



Research Article

Study of predatory lady beetles fauna (Coleoptera, Coccinellidae) associated with pomegranate orchards on *Aphis punicae* Passerini in the Najafabad region (Isfahan province), Iran

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ABSTRACT: Lady beetles (Coleoptera: Coccinellidae) as a biological control agent are a group of beetles with a considerable diversity and adaptation in different habitats. Among aphids, *Aphis punicae* Passerini (Hemiptera: Aphididae) is one of the most important pests of pomegranate orchards in Iran. This pest reduces plant vigor, facilitates the growth of mold on leaves, and consequently influences crop quality and yield. Study on the fauna of predatory ladybugs associated with pomegranate orchards was conducted that were feeding on *Aphis punicae* in the Najafabad region (Isfahan province, Iran). Twelve species of 8 genera were collected sampled specimens were identified according to their morphological, male and female genitalia characters using identification keys. The identified species were as follow: *Adalia bipunctata* (Linnaeus, 1758), *Coccinella septempunctata* Linnaeus, 1758, *Coccinella undecimpunctata* Linnaeus, 1758, *Exochomus undulates* Weise, 1878, *Hippodamia variegata* (Goeze, 1777), *Hippodamia tredecimpunctata* (Linnaeus, 1758), *Oenopia conglobata* (Linnaeus, 1758), *Oenopia oncina* (Olivier, 1808), *Propylea quatuordecimpunctata* (Linnaeus, 1758), *Psyllobora vigintiduopunctata* (Linnaeus, 1758), *Scymnus syriacus* (Marseul, 1868), *Scymnus mongolicus* (Weise, 1890).

KEY WORDS: *Aphis punicae*, lady beetles, Najafabad, natural enemies, pomegranate

(Article chronicle: Received: 10-01-2016; Revised: 05-02-2016; Accepted: 03-03-2016)

INTRODUCTION

Pomegranate (*Punica granatum* L.), is one of ancient fruit trees. The pomegranate fruit juice makes an excellent drink which contains potassium, phosphorous and calcium as well as micronutrients. The antioxidant, immune-boosting, and anti-carcinogenic properties of the pomegranate offers its multiple potential medical applications (Kaplan *et al.*, 2001). Iran as a center of pomegranate growth possesses more than 800 genotypes which have been collected and maintained in Yazd and Saveh germplasm (Behzadi-Shahrehabaki, 1998).

The pomegranate tree is attacked by several insect species which decrease the quality and quantity of its product. Aphids are among the most serious and widespread pests in pomegranate orchards (Rouhani *et al.*, 2013). This species is well known for its ability to reduce plant vigor,

facilitate the growth of mold on leaves, and consequently reduces crop quality and yield. Both adults and nymphs feed on leaves, inflorescences and fruits (Moawad and Al-Barty, 2011). The species has a high reproductive capacity so extensive use of insecticide to control it results in the development of resistance (Pavela *et al.*, 2009). From the years ago, the association between the predatory behaviors of Coccinellidae with many pests e.g. whitefly, mealy bugs, scales, mites and especially aphids was recognized (Obrycki and Kring, 1998). Knowledge of these useful enemies is necessary for any integrated pest management program on the pests in crops and orchards.

Cultivation of pomegranate in Najafabad region in Isfahan province, Iran has a long history. So, the objective of this study was to investigate the lady beetles fauna on pomegranate trees as the natural enemies of *Aphis punicae* in Najafabad region, western part of Isfahan province.

MATERIAL AND METHODS

The samples of lady beetles were collected from the 3 orchards of pomegranate at different locations (South, west and north) in Najafabad region, Isfahan province, Iran. Each orchard was repeatedly sampled in March to September, 2014. Collecting the adult specimens were carried out with a standard sweeping net and a handheld aspirator. Adult insects collected from various orchards were preserved in 70% ethyl alcohol in bottles. Each bottle was labeled with information of site and date of collection. The morphological characters of each species were carefully studied under stereomicroscope. The lady beetles were identified to the species level with the help of available keys (Gordon, 1985; Gordon, 1990; Fürsch, 1981; Fürsch, 1989). The identified specimens were confirmed by Dr. M. R. Bagheri from Agriculture and Natural Resources Research Center of Isfahan Province, Iran.

RESULTS AND DISCUSSION

Overall, 12 species belonging to eight genera from four tribes and three subfamilies were recorded on the pomegranate trees from Najafabad region in Isfahan province.

Subfamily Coccinellinae

Tribe Coccinellini Latreille, 1807

***Adalia bipunctata* (Linnaeus, 1758):** Length 3.7 to 5.1 mm, width 2.8 to 3.9 mm, dorsal color pattern highly variable genitalia with parameres less than basal lobe; siphon spoon-shaped apically (Gordon 1985). The 2-spotted ladybird *A. bipunctata* occurred abundantly in the sampling locations. Four different separable color pattern morphs of *A. bipunctata* was observed and identified. 1) Pale red, separated 2 eyed black-spotted: The wing case with 2 pale red backgrounds and there is a single eyed black spot in the middle of each elytron. Pronotum white with black spots, a bold black m-mark (Fig. 1-A). 2) Pale red, separated 14 black-spotted: The wing case has the pale red background and there are 7 black spots on each wing case. The first and second black marking is on the down of wing, third, fourth and fifth are in the middle of wing and sixth and seventh are in the top of wing. Pronotum white with black spots, a black m-mark (Fig. 1-A1). 3) White separated 20 black-spotted: The wing case has a white background and there are 10 black spots on each wing case. Pronotum white with

black spots, a black m-mark (Fig. 1-A2). 4) Black separated 4 red-spotted: The wing case has a black background with 2 red spots on each wing case. Legs and underside of the abdomen are black and each elytron has two red markings. The first red marking is at the forward angle and second is central of elytron (Fig. 1-A3).

***Coccinella septempunctata* Linnaeus, 1758:** Length 5.3 to 7.6 mm, width 4 to 5.1 mm (Fig. 1-C), elytra red with 6 black spots in addition to scutellar spot, prosternal keels diverging to the front (Gordon 1985).

***Coccinella undecimpunctata* Linnaeus, 1758:** Length 3.5 to 5 mm, width 3.2 to 4 mm (Fig. 1-B), elytra red with 10 black spots in addition to scutellar spot, pronotum with anterior margin black at middle, ventral pale spot large, prosternal keels parallel to the front (Gordon 1985).

***Hippodamia tredecimpunctata* (Linnaeus, 1758):** Length 3.30 to 3.50 mm, width 3.80 to 4 mm in size with nearly rounded (Fig. 1-F), 11 spots always in two rows approximately parallel to the edge of the elytra (13-spots), the white border at the sides of the pronotum (Gordon 1985).

***Hippodamia variegata* (Goeze, 1777):** Length 4.4 to 5 mm, width 3 to 3.25 mm (Fig. 1-E), color and pattern of the elytra varied, male genitalia with flat trabes, fovea at apex; siphon with membranous process at apex. In the collected samples of this species, elytra were red with 6 black spots in addition to scutellar spot. This predator was the most abundant coccinellid predator in three sites (Iablokoff-khznorian 1982).

***Oenopia conglobata* (Linnaeus, 1758):** Length 3.3 to 4 mm, width 2.4 to 3 mm (Fig. 1-G), male genitalia with triangular siphon at apex. Female genitalia with apically divided basal lobe. Coloration of elytra in this species was pink with 8 black spots (Iablokoff-khznorian, 1982).

***Oenopia oncina* (Olivier, 1808):** Length 3.3 to 4 mm, width 2.4 to 3 mm, male genitalia with flat siphon and long setae at apex, female genitalia with basal lobe not apically divided (Iablokoff-khznorian 1982). Two form of this species was collected. 1) The background of the elytra in most specimens was black with joining yellow spots (Fig. 1-H). 2) The background of the elytra was black with joining yellow spots, two spots are in the middle and down on each wing (Fig. 1-H1).

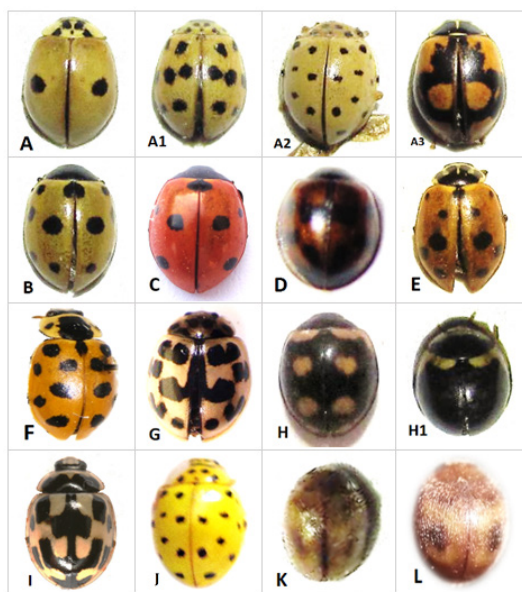


Fig. 1. A, A1, A2 and A3: *Adalia bipunctata* (This species has polymorphism in form); B: *Coccinella undecimpunctata*; C: *Coccinella septempunctata*; D: *Exochomus undulatus*; E: *Hippodamia variegata*; F: *Hippodamia tredecimpunctata*; G: *Oenopia conglobata*; H and H1: *Oenopia oncina* (This species has polymorphism in form); I: *Propylea quatuordecimpunctata*; J: *Psyllobora vigintiduopunctata*; K: *Scymnus mongolicus*; L: *Scymnus syriacus*.

***Propylea quatuordecimpunctata* (Linnaeus, 1758):** Length 3 to 3.5 mm, width 4.6 to 5.2 mm (Fig. 1-I), pale pink elytra (wing covers) with rectangular black spots, elytra usually with 14 black spots, but may be fused together near midline, pronotum (hard shell behind head) black with pale anterior and lateral border (Gordon 1985).

Tribe Psylloborini Casey, 1899

***Psyllobora vigintiduopunctata* (Linnaeus, 1758):** Length 1.75 to 3.0 mm (Fig. 1-J), width 1.40 to 2.35 mm, pronotum with 4 dark spots; elytra usually with 22 spots, spots partially confluent, pattern variable. The background color was yellow; the color of the markings was black (Gordon 1985).

Subfamily Chiolororinae

Tribe Chilcororini Mulsant, 1846

***Exochomus undulatus* Weise, 1878:** Length 3 to 4.2 mm, width 2.4 to 3.6 mm (Fig. 1-D), and elytra black with orange and checkered-shape maculation, spots sometimes joined. Male genitalia with parameres slightly shorter than

basal lobe; siphon membranous at apex. Female genitalia with a long sperm duct, genital plate elongated (Gordon 1985).

Subfamily Scymninae

Tribe Scymnini Weise, 1846

***Scymnus (Pullus) mongolicus* (Weise, 1890):** Length 1.5 to 2.3 mm, width 1 to 1.5 mm (Fig. 1-K), elytra in the middle almost hairless and consecutive which here as polished shiny, pronotum very dense, elytra punctured stronger and less dense, black head, elytra same if bright red, at the seam with a wide black stripe, which extends up behind the center and then suddenly at an acute angle is narrowed; also the side edge in the mid blackish (Fürsch 1989).

***Scymnus (Pullus) syriacus* (Marsuel, 1868):** Length 1.7 to 2.3 mm, width 1.2 to 1.6 mm (Fig. 1-L), elytra light to dark brown with 1 cycle shape spot on middle with yellow surroundings, dorsal surface with bright pubescence, postcoxal line on 1st abdominal sternum complete, recurved, extending to base of first sternum. Male genitalia with parameres as long as basal lobe; siphon curved and with process at apex, with 1 membranous lobe near the apical (Fürsch 1989).

The present study was the first attempt to explore, identify and describe the coccinellid fauna associated with *Aphis punicae* on the pomegranate trees of the Najafabad region, which will be helpful for the future researches on the biological control of this aphid. Similar faunistic studies were carried out by other workers in Iran. For example, Mehrnejad *et al.* (2011) reported 17 coccinellid species, at the wild pistachio plantation and 11 species from planted pistachio trees in Rafsanjan. Mohammadpoor *et al.* (2013) reported also 12 species from 11 genera, 4 tribes and 3 subfamilies from Lorestan province. This study revealed the coccinellid community structure in the three orchards of pomegranate, more or less in different conditions. Overall, 12 species from 8 genera belonging to subfamilies Coccinellinae, Chilolororinae and Scymninae exist in the region. The identified species were *Adalia bipunctata*, *Coccinella undecimpunctata*, *Coccinella septempunctata*, *Exochomus undulatus*, *Hippodamia variegata*, *Hippodamia tredecimpunctata*, *Oenopia conglobata*, *Oenopia oncina*, *Propylea quatuordecimpunctata*, *Psyllobora vigintiduopunctata*, *Scymnus mongolicus* and *Scymnus syriacus*.

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