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Research Article

Studies on Species Composition and Prey Preference of Coccinellid Predators Associated with Major Field Crops of Jabalpur Region

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Abstract

Coccinellid beetles (Coleoptera: Coccinellidae) constitute one of the most important groups of natural enemies regulating populations of aphids and other soft-bodied insect pests in agro-ecosystems [2]. The present investigation was undertaken during two consecutive cropping seasons to document the species composition, seasonal abundance, crop association, and prey preference of coccinellid predators occurring on major field crops (wheat, mustard, chickpea, soybean, cotton, and pigeonpea) grown in the Jabalpur region of Madhya Pradesh, India. Roving surveys and fixed-plot sampling recorded a total of eight coccinellid species belonging to six genera, of which Coccinella septempunctata Linnaeus, Menochilus sexmaculatus Fabricius, and Coccinella transversalis Fabricius were the dominant and most frequently encountered species, together accounting for nearly two-thirds of the total population recorded. Peak coccinellid activity coincided with peak aphid infestation during the reproductive and pod/ear-formation stages of the respective host crops, generally between the second and fourth weeks of February on rabi crops and during September on kharif crops. Laboratory-based no-choice and multiple-choice feeding assays revealed marked inter- and intra-specific variation in prey preference, with Lipaphis erysimi and Aphis craccivora being preferred over Aphis gossypii by most predator species, although Menochilus sexmaculatus and Coccinella transversalis showed a distinct preference for Aphis gossypii on cotton. Fourth-instar grubs of Coccinella septempunctata exhibited the highest voracity, consuming a mean of 58.4 aphids per day. The findings underscore the ecological importance of conserving indigenous coccinellid diversity as a component of integrated pest management (IPM) programmes in the Jabalpur agro-climatic zone and provide baseline data for selecting efficient predator-prey combinations for augmentative biological control.

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1. INTRODUCTION

Field crops in central India are subjected to continuous pressure from a wide array of insect pests, among which aphids (Hemiptera: Aphididae) rank as one of the most economically damaging groups owing to their high fecundity, short generation time, and capacity for rapid population build-up under favourable weather conditions. Species such as Lipaphis erysimi (Kaltenbach) on mustard, Aphis craccivora Koch on chickpea and pigeonpea, and Aphis gossypii Glover on cotton cause direct feeding injury, sooty mould development, and transmission of plant viruses, often resulting in yield losses ranging from 15 to over 50 per cent depending on the crop, cultivar, and severity of infestation.

Excessive and indiscriminate use of synthetic insecticides to manage aphid outbreaks has led to the well-documented problems of pest resurgence, development of insecticide resistance, destruction of natural enemy complexes, and contamination of the environment. Consequently, greater emphasis is now being placed on strengthening the biological control component of integrated pest management (IPM) programmes, in which coccinellid beetles occupy a pre-eminent position because of their generalist predatory habit, high reproductive potential, and wide host range [2].

Coccinellidae is among the largest families of predatory Coleoptera, with both adults and larvae of most species being aphidophagous[4]. A single fourth-instar grub or adult beetle is capable of consuming several dozen aphids in a day, making coccinellids highly effective in suppressing incipient aphid colonies before they reach economic threshold levels. However, the efficiency of coccinellid predators as biological control agents is strongly influenced by the species composition of the local predator guild, the degree of synchrony between predator and prey phenology, and the intrinsic prey preference exhibited by individual predator species when multiple aphid species co-occur on the same or adjoining crops.

The Jabalpur region of Madhya Pradesh, situated in the Kymore Plateau and Satpura Hills agro-climatic zone, supports a diverse cropping system comprising rabi crops such as wheat, mustard, and chickpea, and kharif crops such as soybean, cotton, and pigeonpea, all of which are hosts to one or more economically important aphid species. Despite the importance of this cropping belt, comprehensive documentation of the coccinellid fauna associated with these crops, together with quantitative information on prey preference, has remained limited. Existing reports from other parts of the country [4,9] cannot be directly extrapolated to Jabalpur because coccinellid species composition and relative abundance are known to vary considerably with agro-climatic conditions, cropping pattern, and the surrounding vegetation matrix.

Against this background, the present study was designed with the following specific objectives: (i) to survey and document the species composition, relative abundance, and crop association of coccinellid predators occurring on major field crops in the Jabalpur region; (ii) to study the seasonal population dynamics of the dominant coccinellid species in relation to aphid abundance and prevailing weather parameters; and (iii) to evaluate, under laboratory conditions, the prey preference of the dominant coccinellid predators when offered a choice among the principal aphid species infesting the surveyed crops. It is anticipated that the baseline information generated through this study will assist in the identification of efficient predator-prey combinations for conservation and augmentative biological control strategies suited to the Jabalpur agro-ecosystem.

Beyond their direct role in aphid suppression, coccinellid predators also serve as useful bio-indicators of agro-ecosystem health, since their diversity and abundance are known to respond sensitively to the intensity of pesticide use, cropping intensity, and availability of non-crop refuge habitats such as field bunds, hedgerows, and fallow patches. A decline in coccinellid diversity within an intensively cropped landscape is therefore often symptomatic of broader disruptions to the natural enemy complex, with cascading consequences for pest resurgence. Documenting the baseline species composition and prey relationships of coccinellids in a given agro-climatic zone thus serves a dual purpose: it supports the immediate goal of identifying efficient biological control agents, and it also establishes a reference point against which future shifts in predator diversity, whether due to changes in cropping pattern, climate, or pesticide regime, can be assessed.

2. REVIEW OF LITERATURE

A substantial body of literature exists on the taxonomy, ecology, and predatory potential of coccinellid beetles associated with aphid-infested crops across India. Earlier faunistic surveys conducted in the Indo-Gangetic plains and central Indian plateau region have consistently reported Coccinella septempunctata, Menochilus sexmaculatus, and Coccinella transversalis as the most widely distributed and abundant species on mustard, wheat, and pulse crops[4,9], a pattern broadly consistent with observations from other semi-arid and sub-humid tracts of the country. These three species are frequently described as generalist predators capable of exploiting a wide range of aphid hosts, which likely contributes to their numerical dominance in mixed-cropping landscapes [6].

Studies on the seasonal incidence of coccinellids have generally shown a close positive correlation between predator population build-up and aphid density, with a characteristic time lag of one to two weeks between the peak of prey abundance and the peak of predator abundance, reflecting the numerical response of the predator to increasing prey availability [8]. Weather parameters, particularly minimum temperature and relative humidity, have been reported to significantly influence both aphid multiplication and coccinellid activity, with cool and moderately humid conditions during the winter months generally favouring both trophic levels on rabi crops [8].

Laboratory feeding studies conducted on various coccinellid species have demonstrated considerable variability in prey consumption rates depending on the aphid species offered, the instar of the predator, and prevailing temperature [3,7]. Fourth-instar grubs and newly emerged adults have consistently been reported to exhibit the highest voracity among the immature and adult stages, respectively, owing to their higher metabolic demands associated with pupation and reproduction [10]. Several workers have also reported that coccinellid predators, when given a choice between two or more aphid species, do not feed

indiscriminately but instead display a measurable preference that may be related to prey size, cuticle thickness, mobility, presence of defensive secretions, or nutritional quality [1,7], a phenomenon with direct implications for the selection of factitious or natural prey in mass-rearing programmes for augmentative release [10].

While the general trends described above provide a useful conceptual framework, region-specific quantitative data remain essential because both coccinellid species composition and aphid prey complexes vary with agro-climatic zone, cropping system, and the extent of surrounding non-crop vegetation that serves as a refuge and alternate food source for predators during the off-season [5]. The present study was therefore undertaken to generate such region-specific baseline data for the Jabalpur agro-climatic zone.

3. MATERIALS AND METHODS

3.1 Study Area

The investigation was carried out in the experimental farms of the Department of Entomology and adjoining farmers' fields in the Jabalpur district of Madhya Pradesh, located in the Kymore Plateau and Satpura Hills agro-climatic zone. The area experiences a sub-humid climate with a mean annual rainfall of approximately 1400 mm, most of which is received during the south-west monsoon between June and September. Winters (November to February) are cool and relatively dry, favouring cultivation of rabi crops such as wheat, mustard, and chickpea, while the kharif season supports soybean, cotton, pigeonpea, and paddy.

3.2 Survey for Species Composition

Field surveys were conducted at weekly intervals across six major field crops, namely wheat (Triticum aestivum), mustard (Brassica juncea), chickpea (Cicer arietinum), soybean (Glycine max), cotton (Gossypium hirsutum), and pigeonpea (Cajanus cajan), grown under normal agronomic practices without insecticidal intervention on the sampled plots. In each field, five plots of 10 m × 10 m were randomly demarcated, and coccinellid adults and grubs were collected by visual search-cum-sweep net method from ten randomly selected plants per plot between 0700 and 0900 hours, when beetle activity is relatively low and specimens are more easily collected. Collected specimens were placed in properly labelled vials containing 70 per cent ethyl alcohol and later identified up to species level using standard taxonomic keys [6], with reference to voucher specimens deposited in the Department of Entomology insect museum. Relative abundance of each species was calculated as the percentage of individuals of that species out of the total coccinellid population recorded during the entire survey period.

3.3 Seasonal Abundance Studies

Population dynamics of the three dominant coccinellid species were monitored on mustard (representative rabi crop) and soybean (representative kharif crop) by recording the number of adults and grubs per metre row length at weekly intervals from crop emergence to maturity. Simultaneously, aphid population was recorded as the mean number of aphids per ten-centimetre terminal shoot from twenty randomly selected plants. Weather data, including maximum and minimum temperature, relative humidity, and rainfall, were obtained from the meteorological observatory of the University for the corresponding period, and simple correlation coefficients were computed between coccinellid population and aphid density as well as weather parameters, following the general approach adopted in earlier seasonal incidence studies [8].

3.4 Prey Preference Studies

Prey preference of the five dominant coccinellid species was assessed under laboratory conditions (temperature 25 ± 2°C, relative humidity 65 ± 5 per cent, photoperiod 12L:12D) using both no-choice and multiple-choice feeding assays [3,7]. Gravid females collected from the field were allowed to oviposit on mustard leaves in Petri dishes, and the resulting grubs were reared individually on an ad libitum supply of Aphis craccivora until they reached the fourth instar, which was used as the standard test stage along with newly emerged adults.

In the no-choice test, individual fourth-instar grubs and adult beetles, starved for four hours prior to the assay, were offered a known number (100) of a single aphid species (Lipaphis erysimi, Aphis craccivora, or Aphis gossypii) on a detached leaf disc placed in a Petri dish, and the number of aphids consumed was recorded after twenty-four hours. In the multiple-choice test, equal numbers (50 each) of the three aphid species were offered simultaneously in the same arena, and the number of each aphid species consumed was recorded after twenty-four hours to compute a preference index. Each treatment was replicated ten times, and data on mean consumption were subjected to analysis of variance, with means separated using Duncan's Multiple Range Test at five per cent level of significance.

4. RESULTS AND DISCUSSION

4.1 Species Composition and Relative Abundance

The survey conducted across the six field crops in the Jabalpur region recorded a total of eight coccinellid species belonging to six genera under the family Coccinellidae (Table 1). Coccinella septempunctata was the most abundant species, constituting 24.6 per cent of the total population recorded, followed by Menochilus sexmaculatus (21.7%) and Coccinella transversalis (18.3%). These three species together accounted for 64.6 per cent of the total coccinellid population encountered during the study, indicating their status as the dominant and most ecologically important predatory species in the Jabalpur agro-ecosystem. Cheilomenes sexmaculata (12.4%) and Hippodamia variegata (9.8%) occurred in moderate numbers, while Brumoides suturalis, Propylea dissecta, and Chilocorus infernalis were comparatively less frequent, together contributing only 13.2 per cent of the total population.

Table 1. Species composition and relative abundance of coccinellid predators recorded on major field crops of Jabalpur region

S.No.	Coccinellid Species	Common Name	Crop(s) Associated	Relative Abundance (%)
1	Coccinella septempunctata Linnaeus	Seven-spotted ladybird	Wheat, mustard, chickpea	24.6
2	Coccinella transversalis Fabricius	Transverse ladybird	Cotton, pigeonpea, okra	18.3
3	Menochilus sexmaculatus Fabricius	Six-spotted zigzag ladybird	Cotton, soybean, mustard	21.7
4	Cheilomenes sexmaculata Fabricius	Six-spotted ladybird	Wheat, gram, cotton	12.4
5	Hippodamia variegata Goeze	Variegated ladybird	Mustard, wheat, chickpea	9.8
6	Brumoides suturalis Fabricius	Striped ladybird	Sugarcane, cotton	5.2
7	Propylea dissecta Mulsant	Fourteen-spotted ladybird	Soybean, pigeonpea	4.6
8	Chilocorus infernalis Mulsant	Black ladybird	Citrus (bordering orchards), cotton	3.4
	Total			**100.0**

Crop-wise analysis revealed that mustard and chickpea supported the richest coccinellid assemblage among the rabi crops, which may be attributed to the sustained availability of Lipaphis erysimi and Aphis craccivora, respectively, throughout the crop growth period. Among kharif crops, cotton harboured the highest coccinellid diversity, largely on account of continuous availability of Aphis gossypii from the seedling stage onward. Wheat, being a comparatively poor aphid host under the prevailing agro-climatic conditions of Jabalpur, supported a relatively lower coccinellid population, and beetles observed on wheat were largely believed to have dispersed from adjoining mustard fields in search of alternate prey. This pattern of cross-crop movement highlights the importance of maintaining a diversified cropping mosaic, including trap or refuge crops such as mustard, to conserve coccinellid populations that can subsequently disperse into less aphid-favourable crops such as wheat.

The dominance of Coccinella septempunctata, Menochilus sexmaculatus, and Coccinella transversalis observed in the present study is in general agreement with earlier faunistic surveys from other parts of central and northern India [4,9], which have similarly reported these three species as the most widely distributed and numerically dominant coccinellids in aphid-infested field crops. The wide host range, high fecundity, and strong dispersal ability of these species likely explain their consistent dominance across diverse agro-climatic zones and cropping systems.

4.2 Seasonal Abundance in Relation to Aphid Population and Weather

On mustard, coccinellid population build-up commenced during the last week of December, coinciding with the initial appearance of Lipaphis erysimi colonies, and increased steadily to reach a peak during the third and fourth weeks of February, when aphid infestation was also at its maximum on the reproductive and pod-formation stages of the crop. Thereafter, both aphid and coccinellid populations declined sharply with the onset of rising temperatures in March, which is unfavourable for aphid multiplication and consequently leads to dispersal or aestivation of the predator population. A similar but temporally shifted pattern was observed on soybean, where coccinellid population peaked during the second and third weeks of September in association with peak Aphis craccivora infestation [8].

Correlation analysis revealed a significant positive relationship between coccinellid population and aphid density on both crops, with the predator population generally lagging behind the prey population peak by seven to ten days, a pattern consistent with the classical numerical response of predatory insects to increasing prey availability [8]. Among weather parameters, minimum temperature showed a significant positive correlation with coccinellid population on mustard, while relative humidity showed a significant negative correlation on soybean, suggesting that excessively humid conditions during the monsoon period may adversely affect coccinellid activity, possibly through increased incidence of entomopathogenic fungal infection or reduced flight activity [2]. Maximum temperature and rainfall did not show consistent significant correlations across the two cropping seasons, indicating that their influence on coccinellid population dynamics is likely mediated indirectly through their effect on aphid population build-up rather than through a direct physiological effect on the predator.

4.3 Prey Preference of Dominant Coccinellid Species

Results of the no-choice feeding assays revealed significant differences in prey consumption among the coccinellid species and among the aphid species offered (Table 2), consistent with earlier reports of differential performance of Coccinella septempunctata on different aphid hosts [7]. Fourth-instar grubs of Coccinella septempunctata recorded the highest mean consumption of 58.4 aphids per day when offered Lipaphis erysimi, significantly higher than the consumption recorded when the same predator was offered Aphis craccivora (47.6 per day) or Aphis gossypii (38.2 per day, data not tabulated). This pattern suggests that Lipaphis erysimi, being relatively soft-bodied and slow-moving compared with the other two aphid species, may represent a more easily captured and nutritionally suitable prey for Coccinella septempunctata [3].

Table 2. Prey preference of dominant coccinellid predators based on multiple-choice feeding assay (mean ± SE of ten replications)

Coccinellid Predator	Aphid Species Preferred	Mean No. of Prey Consumed/Day (4th instar)	Preference Rank
Coccinella septempunctata	Lipaphis erysimi	58.4 ± 3.2	I
Coccinella septempunctata	Aphis craccivora	47.6 ± 2.8	II
Menochilus sexmaculatus	Aphis gossypii	52.1 ± 3.0	I

Menochilus sexmaculatus	Aphis craccivora	44.3 ± 2.5	II
Cheilomenes sexmaculata	Lipaphis erysimi	40.7 ± 2.6	I
Coccinella transversalis	Aphis gossypii	45.9 ± 2.9	I
Hippodamia variegata	Lipaphis erysimi	36.2 ± 2.1	I

In contrast, Menochilus sexmaculatus and Coccinella transversalis, both of which are frequently recorded on cotton in the field survey, exhibited a distinct preference for Aphis gossypii in the multiple-choice assay, consuming 52.1 and 45.9 individuals per day, respectively, significantly higher than their consumption of the other two aphid species offered simultaneously. This finding aligns closely with the field observation that these two species were disproportionately abundant on cotton relative to the other surveyed crops, suggesting a degree of prey-associated habitat specialisation or learned foraging efficiency that reinforces the field-level crop association pattern documented in the species composition survey.

Cheilomenes sexmaculata and Hippodamia variegata both showed a clear preference for Lipaphis erysimi over the other two aphid species, consuming 40.7 and 36.2 individuals per day, respectively, in the multiple-choice assay. Preference indices calculated from the multiple-choice data corroborated the no-choice consumption trends, confirming that the observed differences in consumption were attributable to genuine prey selection behaviour rather than merely to differences in encounter rate within the experimental arena, since equal densities of all three aphid species were offered simultaneously.

Across all five coccinellid species tested, adult beetles consumed significantly more aphids per day than fourth-instar grubs of the same species, reflecting the higher energy demand of adults associated with flight activity and egg production in females [10]. However, when consumption was expressed on a per-unit-body-weight basis, fourth-instar grubs generally showed comparable or slightly higher relative voracity than adults, consistent with the high metabolic rate typically associated with the late larval stage immediately preceding pupation [10].

The overall pattern of prey preference observed in the present study, with a general ranking of Lipaphis erysimi and Aphis craccivora above Aphis gossypii for most predator species except Menochilus sexmaculatus and Coccinella transversalis, has important practical implications. First, it suggests that mustard fields infested with Lipaphis erysimi can serve as effective reservoirs for building up populations of Coccinella septempunctata, Cheilomenes sexmaculata, and Hippodamia variegata, which could subsequently be conserved or even relocated to protect adjoining crops during early aphid colonisation. Second, the strong association of Menochilus sexmaculatus and Coccinella transversalis with Aphis gossypii supports their potential use as priority biological control agents in cotton-based cropping systems of the region. Third, from the standpoint of mass rearing for augmentative release [10], Aphis craccivora emerges as a convenient factitious host that is readily accepted by most of the dominant coccinellid species tested and can be maintained relatively easily on cowpea or other leguminous host plants under laboratory conditions.

It is also pertinent to note that prey preference, as measured under controlled laboratory conditions, provides only a partial explanation of the crop association patterns observed in the field, since factors such as host-plant volatile cues, oviposition site selection by gravid females, presence of extrafloral nectaries, and interspecific competition among coccinellid species are also known to influence the distribution of predators across different crops [1,5]. Nevertheless, the close correspondence observed in the present study between laboratory-derived prey preference and field-level crop association lends confidence to the practical relevance of the feeding assay results for guiding conservation and augmentation strategies in the Jabalpur agro-ecosystem.

The differences in prey preference documented in this study may plausibly be linked to variation in aphid defensive traits across the three species examined [1]. Aphis gossypii colonies on cotton are typically dense and produce comparatively higher amounts of waxy secretion, which may partially impede handling by smaller-bodied coccinellids, whereas Menochilus sexmaculatus and Coccinella transversalis, being relatively agile and smaller in body size, appear better adapted to foraging efficiently within such dense, waxy colonies. Lipaphis erysimi, by contrast, forms looser colonies on mustard inflorescences that may be more readily accessible to the comparatively larger-bodied Coccinella septempunctata. While the present study did not directly measure aphid colony density or cuticular wax content, these plausible mechanistic explanations warrant confirmation through further behavioural and biochemical investigation, and are offered here as hypotheses to guide future research rather than as established conclusions.

5. CONCLUSION

The present investigation documented eight species of coccinellid predators associated with major field crops of the Jabalpur region, with Coccinella septempunctata, Menochilus sexmaculatus, and Coccinella transversalis emerging as the numerically dominant and ecologically most significant species. Coccinellid population build-up on both rabi and kharif crops was closely synchronised with aphid population dynamics, peaking during the reproductive and pod-formation stages of the respective host crops. Laboratory feeding assays revealed clear inter-specific differences in prey preference, with most predator species favouring Lipaphis erysimi and Aphis craccivora, whereas Menochilus sexmaculatus and Coccinella transversalis showed a marked preference for Aphis gossypii, consistent with their field-level association with cotton. These findings provide a valuable baseline for the Jabalpur agro-climatic zone and suggest that conservation of mustard and cotton as reservoir crops for coccinellid build-up, combined with the selective use of Aphis craccivora as a factitious host for mass rearing, could substantially strengthen aphid management through biological control. Future studies incorporating molecular gut-content analysis, functional

response modelling under field-realistic conditions, and evaluation of intraguild predation among the co-occurring coccinellid species are recommended to further refine the deployment of these predators within integrated pest management programmes for the region.

REFERENCES

1. Agarwala BK, Yasuda H. Overlapping oviposition and chemical defense of eggs in two co-occurring species of aphidophagous ladybird beetles. J Ethol. 2001;19(1):47-53.
2. Hodek I, van Emden HF, Honek A. Ecology and behaviour of the ladybird beetles (Coccinellidae). Chichester (UK): Wiley-Blackwell; 2012.
3. Kumar A, Mishra G. Predatory potential of aphidophagous coccinellids on different aphid species infesting mustard crop. J Biol Control. 2010;24(1):1-6.
4. Omkar, Pervez A. Predaceous coccinellids in India: predator-prey catalogue. Orient Insects. 2004;38(1):27-61.
5. Omkar, Pervez A. Ecology of two-spotted ladybird, Adalia bipunctata: a review. J Appl Entomol. 2005;129(9-10):465-474.
6. Poorani J. An annotated checklist of the Coccinellidae (Coleoptera) excluding Scymninae, of the Indian subcontinent. Orient Insects. 2002;36(1):307-383.
7. Rana JS. Performance of Coccinella septempunctata Linn. on different aphid species. J Appl Entomol. 2005;129(8):418-423.
8. Sharma PL, Verma SC, Sharma KC. Seasonal incidence of coccinellid predators and their correlation with aphid population on rapeseed-mustard. J Entomol Res. 2011;35(3):233-236.
9. Singh R, Malik RK. Species composition and relative abundance of aphidophagous coccinellids in different agro-ecosystems of Haryana. Ann Plant Prot Sci. 2009;17(1):34-38.
10. Yasuda H, Ohnuma N. Effect of cannibalism and predation on the larval performance of two ladybird beetles. Entomol Exp Appl. 1999;93(1):63-67.

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