealybugs; *Anagyrus pseudococci* (Girault, 1915) against *Planococcus citri* (Risso, 1813), and *Pl. ficus* (Signoret, 1869), *A. lopezi* (De Santis, 1964) against *Phenacoccus manihoti* Matile-Ferrero, 1977, *A. kamali* Moursi 1948 against *Maconellicoccus hirsutus* (Green, 1908). Until now, ten species belonging to *Anagyrus* have been recorded in Turkey; namely *A. alienus* Japoshvili, 2012, *A. aligarhensis* Agarwal and Alam, 1959 (formerly known under the name *Anagyrus diversicornis* Mercet, 1921), *A. dactylopii* (Howard, 1898), *A. descriptus* Japoshvili, 2012, *A. kilinceri* Japoshvili, 2012, *A. matritensis* (Mercet 1912), *A. pseudococci* (Girault 1915), *A. schmuttereri* Ferrière, 1955, *A. schoenherri* (Westwood, 1837) and *A. tamaricicola* Trjapitzin, 1968 (Japoshvili, 2012; Noyes, 2015).

Anagyrus amnestos Rameshkumar, Noyes and Poorani was described for the first time in India as a promising parasitoid of the invasive Madeira mealybug, *Phenacoccus madeirensis* by Rameshkumar *et al.* (2012). However, there are many biological studies on this species under the name of *Anagyrus* sp. nov. nr. *sinope* Noyes and Menezes by Chong and Oetting (2006, 2007a) and they found out that this species was highly host-specific, and gregarious. They also indicated that this encyrtid species has great potential for biological control of *P. madeirensis* in many crops in open areas and greenhouses (Chong and Oetting, 2007b). *Anagyrus amnestos* has been recorded in the USA (Georgia); Italy (Sicily) and India (Karnataka) on *P. madeirensis* on different host plants such as *Hibiscus rosa-sinensis*, *Solanum melongena*, *Solanum* spp., and *Lantana camara* L. (Verbenaceae) (Rameshkumar *et al.,* 2012).

In this paper we report the presence of *Anagyrus amnestos* as a parasitoid of *P. madeirensis* in Turkey and add a new locality record for the Palaearctic region. This is the first record of this parasitoid from Turkey. We present here a diagnosis of the species supported by some illustrations.

MATERIALS AND METHODS

Mealybug samples including parasitized and unparasitized specimens were collected from ornamental plants from Adana in Turkey. Each sample was placed into a plastic bag and taken to the laboratory for examination. Mealybug specimens

were prepared for light microscopy using the slide-mounting method of Kosztarab and Kozár (1988) and identified according to the key provided by Williams (2004). Identification of the mealybug was made by the first author.

The parasitoid specimens were reared in the laboratory from parasitized mealybug samples. Parasitoid specimens were prepared for light microscopy using the slide-mounting method of Noyes and Hayat (1994) and Noyes (2000) and identified according to the description given by Rameshkumar *et al.* (2012). Identification of the parasitoid was made by MH. Photographs of card-mounted specimens were made by a digital camera (Nikon, DSFi2) attached to a Nikon SM225 compound microscope, and slide-mounted parts were photographed with a digital camera (Leica, DFC 295) attached to Leica DM2500 compound microscope, and the stack images obtained were combined with Combine ZP.

Both dry and mounted materials are deposited in the Scale Insect Collection in Çukurova University, Adana, Turkey (KPCT) and in the Department of Zoology, Aligarh Muslim University, Aligarh, India (ZDAMU).

RESULTS AND DISCUSSION

This is the first record of *Anagyrus amnestos*, parasitoid of *Phenacoccus madeirensis* in Turkey. Adiagnosis of the parasitoid species is supported by new illustrations.

Anagyrus amnestos Rameshkumar, Noyes and Poorani (Figs. 1-10)

Anagyrus amnestos Rameshkumar, Noyes and Poorani, in Rameshkumar *et al.,* 2012: 77-83, female, male. *Holotype*, female, India, Karnataka, Hebbal. Paratypes from Karnataka (Hessarghatta) and Italy (Sicily, Marsala).

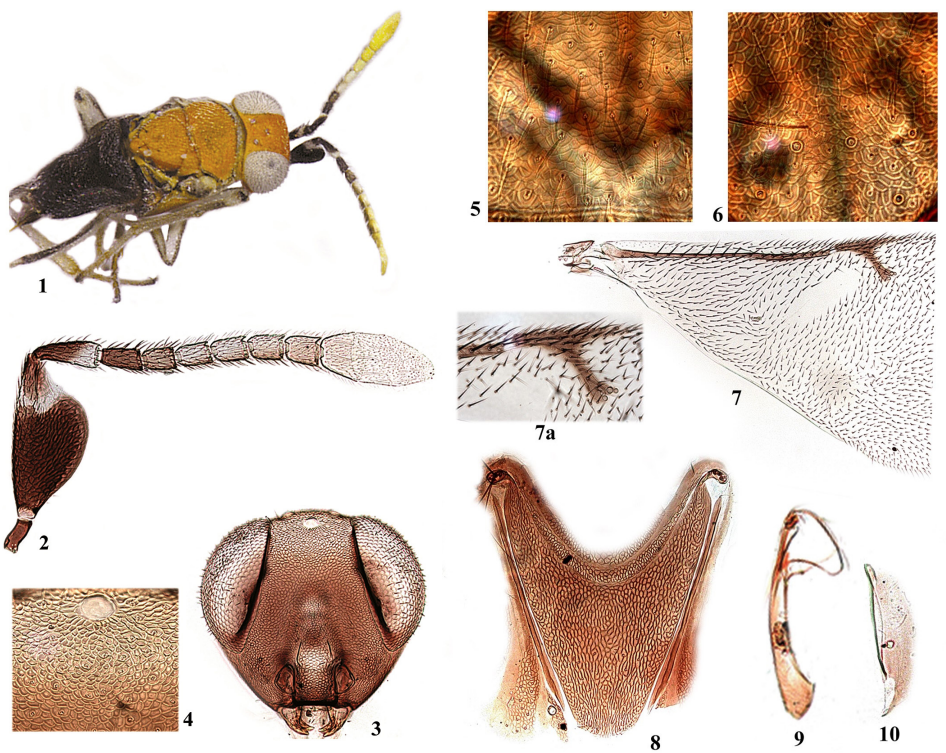
Material examined: Turkey, Adana, 5 ♀♀ (one on slide, No. EH.1793). Ex. *Phenacoccus madeirensis* on *Hibiscus rosa-sinensis* (Malvaceae), 12.09.2014, Coll.: A.F. Çalışkan (No. PR-48).

This species was adequately described by Rameshkumar *et al*. (2012), therefore, here we give a diagnosis of the species, and illustrate some structures to facilitate the identification of the Turkish specimens.

Diagnosis

Female (Fig. 1). Length 0.9 mm. Head orange yellow; occiput brown; inter-torular prominence down to mouth margin dark brown; malar space, except orange below eye, dark brown. Mandible pale with apex pale brown. Maxillary palp with fourth segment brown, segments 1-3 white. Antenna (Fig. 2) with radicle, scape except a white subapical curved band, pedicel except apical third, and F1 (= first funicle segment), dark brown; F2 variable nearly dark brown to brown; F3-6 white with ventral surface brown to dark brown; clava white; funicle segments with brown to dark brown areas with dark setae. Mesosoma with pronotal collar white, anteriorly yellow brown to brown; mesoscutum orange, with anterior margin (in card-mounted specimens hidden by collar of pronotum) dark brown; axilla and scutellum orange;

tegula white with about apical third brown; propodeum dark brown; prepectus white; mesopleuron anteriorly orange, but largely pale brownish yellow. Wings hyaline; fore wing with discal setae brown; hind wing with discal setae translucent. Legs, including coxae, white, with brown to dark brown as follows: fore coxa with a brown streak in basal half on outer surface; mid coxa in basal half on ventral surface brown; hind coxa brown; fore femur with a distinct dark brown dorsal streak and a fine ventral streak; mid and hind femora as on fore femur; fore tibia with a pale brown streak on both margins; mid tibia on outer surface with a dark brown streak; hind tibia with a pale brown streak; all tibiae at bases (knee joints) dark brown; fore tarsal segments 1-4 brown, fifth dark brown; mid basitarsus white, following segments becoming yellow, fifth segment brown; hind tarsus with segment 1 white, 2-4 brownish yellow, and fifth brown. Gaster dark brown; third valvula dark brown.



Figs. 1-10. *Anagyrus amnestos*, female: 1. Body dorsal. 2. Antenna. 3. Head, frontal view. 4. Sculpture on frons. 5. Sculpture on mesoscutum. 6. Sculpture on scutellum. 7. Fore wing, basal part. 7a. Fore wing, distal veins enlarged. 8. TVII of gaster. 9. Ovipositor. 10. Outer plate of ovipositor.

Head dorsal width 2× dorsal length; frontovertex width 0.4× head width; ocellar triangle with apical angle slightly acute, POL, OOL, OCL ratios-5.5:2:2.5; head, in frontal view, 1.11× as broad as high (Fig. 3); malar space 0.52× eye height; head with raised reticulate sculpture (Figs. 3, 4); head with setae silvery white; eye setose, setae brown and each seta slightly longer than a facet diameter. Antenna with

scape 2.25× as long as broad, other dimensions as in Fig. 2. Mesosoma with fine reticulate sculpture on mesoscutum as in Fig. 5; scutellum sculptured as in Fig. 6, slightly deeper than that on mesoscutum; setae on mesosoma silvery white, except for 2 subapical pairs on scutellum brown. Fore wing (Figs. 7, 7a) 2.38× as long as broad; marginal vein slightly longer than postmarginal, and shorter than stigmal vein (27:21:30); costal cell with one line of setae on ventral surface, which becomes two lines proximally; linea calva interrupted posteriorly by about 5 lines of setae, and the basal cut-off portion small and rounded. Hind wing 3.94× as long as broad, and 0.68× fore wing length. Mid tibia 2.83× as long as mid basitarsus; mid tibial spur 0.77× mid basitarsus length. Gastral tergites strongly sculptured (Fig. 8 of TVII) and with silvery white setae; ovipositor and outer plate as in Figs. 9 and 10; tergite 7 (TVII) 1.55× as long as ovipositor (45:29); ovipositor 0.56× mid tibia length (29:51); second valvifer 4.8× as long as third valvula (= gonostylus).

Male: Not yet collected in Turkey. Recorded and described by Rameshkumar *et al.* (2012).

Host: *Phenacoccus madeirensis* Green, 1923 (Hemiptera: Pseudococcidae).

Distribution: India (Karnataka); Italy (Sicily); USA (Georgia); Turkey (New record).

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