

Coccinellidae beetles (Coleoptera) fauna of district Layyah (Punjab), Pakistan

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Abstract

Beetles belonging to family Coccinellidae are predators of various sucking insect pests, some of them are phytophagous. A lot of work for the exploration of these beetles has been done in Pakistan. Layyah being a multi crop area was selected as study area for the exploration of Coccinellidae beetles. A survey was conducted for the collection of Coccinellidae adult specimens from the territory of Layyah district of southern Punjab, Pakistan, during 2018-19. A total 568 adult specimens were collected from seven localities. Out of which, ladybird beetles belonging to seven genera, with ten species namely; *Coccinella septempunctata* Linnaeus, 1758, *Brumoides suturalis* (Fabricius, 1798), *Henosepilachna vigintioctopunctata* (Fabricius, 1775, *Henosepilachna elaterii* (Rossi, 1794), *Hippodamia variegata* (Goeze, 1777), *Scymnus (Pullus) quadrillum* Motschulsky, 1858, *Scymnus (Pullus) posticalis* Sicard, 1913, *Scymnus (Scymnus) nubilis* Mulsant, 1850, *Micraspis allardi* (Mulsant, 1866), *Pharoscyms flexibilis* (Mulsant, 1853), have been recorded with their prey and host plants for the first time from the surveyed area. The coccinellids distribution is also given and map was prepared by using ArcGIS map tool. Explored predatory beetles may be used as bio-control agents in the region for the management of various sucking insect pests of various crops, fruits vegetables etc.

Keywords: Ladybird beetles, Coccinellidae, Predators, Diversity, Taxonomy, Layyah, Punjab

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Introduction

The voracious and non-specialist predator, beetles belong to the family Coccinellidae, are the beneficial

insects for having ample impacts on diverse insect pest species like aphids, mites, scale insects, whiteflies (Obrycki and Kring, 1998). The predatory behavior of the Coccinellidae varies within the species as they



have a positive impact by feeding on the insect pests and intraguild cannibalism included in their negative feeding behavior (Lucas, 2012). Most of the species are economically important predators, while some are also plant or being mycetophagous (Sutherland and Parrella, 2009). So, the predatory behavior of the Coccinellids includes different transitions throughout different trophic levels which covers primary carnivores to herbivorous insect. Similarly, the female Coccinellids are being proved stronger predators than the male beetles (Chowdhury et al., 2008).

Most of the Coccinellidae species adults are with bright and shining color patterns with patches or spots against the contrasting backgrounds. Similarly, these color patterns have been found defensive as signs of warning or danger or distasteful for their bird predators (Moreton, 1969). The farmers usually spray pesticides to kill pests extensively which kills both the pests and their natural enemies. The indiscriminate use of chemicals may affect lady bird beetles searching behavior, feeding behavior, mating behavior, number of eggs, and overall life span (Alinejad et al., 2014; Afza et al., 2020). However, ladybird beetles have great potential to survive the lethal effects of applied chemicals which makes them preferable for any integrated pest management (Mughal et al., 2017)

According to the latest classifications, Coccinellinae Latreille, 1807 and Microweiseinae Leng, 1920, are now subfamilies of Coccinellidae family (Slipinski, 2007; Seago et al., 2011). Moreover, it is reclassified to superfamily Coccinelloidea (Coleoptera: Polyphaga: Cucujiformia) (Robertson et al., 2015). Overall, more than 6000 species with 360 genera have been reported worldwide. Additionally, more than 300 species have been reported from Indo-Pak subcontinent and more than 71 species specifically from Pakistan. (Fleming, 2000; Irshad, 2001; Boopathi et al., 2020). Most recently and locally, Irshad (2001) 71 species, Rafi et al. (2005) 75 species, Khan et al. (2007) 12 species, Ali et al. (2014a, 2014b, 2015) 29 species, Ahmed et al. (2017) 9 species, Iqbal et al., (2017, 2018, 2019a, 2019b, 2020) 5 species, described predatory ladybird beetles with their associated prey insect pests from different locations of provinces in Pakistan. However, till now there is still deficiency of information about this economically important biological control agent's family from Pakistan. The current study was intended to explore the ambiguous species riches and distribution of Coccinellidae family from the district Layyah of Punjab, Pakistan.

Material and Methods

Area surveyed for collection

Multiple surveys were carried out in the district Layyah during 2018-19 to collect ladybird beetles, which covers an area of 6,291 km² with its geographical presence as 30°58'15.2"N and 70°56'39.6"E. The major cereal crops are (wheat, millet, barley, rice), oil seed crops (sunflower, linseed and rapeseed), pulses (gram, mash, masoor, moong), fodder (maize, millet, Alfalfa, barley), fruits (citrus, date palm, guava, jamun, mango) and vegetables (potato, radish, carrot, cauliflower, onion, garlic, green pepper) are grown in district Layyah.

Collection and identification

The ladybird beetle specimens were collected in the morning (8:00-10:00 am) and afternoon (2:00 to 4:00 pm) from different intended areas of district Layyah as shown in figure 1. The ladybird beetle's distribution map is prepared by using ArcGIS map tool. The adult ladybird beetles were collected through hand-picking and net sweep method and killed by using cyanide insect killing glass bottle (Iqbal et al., 2017). The killed specimens were brought to the insect taxonomy laboratory of Fareed Biodiversity Conservation Centre, Department of Agricultural Engineering, Khwaja Fareed University of Engineering and Information Technology, Rahim Yar Khan, Punjab, Pakistan, and preserved in wooden boxes.

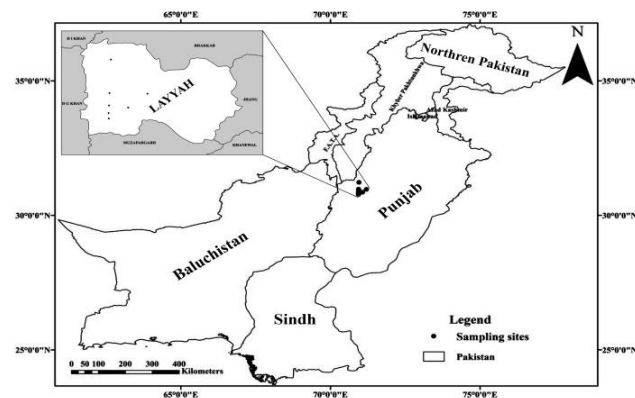


Figure-1. Distribution map of collected coccinellid specimens from Layyah district of Punjab, Pakistan.

Each specimen was pinned and mounted on small triangular plastic card tips with the labelling information of their locality, date of collection, host plants etc. Before placing specimens, the wooden

boxes were treated with Coopex Powder (®) and naphthalene tablets were placed to deter the other insects feeding on preserved insects. The morphological and taxonomic characters of ladybird beetles were studied on the basis of available published literature and checklists by Poorani, (2002), Rafi et al. (2005), Ali et al. (2015, 2018), Ashfaque et al. (2015) and other website links like NBAII, (2009) under the microscope ZMS 2000 compound microscope. However, Photographs of the adult specimens were taken using Nikon Digital camera (SMZ 1500), which was attached to the stereo microscope and photographs were processed by using Helicon focus 6.7.1 and Adobe Photoshop CS 6.0.

Results

Coccinella septempunctata Linnaeus, 1758 (Fig. 2a)

Material examined

Karor Lal Esan, 7♀ and 6♂, Chowk Azam, 12♀ and 14♂; Jaman Shah, 9♀ and 5♂; Kot Sultan, 14 and 3♂; Ladhana, 7♀ and 13♂, Layyah, 6♀ and 2♂

World distribution

Indo-Pak, Indo-China subcontinents, New Zealand, Indonesia, Australia, Japan, Nepal, (Poorani 2002).

Prey species with host plants

Aphis gossypii (Glover), *Brevicoryne brassicae* (L.), *Schizaphis graminum* (Rondani), *Myzus persicae* (Sulzer), *Phenacoccus solenopsis* (Tinsley) and *Amrasca biguttula biguttula* (Ishida) on cotton, mustard, cabbage, potato, okra, wheat and rose plants respectively.

General comments

Coccinella septempunctata found similar with the given diagnostic characters description by Ali et al. (2018) and first time reported from Layyah district.

Brumoides suturalis (Fabricius, 1798) (Fig. 2b)

Material examined

Karor Lal Esan, 4♀ and 2♂, Chowk Azam, 11♀ and 12♂; Jaman Shah, 10♀ and 3♂; Kot Sultan, 4 and 5♂; Ladhana, 2♀ and 7♂, Hafiz Abad, 2♀ and 2♂

World distribution

Bhutan, Pakistan, Sri Lanka, Nepal, India, Bangladesh (Poorani, 2002)

Prey species with host plants

Lipaphis erysimi (Kaltenbach), *Myzus persicae* (Sulzer), *Macrosiphum granarium* (Kby), *Brevicoryne brassicae* (L.), *Aphis craccivora* Koch, *Ropalosiphum maidis* (Fitch), *Phenacoccus solenopsis* (Tinsley), *Amrasca devastans* (Dist), *Drosicha mangiferae* (Green), *Amrasca biguttula biguttula* (Ishida) on plant host like potato, lucern, eggplant, okra, flowers and weeds.

General comments

Brumoides suturalis found similar with given diagnostic characters description by Ali et al. (2018) and first time reported from Layyah district.

Henosepilachna vigintioctopunctata (Fabricius, 1775) (Fig. 2c)

Material examined

Karor Lal Esan, 2♀ and 3♂, Chowk Azam, 5♀ and 14♂; Layyah, 3♀ and 5♂ Jaman Shah, 8♀ and 3♂; Kot Sultan, 8 and 2♂.

World distribution

Reported from different European, African and Asian countries of the world. (Katoh et al., 2014)

Host plants

Being a phytophagous pest from coccinellid family, was found on Solanaceous and Cucurbitaceae family vegetables including tomato, potato, bitter gourds and pumpkins.

General comments

This species also named as Hadda beetle. *Henosepilachna vigintioctopunctata* found similar with given diagnostic characters description by Ahmed et al. (2017). This species first time reported from district Layyah.

Henosepilachna elaterii (Rossi, 1794) (Fig. 2d)

Material examined

Karor Lal Esan, 5♀ and 6♀, Layyah, 7♀ and 2♂ Jaman Shah, 9♀ and 6♂; Kot Sultan, 4 and 5♂

World distribution

Middle East, Madagascar, Africa, South Europe and Asian countries. (Katoh et al., 2014).

Host plants



It's a phytophagous invasive pest of Cucurbitaceae family vegetables like pumpkins.

General comments

Henosepilachna elaterii also known as Melon ladybird beetle first time reported from Layyah district and found similar with given diagnostic characters description by Ahmed et al. (2017).

Hippodamia variegata (Goeze, 1777) (Fig. 2e).

Material examined

Karor Lal Esan, 4♀ and 2, Chowk Azam, 11♀ and 12♂; Jaman Shah, 10♀ and 3♂; Kot Sultan, 4♀ and 5♂; Ladhana, 2♀ and 7♂, Hafiz Abad, 2♀ and 2♂

World distribution

Afghanistan, India, China, Pakistan, Africa, Nepal (Poorani, 2002).

Prey species with host plants

Aphis punicae Passerini, *Lipaphis erysimi* (Kaltenbach), *Aphis gossypii* (Glover), *Schizaphis graminum* (Rondani), *Brevicoryne brassicae* (L.), *Hyadaphis coriandri* (Das), *Myzus persicae* (Sulzer), *Amrasca biguttula biguttula* (Ishida) and *Bemisia tabaci* (Gennadius) on different plant hosts like lucern, potato, turnip, brinjal, okra, cotton, wheat mustard and weeds.

General comments

Hippodamia variegata found similar with given diagnostic characters description by Ali et al. (2018) and first time reported from Layyah district.

Scymnus (Pullus) quadrillum Motschulsky, 1858 (Fig. 2f)

Material examined

Karor Lal Esan, 16♀ and 4♂, Jaman Shah, 4♀ and 7♂; Kot Sultan, 11♀ and 9♂

World distribution

Pakistan, Vietnam, Nepal, Laos, Bangladesh, India, Taiwan, China, Thailand (Ali et al., 2015).

Prey species with host plants

Brevicoryne brassicae (L.), *Aphis gossypii* (Glover), and *Aphis punicae* Passerini on different crops and fruit plants.

General comments

Scymnus (Pullus) quadrillum found similar with given diagnostic characters description by Ali et al. (2015) and first time reported from Layyah district

Scymnus (Pullus) posticalis Sicard, 1913 (Fig. 2g).

Material examined

Layyah, 3♀ and 4♂, Chowk Azam, 12♀ and 7♂, Jaman Shah, 7♀ and 5♂; Kot Sultan, 13♀ and 14♂

World distribution

African, European and very common in Asian countries like India, Nepal, Pakistan. (Ashfaq et al., 2015).

Prey species with host plants

Generally, it feeds on aphid species like *Aphis punicae* Passerini, *Myzus persicae* (Sulzer), *Aphis craccivora* Koch, *Brevicoryne brassicae* (L.), *Aphis gossypii* (Glover), phytophagous mites and scale insects on different weeds and fruit plants like grapes, apples.

General comments

Scymnus (Pullus) posticalis found similar with given Diagnostic characters description by Ashfaq et al. (2015) and first time reported from Layyah district.

Scymnus (Scymnus) nubilus Mulsant, 1850 (Fig. 2h).

Material examined

Karor Lal Esan, 13♀ and 6♂, Layyah, 2♀ and 3♂, Chowk Azam, 5♀ and 2♂, Jaman Shah, 6♀ and 3♂; Kot Sultan, 2♀ and 4♂

World distribution

Pakistan, Myanmar, Nepal, Bangladesh, China, Sri Lanka, Indian (Ashfaq et al., 2015)

Prey species with host plants

This species feed on different life stages of insect pests like, *Myzus persicae* (Sulzer), *Aphis craccivora* Koch, *Brevicoryne brassicae* (L.), *Aphis gossypii* (Glover), *Lipaphis erysimi* (Kaltenbach), *Drosicha mangiferae* (Green) and *Bemisia tabaci* (Gennadius) on different corps, fruit, flowering and weed plants.

General comments

Scymnus (Scymnus) nubilus found similar with given diagnostic characters description by Ashfaq et al. (2015) and first time reported from Layyah district.



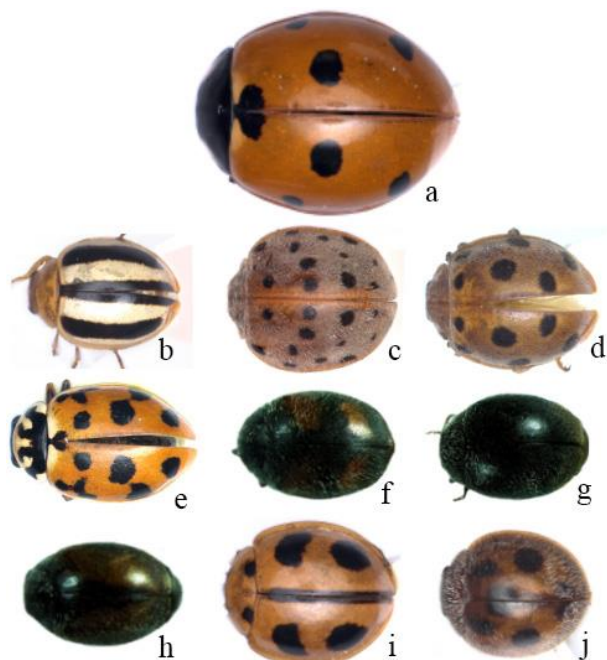


Figure-2 (a-j): (a) *Coccinella septempunctata* Linnaeus, 1758; (b) *Brumoides suturalis* (Fabricius, 1798); (c) *Henosepilachna vigintioctopunctata* (Fabricius, 1775); (d) *Henosepilachna elaterii* (Rossi, 1794); (e) *Hippodamia variegata* (Goeze, 1777); (f) *Scymnus (Pullus) quadrillum* Motschulsky, 1858; (g) *Scymnus (Pullus) posticalis* Sicard, 1913; (h) *Scymnus (Scymnus) nubilus* Mulsant, 1850; (i) *Micraspis allardi* (Mulsant, 1866); (j) *Pharoscymnus flexibilis* (Mulsant, 1853).

Micraspis allardi (Mulsant, 1866) (Fig. 2i).

Material examined

Layyah, 6♀ and 3♂; Jaman Shah, 2♀ and 3♂; Kot Sultan, 4 and 2♂; Ladhana, 2♀ and 3♂,

World distribution

Indonesia, Pakistan, Nepal, Myanmar, Nepal, Bangladesh (Poorani 2002; Ali et al., 2018)

Prey species with host plants

Quadraspidiotus perniciosus Comst, *Amritodus atkinsoni* Teth, *Pyrilla perpusilla* Walk and *Macrosiphum granarium* (Kby), on different crops, fruits and weed host plants.

General comments

Micraspis allardi found similar with given diagnostic characters description by Ali et al. (2018) and first time reported from Layyah district.

Pharoscymnus flexibilis (Mulsant, 1853) (Fig. 2j).

Material examined

Layyah, 11♀ and 6♂; Jaman Shah, 4♀ and 2♂; Kot Sultan, 5 and 7♂; Ladhana, 7♀ and 7♂, Hafiz Abad, 4♀ and 7♂

World distribution

USA, Pakistan, Brazil, India, (Poorani 2002; Ali et al., 2018)

Prey species with host plants

Schizaphis graminum (Rondani), *Aphis craccivora* Koch, *Siassetia nigra* (Nietn) and *Aspidiotus destructor* Sign, on host plants like lucern, wheat, mustard, cotton, grams.

General comments

Pharoscymnus flexibilis found similar with given diagnostic characters description by Ali et al. (2018) and first time reported from Layyah district.

Discussion

The current surveys were anticipated to explore the indigenous Coccinellidae fauna from southern Punjab district Layyah. A total of 10 species belonging to 7 genera with their prey, associated host plants and distribution were recorded. Previously Poorani (2002) from India, Ali et al. (2015, 2018) from Sindh province, Ashfaq et al. (2015) from Northern area of Pakistan, Ahmed et al. (2017) from Sargodha, Gilani (1976) from Faisalabad and Rafi et al. (2005) from different localities of Pakistan reported these species. Other than these species, Shah (1985) reported about sixteen ladybird species with their distribution and pests host plants from Peshawar. Hussain et al. (2018) described four species from rainfed and irrigated localities of Gujrat. Din (2002) reported similar species from Chitral and Rafi et al. (2005) surveyed Districts of Azad Kashmir areas and reported similar seventy-five predatory ladybird beetles. Whereas, according to Abbas et al. (2013), there are about 91 species have been reported from Pakistan.

Irshad (2001) studied the biotic potential, ecology, distribution and host of Coccinellids from Pakistan. Moreover, Coccinellidae distribution and diversity from District Dir Lower Pakistan have been studied by Rahatullah et al., 2011. Coccinellidae regional distribution record of Gilgit-Baltistan was given by Ashfaq et al. (2013). Similarly, different predacious Coccinellids have been reported from different

districts of Khyber Pakhtunkhwa province of Pakistan like Nowshera, Mardan and Sawabi with species richness, diversity and dominance by Urooj and Ali, 2016.

The persuasion for higher crops production has been directed towards intensive farming systems. That, however, become the reason for high pest populations followed by high intensity pesticides usage and other pest control techniques. The current study will be supportive in mass production of ladybird beetles against pests, reduction in number of insecticide applications and ultimately helping in reduction of environmental pollution.

Conclusion

The current study results contribute to a baseline to study ladybird beetle's ecology, biology, phytophagy, and predatory behavior against different pests. The current reported species of Coccinellidae family were diversified and abundant. These species may be utilized as potential biological control agents after evaluating their predatory potentials. Finally, it leads the researchers towards the conservatory biological control strategies for the endemic plant protection programs.

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Contribution of Authors

Bodlah MA: Collected the samples and wrote the paper
Bodlah I: Designed research methodology
Rasheed MT & Fareen AGE: Species mapping and identification
Ikram K: Reviewed & edited manuscript
Iqbal Z: Species Photography
Zada R: Provided the guidelines

