

Review Article

A comprehensive review on diversity of predaceous coccinellid beetles (Coleoptera: Coccinellidae)

Abstract

This review delves into the pivotal role of coccinellid beetles, commonly known as ladybird beetles, in biological pest control and their significance in maintaining ecological balance. The successful introduction of the vedalia ladybird in 1888 to control the cottony cushion scale in California stands as a landmark in biological pest control, prompting numerous global attempts to employ predaceous ladybird beetles for aphid control. Predaceous ladybird beetles have gained attention for their ability to feed on a diverse range of prey, emphasizing the need for comprehensive biodiversity information in new areas. Coccinellids, with approximately 6,000 species globally, inhabit various environments, contributing significantly to pest management. The Indian subcontinent, with its rich coccinellid diversity, is explored through catalogues and surveys, highlighting the ecological balance they maintain and the potential for sustainable pest management practices.

Keyword: Coccinellid beetle, Predator, insect pest, beneficial and diversity.

Introduction

The successful introduction of the vedalia ladybird, *Rodolia cardinalis* Mulsant, from Australia into California in 1888 is widely acknowledged as the most effective instance of biological pest control, specifically targeting the cottony cushion scale, *Icerya purchasi*, which posed a threat to the citrus industry [1]. This historic success prompted 155 worldwide attempts to control aphids by introducing predaceous ladybird beetles, as documented by Joshi et al. 2003 [2]. The outcomes of these attempts underscore the efficacy of predaceous ladybird beetles in pest management. Predaceous ladybird beetles have gained substantial attention in recent years as biological control agents due to their remarkable ability to feed on a wide range of prey, including aphids, coccids, phytophagous mites, adelgids, and aleyrodids [3,4,5,56,57]. Recognizing their potential for biocontrol, there is a pressing need to generate comprehensive information on the biodiversity of these agents in new areas [6,7].

Coccinellid beetles, commonly known as ladybird beetles, emerge as a crucial group of predatory insects playing a significant role in the biological control of diverse insect pests worldwide [8]. While exhibiting polyphagous behavior, some coccinellids display specificity in their food preferences [9,57]. Inhabiting a variety of environments such as forests, agricultural fields, grasslands, gardens, and human habitats, the Coccinellidae family encompasses

approximately 6,000 described species globally, distributed across 360 genera [10]. Notably, the Indian Prey-Predator catalogue of coccinellid beetles by Omkar and Pervez (2004) records 261 known predaceous coccinellids in India, belonging to 57 genera [11]. Poorani's checklist of Coccinellidae in the Indian sub-region (2002) lists 79 genera and 400 species of ladybeetles, providing insights into their distribution in the subcontinent [12]. Jadhav and Sharma (2012) further contribute to this knowledge by identifying twenty coccinellid beetle species under 15 genera and 6 subfamilies in the fauna of Maharashtra [13,57].

Beyond their role as predators, coccinellids play a vital role in maintaining ecological balance by regulating pest densities, ultimately reducing the dependence on chemical pesticides in agriculture. This review article underscores the significance of research on the diversity of predaceous coccinellid beetles and their potential impact on sustainable pest management practices.

Global Overview

Numerous researchers from diverse regions around the globe have documented various species of Coccinellid beetles during their investigations. Lovei (1981) examined the composition and diversity of the coccinellid community in both insecticide-treated and untreated blocks within an apple orchard near Budapest, Hungary [14]. Garcia et al. (1997) identified 13 coccinellid species in uncultivated habitats [15]. Franzmann (2002) documented the presence of *Hippodamia variegata* on crops such as sorghum, sunflower, Lucerne, triticale, and citrus in Austria [16]. Irshad (2001) provided a comprehensive review detailing the distribution, host range, ecology, and biotic potential of 71 species of predaceous coccinellids in Pakistan [17]. Zahoor et al. (2003) assessed the diversity, richness, and evenness of Coccinellids and their role as bioindicators in crop and forest areas in Faisalabad, Pakistan, identifying 22 coccinellid species [18].

Mayadunnage et al. (2007) recorded 15 coccinellid species in vegetable-growing areas of Sri Lanka [19]. Cotes et al. (2010) collected 13 ladybird beetle species from the canopies of olive orchards in southern Spain [20]. Abbas et al. (2013) reported 12 coccinellid species from the Faisalabad district, Pakistan [21]. Hayat and Khan (2013) gathered data on 51 coccinellid species in the Mirpur Division of Jammu and Kashmir, Pakistan [22]. In Mehriz region of Iran, 11 species of ladybird beetles reported [23].

Diversity in India

In India, numerous researchers have delved into various aspects of Coccinellid beetles. Various scientists, such as Kapur (1972), contributed to the understanding of the diversity of coccinellid beetles. Agarwala and Ghosh (1988) reported a total of 36 coccinellid beetle species across India [25]. Kapur's work focused on documenting 17 species of ladybird beetles in Goa [24]. Joshi and Sharma (2008) conducted a collection and identification effort in the Haridwar district of Uttarakhand, revealing 31 species of coccinellid beetles [26].

A survey conducted by Khan et al. (2009) in the Srinagar district of Kashmir documented 15 coccinellid species across 12 different crop ecosystems [27]. Sharma and Joshi (2010) identified 25 species of predatory Coccinellid beetles in Dehradun [28]. Roy et al. (2010) collected 20 species of coccinellid beetles from tea plantations in North Bengal [29]. Kedar et al. (2011) observed six coccinellid species in Hissar, Haryana [30]. Ghosh and Chakraborty (2012) conducted a study on the incidence and abundance of predatory beetles, particularly *C. septempunctata*, in the Sub-Himalayan region of North-East India, documenting 12 coccinellid species [31].

Vinothkumar (2013) observed 13 coccinellid species in the rice agroecosystem at Hybrid Rice Evaluation Centre, Tamil Nadu Agricultural University, Gudalur [32]. Majumder et al. (2013) surveyed the diversity of coccinellid beetles in agricultural and forest habitats of Tripura, Northeast India, reporting approximately 24 species under 17 genera [33]. Shah and Khan (2014) conducted a biodiversity survey of coccinellids in the major fruit and vegetable growing belts of Kashmir Valley, observing 17 and 15 species of predaceous coccinellids in fruit and vegetable ecosystems, respectively [34].

Chaudhary et al. (2014) collected 16 species of predaceous coccinellids in Mango agroecosystems in Jharkhand [35]. Megha et al. (2015) surveyed crop fields in the Dharwad region, India, reporting 18 species of coccinellid beetles [36]. Ramya and Thangjam (2016) recorded 12 species of coccinellid beetles associated with insect pests of Assam Lemon in the citrus orchard of Assam Agricultural University, Jorhat [37].

Ankalgi and Jadesh (2016) conducted a study on the Coccinellid fauna of Ankalg Village, Gulbarga, Karnataka, discovering 12 species belonging to 4 different subfamilies and 9 genera [38]. Goswami et al. (2016) performed field experiments to investigate the relative abundance of coccinellid predators in major Rabi oil seeds and pulse crops at Sabour, Bihar, recording 4 species of coccinellid beetles during the Rabi season [39]. Kumar et al. (2017) documented 21 species of predatory coccinellid beetles in the Western plain zone of Uttar Pradesh [40].

Mukherjee and Suman (2017) documented the presence of 10 different species of ladybird beetles in the agroclimatic zone of Bhubaneswar [41]. Sharma et al. (2017) recorded a total of 65 coccinellid species in the agroclimatic zones of Himachal Pradesh [42]. Murali et al. (2017) observed 10 species of coccinellid beetles across various seasons of brinjal crops [43]. Rasheed and Buhroo (2018) collected 13 species of ladybird beetles from agricultural and horticultural crop fields in Kashmir [44]. Jesu Rajan et al. (2018) documented 9 species of coccinellids in vegetable crops from agricultural fields in Hyderabad [45]. Shanker et al. (2018) gathered coccinellid species from 15 genera, representing 5 tribes of the Coccinellidae family, during their research on biodiversity and predatory potential of coccinellids in rice ecosystems in Malan, Himachal Pradesh [46].

Mishra and Yusuf (2019) recorded 15 species of coccinellid beetles from the forest ecosystem of Uttarakhand, India [47]. Kiran et al. (2019) identified 36 species of coccinellid beetles during a survey of the coccinellid fauna in crop fields of North eastern Karnataka [48]. Sundareshwari et al. (2019) observed 6 species of predatory lady beetles in Sivakasi [49].

Table 1.Information on the biodiversity and distribution of different subfamilies within the Coccinellidae family in India [56].

S.No.	Subfamily	Species	Distribution
1.	Chilocorinae	<i>Brumoidessuturalis</i>	North Eastern region of India, Maharastra, West Bengal, Tamilnadu and Gujarat
		<i>Chilochorusnigrita</i>	Southern region of India
		<i>Chilochorussubindicus</i>	Southern region of India
2.	Coccidulinae	<i>Rodoliacardinalis</i>	Southern region of India
		<i>Rodoliafumida</i>	Northern and central region of India
3.	Coccinellinae	<i>CheilomenesSexmaculata</i>	Alloverthecounrty
		<i>CoccinellaSeptempunctata</i>	Whole country
		<i>Harmonisoctomaculata</i>	Wholecountry
		<i>Hippodamiavariegata</i>	Northern region of India
		<i>Illiescincta</i>	Whole country
4.	Epilachninae	<i>Henosepilachna Narayana</i>	Maharashtra, Karnataka
		<i>Henosepilachnaseptima</i>	wholecountry
5.	Scymninae	<i>Cryptogonusorbiculus</i>	North Eastern region of India
		<i>Pseudaspidimerustrinotatus</i>	Southern region of India
		<i>Scymnusnubilus</i>	Southern region of India
		<i>Stethoruspauperculus</i>	Central region of India
6.	Sticholotidinae	<i>Serangiumparcesetosum</i>	Central region of India
		<i>Jauraviaopaca</i>	Karnataka,Maharashtra

		<i>Jauraviasimplex</i>	Southern region of India
		<i>Jauraviapallidula</i>	Maharashtra, Karnataka, Meghalaya, Tamil Nadu, WestBengal

Maqbool et al. (2020) reported 12 species of coccinellids belonging to 11 genera from apple orchard ecosystems in Kashmir Himalayas, India [47]. Das et al. (2020) reported 44 species of coccinellids belonging to 22 genera and 6 tribes from Arunachal Pradesh [50]. Pervez et al. (2020) conducted a field survey exploring the diversity of predaceous ladybird beetles in different geographical habitats of Uttarakhand, North India, identifying 18 species of predaceous ladybird beetles from 15 genera and 3 subfamilies [51]. Thangjam et al. (2020) observed 19 species of coccinellid beetles belonging to 11 genera, predaceous on sucking pests of king chilli in Assam, India [52].

Vasista et al. (2020) documented 9 species of coccinellid beetles in groundnut crop ecosystems in the Rayalaseema Region of Andhra Pradesh [53]. Anitha et al. (2020) recorded 6 species of coccinellids in kharif rice fields in Rajendranagar, Hyderabad [54]. Hirur et al. (2020) conducted a study on the biodiversity and abundance of coccinellids in rabi tomato under sprayed and unsprayed conditions during the rabi season, and they observed 3 species of coccinellids [55].

The works mentioned above collectively reveal that coccinellid beetles inhabit various habitats, including forests, grasslands, and agro-ecosystems. These researchers conducted comprehensive studies on different aspects of coccinellid beetles, collecting specimens for their analyses. Among the collected specimens, *Cheilomenes sexmaculata* emerged as the most dominant predatory coccinellid species across diverse ecosystems. The diversity and abundance of coccinellid beetle species exhibit variations influenced by environmental conditions, agricultural crops, and prey species. Despite the richness and diversity of the coccinellid fauna in the Indian region, a complete understanding is hindered by the limited exploration and collections spanning the entire geographic expanse of India.

Conclusion

In conclusion, this comprehensive review sheds light on the pivotal role of coccinellid beetles, popularly known as ladybird beetles, in the realm of biological pest control. The historical success of introducing the vedalia ladybird (*Rodolia cardinalis* Mulsant) in 1888 to combat the cottony cushion scale in California remains a watershed moment in the field, symbolizing the efficacy of biological control methods. The subsequent global endeavors, totaling 155 attempts, to utilize predaceous ladybird beetles for aphid control underscore their significance in pest management. The spotlight on predaceous ladybird beetles intensifies due to their exceptional

ability to feed on a diverse array of prey, encompassing aphids, coccids, phytophagous mites, adelgids, and aleyrodids. This recognition elevates their status as potent biological control agents, prompting the urgent need for an extensive understanding of their biodiversity in new territories. The call for more information is particularly pertinent considering their potential for biocontrol and sustainable pest management practices. Zooming into the realm of coccinellid beetles globally, researchers from various corners of the world have contributed valuable insights into their diversity and ecological roles. The documentation of diverse coccinellid species in different habitats, from orchards in Hungary to uncultivated areas and agricultural fields in Spain and Pakistan, illustrates the adaptability and ubiquity of these beneficial insects. The surveys conducted in Sri Lanka, Spain, and various regions of India provide a snapshot of the rich tapestry of coccinellid fauna in different geographical contexts. However, the review highlights a persistent gap in our understanding of coccinellid diversity in India. Despite substantial efforts by researchers, the sheer vastness of the country and the diversity of ecosystems demand more comprehensive exploration. The dominance of *Cheilomenes sexmaculata* among collected specimens showcases the adaptability of coccinellids across diverse ecosystems.

In essence, this review encapsulates the global and Indian perspectives on coccinellid beetles, emphasizing their crucial role in biological pest control, ecological balance, and the pressing need for continued research to unlock the full potential of these remarkable insects in sustainable agriculture.

References:

1. Majerus, M. E. N. (1994). Ladybirds. Harper Collins, London. 359 pp.
2. Joshi, S., Mohanraj, P., Rabindra, R. J. and Rao, N. S. (2003). Production and use of coccinellid predators. Technical Bulletin No. 32, Project Directorate of Biological Control, Bangalore, India.
3. Moreira, L. R., Oliveira, E. E., Hatano, E., Pallini, A., Vilela, E. F. and Lima, F. N. B. (2004). Infoguimicos de tomateiro mediam o comportamento de herbívoros? Ceresi, 51: 397-404.
4. Oliveira, E. E., Oliveira, C. L., Sarmiento, R. A., Rezende, L. M. and Fadini, M. A. M. (2004). Aspectos biológicos de predador *Cycloneda sanguinea* (Coleoptera: Coccinellidae) alimentado com *Tetranychus evansi* (Acari: Tetranychidae) *Macrosiphum euphorbiae* (Homoptera: Aphididae). Bioscience Journal, 21: 33-39.
5. Khan, A. A. and Zaki, F. A. (2007). Predation rates of *Coccinella septempunctata* Linnaeus and *Chilocorus infernalis* Mulsant on aphids. Asian Journal of Bio Science, 2: 53-55.
6. Omkar and Parvez, A. (2003). Ecology and biocontrol potential of a scale predator, *Chilocorus nigritus*. Biocontrol Science and Technology, 13: 379-390.

7. Alia, H. (2002). Coccinellid (Coccinellidae: Coleoptera) fauna of District Poonch, Azad and Jammu Kashmir. M. Sc. Thesis submitted to department of Entomology, NWFP Agricultural University, Peshawar. 55pp.
8. Moreton BD. (1969) Beneficial Insects and Mites. Vol. 20. Her Majesty, Stationary Office London. Ministry of Agriculture, Fisheries and Food. Bulletin; Ladybirds and spider mites;. p. 15-20.
9. Khan I, Din S, Khalil SK, Rafi MA. (2007) Survey of predatory coccinellids (Coleoptera: Coccinellidae) in the Chitral district, Pakistan. Journal of Insect Science. Jan 1;7(1):7.
10. Slipinski A. (2013) Australian ladybird beetles (Coleoptera: Coccinellidae): their biology and classification. CSIRO publishing; May 27, 286.
11. Pervez A. (2004) Predaceous coccinellids in India: predator-prey catalogue (Coleoptera: Coccinellidae). Oriental Insects. May 1;38(1):27-61.
12. Poorani J. (2002) An annotated checklist of the Coccinellidae (Coleoptera) (excluding Epilachninae) of the Indian subregion. Oriental Insects. Jan 1;36(1):307-83.
13. Jadhav SS, Sharma RM. (2012) Insecta: Coleoptera: Coccinellidae. Zool. Surv. India Fauna of Maharashtra, State Fauna.;20:507-9.
14. Lovei GL, Sarospataki M, Radwan ZA. (1991) Structure of ladybird (Coleoptera: Coccinellidae) assemblages in apple: changes through developmental stages. Environmental entomology. Oct 1;20(5):1301-8.
15. Colunga-Garcia M, Gage SH, Landis DA. (1997) Response of an assemblage of Coccinellidae (Coleoptera) to a diverse agricultural landscape. Environmental Entomology. Aug 1;26(4):797-804.
16. Franzmann BA. (2002) Hippodamia variegata (Goeze) (Coleoptera: Coccinellidae), a predacious ladybird new in Australia. Australian Journal of Entomology. Oct;41(4):375-7.
17. Irshad M. (2001) Distribution, hosts, ecology and biotic potentials of coccinellids of Pakistan. Pakistan Journal of Biological Sciences.;4(10):1259-63.
18. Zahoor MK, Suhail A, Iqbal J, Zulfaqar Z, Anwar M. (2003) Biodiversity of predaceous coccinellids and their role as bioindicators in an agro-ecosystem. International Journal of Agriculture and Biology.;5(4):555-9.
19. Mayadunnage S, Wijayagunasekara HN, Hemachandra KS, Nugaliyadde L. Predatory Coccinellids (Coleoptera: Coccinellidae) of vegetable insect pests: a survey in mid country of Sri Lanka. Tropical Agricultural Research. 19:69-77.

20. Cotes B, Campos M, Pascual F, Ruano F. (2010) The ladybeetle community (Coleoptera: Coccinellidae) in Southern olive agroecosystems of Spain. *Environmental entomology*. Feb 1;39(1):79-87.
21. Abbas MN, Kausar S, Rana NA. (2013) Diversity and distribution of ladybird beetles (Coccinellidae) in the cropland of Faisalabad District. *International Journal of Advanced Research*.;1:27-33.
22. Hayat AL, Khan MR. (2013) Biodiversity and Species Composition of Lady Bird Beetles (Coccinellidae: Coleoptera) from Mirpur Division of Azad Jammu & Kashmir, Pakistan. *Sarhad J. Agric.*;30(3):341-50.
23. Khormizi ZM, Biranvand A, Shakarami J. (2013) The faunistic survey of lady beetles (Coleoptera: Coccinellidae) in the Mehriz region (Yazd Province), Iran. *Bulletin of the Iraq Natural History Museum* (P-ISSN: 1017-8678, E-ISSN: 2311-9799), 2013;12(4):43-51.
24. Kapur AP. (1968) The Coccinellidae (Coleoptera) of Goa. *Records of the Zoological Survey of India*. Dec 1;66(1-4):309-20.
25. Agarwala BK, Ghosh AK. Prey records of aphidophagous Coccinellidae in India. A review and bibliography. *Tropical Pest Management*, 34:1-14.
26. Joshi PC, Sharma PK. (2008) First records of coccinellid beetles (Coccinellidae) from the Haridwar, (Uttarakhand), India. *Tropical Natural History*. Oct 1;8(2):157-67.
27. Khan AA, Mir RA, Zaki FA. (2007) Relative abundance of predacious ladybird beetle (Coleoptera: Coccinellidae) in Kashmir. *Journal of Aphidology*.;21:23-30.
28. Sharma PK, Joshi PC. (2010) New records of coccinellid Beetles (Coccinellidae: Coleoptera) from District Dehradun (Uttarakhand), India. *New York Science Journal*.;3(6):112-20.
29. Roy S, Rahman A. (2014) A study on the comparative predatory efficiency and development of *Micraspis discolor* (F.) and *Menochilus sexmaculatus* (F.) on tea aphid *Toxoptera aurantii* (Boyer de Fons.). *Zoology and Ecology*. Jul 3;24(3):285-7.
30. Kedar SC, Saini RK, Ram P. (2011) Relative abundance of coccinellid predators associated with *Phenacoccus solenopsis* on Cotton. *Annals of Plant Protection Sciences*. 2011;19(2):475-6.
31. Ghosh SK, Chakraborty K. (2012) Incidence and abundance of important predatory beetles with special reference to *Coccinellaseptempunctata* in sub-Himalayan region of north-east India. *International Journal of Plant, Animal and Environmental Sciences*.;2:157-62.
32. Vinothkumar B. (2013) Diversity of coccinellid predators in upland rainfed rice ecosystem. *Journal of Biological Control*. Sep 4:184-9.

33. Majumder J, Bhattacharjee PP, Agarwala BK. (2013) Diversity, distribution and habitat preference of predacious coccinellids (Coleoptera: Coccinellidae) in agro-and forest habitats of Tripura, northeast India. *International Journal of Current Research*. Mar 19;5(5):1060â.
34. Shah MA, Khan AA. (2014) Assessment of coccinellid biodiversity under pesticide pressure in Horticulture ecosystems. *Indian Journal of Entomology*.;76(2):107-16.
35. Choudhary JS, Naaz N, Mukherjee DE, Prabhakar CS, Maurya S, Das B, et al. Biodiversity and seasonality of predaceous coccinellids (Coleoptera: Coccinellidae) in mango agro-ecosystem of Jharkhand.
36. Megha RR, Vastrad AS, Kamanna BC, Kulkarni NS. (2015) Species complex of coccinellids in different crops at Dharwad region. *Journal of Experimental Zoology (India)*.;18(2):931-5.
37. Ramya HR, Thangjam R. (2016) Predatory coccinellids of insect pests of Assam lemon (*Citrus Limon* L. Burmf) in Jorhat district of Assam. *Journal of Biological control*.;30(2):121-3.
38. Ankalgi S, Murali J. (2016) Diversity and distribution of Coccinellidae (Coleoptera) in Ankalg village (Gulbarga district) Karnataka, India. *International Journal of Basic and Applied Sciences*.;5(1):1-5.
39. Goswami TN, Anil CN. (2016) Ladybird beetles in major Rabi oil seeds and pulse crops at Sabour, Bihar. *Int J Sci Environ Technol*.;5(4):2382-6.
40. Kumar A, Singh R, Prasad CS, Tiwari GN, Kumar S. (2017) New records of predatory coccinellids beetles (Coccinellidae: Coleoptera) in Western plain zone of Uttar Pradesh. *Journal of Entomology and Zoology Studies*.;5(3):1140-7.
41. Mukherjee SK, Suman SS. (2017) Coccinellid beetles diversity in agro-climatic zones of Bhubaneswar. *Journal of Entomology and Zoological Studies*.;5(4):12441248.
42. Sharma PL, Verma SC, Chandel RS, Chandel RP, Thakur P. (2017) An inventory of the predatory Coccinellidae of Himachal Pradesh, India. *Journal of Entomology and Zoology Studies*.;5:2503-7.
43. Murali S, Jalali SK, Shylesha AN, Shivalinga Swamy TM, Gandhi Gracy R. (2017) Relative abundance and species composition of predatory coccinellids fauna in different seasons of Brinjal crop. *Journal of Entomology and Zoology Studies*. 2017;5(5):682-686
44. Rasheed R, Buhroo AA. (2018) Diversity of coccinellid beetles (Coccinellidae: Coleoptera) in Kashmir, India. *Entomon*. Jun 8;43:129-34.

45. Jesu Rajan S, Sree Latha E, K Sneha Madhuri, Vijaya Raghavendra R, Rao CS. (2019) Predatory coccinellids diversity in organic vegetable farming systems: Conservation and mass production. *Journal of Entomology and Zoology Studies*.;7(1):1148-1151.
46. Shanker C, Mohan M, Sampathkumar M, Lydia C, Katti G. (2013) Functional significance of *Micraspis discolor* (F.) (Coccinellidae: Coleoptera) in rice ecosystem. *Journal of Applied Entomology*. Sep;137(8):601-9.
47. Mishra AK, Yousuf MO. (2019) Notes on coccinellid beetles (Coleoptera: Coccinellidae) from forest ecosystem of Uttarakhand, India. *J Biol. Cont. Mar*;33(1):1-6.
48. Kiran S, Prabhuraj A, Hosmani A, Shivaleela, Pampanna Y. (2019) Species composition of predatory coccinellids from different ecosystems of north-eastern Karnataka. *Journal of Farm Science*.;32(4):452-455.
49. Sundareswari C, Sudarmani DNP, Jaya Durkga S. (2019) Diversity and abundance of ladybird beetles in selected agricultural fields of Sivakasi in relation to weather factors. *International Journal of Scientific Research in Biological Sciences*.;6(6):135-137.
50. Das P, Chandra K, Gupta D. (2020) The Ladybird Beetles (Coleoptera: Coccinellidae) of Arunachal Pradesh, East Himalaya, India with new combinations and new country records. *Bonn zoological Bulletin*.;69(1):27-44.
51. Pervez A, Yadav M, Khan M. (2020) Diversity of predaceous coccinellid beetles (Coleoptera: Coccinellidae) in Uttarakhand, North India. *Journal of Mountain Research*.;15:7-20.
52. Thangjam R, Kadam V, Ningthoujam K, Borah RK, Saikia DK. (2020) Diversity and abundance of predatory coccinellid beetles (Coleoptera: coccinellidae) of king chilli (*Capsicum chinense* Jacq.) in Assam, India. *Journal of Entomology and Zoology Studies*.;8(5):178-183.
53. Vasista T, Chalam MS, Hariprasad KV, Mohan Naidu G. (2020) Bio diversity of coccinellid fauna associated with groundnut crop-ecosystem from Rayalaseema region of Andhra Pradesh. *J EntomolZool Stud*.;8(4):1313-9.
54. Anitha G, Shanker C, Shashibhushan V, Srinivas C. (2020) Diversity analysis of coccinellids in Kharif Rice. *Journal of Entomology and Zoology Studies*.;8(4):18761878.
55. Hirur ME, Anitha G, Kumari AD, Devi UG. Diversity of coccinellids in rabi tomato and effect of dimethoate. *Indian Journal of Entomology*. 82(4):781-783.
56. Prince Paul , Kabilan M , Veeramuthu Duraipandiyan, V. Pushpa Rani , Poothapandi Oviya, D. Antony Prabhu , Deon David , Jofy Francis(2023) Biodiversity and Biosystematics of Ladybird Beetles (Coleoptera: Coccinellidae) in India.*The academic*2(1):366-371-1.

57. Muley, E. D., & Chavan, R. J. (2023). Review on diversity of predaceous coccinellid beetles (Coleoptera: Coccinellidae). *Journal of Entomology and Zoology Studies* 11(2): 128-132

UNDER PEER REVIEW