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A Contribution to the Knowledge of Whiteflies (Hemiptera: Aleyrodidae) in Khorasan and Semnan Provinces, Iran

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Whiteflies (Hemiptera: Aleyrodidae) are some of the most potentially detrimental pests for agricultural crops and the ornamental plant industry in Iran. The present paper deals with the faunistic survey of whiteflies in two provinces of Iran, Khorasan and Semnan. During the survey a total of 16 species from 12 genera were collected and identified. Distribution data are given for the species.

Keywords: Hemiptera, Aleyrodidae, whitefly, fauna, host plant, Khorasan, Semnan, Iran.

Whiteflies (Hemiptera: Aleyrodidae) are tiny, sucking insects and the wings and bodies of the adults are covered with a fine, powdery or flour-like white wax (Mound and Halsey, 1978; Hodges and Evans, 2005). There are over than 1560 whitefly species worldwide and they represent an important agricultural pest group (Martin and Lau, 2011).

Several species cause crop losses through direct feeding but the main problem still remains the transmission of different viral plant diseases (Inbar and Gerling, 2008; De Barro et al., 2011). Crop plants are damaged in three ways: direct feeding, virus transmission and fouling with honeydew and sooty moulds. They can cause the plant's foliage changing into yellow and mottled at higher population levels. Additionally excretion of honeydew and sugary sap onto the plant's foliage causes sooty moulds to interfere the photosynthesis (Mound and Halsey, 1978; Gerling, 1990; Byrne and Bellows, 1991). Whiteflies continue to attract great ecological, physiological and agroeconomic interest, primarily because of a few highly polyphagous pest species such as the spiraling whitefly (*Aleurodiscus disperses* Russell, 1965), the greenhouse whitefly [*Trialeurodes vaporariorum* (Westwood, 1856)] and the sweet potato whitefly [*Bemisia tabaci* (Gennadius, 1889)] (Gerling, 1990; Oliveira et al., 2001). In contrast to most oligophagous or monophagous (rarely studied) species, the polyphagous species' diversity and adaptability have facilitated worldwide spread (Costa et al., 1993; Brown et al., 1995; Oliveira et al., 2001).

Several species of whiteflies attack agricultural crops typically have a wide host range and generally occurred in Iran. The fauna of Iranian Aleyrodidae was studied rather

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well (Kiriukhin, 1947; Zarrabi, 1998a, b; Ghahari and Hatami, 2001; Manzari, 2005; Manzari and Alemansoor, 2005; Manzari and Moghaddam, 2005; Abd-Rabou and Ghahari, 2005, 2006; Ghahari et al., 2007a, b, 2009a, b; Shahbazvar et al., 2010a, b; Zarei and Asgari, 2013; Zarei et al., 2013). In the mentioned investigations several whitefly species were reported together with their host plants and natural enemies. Several investigation were made regarding to the natural enemies of whiteflies such as genera *Encarsia* Förster (Abd-Rabou and Ghahari, 2004) and *Eretmocerus* Haldeman (Hymenoptera: Aphelinidae) (Abd-Rabou et al., 2005).

The objective of this research is to present new data on whitefly fauna of two Iranian provinces, Semnan and Khorasan where the fauna of whiteflies was poorly explored.

Semnan province covers an area of 96,816 km^2 and stretches along the Alborz mountain range and borders to Dasht-e Kavir desert in its southern parts. The province is divided into two parts: a mountainous region and the plains at the foot of the mountains.

Khorasan province covers an area of 329,327 km^2 and upon the recent dividing, it is consisting of three different parts: northern, Razavi, and southern provinces. It is one of the largest provinces located in East and North-eastern Iran, having boundaries with Afghanistan and Turkmenistan.

Materials and Methods

Whitefly taxonomy relies primarily on morphological characters of the fourth instar (Mound and Halsey, 1978; Ma et al., 2007). Therefore, the puparia of whiteflies were collected on the leaves of their host plants from natural habitats and agricultural fields of Semnan and Khorasan provinces. The specimens were studied using the technical and slide making procedure of Martin (1985) and are deposited in the collections of the authors. The classification and nomenclature suggested by Bink-Moenen (1983), Evans (2007) and Martin and Mound (2007) have been followed, and distribution data are according to Martin et al. (2000) and Evans (2007).

Results

In total sixteen whitefly species from twelve genera were collected and identified from different regions of Semnan and Khorasan provinces. Species list with distributional data is given below.

Family Aleyrodidae Westwood, 1840
Subfamily Aleyrodinae Westwood, 1840
Genus *Aleurocanthus* Quaintance and Baker, 1914

1. *Aleurocanthus woglumi* Ashby, 1915

Material examined: Semnan province: Shahrood, 1312 m, 35°30'N 55°30'E, on *Hibiscus rosa-sinensis* (Malvaceae), 3 specimens, 14. VI. 2011.

General distribution: Virtually worldwide. USA, Mexico, Guatemala, Cuba, Honduras, Nicaragua, El Salvador, Panama, Costa Rica, Venezuela, Colombia, Brazil, Argentina, Paraguay, Peru, Uruguay, Jamaica, Puerto Rico, Egypt, England, France, Iran, Israel, Italy, Spain, Russia and adjacent countries, Uganda, Kenya, South Africa, Tanzania, China, India, Philippines, Malaysia, Vietnam, Taiwan Thailand, Australia, Indonesia, New Zealand, Hawaii.

2. *Aleurocanthus zizyphi* Priesner and Hosny 1934

Material examined: Khorasan province: Mashhad, 991 m, 36°17'N 59°40'E, on *Ziziphus spina-christi* (Rhamnaceae), 2 specimens, 14. VI. 2011.

General distribution: Egypt, Iran, Jordan, Chad, Congo, Ivory Coast, Kenya, Nigeria, South Africa, Uganda.

Genus *Aleurolobus* Quaintance and Baker 1914

3. *Aleurolobus olivinus* (Silvestri) 1911

Material examined: Semnan province: Semnan, 1163 m, 35°20'N 53°20'E, on *Olea* sp. (Oleaceae), 2 specimens, 12. IV. 2010.

General distribution: China, Cyprus, Egypt, France, Iran, Israel, Italy, Morocco, Spain.

Genus *Aleyrodes* Latreille 1796

4. *Aleyrodes singularis* Danzig 1964

Material examined: Khorasan province: Kashmar, 1060 m, 35°26'N 58°29'E, on *Lactuca* sp. (Asteraceae), 3 specimens, 11. VII. 2011.

General distribution: Azores, Canary Islands, Iran, Jordan, Russia and adjacent countries.

Genus *Asterobemisia* Trehan 1940

5. *Asterobemisia trifolii* (Danzig) 1966

Material examined: Semnan province: Shahrood, 1312 m, 35°30'N 55°30'E, on *Trifolium lupinaster* (Fabaceae), 1 specimen, 11. IV. 2010.

General distribution: Caucasus, Iran, Russia.

Genus *Bemisia* Quaintance and Baker 1914

6. *Bemisia afer* (Priesner and Hosny) 1934

Material examined: Khorasan province: Bojnord, 1070 m, 37°35'N 57°20'E, on *Gossypium hirsutum* (Malvaceae), 2 specimens, 14. VI. 2012.

General distribution: Australia, Brazil, Cameroon, Chad, China, Congo, Egypt, Iran, Israel, Italy, Spain, Guinea, India, Ivory Coast, Kenya, Korea, Madagascar, New Guinea, Niger, Nigeria, Sierra Leon, South Africa, Sudan, Pakistan, Uganda, Zaire.

7. *Bemisia tabaci* (Gennadius 1889)

Material examined: Semnan province: Shahmirzad, 1944 m, 35°46'N 53°19'E, on *Populus nigra* (Salicaceae), 4 specimens, 24. IV. 2009.; Garmsar, 848 m, 35°00'N 52°20'E, on *Lycopersicum esculentum* (Solanaceae), 6 specimens, 8. III. 2010.; Shahrood, 1312 m, 35°30'N 55°30'E, on *Euphorbia bungei* (Euphorbiaceae), 2 specimens, 11. IV. 2010; Khorasan province: Mashhad, 991 m, 36°17'N 59°40'E, on *Petunia hybrida* (Solanaceae), 2 specimens, 14. VI. 2011.; Sabzevar, 1023 m, 36°12'N 57°35'E, on *Althaea officinalis* (Malvaceae), 5 specimens, 2. X. 2011.

General distribution: Cosmopolitan species.

Genus *Bulgarialeurodes* Corbett 1936

8. *Bulgarialeurodes cotesii* (Maskell) 1895

Material examined: Semnan province: Semnan, 1163 m, 35°20'N 53°20'E, on *Rosa canina* (Rosaceae), 4 specimens, 12. IV. 2010; Khorasan province: Mashhad, 1182 m, 36°17'N 59°40'E, on *Rosa canina* (Rosaceae), 7 specimens, 6 VIII. 2009.

General distribution: Afghanistan, Bulgaria, Iran, Pakistan, Romania, Turkmenistan, Russia and adjacent countries, former Yugoslavia.

Genus *Dialeurodes* Cockerell 1902

9. *Dialeurodes citri* (Ashmead) 1885

Material examined: Khorasan province: Kashmar, 1060 m, 35°26'N 58°29'E, on *Punica granatum* (Punicaceae), 2 specimens, 11. VI. 2011.

General distribution: Afghanistan, China, Cuba, Dominican Republic, El Salvador, France, Greece, Guam, Haiti, Hawaii, Honduras, Hong Kong, India, Iran, Italy, Japan, Korea, Macau, Mexico, Pakistan, Panama, Philippines, Portugal, Puerto Rico, Taiwan, Thailand, Turkey, USA.

Genus *Dialeurolonga* Dozier 1928

10. *Dialeurolonga maculata* (Singh) 1931

Material examined: Khorasan province: Mashhad, 1182 m, 36°17'N 59°40'E, on *Ficus religiosa* (Moraceae), 1 specimen, 14. VI. 2011.

General distribution: India, Iran, Pakistan.

Genus *Neomaskellia* Quaintance and Baker 1913

11. *Neomaskellia bergii* (Signoret) 1868

Material examined: Semnan province: Semnan, 1163 m, 35°20'N 53°20'E, on *Sorghum halepense* (Poaceae), 2 specimens, 2. III. 2008.

General distribution: Australia, Caroline Islands, Central African Republic, Congo, Fiji, Gambia, India, Iran, Japan, Java, Mauritius, New Zealand, Senegal, Sierra Leon, South Africa, Sudan, Taiwan, Tanzania, Thailand, Uganda, Zaire.

Genus *Ramsesseus* Zahradnik 1970

12. *Ramsesseus follioti* Zahradnik 1970

Material examined: Khorasan province: Sabzevar, 1023 m, 36°12'N 57°35'E, on *Acacia* sp. (Fabaceae), 1 specimen, 2. X. 2011.

General distribution: Egypt, Iran, Iraq.

Genus *Siphoninus* Silvestri 1915

13. *Siphoninus phillyreae* (Haliday) 1835

Material examined: Semnan province: Garmsar, 850 m, 35°00'N 52°20'E, on *Punica granatum* (Punicaceae), 3 specimens, 29. III. 2010; Khorasan province: Bojnord, 1070 m, 37°35'N 57°20'E, on *Fraxinus excelsior* (Oleaceae), 4 specimens, 14. VI. 2012.

General distribution: Australia, Bulgaria, Cameroon, Corsica, Cyprus, England, Egypt, Eritrea, Ethiopia, Finland, France, Germany, Greece, Hungary, Iran, Ireland, Israel, Italy, Java, Jordan, Mexico, Peru, Spain, Sudan, Syria, Taiwan, USA, Russia and adjacent countries, former Yugoslavia, Venezuela, Zaire.

Genus *Trialeurodes* Cockerell 1902

14. *Trialeurodes packardi* (Morrill) 1903

Material examined: Semnan province: Shahmirzad, 1944 m, 35°46'N 53°19'E, on *Juglans regia* (Juglandaceae), 2 specimens, 4. IV. 2010.

General distribution: Canada, Hungary, Iran, Korea, USA.

15. *Trialeurodes ricini* (Misra) 1924

Material examined: Semnan province: Semnan, 1163 m, 35°20'N 53°20'E, on *Ricinus communis* (Euphorbiaceae), 4 specimens, 5. X. 2009; Khorasan province: Kashmar, 1060 m, 35°26'N 58°29'E, on *Gossypium hirsutum* (Malvaceae), 2 specimens, 11. VII. 2011.

General distribution: Cameroon, Chad, Gabon, India, Iran, Israel, Ivory Coast, Madagascar, Malaya, Malaysia, Nigeria, Pakistan, Saudi Arabia, Sierra Leon, Sri Lanka, Sudan, Thailand, Turkey, Uganda, Zaire, Zimbabwe.

16. *Trialeurodes vaporariorum* (Westwood) 1856

Material examined: Semnan province: Shahmirzad, 1944 m, 35°46'N 53°19'E, on *Verbena officinalis* (Verbenaceae), 3 specimens, 7. VI. 2010.; Shahrood, 1312 m, 35°30'N 55°30'E, on *Amaranthus blitoides* (Amaranthaceae), 2 specimens, 10. IV. 2010.; Garmsar, 848 m, 35°00'N 52°20'E, on *Malva montana* (Malvaceae), 4 specimens, 8. III. 2010; Khorasan province: Mashhad, 991 m, 36°17'N 59°40'E, on *Lavandula vera* (Labiatae), 2 specimens, 14. VI. 2011.; Neyshabour, 1211 m, 36°12'N 58°45'E, on *Sonchus oleraceus* (Asteraceae), 7 specimens, 16. IX. 2011.; Quchan, 1273 m, 37°09'N 58°34'E, on *Chenopodium album* (Chenopodiaceae), 1 specimen, 18. IX. 2011.

General distribution: Cosmopolitan species.

Discussion

In this research, among the 16 species, 5 species were collected just from Semnan province, 6 species just from Khorasan province, and 5 species from the both provinces (Figs. 1 and 2). Although Semnan and Khorasan provinces are nearly dry regions, a rather diverse fauna of whitefly were collected. Among the different sampled regions, Jangal-e Abr in Shahrood contains more diverse flora and consequently diverse whitefly species. Future sampling surveys of the area may result to new findings on this taxon.

During the investigation 17 plant families were identified as host plants of whiteflies. Plant species from Malvaceae family were common host of several whitefly species which were recorded in five different sampling sites in both provinces.

As we predicted, two species, *B. tabaci* and *T. vaporariorum* are more common than the others and well distributed in all of the natural habitats of the sampled regions. Both of them are serious pests especially in vegetables and ornamental crops (Mound and Halsey, 1978; Brown and Bird, 1992; van Lenteren and Martin, 2000), and vectors of over than 60 plant viruses in the genera Geminivirus, Clostevirus, Nepovirus, Carlarvirus, Potyvirus and a rod-shaped DNA virus (Fauquet and Fargette, 1990; Markham et al., 1994; Alegbejo and Banwo, 2005). In Iran, *B. tabaci* and *B. argentifolii* Bellows and Perring (Ghahari et al., 2008) are serious and occasionally destructive pests in cotton fields, while *T. vaporariorum* is an economic pest of ornamental plants in most greenhouses (Ghahari et al., 2007a, b).

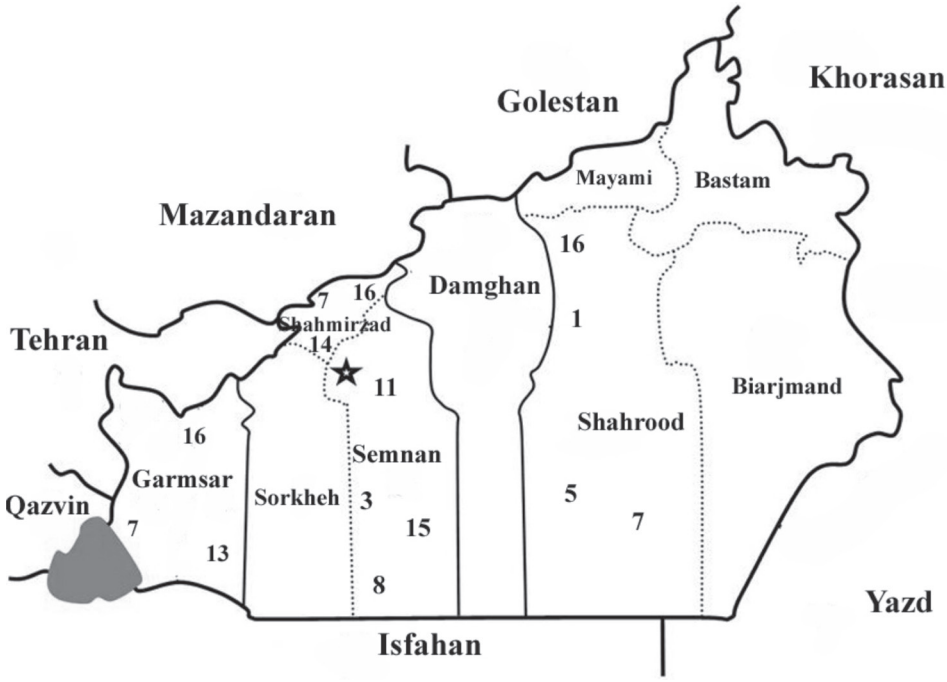

Fig. 1. Semnan province with distribution data of Aleyrodidae

Fig. 2. Khorasan province with distribution data of Aleyrodidae

The results indicate that Semnan and Khorasan provinces can be characterized with a diverse whitefly fauna. Despite the limited sampling sites which includes only natural habitats future survey of various agricultural fields of this regions could give interesting findings.

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