Entomofauna	39/2	Heft 22: 909-918	Ansfelden, 31. August 2018

Natural enemies of *Peliococcus kimmericus* (Hem: Pseudococcidae) in Mashhad, Iran

Zahra Nazari, Gholamhossein Moravvej & Hossein Lotfalizadeh

Abstract

Leaf and stem samples of *Lactuca serriola* infected by the mealybug, *Peliococcus kimmericus* (Kiritshenko) were collected during 2011-2012, from Mashhad, the northeast of Iran. Totally 4 species of predators and 8 parasitoids and hyperparasitoids belonging to 8 genera and 3 families were found. Among the natural enemies associated with *P. kimmericus*, three species, *Anagyrus* near *kilinceri* Japoshvili, 2010, *Aphycus secundus* (Mercet, 1925) and *Charitopus* sp. were recorded for the first time from Iran.

Keywords: Predators, Parasitoids, *Peliococcus kimmericus*, Iran.

Zusammenfassung

In Mashhad im Nordosten des Iran wurden in den Jahren 2011-2012 Blätter und Stengel von *Lactuca serriola* gesammelt, die durch die Schmierlaus *Peliococcus kimmericus* (Kiritshenko) infiziert waren: entdeckt wurden insgesamt 4 Arten von Raubtieren und 8 Parasitoide und Hyperparasitoide aus 8 Gattungen und 3 Familien. Unter den natürlichen Feinden von *P. kimmericus* konnten 3 Arten, *Anagyrus* near *kilinceri* Japoshvili, 2010, *Aphycus secundus* (Mercet, 1925) und *Charitopus* sp. erstmalig für den Iran nachgewiesen werden.

Introduction

The family Pseudococcidae, commonly known as the mealybugs, is the second largest family within scale insects (Hemiptera: Sternorrhyncha: Coccoidea), with 1992 described species in 262 genera (Moghaddam, 2013). These pests contain a proportion of injurious species attacking various plants. They feed on different parts of plants including roots, stems, leaves, buds and fruits. *Peliococcus kimmericus* (Kiritshenko) has been reported

from Afghanistan, Armenia, Iran, Kazakhstan, Saudi Arabia, Tajikistan, Turkey and Turkmenistan (Ben-Dov, 1994) attacking 10 plant families worldwide. In Iran, *P. kimmericus* is only known from Khuzestan (Moghaddam, 2006). Females pass through three nymphal instars before reaching adulthood and the nymphs differ from the adult females by having a much thinner wax covering and fewer antennal segments. The mealybugs produce wax covering their body. The curled wax filaments are also found on the surface of ovisacs, droplets of honeydew and ostiole exudates. Because of waxy layer, chemical insecticides application on mealybug has no significant effects. Therefore, biological control has been regarded as a useful alternative measure. Information on the biology and natural enemies of *P. kimmericus* is scanty and only a few attempts have been made in Iran (Fallahzadeh, et al., 2006) Encyrtidae parasitoid wasps including *Anagyrus orbitalis* (Timberlake), *Leptomastix histrio* (Mayr)*, Cheiloneurus kollari* (Mayer), *Anagyrus matritensis* (Mercet) and *C. paralia* (Mayer) have been reported as natural enemies of *P. kimmericus* in Fars province (Fallahzadeh et al., 2006). A different assemblage of natural enemies have been recorded in Turkey including two predaceous coccinellids *Nephus kreissli* (Fürsch & Uygun) and *Nephus nigricans* (Weise), and the parasitoids *Cheiloneurus* sp., *Coccidoxenoides perminutus* (Girault), *Tetracnemoidea* sp., *Eunotus acutus* (Kurdjumov) and *Chartocerus kurdjumovi* (Nikol'skaya) (Kaydan et al., 2006). Noyes (2012) listed seven encyrtid species as parasitoids of *P. kimmericus*. Successful programs of biological control depend on the correct identification of the natural enemies of the target pest species. The present work aimed to survey on the natural enemies of *P. kimmericus* in Mashhad, Iran.

Materials and methods

Samples of *Lactuca seriula* infested by *Peliococcus kimmericus* were collected in Mashhad city during 2012-2013. Infested plants were transferred to the laboratory in plastic bags and kept within transparent plastic boxes. During a 30-day period, the boxes were examined to determine parasitized mealybug. Emerged parasitoids were counted and placed into 75% ethanol for further examination. Other natural enemies including coccinellidae and Cecidomyiidae were inspected on the rearing boxes.

The parasitoids were cleared in lactophenol and mounted on microscope slides directly into Canada balsam mounting medium and identified using the keys and descriptions provided by Timberlake (1916), Springate & Noyes (1990), Trjapitzin & Doganlar (1997), Hayat (2009), Kaydan & Japoshvili (2010) and Lotfalizadeh (2013).The wasps were dissected subsequently for microscopic studies. The external morphology of parasitoids was illustrated using a Stereo Microscopes Olympus SZH10 armed with camera DT71.

The specimens were deposited to the insect collection of the Department of Plant Protection, East-Azarbaijan Research Center for Agriculture and Natural Resources, Tabriz and Insect Collection of Ferdowsi University of Mashhad. General data regarding geographical distribution, biology and brief taxonomic comments were given for each species.

Adult and immature specimens of *Peliococcus kimmericus* were slide mounted in Canada balsam using the method described in Williams & Watson (1988) and their identification was confirmed by M. Moghaddam, Insect Taxonomy Research Department, Iranian Research Institute of Plant Protection, Tehran, Iran.

Results

Nine species of chalcidoid wasps (Hym.: Chalcidoidea) and four species of predatory insects were associated with the *P. kimmericus* in Mashhad (Table 1). These include three new records for the fauna of Iran as follows.

Aphycus secundus (Mercet, 1925)

D i s t r i b u t i o n : This species known only from Spain (Noyes 2012) and is new record for Iran.

M a t e r i a l e x a m i n e d : Khorasan-e-Razavi, Mashhad, 6 ♀, 20.VII.2013, Leg. Z. Nazari.

H o s t : There is any biological data on *A. secundus* (Noyes, 2012), therefore, *Peliococcus kimmericus* is the first host for this species.

D i a g n o s t i c c h a r a c t e r s : Female 1.3 mm; scutellum and axillae yellow; abdomen dark brown, yellowish at base (Fig. 1A); ovipositor more than 0.25 of abdominal length; fore wing with 2 dark bands (Fig. 1C).

Anagyrus near *kilinceri* Japoshvili, 2010

D i s t r i b u t i o n : Iran.

M a t e r i a l e x a m i n e d : Khorasan-e-Razavi, Mashhad, 50♀, 25♂, 20.VII.2013, Leg. Z. Nazari.

H o s t : *Anagyrus kilinceri* was reported on *Heterococcopsis opertus* on *Cynodon dactylon* (Poaceae) (Kaydan & Japoshvili, 2010). Our research showed *A.* near *kilinceri* attacks *P. kimmericus*.

D i a g n o s t i c c h a r a c t e r s : This species is similar to *A. kilinceri* but has some characters of *A. matritensis* (Mercet) so considered as *Anagyrus* near *kilinceri*. Female 3 mm, Male 2-2.5 mm; head and thorax predominantly black or dark brown (Fig 2A), mesopleuron dark (yellow in *A. kilinceri*), flagellum completely black, F1 white basally (such as *A. matritensis*), scape white apically (Fig 2A); all legs yellow, femora with orange-yellow color (such as *A. kilinceri*), abdomen shorter than head and thorax together (as long as in *A. kilinceri*) (Fig 2E); pedicel longer than F1 (such as *A. kilinceri*), F6 not more than 1.5 times as long as wide (such as *A. kilinceri*) (Fig 2A).

Charitopus sp.

D i s t r i b u t i o n : The genus *Charitopus* with 19 nominal species in the world, includes 10 species in the Palaearctic region (Noyes, 2012), but this is the first report from Iran.

M a t e r i a l e x a m i n e d : Khorasan-e-Razavi, Mashhad, 10♀, 20.VII.2013, Leg. Z. Nazari.

H o s t : *Charitopus* spp. are parasitoids of Pseucococcidae and we reread for first time on *P. kimmericus*.

D i a g n o s t i c c h a r a c t e r s : Antenna long and filiform (Fig 3C), inserted over clypeus (Fig 3A), pedicel and funicular segments longer than wide, funicul 6-segmented, club 3-segmented; mandibles bidentate, notauli present; marginal vein long, longer than

postmarginal vein, as long as stigmal vein (Fig 3B); ovipositor slightly protruding (Fig 3A).

Discussion

The occurrence of such a diversity of natural enemies may indicate the potential availability of biological agents against *Peliococcus kimmericus* in Mashhad.

The present study reported nine species of chalcidoid wasps, three of which including *Anagyrus* near *kilinceri*, *Aphycus secundus* and *Charitopus* sp. (Hym.: Encyrtidae) were new for fauna of Iran. The species of *Anagyrus* Howard are considered as primary parasitoids of mealybugs. In the present study, *Aphycus secundus* was found in a few locations in low numbers.

The genus *Charitopus* is a new record for the Iran's parasitoid fauna. A number of species including *C. bulentyasari* Japoshvili, *C. fulviventris* Förster and *C. eristoi* Japoshvili have been collected on Coccoids (Hemiptera: Coccoidea) from Turkey (Japoshvili 2012).

Leptomastix flava have been recorded from a few provinces in Iran including Isfahan, Tehran (Radjabi & Amir 1989), Kerman (Asadeh & Mossadegh, 1993). Noyes (2012) regarded the species as a parasitoid of *P. citri*, attacking many other mealybugs.

The species of *Marietta* has been regarded mainly as the hyperparasitoids of Homoptera including Diaspididae, Coccidae and other families (Noyes 2012). *Marietta picta* was found in large density on the population of mealybug. This species was previously known as a parasitoid of *A. pseudococci* from Fars (Lotfalizadeh & Ahmadi 2001). In the present study, *Prochiloneurus indicus* and *Chartocerus kurdjumovi* were recorded as the hyperparasitoid of the mealybug, *P. kimerricus*. *Prochiloneurus indicus* has been previously recorded on *Nipaecoccus viridis* (Newstead) (Hem.: Pseudococcidae) and *C. kurdjumovi* has been recorded as the hyperparasitoid of *N. viridis* (Asadeh & Mossadegh, 1993) and *Planococcus ficus* (Signoret) (Fallahzadeh & Japoshvili, 2010).

The ladybird beetles (Col.: Coccinellidae) are the most common and best studied of the natural enemies of aphids, soft scales, armored scales, whiteflies and mites (Majerus, 1994). Among the natural enemies, the ladybird beetle, *Exochomus nigromaculatus* was the predominant predators. Adults and larvae were found preying on the eggs, larvae and adults of *P. kimmericus*. Lotfalizadeh et al. (1999) studied the biology of *E. quadripustulatus* on *Planococcus vovae* (Nasanov). The present study suggested that *Nephus bisignatus* (Boheman) could have an important role in reducing the number of mealybugs but its potential might have decreased due to parasitization by hyperparasitoides.

Predaceous coccinellides were parasitized by two encyrtidae wasps, *Homalotylus quaylei* and *Homalotylus flaminius* (Table 1). The genus *Homalotylus* Mayr comprises one of the most important parasitoids of Coccinellidae with about 65 species worldwide, nine species of parasitoids of ladybirds have been previously reported from Iran (Fallahzadeh & Japoshvili, 2010).

In this study, larvae of *Dicrodiplosis manihoti* Hariss, were found feeding on egg masses ovisacse of *P. kimmericus*. This species has been recorded from Shiraz as predator of *Planococcus vovae* (Lotfalizadeh & Ahmadi, 2001).

Acknowledgments

Thanks are due to Faculty of Agriculture, Ferdowsi University of Mashhad, Iran for their financial support.

References

Asadeh G. & M.S. Mossadegh (1993): Important natural enemies of mealybugs (*Pseudococcus* spp.) in the Khuzestan province Iran. – Scientific Journal of Agriculture **16**:(1,2): 46-52.

Ben-Dov Y. (1994): A Systematic Catalogue of the Mealybugs of the World (Insecta: Homoptera: Coccoidea: Pseudococcidae and Putoidae) with Data on Geographical Distribution, Host Plants, Biology and Economic Importance. – Andover, UK, Intercept Limited. 686 pp.

Fallahzadeh M. & G. Japoshvili (2010): Checklist of Iranian Encyrtids (Hymenoptera: Chalcidoidea) with descriptions of new species. – Journal of Insect Science **10**:(68): 1-24.

Fallahzadeh M., Shojaei M., Ostovan H. & K. Kamali (2006): The first report of four parasitoid wasps on *Peliococcus kimmericus* (Hem.: Pseudococcidae) from Iran. – Journal of Entomological Society of Iran **26**:(1): 97-98.

Hayat M. (2009): A review of the Indian Signiphoridae (Hymenoptera: Chalcidoidea). – Biosystematica **3**:(2): 5-27.

Japoshvili G. (2012): New data on encyrtid (Hymenoptera: Chalcidoidea: Encyrtidae) parasitoids of Coccoids (Hemiptera: Coccoidea) from Turkey,with description of five new species. – Acta Entomologica Fennica **23**:(2): 72-82.

Kaydan M.B. & G. Japoshvili (2010): The aphelinid and encyrtid parasitoids (Hymenoptera: Chalcidoidea) of Pseudococcidae (Hemiptera: Coccoidea) in the Van Lake basin of Turkey. – Turkish Journal of Entomology **34**:(4): 465-476.

Kaydan M.B., Kilincer N., Uygun N., Japoshvilli G. & S. Gaimari (2006): Parasitoids and Predators of *Pseudococcidae* (Hemiptera: Coccoidea) in Ankara, Turkey. – Phytoparasitica **34**:(4): 331-337.

Lotfalizadeh H. (2013): Introduction to Hymenopterous Parasitoids of Important Agricultural Pests. – PhD, Islamic Azad University of Entomology.Tabriz, Iran.

Lotfalizadeh H. & A.A. Ahmadi (2001): Natural Enemies of Cypress Tree Mealybug *Planococcus vovae* (Nasonov), and Their Parasitoid in Shiraz, Iran. – Iran Agricultural Research **19**:(2): 145-154.

Lotfalizadeh H., Hatami B. & Khalghani J. (1999): Biology of *Exochomus quadripustulatus* (L.) on cypress tree mealybug, *Planococcus vovae* (Nasanov) (Hom.: Pesudococcidae) in Shiraz. – Journal of Entomological Society of Iran **20**:(61-76.

Majerus M.E.N. (1994): Ladybirds. – London, Hopper Collins. 367 pp.

Moghaddam M. (2006): The mealybugs of southern Iran (Hem.: Coccoidea: Pseudococcidae). – Journal of Entomological Society of Iran **26**:(1): 1-11.

Moghaddam M. (2013): A review of the mealybugs (Hemiptera: Coccoidea: Pseudococcidae, Putoidae and Rhizoecidae) of Iran, with descriptions of four new species and three new records for the Iranian fauna. – Zootaxa **3632**:(1): 1-107.

Noyes J.S.: Universal Chalcidoidea Database.{10 2012}. – <http://www.nhm.ac.uk/chalcidoids>.

Radjabi G. & Amir M. (1989): Egg parasites of the sunn pest in the central part of the Iranian plateau. – Entomologie et Phytopathologie Appliquées **56**:(1-2): 1-12.

Springate N.D. & Noyes G. (1990): A Review of british specles of *Anagyrus* Howard (Hymenoptera : encyrtidae) with new records and descriptions of other chalcidoidea. – Entomologists Gazette **41**: 213-230.

Timberlake P.H. (1916): Revision of the parasitic Hymenopterous insects of the genus *Aphycus* Mayr, with notice of some related genera. – Washington, Government Printing Office. 561-640 pp.

Trjapitzin V.A. & M. Doganlar (1997): A review of encyrtids (Hymenoptera, Encyrtidae) of Turkey. – Entomologicheskoe Obozrenie **76**:(1): 213-222.

Williams D.J. & G.W. Watson (1988): The Scale Insects of the Tropical South Pacific Region. Part. 2: The Mealybugs (Pseudococcidae). – Wallingford, UK, CAB International. 260 pp.

Authors' addresses:

Zahra Nazari[1]
Dr. Gholamhossein Moravvej[1] (Corresponding author)
Dr. Hossein Lotfalizade[2]
E-mail: moravej@um.ac.ir

[1] Department of Plant Protection, Faculty of Agriculture,
Ferdowsi University of Mashhad, Mashhad, Iran

[2] Department of Plant Protection, East-Azarbaijan Research Center
for Agriculture and Natural Resources, Tabriz

Table 1. Natural enemies of *Peliococcus kimmericus* in Mashhad

Order	Family	Species	Type
Hymenoptera	Encyrtidae	*Anagyrus* near *kilinceri* Japoshvili*	Parasitoid
		Aphycus secundus (Mercet)*	Parasitoid
		Charitopus sp.*	Parasitoid
		Leptomastix flava (Mercet)	Parasitoid
		Homalotylus flaminius (Dalman)	Parasitoid of Coccinellidae
		Homalotylus quaylei Timberlake	Parasitoid of Coccinellidae
		Prochiloneurus indicus Shafee, Alam & Agarwal	Hyperparasitoid
	Signiphoridae	*Chartocerus kurdjumovi* (Nikol'skaya)	Hyperparasitoid
	Aphelinidae	*Marietta picta* (Andre)	Hyperparasitoid
Coleoptera	Coccinelidae	*Exochomus nigromaculatus* (Goeze)	Predator
		Nephus bisignatus (Boheman)	Predator
Neuroptera	Chrysopidae	*Chrysoperla carnea* (Stephens)	Predator
Diptera	Cecido-myiidae	*Dicrodiplosis manihoti* Harris	Predator
* Species marked with an asterisk are new records for the fauna of Iran.			

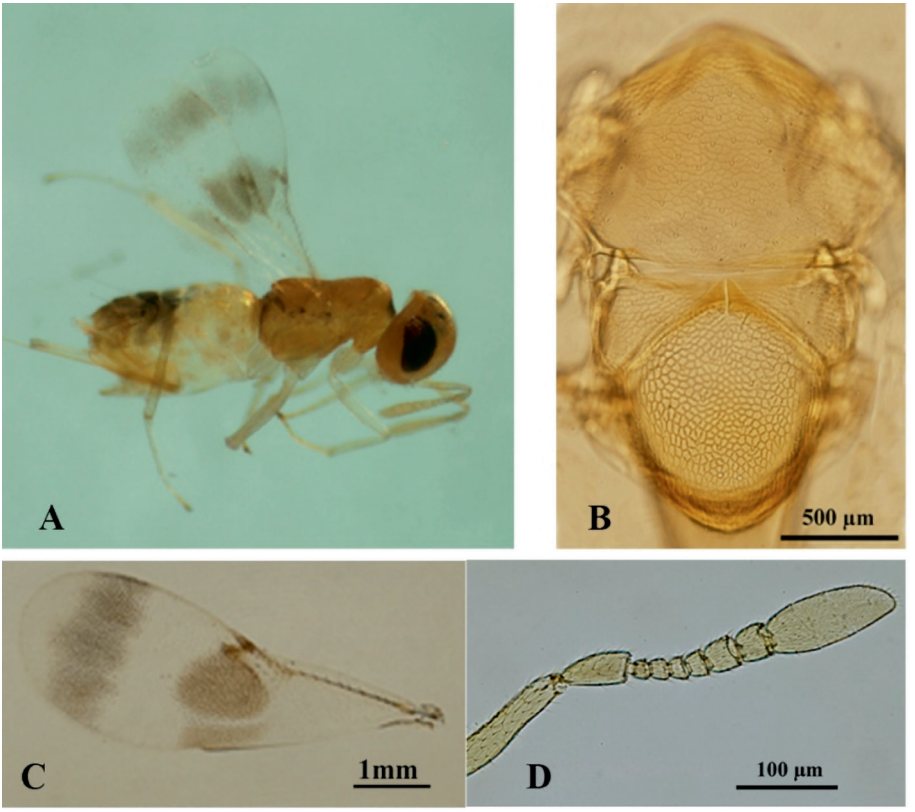

Fig 1. *Aphycus secundus:* **A.** Female (lateral view), **B.** Mesosoma (dorsal view), **C.** Forewing, **D.** Antenna of female.

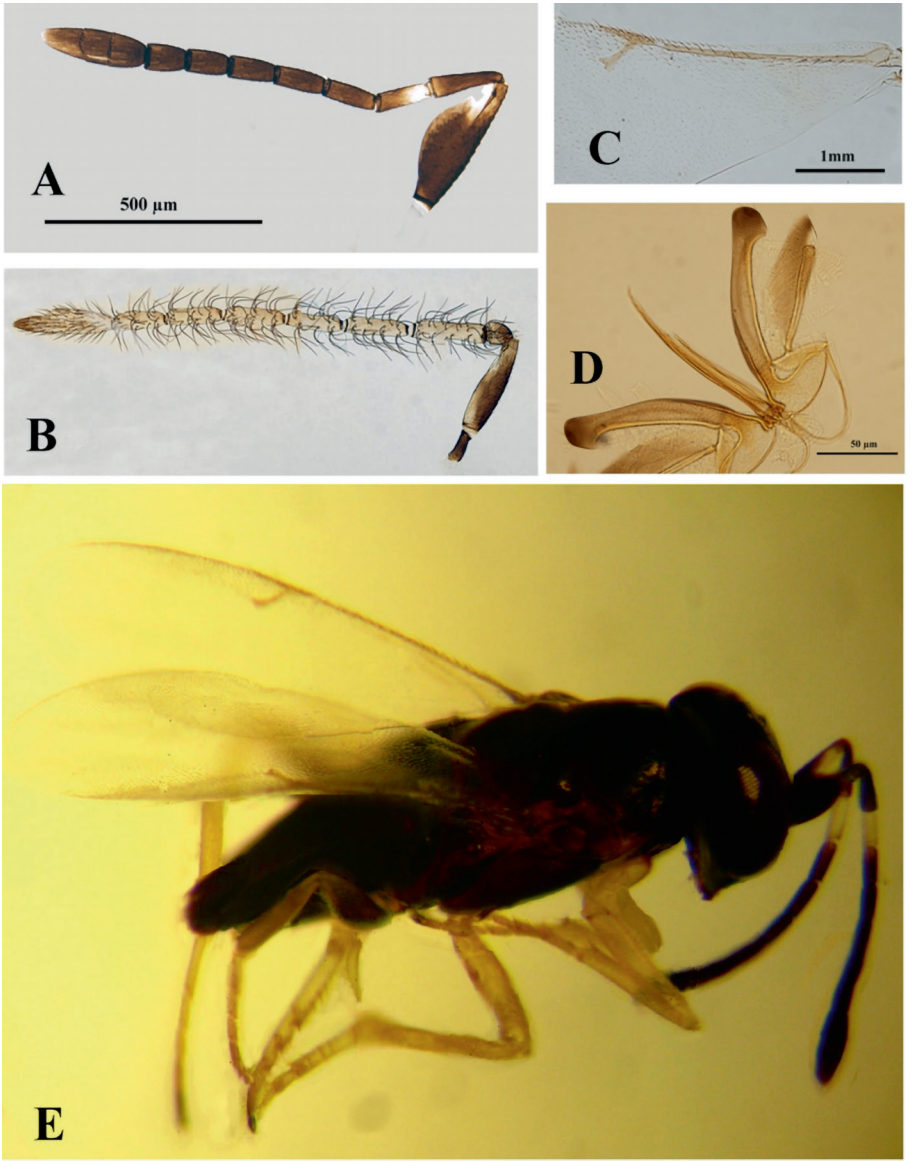

Fig 2. *Anagyrus securic ornis* **A.** Antenna of female, **B.** Antenna of male, **C.** Forewing venation, **D.** Ovipositor, **E.** Female (lateral view).

Fig 3. *Charitopus* sp.: **A.** Female (lateral view), **B.** Forewing venation, **C.** Antenna of female