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Aphidophagous syrphids and coccinellids in colonies of aphids on ornamental shrubs in Mashhad, Northeast of Iran

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Abstract

The decorative character of shrubs is significantly lowered by phytophagous insects. Among the most injurious ones are aphids, due to their big populations and the kind of damage they do. The damage caused by aphids may lead to deterioration of the ornamental qualities of infested plants and sometimes even death. Injurious aphids and their predators associated with ornamental shrubs in urban green spaces of Mashhad were investigated for the first time in the years 2014-2015. As a result, 10 species of aphids and 27 predatory insects including 15 coccinellids and 12 syrphids on 16 ornamental shrub species is introduced. Among the aphids, *Appendiseta robiniae* (Gillette, 1907) is a new record for fauna of Iran. Also, two coccinellids, namely *Nephus nigricans* (Weise, 1879), and *Psyllobora bisoctonotata* (Mulsant, 1850), and the two syrphids *Paragus radjabii* Gilasian & Sorokina, 2011 and *Paragus* sp. are reported for the first time from the study area. Information regarding aphid species of each host plant and diversity of their associated predators along with some ecological data is given.

Key words: Aphidophagous, Aphids, Coccinellids, Ornamental plants, Syrphids.

Zusammenfassung

Die Schönheit von Sträuchern wird durch pflanzenfressende Insekten sichtbar beeinträchtigt. Zu den gefürchtetsten Schädlingen gehören Blattläuse, ihrer großen Anzahl und der Art des Schadens halber, den sie hervorrufen und der bis zum Absterben der Pflanze führen kann. Blattläuse und ihre Fressfeinde wurden in öffentlichen Grünflächen in Mashhad erstmals in den Jahren 2014-2015 untersucht. 10 Arten von Blattläusen wurden dokumentiert, sowie 27 Arten von Fressfeinden (15 Marienkäferarten und 12 Schwebfliegenarten auf 16 verschiedenen Arten von Wirtspflanzen). Unter den Blattläusen taucht *Appendiseta robiniae* (Gillette, 1907) erstmals in der Fauna des Iran auf. Auch zwei Marienkäfer, namentlich *Nephus nigricans* (Weise, 1879) und *Psyllobora bisoctonotata* (Mulsant, 1850), sowie die beiden Schwebfliegen *Paragus radjabii* Gilasian & Sorokina, 2011 und *Paragus* sp. wurden erstmals im Untersuchungsgebiet dokumentiert. Beschrieben wird, welche Arten von Blattläusen mit den entsprechenden Fressfeinden auf welchen Wirtspflanzen unter welchen ökologischen Bedingungen vorkommen.

Introduction

Ornamental shrubs, which are an element of urban green areas, perform a number of important functions in man's surroundings. They are not only the "green lungs" of urbanised areas, but they also contribute to the satisfaction of the inhabitants aesthetic needs (Jaśkiewic 2000). In the city areas of parks, gardens, squares and housing estates the shrubs due to their colour accents introduce a lot of beauty and harmony to the surrounding landscape, also in winter (Jaśkiewicz 2003).

Worse ecological conditions in city agglomerations make the plants weaker, increasing their susceptibility to pests and disease. The pollution of the urban environment with industrial and transportation emissions has a negative effect on the condition of plants (Majdecki 1988). Their susceptibility to injuries caused by the feeding of numerous pests, especially those with a stinging-sucking apparatus, is increasing. Aphids are the most dangerous among the insects feeding on plant sap, and they constitute a group of most dangerous insects. In urbanised conditions a pest is not only the species causing measurable economic losses, but also lowering the ornamental values of shrubs. Aphid colonies inhabit leaves on the top parts of shoots, stalks and flowers, and their feeding results in hampering the shoot growth. The attacked leaves are twisted and deformed, flowers are deformed and whole shrubs are covered with honeydew on which sooty mould develops, limiting the assimilation area (Wojciechowicz-Żytko & Jankowska 2011). Containerized contaminated plants may easily become disseminators of harmful insects when they are transported by people to regions or countries far from their place of origin or production (Peronti et al. 2002).

The arguments against chemical pesticides are that they not only kill the pest organism, but also many non-target species, including natural enemy species, which in turn, may increase the pest status of species that were previously unimportant or easy to control. Furthermore, chemical control is limited to the area within which the pesticide is applied, frequent application may be required, and this selects for pest resistance (Bale et al. 2008).

Biological control's importance often becomes apparent when broad-spectrum, residual pesticides cause secondary pest outbreaks or pest resurgence (Dreistadt 2014).

Aphids are quite defenseless and there are numerous insects that feed on them. The best known of these natural enemies are larvae of lady beetles, green lacewings and flower flies. The other group of aphid predators include generalist insects and Araneae. The natural control of aphids can be viewed as the result of a combined action of generalist predators and more or less specialized aphidophagous predators. Because the generalists can subsist and reproduce on prey other than the aphids, they are present in the fields and may exert their influence at the time the aphids first arrive there, i.e. before the aphids have multiplied to create an outbreak (Toft 2005). Specialist aphid predators on the other hand, depend on aphids for reproduction. They invade the fields only if the aphid populations have reached a sufficient level to induce egg laying. In this situation they may multiply quickly and sometimes be able to graze down an existing aphid outbreak. The two predator groups thus play very different roles in aphid control and exert their effect in different phases of the aphid population cycle: the generalists may work as a preventive force against a prospective outbreak, whereas the specialists may suppress an ongoing outbreak (Toft 2005).

Up to now 4700 aphid species are known worldwide, mainly distributed in temperate regions. Among theme, 1758 species belonging to 270 genera are tree-dwelling aphids, spending all or part of their life cycles on woody hosts (Güçlü et al. 2015*)*. According to Mortazavi et al. (2015), the Iranian aphid fauna has at least 485 species which only 140 species have been found on ornamental plants throughout the country (Rezwani 2004).

Despite the economic importance of aphids on ornamental plants in Iran, the knowledge on the species diversity of aphids is far from enough. Many plants in different parts of the country have not been explored in this regard. The situation on aphid predators especially on ornamental plants is even worse. In a recent survey of aphids in Mashhad region 27 aphid species belonging to 13 genera were identified (Mortazavi et al. 2015). Regarding aphid predators in the study area, 23 species of lady birds (Ebrahimi 2013) and 30 syrphid species (Hosseini & Sadeghi 2009; Farahi 2009; Kayvanfar 2002; Sadeghi Namaghi 2002) have been recorded so far. To improve the knowledge on aphid species and their predators associated with ornamental and shaded plants in green spaces in Northeastern part of Iran and to provide a base for further studies on interactions between aphids and their natural enemies, the present study was conducted in green spaces of Mashhad city in Razavi Khorasan province, NE Iran.

Material and Methods

Sampling of aphids and their predators occurring on ornamental shrubs were carried out in urban and suburban parks, administrative green lands and street margins and boulevards of Mashhad, Razavi Khorasan province, in the years 2014-2015. The survey was carried out on a variety of ornamental plants including *Euonymus japonicus* Thunb. (Celastraceae); *Hibiscus syriacus* L. (Malvaceae); *Pyracantha coccinea* M. Roem. (Rosaceae); *Chaenomeles japonica* (Thunb.) Lindl. ex Spach (Rosaceae); *Cytisus scoparius* (L.) Link (Fabaceae); *Cotoneaster horizontalis* Decne. (Rosaceae); *Caesalpinia gilliesii* (Wallich ex Hook.) Wallich ex D. Dietr. (Fabaceae); *Euonymus microphylla* Thunb. (Malvaceae); *Wistaria sinensis* (Sims) DC. (Fabaceae); *Viburnum opulus* L. (Adoxaceae); *Nerium*

oleander L. (Apocynaceae); *Rosa damascene* Mill. (Rosaceae); *Vitex agnus-castus* L. (Verbenaceae); *Spirae acantoniensis* Lour (Rosaceae); *Campsis grandiflora* (Thunb.) K. Schum. (Bignoniaceae); *Berberis thunbergii* DC. (Berberidaceae). To do that, from April until November, host plants in green spaces of the study area were visited at least once a week and sampled for aphids and their attendant predators. Sampling was mostly done by visual inspection of plants. Aphids and their predators were removed from their host plants by using a soft brush and forceps. Collected materials were preserved in ethanol (75%) in small glass vials, labeled and transferred to the laboratory for processing and identification. The collected larvae of syrphids and coccinellids were reared in Petri dishes until they pupated and emerged as adult. Microscopic slides of aphid specimens were prepared following Blackman & Eastop (2000). Primary identification of most specimens was done according to Blackman & Eastop (2000; 2006) and available identification keys for Iranian aphids (Rezvani 2004; 2010). Final identification and confirmation of aphid species were done by Dr. Lukasz Depa (University of Silesia in Katowice, Poland), coccinellid specimens were identified by Dr. Oldrich Nedved from (University of South Bohemia, Czech Republic), and syrphid specimens by Dr. Hussein Sadeghi Namaghi (Ferdowsi University of Mashhad, Iran) and Ante Vujic (Novi Sad, Serbia).

Voucher specimens of aphids and of predators are held at the collection of Department of Plant Protection, Ferdowsi University of Mashhad, Iran. Also, specimens of species belonging to the genus paragus are deposited at Novi Sad University, Serbia.

Results

10 aphid species of three subfamilies and 27 specialized aphidophagous insects including 15 species of Coccinellidae and 12 species of Syrphidae were collected and identified on 16 ornamental shrubs in the study area. Information regarding host plant species of aphids and species diversity of their predators along with some ecological data is given.

List of species

A – Aphids (Aphidoidea: Hemiptera)

Hemiptera: Aphidinae

***Acyrthosiphon gossypii* Mordvilko, 1914**

Material examined: Specimens of this aphid were collected from *Rosa damascene* (at the campus of Ferdowsi University of Mashhad on 23.5.2014 & 30.4. 2014.)

Worldwide host plants: Mainly Leguminosae/Fabaceae especially tribe *Phaseoleae* (*Dolochos*, *Phaseolus*, *Vigna*, but not known from *Glycine*), Malvaceae (including cotton) and Zygophyllaceae; more rarely on other plants including Brassicaceae. Trees recorded from include *Hibiscus esculentus*, *Robinia pseudoacacia* and *Sophora japonica* (Blackman & Eastop, 2016).

General distribution: Southern Europe, North Africa, Middle East, south-

west and central Asia, India, China, and possibly Korea and Japan (Blackman & Eastop, 2016).

Diagnostic features: Green in life, adults as well as immatures dusted with fine wax (unlike *A. pisum*, in which adult apterae have no wax bloom); BL of apterae 2.5-3.8 mm, alatae 2.1- 3.5 mm (Blackman & Eastop 2000, 2016) (Fig 1- A).

Aphis craccivora (Koch, 1854)

Material examined: Specimens of this aphid were collected from *Cytisus scoparius* (in Koohsangi park of Mashhad; 15.6.2014, 27.6.014, 10.10.2014, 18.4.2015), *Wistaria sinensis* (in koohsangi park of Mashhad & Mellat Park of Mashhad; 25.4.2015, 30.3.2015) and *Caesalpinia gilliesii* (in Torghabeh on 3.8.2014).

Worldwide host plants: This aphid colonizing young growth of numerous plants, particularly Leguminosae/Fabaceae; plants in other families tend to be colonized more in the dry season. A major pest of leguminous crops (Blackman & Eastop 2000).

General distribution: Worldwide in distribution, but particularly common in warm temperate and tropical regions (Favret & Miller 2012).

Diagnostic features: The live parthenogenetic apterous females are black with a characteristic metallic shine, due to an extensive sclerotized patch on the dorsal abdomen, best seen in microscopic preparations. Parthenogenetic alatae females lack that patch, but several transversal stripes are evident on the abdomen in microscopic preparations, as is the stripe between the bases of the siphunculi. The cauda usually bears 7 setae (Vacante and Gerson 2012) (Fig 1- B).

Aphis fabae Scopoli, 1763

Material examined: Specimens of this aphid were collected from *Euonymus japonicus* (in Mellat Park of Mashhad & campus of Ferdowsi University of Mashhad; 20.5.2014, 5.6.2014), *Chaenomeles japonica* (in Garden oF University & Vakil Abad Boulevard; 25.7.2014, 7.7.2014, 19.4.2015, 2.5.2015), *Cotoneaster horizontalis* (in Mellat Park of Mashhad & Vakil Abad Boulevard; 18.5.2015, 26.4.2015) and *Viburnum opulus* (at campus of Ferdowsi University of Mashhad on 5.5.2014, 28.5.2015).

Worldwide host plants: It has one of the broadest host ranges, having been recorded from nearly 120 plant families (Favret & Miller 2012). Curling leaves of *Euonymus europaeus* in spring (also *Philadelphus coronarius* and/or *Viburnum opulus*, depending on subspecies), and migrating to a wide range of secondary hosts, including young growth of some trees, and many crops (Blackman & Eastop, 2016).

General distribution: Worldwide, found commonly in temperate regions of the northern hemisphere and in cooler regions of South America, Africa, and the Middle East (Favret & Miller 2012).

Diagnostic features: A black or very dark brown species with a variable abdominal sclerotic pattern confined to abdominal tergites 6-8 in smaller apterae but broken bands present in larger ones. The siphunculi and cauda are dark. The longest femoral and tibial hairs are longer than the least width of tibiae. Apterae often, and

immatures very often, have discrete white wax spots (Dransfield & Brightwell 2016) (Fig 1-C).

Aphis gossypii Glover, 1877

Material examined: Specimens of this aphid were collected from *Hibiscus syriacus* (at campus of Ferdowsi University of Mashhad & Mellat Park of Mashhad; 24.5.2014, 15.6.2014, 1.10.2014, 27.4.2015,), *Cytisus scoparius* (in Koohsangi park of Mashhad; 15.6.2014, 10.10.2014, 18.4.2015), *Euonymus microphylla* (at campus of Ferdowsi University of Mashhad; 2.4.2015, 1.5.2015), *Spiraea cantoniensis* (in Garden of University & Shandiz city of Mashhad; 19.4.2014, 16.5. 2015) and *Wistaria sinensis* (in koohsangi park of Mashhad & Mellat Park of Mashhad; 25.4.2015, 30.3.2015).

Worldwide host plants: The species has a broad host range and can damage various crops, including those in Cucurbitaceae, Malvaceae, Solanaceae, and Rutaceae as well as some ornamental plants such as chrysanthemum. Their primary hosts are typically woody plants, including hibiscus, where they migrate and conduct sexual reproduction during autumn; and the secondary hosts are usually herbaceous plants (Wang et al. 2016).

Distributions: worldwide, and particularly abundant and well-distributed in the tropics, including many Pacific islands.

Diagnostic features: Apterae are very variable in colour. Large specimens are dark green, almost black, but the adults produced in crowded colonies at high temperature may be less than 1 mm long and very pale yellow to almost white. Most commonly light green mottled with darker green. Often ant-attended (Blackman & Eastop 2000) (Fig 1-D).

Aphis nasturtii Kaltenbach, 1843

Material examined: Specimens of this aphid were collected from *Tecoma grandiflora* (in green space of Ferdowsi University of Mashhad on 4.8.2014).

Worldwide host plants: It is particularly important on species of *Helianthus*, including sunflower, and lettuce (Asteraceae), watercress (Brassicaceae), parseley (Apiaceae), potato (Solanaceae), beets (Polygonaceae) and buckthorn (Rhamnaceae) but also attacks many other plant families (Favret & Miller 2012).

General distribution: Now almost worldwide, but not yet in Australasia (Blackman & Eastop 2016).

Diagnostic features: Aptera is rather bright pale green to yellowish green in life and is not wax-powdered. The abdominal dorsum is membranous without dark bands or sclerites. The antenna barely exceed half the body length. The siphunculi are usually rather pale sclerotic becoming a little darker towards the apex. Alates have some variably developed dorsal bands (Dransfield & Brightwell 2016) (Fig 1- E).

***Aphis nerii* Boyer de Fonscolombe, 1841**

Material examined: Specimens of this aphid were collected from *Nerium oleander* (in Vakil Abad Boulevard; 23.5.2014, 15.7.2014, 4.9. 2014).

Worldwide host plants: It comes from the Mediterranean region, where it is present on plants of the Asclepiadaceae and Apocynaceae family, but mainly on *Nerium oleander*. Occasionally, it settles plants of other families, such as Euphorbiaceae, Asteraceae, Convolvulaceae (Łabanowski, 2008).

General distribution: worldwide especially in tropical and subtropical regions.

Diagnostic features: Apterae are bright lemon yellow with dark antennae and legs, and black siphunculi and cauda; BL 1.5-2.6 mm. Alatae have dark wing veins. Often forming dense colonies on younger stems of host plants. Apterae and alatae both 1.5-2.6 mm (Blackman & Eastop 2000, 2016) (Fig 1-F).

***Aphis solanella* Theobald, 1914**

Material examined: Specimens of this aphid were collected from *Cotoneaster horizontalis* (in Vakil Abad Boulevard & Mellat Park of Mashhad; 18.5.2015, 26.4.2015).

Worldwide host plants: It has a broad host range, having been recorded from species of over 45 plant families (Favret & Miller 2012).

General distribution: In Europe, and with a more extensive distribution than *A. fabae* in Asia, Africa and South America (Blackman & Eastop, 2016).

Diagnostic features: Apterae are dull black, sometimes with white wax markings; BL 1.2-2.6 mm. Alatae have secondary rhinaria distributed III 9-22, IV 0-7, V 0-1 (Blackman & Eastop 2016) (Fig 1-G).

***Aphis spiraecola* Patch, 1914**

Material examined: Specimens of this aphid were collected from *Chaenomeles japonica* (in Garden of University & Vakil Abad Boulevard; 25.7.2014, 19.4.2015, 2.5.2015), *Cotoneaster horizontalis* (in Mellat Park of Mashhad & Vakil Abad Boulevard; 18.5.2015, 26.4.2015) and *Pyracantha coccinea* (in Koohsangi park of Mashhad & Mellat Park of Mashhad; 29.4.2014, 23.7.2014, 3.9.2014).

Host plants: It has a broad host range, having been recorded from species of over 90 plant families (Favret & Miller 2012).

General distribution: worldwide (Blackman & Eastop 2016).

Diagnostic features: Apterae are bright greenish yellow to apple green with brown head and black siphunculi and cauda; BL 1.2-2.2 mm. Alatae have secondary rhinaria distributed III 6-11, IV 0-5 (Blackman & Eastop 2016) (Fig 1-H).

Diagnostic features: wingless virginoparae antennae reaching the middle part of their body or slightly longer; abdomen with no sclerites; siphunculi and cauda dark with 5-6 pairs of hair; winged virginoparae abdomen with marginal sclerites on tergites II-IV, on tergite VIII there is a narrow transverse sclerite; cauda finger-like, narrow at the base with 4-6 pairs of hairs (Miller & Stoetzel 1997).

Hemiptera: Calaphidinae

***Appendiseta robiniae* (Gillette, 1907)**

Material examined: Specimens of this aphid were collected from *Vitex agnus-castus* (in green space of Ferdowsi University of Mashhad; 20.6.2015).

This species is new for Iran.

Worldwide host plants: This is the single species of the genus *Appendiseta* which found on undersides of leaves of *Robinia pseudacacia* and *R. neomexicana*, and also has been recorded from *Sophora japonica* (Forbes & Chan 1989).

General distribution: Widespread in North America, and introduced into Chile and Argentina (Pagnone et al. 1993), Europe (England, Netherlands, Germany, Poland, Hungary, Italy, Spain, Switzerland) and the Middle East (Jordan) (Blackman & Eastop 2016).

Diagnostic features: Viviparae all alate, pale yellow-green with spinopleural and marginal longitudinal rows of pale powdery spots; BL 1.6-1.9 mm (Blackman & Eastop 2016) (Fig 1-I).

Hemiptera: Aphidinae

***Macrosiphum euphorbiae* Thomas, 1878**

Material examined: Specimens of this aphid were collected from *Chaenomeles japonica* (in Garden of University & Vakil Abad Boulevard; 25.7.2014, 19.4.2015, 2.5.2015) and *Euonymus japonicus* (in green space of Ferdowsi University of Mashhad; 20.5.2015).

Host plants: This aphid a common and highly polyphagous species and is a vector of about one hundred plant viruses (Dransfield & Brightwell 2016).

General distribution: Worldwide (Blackman & Eastop 2016).

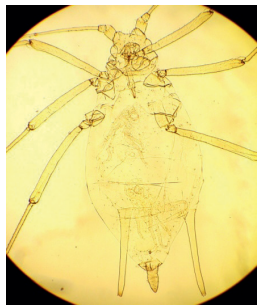
Diagnostic features: Apterae are broadly spindle-shaped, usually green, sometimes yellowish, pink or magenta, with red eyes, and femora and siphunculi pale or only slightly darker towards apices; BL 1.7-3.6 mm. Alatae are rather pale, with a pale greenish to yellow-brown thorax, only the antennae and siphunculi noticeably darker than in apterae, and have 12-21 secondary rhinaria on ANT III (Dransfield & Brightwell 2016) (Fig 1-J).

Hemiptera: Aphidinae

***Metopolophium* sp.**

Material examined: Specimens of this aphid were collected from *Berberis thunbergii* (in Garden of University, Mellat Park of Mashhad, Koohsangi park of Mashhad and Torghabeh; 9.5.2014, 15.6.2014, 5.9.2014, 30.1.2014)

Fig. 1



A

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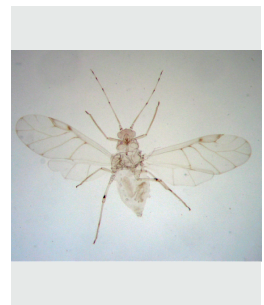


I

J

A: *Acyrthosiphon gossypii*, **B:** *Aphis craccivora*, **C:** *Aphis fabae*, **D:** *Aphis gossypii*, **E:** *Aphis nasturtii*, **F:** *Aphis nerii*, **G:** *Aphis solanella*, **H:** *Aphis spiraecola*, **I:** *Appendiseta robiniae* (Borowiak-Sobkowiak et al. 2008), **J:** *Macrosiphum euphorbia*

(A-H & J: Orginal photographs)

B - Aphid predators

1) Coccinellidae (Coleoptera)

***Adalia bipunctata* (Linnaeus, 1758)**

Specimens of this predator were found at colonies of *Aphis gossypii* on *Hibiscus syriacus* (6 specimens; 29.4.2014, 17.4.015) and *Aphis spiraecola*, *Macrosiphum euphorbiae* and *Aphis fabae* on *Chaenomeles japonica* (3 specimens; 2.6.2015) (Fig. 2-A)

***Clitostethus arcuatus* (Rossi, 1794)**

Specimens were found at colonies of *Aphis fabae*, *Aphis spiraecola* and *Macrosiphum euphorbiae* on *Chaenomeles japonica* (20 specimens; 25.4.2015, 8.5.2015, 2.6.2015) and *Aphis gossypii* on *Hibiscus syriacus* (4 specimens; May 9.5.2015) (Fig. 2-B).

***Chilochorus bipustulatus* (Linnaeus, 1758)**

Specimens were found at colonies of *Aphis gossypii* and *Aphis craccivora* on *Cytisus scoparius* (2 specimens; 29.4.2014, 10.6.2015) and *Aphis fabae* on *Euonymus japonicus* (1 specimen; 5.5.2015) (Fig. 2-C).

***Coccinella septempunctata* (Linnaeus, 1758)**

Specimens of different stages of this coccinellid were found at almost all aphids on all studied host plants (Fig. 2-D).

***Coccinella undecimpunctata* (Linnaeus, 1758)**

One specimen of this species was found at a colony of *Aphis spiraecola* on *Pyracantha coccinea* on 6.5.2015 (Fig. 2-E).

***Hippodamia variegata* (Goeze, 1777)**

Adult and larval specimens of this species were collected frequently from all aphid species on all host plants studied (Fig. 2-F).

***Nephus nigricans* (Weise, 1879)**

One specimen of this species was found at a colony of *Aphis gossypii* on *Euonymus japonicus* on 10.10.2014 (Fig. 2-G).

This species is new record for Razavi khorasan province.

***Oenopia oncina* (Olivier, 1808)**

Two specimens of this coccinellid were found at colonies of *Aphis gossypii* and *Aphis craccivora* on *Cytisus scoparius* on 27.6.2014 (Fig. 2-H).

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

Adult and larval specimens of this species were collected frequently from almost all aphid species on all host plants studied (Fig. 2-I).

***Parexochomus nigromaculatus* (Goeze, 1777)**

Specimens were found at colonies of *Aphis gossypii* and *Aphis craccivora* on *Cytisus scoparius* (2 specimens; 5.9.2014), *Aphis gossypii* on *Euonymus microphylla* (1 specimen; 30.3.2015), *Aphis craccivora* on *Caesalpinia gilliesii* (2 specimens; 26.8.2014), *Aphis nerii* on *Nerium oleander* (11 specimens; 21.9.2014, 1.8.2014) and *Aphis spiraecola* on *Pyracantha coccinea* (5 specimens; 13.9.2014) (Fig. 2-J).

***Propylea quatuordecimpunctata* (Linnaeus, 1758)**

One specimen was found at a mixed colony of *Aphis gossypii* and *Aphis craccivora* on *Cytisus scoparius* on 11.6.2015 (Fig. 2-K).

***Psyllobora bisoctonotata* (Mulsant, 1850)**

Specimens were found at colonies of *Metopolophium* sp. on *Berberis thunbergii* (2 specimens; 6.6.2014) and *Aphis spiraecola* on *Pyracantha coccinea* (1 specimen; 3.5.2015) (Fig. 2-L).

This species is new record for Razavi khorasan province.

***Scymnus frontalis* (Fabricius, 1787)**

Specimens were found at colonies of *Aphis fabae* on *Euonymus japonicus* (3 specimens; 27.5.2014) and *Aphis gossypii* on *Hibiscus syriacus* (3 specimens; 29.6.2014) (Fig. 2-M).

***Scymnus syriacus* (Marseul, 1868)**

Specimens were found at colonies of *Aphis gossypii* and *Aphis craccivora* on *Cytisus scoparius* (3 specimens; 1.8.2014), *Macrosiphum euphorbiae* and *Aphis fabae* on *Euonymus japonicus* (2 specimens; 28.4.2014), *Aphis gossypii* on *Hibiscussyriacus* (4 specimens; 15.5.2014, 21.6.2015), *Aphis spiraecola* on *Pyracantha coccinea* (1 specimen; 11.7.2014) and *Metopolophium* sp. on *Berberis thunbergii* (2 specimens; 29.8.2014) (Fig. 2-N).

***Stethorus gilvifrons* (Mulsant, 1850)**

Specimens were found at colonies of *Aphis spiraecola*, *Macrosiphum euphorbiae* and *Aphis fabae* on *Chaenomeles japonica* (2 specimens; 2.5. 2015) (Fig. 2-O).

Fig. 2

A: *Adalia bipunctata*, **B:** *Clitostethus arcuatus*, **C:** *Chilochorus bipustulatus*, **D:** *Coccinella septempunctata*, **E:** *Coccinella undecimpunctata*, **F:** *Hippodamia variegata*, **G:** *Nephus nigricans*, **H:** *Oenopia conglobata*, **I:** *Oenopia oncina*, **J:** *Parexochomus nigromaculatus*, **K:** *Propylea quatuordecimpunctata*, **L:** *Psyllobora bisoctonotata*, **M:** *Scymnus frontalis*, **N:** *Scymnus syriacus*, **O:** *Stethorus gilvifrons* (Orginal photographs).

2) Syrphidae (Diptera)

***Episyrphus balteatus* (De Geer, 1776)**

Collected materials: 2 females reared from larvae found on 10 May 2015 in colonies of *Aphis gossypii* on *Hibiscus syriacus*; 2 females and 1 male reared from larvae found on 29 May 2015 in colonies of *Aphis craccivora* and *Aphis gossypii* on *Cytisus scoparius* (Fig. 3-A).

***Eupeodes corollae* (Fabricius, 1794)**

Collected materials: 1 male reared from larvae found on 2 October 2014 in a colony of *Aphis gossypii* on *Hibiscus syriacus* (Fig. 3-B).

***Eupeodes luniger* (Meigen, 1822)**

Collected materials: 4 males and 3 females reared from larvae found on 2 October 2014 and 30 April 2015 in colonies of *Aphis gossypii* on *Hibiscus syriacus*; 2 males reared from larvae found on 16 May 2015 in colonies of *Aphis craccivora* and *Aphis gossypii* on *Cytisus scoparius* (Fig. 3-C).

***Ischiodon aegyptius* (Wiedemann, 1830)**

Collected materials: 1 male reared from larvae found on 19 May 2014 in a colony of *Aphis fabae* on *Euonymus japonicus*; 2 females and 1 male reared from larvae found on 6 June 2014 and 30 April 2015 in colonies of *Aphis fabae*, *Aphis spiraecola* and *Macrosiphum euphorbiae* on *Chaenomeles japonica*; 2 males reared from larvae found on 29 May 2015 in colonies of *Aphis craccivora* and *Aphis gossypii* on *Cytisus scoparius*; 1 male reared from larvae found on 28 June 2014 in a colony of *Metopolophium* sp. on *Berberis thunbergii* (Fig. 3-D).

***Paragus bicolor* Fabricius, 1794**

Collected materials: 2 males reared from larvae found on 2 October 2014 in colonies of *Aphis gossypii* on *Hibiscus syriacus*; 1 male and 1 female reared from larvae found on 10 October 2014 in colonies of *Aphis craccivora* and *Aphis gossypii* on *Cytisus scoparius*; 1 male and 1 female reared from larvae found on 9 September 2014 in colonies of *Aphis nerii* on *Nerium oleander*, 1 female reared from larvae found on 28 June 2014 and 17 June 2014 in a colony of *Metopolophium* sp. on *Berberis thunbergii* (Fig. 3-E).

***Paragus compeditus* Wiedemann, 1830**

Collected materials: 3 females reared from larvae found on 15 June 2014 in colonies of *Metopolophium* sp. on *Berberis thunbergii* DC; 1 female reared from larvae found on 10 May 2015, 5 June 2015 in a mixed colony of *Aphis fabae*, *Aphis spiraecola* and *Macrosiphum euphorbiae* on *Chaenomeles japonica* (Fig 3-F).

***Paragus haemorrhous* Meigen, 1822**

Collected materials: 5 females reared from larvae found on 7 July 2014 and 29 April 2015 in colonies of *Aphis fabae*, *Macrosiphum euphorbiae* and *Aphis spiraecola* on *Chaenomeles japonica*; 2 females reared from larvae found on 8 May 2015 in colonies of *Aphis fabae* on *Euonymus japonicus* (Fig. 3-G).

***Paragus quadrifasciatus* Meigen, 1822**

Collected materials: 2 males reared from larvae found on 8 July 2014 in colonies of *Metopolophium* sp. on *Berberis thunbergii* DC.

***Paragus radjabii* Gilasian & Sorokina, 2011**

Collected materials: 2 males reared from larvae found on 18 June 2015 in colonies of *Aphis craccivora* and *Aphis gossypii* on *Cytisus scoparius* (Fig 3-H).

This species is new record for Razavi khorasan province.

***Paragus* sp**.

Collected materials: Two male specimens of this species which are very similar to *P. radjaii* were reared from larvae found on 2 October 2014 in colonies of *Aphis gossypii* on *Hibiscus syriacus*.

***Scaeva albomaculata* (Macquart, 1842)**

Collected materials: 2 females reared from larvae found on 9 September 2014 in colonies of *Aphis fabae*, *Macrosiphum euphorbiae* and *Aphis spiraecola* on *Chaenomeles japonica*; 1 male and 1 female reared from larvae found on 19 May 2015 in colonies of *Aphis craccivora* and *Aphis gossypii* on *Cytisus scoparius* (Fig. 3-I).

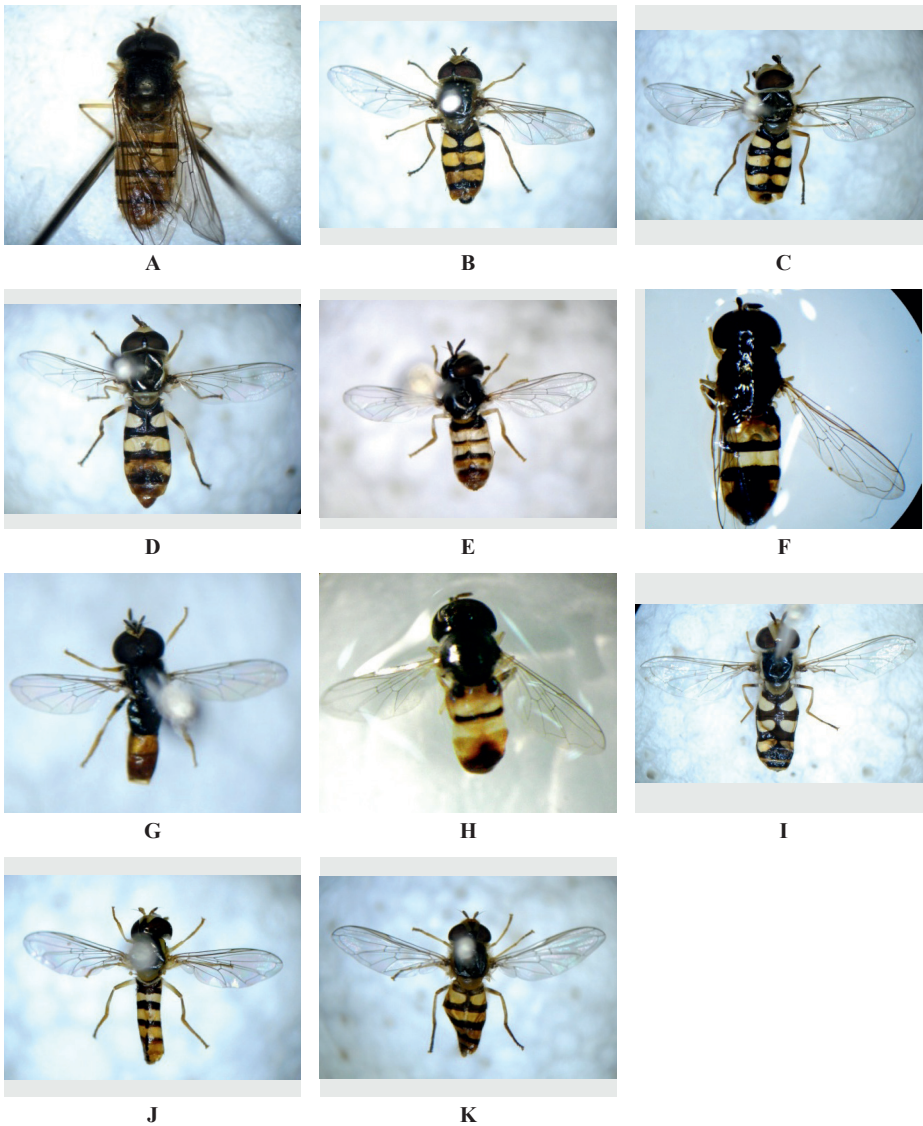
***Sphaerophoria scripta* (Linnaeus, 1758)**

Collected materials: 2 males and 1 female reared from larvae found on 30 April 2015 and 25 May 2015 in colonies of *Aphis craccivora* and *Aphis gossypii* on *Cytisus scoparius*; 2 males and 3 females reared from larvae found on 24 April 2015 and 9 May 2015 in colonies of *Macrosiphum euphorbiae*, *Aphis fabae* and *Aphis spiraecola* on *Chaenomeles japonica* (Fig. 3-J).

***Syrphus ribesii* (Linnaeus, 1758)**

Collected materials: 4 females and 1 male reared from larvae found on 23 April 2014, 30 April 2014 in colonies of *Aphis gossypii* on *Hibiscus syriacus*; 1 male was reared from larvae found on 24 April 2015 in colonies of *Macrosiphum euphorbiae*, *Aphis fabae* and *Aphis spiraecola* on *Chaenomeles japonica* (Fig. 3-K).

Fig. 3



A: *Episyrphus balteatus*, **B:** *Eupeodes corollae*, **C:** *Eupeodes luniger*, **D:***Ischiodon aegyptius*, **E:** *Paragus bicolor*, **F:** *Paragus compeditus:*, **G:** *Paragus haemorrhous*, **H:** *Paragus radjabii*, **I:** *Scaeva albomaculata*, **J***: Sphaerophoria scripta*, **K:** *Syrphus ribesii*

(Orginal photographs).

Discussion

As this is the first study of aphids and their predatory insects associated with ornamental plant in the study area, the results are far from complete and a full understanding of this issue needs further studies. Among the collected and identified aphids, the most common ones were *Aphis gossypii* (on *Hibiscus syriacus*, *Cytisus scoparius*, *Euonymus microphylla*, *Wistaria sinensis*, *Spiraea cantoniensis*), *Aphis fabae* (on *Euonymus japonicus*, *Chaenomeles japonica*, *Cotoneaster horizontalis*, *Viburnum opulus*), and *Aphis craccivora* (on *Cytisus scoparius*, *Caesalpinia gilliesii*, *Wistaria sinensis*). Also it was observed that different species of predators attacked several species of aphids on different host plants. Among the cocconellid specimens, *Coccinella septempunctata*, *Hippodamia variegata* and *Oenopia conglobata* were collected frequently on most aphid species on all host plants studied. 5 out of 12 aphidophagous syrphids were belonged to the genus paragus. Among the paragus species, *P. radjabii* is a new record for fauna of NE Iran. Up to now the total number of species of paragus in Iran reached to 14. Among the collected syrphid species, *Ischiodon aegyptius* and *Paragus bicolor* were reared more frequently. At this study a diverse range of generalist and specialist predators from colonies of aphids on ornamental shrubs were collected and identified, but in this paper, only two groups of them were introduced and others are the subject of the another work. Due to the economic importance of aphids on ornamental plants in Iran and the limited knowledge on this issue, further investigation on the species diversity of aphids and their predator on cultivated and uncultivated plant in many unexplored area is needed.

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