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Crop Association and Predator-Prey Relationship of Predaceous Coccinellid Beetles (*Coleoptera: Coccinellidae*) from Aurangabad District, Maharashtra, India

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Authors' contributions

This work was carried out in collaboration among between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

A field study was conducted to explore the crop association and predator-prey relationship of predaceous coccinellid beetles of Aurangabad district, starting from May 2022 to April 2024. All the specimens of coccinellid beetles were collected from different agricultural fields. In the family Coccinellidae, 13 species belonging to 11 genera and 3 subfamilies were found during the study period. The collected specimens were found to be associated with various agricultural crops and insect pests.

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Keywords: Coccinellid beetles; predaceous; agricultural fields; insect pests.

1. INTRODUCTION

Coccinellids belong to the order Coleoptera, suborder Polyphaga, super-family Cucujoidea, and the family Coccinellidae and are commonly called as ladybird beetles or lady bugs. Many beneficial insects are there to control insect pests but among them, Coccinellids are the important ones. These predaceous ladybird beetles occur within subfamilies Chilocorinae, Coccicornae, Coccinellinae, Coccidulinae, Scymninae and Sticholotidinae whereas the Epilachninae are phytophagous. Although subfamilies of the Coccinellidae are more or less distributed worldwide in distribution, many tribes within these subfamilies are restricted to particular bio-geographical regions. About 6000 species of coccinellidae are known worldwide (Vanderberg, 2002). Hawkeswood (1987) reported about 5200 species of coccinellid worldwide, while Slipinski (2013) reported 6000 species in 490 genera. The population dynamics of predator-prey systems are largely governed by the functional response of predators. It describes the rate at which a predator kills its prey at different prey densities and can thus determine efficiency of the predator in regulating prey populations (Murdoch and Oaten 1975). The objective of the study is to provide insight into the association between coccinellid species, prey species, and agricultural crops in Aurangabad. By obtaining this information, researchers and farmers may collaborate to develop sustainable and environmentally- friendly pest management strategies adapted to local conditions, ensuring long-term wellness and yield of crops in the region.

2. MATERIALS AND METHODS

The current investigation was conducted in Aurangabad district, Maharashtra, which is located at 19.826417^{o} N 75.372584^{o} E. Various adult coccinellid beetles were sampled from different agricultural fields of Aurangabad district starting from May 2022 to April 2024. The insects were collected by hand picking or using a sweep net. The collected specimens were placed in containers with chloroform-soaked cotton. These containers were taken to the laboratory and dried to preserve them, then pinned in wooden boxes. Each specimen was labelled with information on the host plants, locality, and date. Under a stereoscopic microscope, adult specimens were closely examined in order to record the details. Using standard literature and keys that were readily available, the collected specimens were identified up to the species level, crop association and prey species were also studied in detail (Booth, 1998; Omkar and Bind, 1995; Poorani 2002; Pervez, 2004).

3. RESULTS AND DISCUSSION

Throughout the investigation, a total 13 species belonging to 11 genera and 3 subfamilies were identified. The collected specimens were found to be associated with a range of agricultural crops such as wheat, maize, pearl millet, sorghum, beans, legumes, vegetables and mulberry etc., The predaceous behaviour of the coccinellid species was observed towards different insect pests such as aphids, white flies, mealy bugs and powdery mildew etc., *Cheilomenes sexmaculata* was associated with almost all the agricultural crops, insect pests and was observed throughout the year. The phytophagous behaviour of members of the family Epilachninae was also observed.

The highest number of coccinellid species were associated with soybean, pearl millet (bajra), and green grams, as shown in Table 1 and Graph 1. The least number of species were associated with brinjal, cabbage, and okra. The collected coccinellid species showed predaceous activity against a variety of agricultural crop insect pests.

With the exception of the members of the subfamily Epilachninae, which showed phytophagous activity, eleven coccinellid species exhibited a notable predaceous behaviour, as shown in Table 2 and Photo Plate III. During the current investigation, an association between *C. sexmaculata* and the majority of agricultural crops and insect pests was observed.

Table 1. Taxonomic Composition of Coccinellid Beetles collected from Aurangabad district

Family	Subfamily	Genus	Species
Coccinellidae	Coccinellinae	Coccinella	*Coccinella sepetempuncta* (Linnaeus, 1758)
			Coccinella transversalis (Fabricius, 1781)
		Cheilomenes	*Cheilomenes sexmaculata* (Fabricius, 1781)
		Hippodamia	*Hippodamia variegate* (Goeze, 1777)

Family	Subfamily	Genus	Species
		Micraspis	*Micraspis discolor* (Fabricius, 1798)
		Propylea	*Propylea dissecta* (Mulsant, 1850))
		Harmonia	*Harmonia octomaculata* (Fabricius, 1781)
		Illeis	*Illeis cincta* (Fabricius, 1798)
		Pseudaspidimerus	*Pseudaspidimerus trinotatus* (Thunberg, 1781)
		Brumoides	*Brumoides suturalis* (Fabricius, 1789)
	Chilocorinae	Chilochorus	*Chilochorus nigrata* (Fabricius, 1798)
	Epilachninae	Epilachna	*Henosepilachna vigintioctopunctata* (Fabricius, 1775)
			Henosepilachna implicata (Mulsant)

Photo Plate I. Collection of Coccinellid beetles

Table 2. Coccinellid beetles associated with agricultural crops from Aurangabad district

Sr. No	Crops	Coccinellid species
1.	Maize *Zea mays*	*C. sexmaculata, C. septempunctata, C. transversalis, H. variegate, P. dissecta*
2.	Jowar *Sorghum bicolor*	*C. sexmaculata, C. septempunctata, C. transversalis, P. trinotatus*
3.	Pearl millet *Pennisetum glaucum*	*C. sexmaculata, C. transversalis, H. variegata, P. dissecta, C. septempunctata, P. trinotatus, M. discolor*
4.	Wheat *Triticum aestivum*	*C. septempunctata, C. transversalis, C. sexmaculata, H. variegata*
5.	Pigeon pea *Cajanus cajan*	*C. transversalis, C. sexmaculata, H. variegata, I. cincta*

Sr. No	Crops	Coccinellid species
6.	Chick pea *Cicer arietinum*	*C. septempunctata, C. transversalis*
7.	Green gram *Vigna radiata*	*C. sexmaculata, C. transversalis, H. variegate, H. convergens, B. suturalis, C. septempunctata, P. dissecta, H. vigintiopunctata, C. nigrata, B. suturalis*
8.	Groundnut *Arachis hypogaea*	*C. transversalis, C. sexmaculata and H. variegata*
9.	Soybean *Glycine max*	*C. sexmaculata, C. transversalis, H. variegate, M. discolor, B. suturalis, C. nigrata*
10.	Cotton *Gossypium* sp.	*C. sexmaculata, C. transversalis, H. variegata and I. cincta*
11.	Okra *Abelmoschus esculentus*	*C. sexmaculata and I. cincta*
12.	Cabbage *Brassica oleracea*	*C. sexmaculata and H. variegate*
13.	Chilli *Capsicum frutescens*	*C. sexmaculata, and I. cincta*
14.	Brinjal *Solanum melongena*	*E. vigintioctopunctata and H. implicta*
15.	Mulberry *Morus alba*	*C. sexmaculata, C. transversalis, I. cincta*

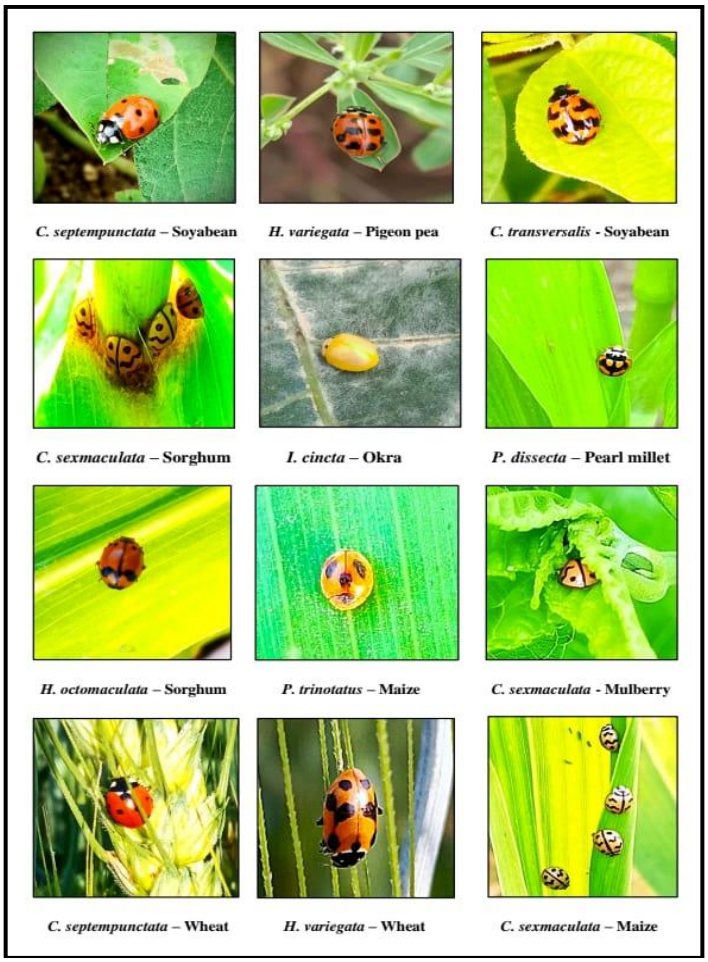
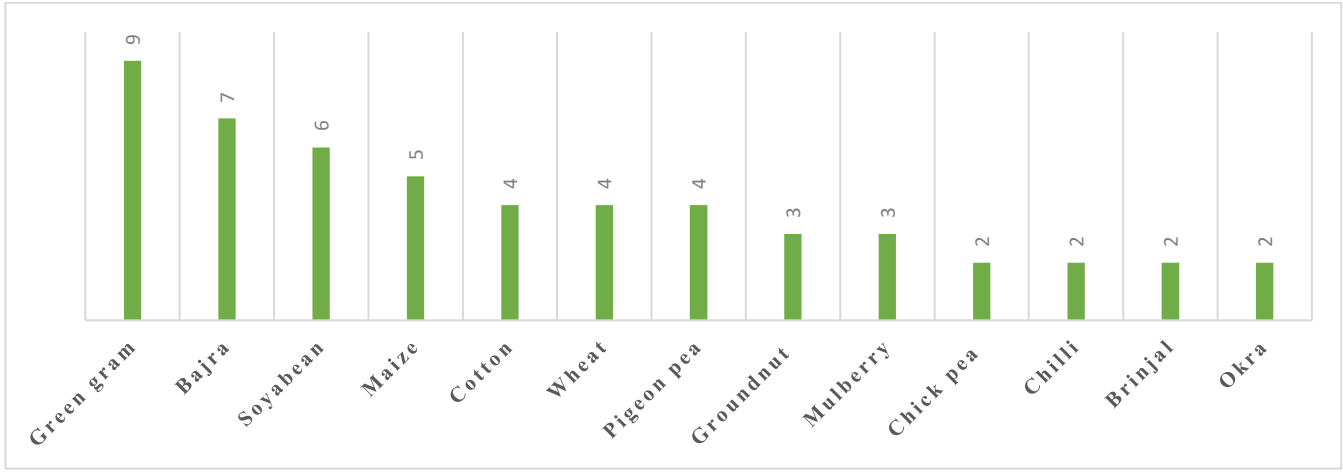


Photo Plate II. Coccinellid Beetles associated with different agricultural crops



Graph 1. Number of Coccinellid Species Associated with Different Agricultural Crops

Table 3. Prey Species of Coccinellid Beetles from Aurangabad District

Sr. No.	Name of the Coccinellid Species	Prey Species
1.	*Coccinella sepetempuncta*	*Myzus persicae, Aphis craccivora, Aphis fabae, Aphis gossypii*
2.	*Coccinella transversalis*	*Rhopalosiphum maidis, Aphis craccivora, Acyrthosiphon pisum*
3.	*Cheilomenes sexmaculata*	*Rhopalosiphum maidis, Aphis craccivora, Aphis gossypii, Myzus persicae, Uroleucon compositae, Aleurodicus rugioperculatus.*
4.	*Hippodamia variegate*	*Aphis craccivora, Uroleucon compositae, Myzus persicae*
5.	*Micraspis discolor*	*A. gossypii, M. persicae, A. craccivora,*
6.	*Propylea dissecta*	*Aphis craccivora, Acyrthosiphum pisum,*
7.	*Harmonia octomaculata*	*Rhopalosiphum maidis, Aphis craccivora,*
8.	*Illeis cincta*	*Rhopalosiphum maidis, Aphis craccivora, Myzus persicae*
9.	*Pseudaspidimerus trinotatus*	*Aphis craccivora, Aphis fabae*
10.	*Brumoides suturalis*	*Aphis craccivora, Aphis gossypii, Myzus persicae, Ropalosiphum maidis*
11.	*Chilochorus nigrata*	*Aphis craccivora, Myzus persicae*
12.	*Henosepilachna vigintioctopunctata*	Phytophagous
13.	*Henosepilachna implicata*	Phytophagous

Photo Plate III. Infestation of Pests & Predaceous Activity of Coccinellid Beetles

Similar studies regarding crops association and predator- prey relation of coccinellid beetles were carried out by numerous researchers. They studied the crop association and predaceous behaviour of coccinellid beetle species they encountered during their research. Joshi et al., (1999) noted that *C. sexmaculata* preyed on insect pests related to cotton crops. The appearance of *C. sexmaculatus* and *Illeis darbari* Fabricius on sorghum crop was reported by Patil and Sathe (2003). Ladybird beetles were found in far higher numbers in organic farming than in conventional ways, according to Lawanprasert et al., (2007). A survey of predaceous coccinellid beetles in vegetable-growing districts of Mid Country, Sri Lanka, was conducted by Mayadunnage et al., (2007). The majority of the coccinellid species that they studied were found to be feeding on plant hoppers, and aphids.

A study on the diversity and distribution of lady-beetles in economically significant crops, such as wheat, sugarcane, fodder, maize, and vegetables, was carried out by Abbas et al., (2013). They came to the conclusion that certain coccinellid species are more effective at controlling insect infestations. Megha et al., (2015) investigated the coccinellid species complex related to several crops in the Dharwad area. They observed that *Cheilomenes sexmaculata* dominated every crop field. Mishra and Yousuf (2019) studied coccinellid species related to the forest habitat of Uttarakhand. They observed the predaceous behaviour of these species on mealybugs and aphids associated with certain species of forest trees. The association between lady-bird beetles and several agricultural crops from the Kolhapur district was investigated by Patil and Gaikwad (2019). They noticed the phytophagous activity of one species (*E. vigintioctopunctata*) as well as the predaceous activity of twelve species on insect pests of various crops. Teja et al., (2023) carried out a review on diversity of coccinellid beetles and also highlighted the role of coccinellids in ecological balance and sustainable pest management practices. In their research on the variety of coccinellid beetles in agricultural areas of Northern Kerala, Gokul et al., (2024) identified 27 species that were linked to several crop species. The results of this investigation will prove helpful in improving our knowledge of the associations between coccinellid beetles and various agricultural crops as well as insect pests in the Aurangabad district. It provides helpful information about the coccinellid beetles in the mentioned area, as well as baseline data for future researchers and a wide range of opportunities for further research.

4. CONCLUSION

The present investigation attempted to study several aspects of coccinellid beetles such as crop association and predaceous activity. It was observed that the coccinellid beetles were associated with various agricultural crops from Aurangabad district. Monophagous, polyphagous and phytophagous behaviour of these beetles was also observed. The study area has an extensive range of coccinellid beetles, and it is crucial to protect them because perhaps they are needed in the future as a natural pest management strategy for aphids, white flies, and other small insect pests, particularly in agricultural crop fields.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Authors hereby declare that generative AI technologies such as Quill Bot software has been used during the writing or editing of manuscripts for grammar checking and summarizing.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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