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## Review on diversity of predaceous coccinellid beetles (Coleoptera: Coccinellidae)

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**Abstract**

Coccinellid beetles are predaceous on various insect pests such as aphids, mealy bugs, scale insects, mites, whiteflies and some other soft bodied insects. Literature review shows that they show significant role in control of agricultural and horticultural insect pests. Most of the coccinellid species are predatory in nature and considered as benignant. This review reveals the work done on the diversity of coccinellid beetles and highlights the role of coccinellid beetles as bio control agents of insect pests.

**Keywords:** Diversity, coccinellids, predators, insect pests, benignant

**Introduction**

Coccinellid beetles also called ladybird beetles (Coleoptera: Coccinellidae) are one of the most important groups of predaceous insects. Coccinellids play a major role in biological control of insect pests such as aphids, mealybugs, scale insects, thrips and mites in all parts of the world. (Moreton 1969) <sup>[45]</sup>. Most of the coccinellids are polyphagous, while some are specific to their food choice. (Khan *et al.*, 2007) <sup>[34]</sup>. Coccinellids live in a variety of habitats, including forests, agricultural fields, grasslands, gardens and even in human habitat. Family Coccinellidae includes approximately 6,000 described species worldwide that belong to 360 genera (Slipinski, 2007) <sup>[62]</sup>. The Indian Prey-Predator catalogue of coccinellid beetles (Omkar and Pervez, 2004) comprises record of 261 known predaceous coccinellids of India belonging to 57 genera <sup>[48]</sup>. A checklist of the Coccinellidae of Indian sub-region (Poorani, 2002) includes record of 79 genera and 400 species of ladybeetles along with their distribution in the sub-continent <sup>[52]</sup>. Twenty species of coccinellid beetles under 15 genera and 6 subfamilies were enlisted by Jadhav and Sharma (2012) in the fauna of Maharashtra <sup>[27]</sup>. Coccinellids can help in maintenance of ecological balance by keeping the pest densities low and help in reduction of farmer's dependence on chemical pesticides. The present review article therefore flashes on the major work done on the diversity of predaceous coccinellid beetles.

**Worldwide Status**

Many researchers from different parts of the world have reported various species of Coccinellid beetles which were observed during their studies. Lovei (1981) conducted a study on the composition and diversity of the coccinellid community in an insecticide-treated and untreated block in an apple orchard situated in the forests near Budapest, Hungary <sup>[38]</sup>. Garcia *et al.*, (1997) recorded 13 species of coccinellids from uncultivated habitats <sup>[12]</sup>. Franzmann (2002) reported *Hippodamia variegata* on crops of sorghum, sunflower, Lucerne, triticale, citrus from Austria <sup>[17]</sup>. A review summarizing the distribution, host range, ecology and biotic potential of 71 species of predaceous coccinellids from Pakistan was published by Irshad (2001) <sup>[25]</sup>.

Zahoor *et al.*, (2003) calculated the diversity, richness and evenness of Coccinellids and their role as bio indicators in two types of habitats i.e., crop area and forest area from Faisalabad, Pakistan and collected 22 species of coccinellid beetles <sup>[70]</sup>. Mayadunnage *et al.*, (2007) recorded 15 species of coccinellid beetles in vegetable growing areas of Sri Lanka <sup>[42]</sup>. Cotes *et al.*, (2010) collected 13 species of ladybird beetle from the canopies of olive orchards in southern Spain <sup>[13]</sup>. Abbas *et al.*, (2013) reported 12 species of coccinellid beetles from Faisalabad district, Pakistan <sup>[1]</sup>. Hayat and Khan (2013) collected 51 species of coccinellids from Mirpur Division of Jammu and Kashmir, Pakistan <sup>[20]</sup>.

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11 species of ladybird beetles in Mehriz region, Iran [35]. A study for the assessment of biodiversity and distribution of Coccinellids in five regions of the west Lorestan Province, Iran was conducted by Biranvand *et al.*, (2014) and they collected the specimens of 11 species of coccinellid beetles [8]. Perveen *et al.*, (2014) collected 7 species of coccinellid beetles from Hazara University, Mansehra, Pakistan [50]. Rahaman and Aniszewski (2016) conducted a survey of coccinellid beetle population in Joensuu area, Finland and reported 16 species belonging to 10 genera [53]. Ahmed *et al.*, (2017) collected 9 species belonging to 9 genera and 4 subfamilies district Sargodha, Pakistan [3]. Biranvand *et al.*, (2017) worked out a survey to study the lady beetle community in North East of Iran and recorded 21 species belonging to 16 genera [9]. Hussain *et al.*, (2018) collected the specimens of 14 species of ladybird beetles from different localities of Gujrat, Pakistan [23].

A checklist of the Coccinellidae of Bhutan, comprising 91 species, 17 of which were recorded for the first time from Bhutan was presented by Dorji *et al.*, (2019) [15]. Sajan *et al.*, (2019) carried out a study on the diversity of lady beetle fauna from NARC Khumaltar and Lalitpur, Nepal and collected 14 species of lady beetles belonging to 9 genera [57]. Maulana *et al.*, (2020) conducted a study on diversity of coccinellid beetles in Mount Gede- Pangrango National Park, Bogor, Indonesia and collected 17 species of coccinellids [41]. Louis S. Hesler (2021) reported 4 species of lady beetles from north eastern United states [38]. Coccinellids show a wide range of behaviour and live in almost all the ecosystems of the world including tundra, forest, grassland and agro-ecosystems (Iperti, 1999) [24]. All these works indicate that coccinellid beetles can show high degree of adaptations to different habitats. So, they are considered as potential remedies for bio control of insect pests in different parts of the world.

### Indian Fauna of Coccinellidae

In India, many workers have worked on various aspects of Coccinellid beetles. The diversity of coccinellid beetles is studied by various scientists such as, Kapur (1972) who contributed 17 species of ladybird beetles from Goa [31]. Thirty six species of coccinellid beetles have been reported from India by Agarwala and Ghosh (1988) [2]. Joshi and Sharma (2008) collected and identified 31 species of coccinellid beetles from Haridwar district, Uttarakhand [29].

A survey of coccinellid beetles in Srinagar district of Kashmir, was conducted by Khan *et al.*, (2009) and recorded 15 species of coccinellids from 12 different crop ecosystems [33]. Sharma and Joshi (2010) identified 25 species of predatory Coccinellid beetles from Dehradun [60]. Roy *et al.*, (2010) collected 20 species of coccinellid beetles from tea plantations of North Bengal [56]. Kedar *et al.*, (2011) observed six species of coccinellids from Hissar, Haryana [32]. A study on incidence and abundance of predatory beetles with special reference to *C. septempunctata* in Sub-Himalayan region of North-East India was conducted by Ghosh and Chakraborty (2012). They collected 12 species of coccinellid beetles [18]. Vinothkumar (2013) observed 13 species of coccinellid beetles in rice agroecosystem at Hybrid Rice Evaluation Centre, Tamil Nadu Agricultural University, Gudalur [67]. Majumder *et al.*, (2013) conducted a survey to study the diversity of coccinellid beetles in agricultural and forest habitats of Tripura, Northeast India. They collected about 24 species under 17 genera of coccinellid beetles [39]. A survey on biodiversity of coccinellids in major fruit and vegetable

growing belts of Kashmir valley was worked out by Shah and Khan (2014). They observed the presence of 17 and 15 species of predaceous coccinellids in fruit and vegetable ecosystems respectively [58]. Chaudhary *et al.*, (2014) collected 16 species of predaceous coccinellids in Mango agroecosystems of Jharkhand [11]. Megha *et al.*, (2015) carried out a survey in the crop fields of Dharwad region, India and reported 18 species of coccinellid beetles [43]. 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 [54]. A study on the Coccinellid fauna of Ankalga Village, Gulbarga, Karnataka was carried out by Ankalgi and Jadesh (2016). They collected 12 species belonging to 4 different subfamilies and 9 genera [5]. Goswami *et al.*, (2016) conducted the field experiments to investigate the relative abundance of coccinellid predators in major Rabi oil seeds and pulse crops at Sabour, Bihar and recorded 4 species of coccinellid beetles during Rabi season [19]. Kumar *et al.*, (2017) recorded 21 species of predatory coccinellid beetles in Western plain zone of Uttar Pradesh [37].

Mukherjee and Suman (2017) observed the presence of 10 different species of ladybird beetles around the agroclimatic zone of Bhubaneswar [46]. Sharma *et al.*, (2017) observed total 65 coccinellid species in agroclimatic zones of Himachal Pradesh [61]. Murali *et al.*, (2017) recorded 10 species of coccinellid beetles in different seasons of brinjal crop [47]. Rasheed and Buhroo (2018) collected 13 species of ladybird beetles from agricultural and horticultural crop fields of Kashmir [55]. Jesu Rajan *et al.*, (2018) recorded 9 species of coccinellids in vegetable crops from agricultural fields of Hyderabad [28]. Shanker *et al.*, (2018) collected coccinellid species belonging to 15 genera, under 5 tribes of the family Coccinellidae during their studies on biodiversity and predatory potential of coccinellids of rice ecosystems from Malan, Himachal Pradesh [59]. Mishra and Yusuf (2019) recorded 15 species of coccinellid beetles from forest ecosystem of Uttarakhand, India [44]. Kiran *et al.*, (2019) revealed the presence of 36 species of coccinellid beetles conducted a survey to study the coccinellid fauna in crop fields of North eastern Karnataka [36]. Sundareshwari *et al.*, (2019) observed 6 species of predatory lady beetles from Sivakasi [63]. Maqbool *et al.*, (2020) reported 12 species of coccinellids belonging to 11 genera from apple orchard ecosystems of Kashmir Himalayas, India [44]. Das *et al.*, (2020) reported 44 species of coccinellids belonging to 22 genera and 6 tribes from Arunachal Pradesh [14]. A field survey to was conducted by Pervez *et al.*, (2020) explored the diversity of predaceous ladybird beetles from different geographical habitats of Uttarakhand, North India. During this study, they identified 18 species of predaceous ladybird beetles belonging to 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 from Assam, India [64].

Vasista *et al.*, (2020) reported 9 species of coccinellid beetles from groundnut crop ecosystems from Rayalaseema Region of Andhra Pradesh [66]. Anitha *et al.*, (2020) recorded 6 species of coccinellids in kharif rice fields of Rajendranagar, Hyderabad [4]. Hirur *et al.*, (2020) conducted a study on the biodiversity and abundance of coccinellids in rabi tomato under sprayed and unsprayed conditions during rabi season and on the effect of dimethoate. They observed 3 species of coccinellids [22]. According to all these works cited above,

Coccinellid beetles inhabit different habitats such as forest, grassland, agro-ecosystem etc. All these workers have carried out studies on various aspects of coccinellid beetles and collected the specimens. Among all the collected specimens, *Cheilomenes sexmaculata* was the most dominant predatory coccinellid species found in all the ecosystems. Diversity and abundance of various species of coccinellid beetles varies according to environmental conditions, agricultural crops and prey species. Coccinellid fauna of Indian region is rich and diverse but not completely studied due to the lack of exploration and collections from the entire geographic spread of India.

### Coccinellid Fauna of Maharashtra

Work done on Coccinellid fauna of Maharashtra is not very encouraging and has been found to be restricted to some regions such as Western Ghats, Nashik, Kolhapur, Konkan region and a very few or no work has been found from other parts of Maharashtra. Bharamal *et al.*, (2014) conducted a study of coleopteran fauna of Sindhudurg district, Maharashtra and reported 3 species of coccinellid beetles belonging to 3 genera <sup>[6]</sup>. Bhatnagar (2016) reported 16 species of coccinellids belonging to 14 genera, 3 subfamilies and 6 tribes from Northern-Western ghats region of Maharashtra <sup>[7]</sup>. Walawalkar *et al.*, (2019) carried out a survey to study the coccinellid fauna in the Dapoli area of Konkan region and collected 5 species of coccinellid beetles <sup>[68]</sup>. Patil and Gaikwad (2019) observed 13 species of coccinellid beetles from various agricultural fields of Kolhapur district, Maharashtra, out of which 11 were predatory and 2 were phytophagous species <sup>[49]</sup>.

Shaikh and Dugaje (2020) recorded 14 species of coccinellid beetles belonging to 11 genera under 5 tribes and 4 subfamilies were identified from the agricultural, grassland, forest and human habitat of Nashik, Maharashtra <sup>[69]</sup>. Jadhav *et al.*, (2020) conducted a survey to find out ladybird beetle fauna from various sampling sites of 12 villages in Hatkanangale tahsil having different cropping patterns and recorded 5 species of coccinellid beetles <sup>[26]</sup>. According to all these works, Coccinellid fauna of Maharashtra is sufficiently diverse but not completely studied. More inclusive work on various aspects of coccinellid beetles is needed for the accurate identification of Coccinellid fauna associated with crop ecosystems of various regions in Maharashtra, which will help to apply the accurate bio control strategies in order to reduce the attack of insect pests on agricultural and horticultural crop fields of Maharashtra.

### Conclusion

This review has attempted to assemble all the available and relevant information related with the diversity of coccinellid beetles. Many Zoologists have reported various species of coccinellid beetles that are found in their specific region of survey. Entomologists have verified the role of coccinellids as a potential remedy in biological control of insect pests. The burning question at the end is whether people can be convinced enough to reduce the use of pesticides and switch to biological control. There might be opportunities to create noticeable profits in the field of agriculture by reducing the use of conventional pesticides and thereby increasing the use of several bio control agents including Coccinellid beetles.

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