Article

Catalogue of tri-trophic associations of aphidophagous *Micraspis* Chevrolat species (Coccinellidae: Coleoptera) in India

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Abstract

The current checklist highlights the tri-trophic interactions involving five species of *Micraspis* Chevrolat (Coccinellidae: Coleoptera), namely, *Micraspis allardi* (Mulsant), *Micraspis discolor* (Fabricius), *Micraspis tenuilinea* (Walker), *Micraspis univittata* (Hope), and *Micraspis yasumatsui* Sasaji, recorded from India in association with agricultural fields and orchards. Among them, *Micraspis discolor* is the most polyphagous, preying on 33 aphid species, followed by *Micraspis univittata* with 21, while the remaining species feed on 1 to 11 aphid species. Collectively, these ladybird species are known to consume 41 aphid species that infest 82 food crop plants across 23 Indian states and union territories, resulting in 203 recorded tri-trophic associations. The highest number of such associations has been observed in Uttar Pradesh (54), followed by West Bengal (48), Manipur (28), Odisha (23), and Bihar (21), with other regions reporting between 1 and 15 associations. These *Micraspis* species predominantly prey on aphids such as *Aphis craccivora* Koch, *Aphis gossypii* Glover, *Brevicoryne brassicae* (Linnaeus), *Lipaphis erysimi* (Kaltenbach), *Melanaphis sacchari* (Zehntner), *Myzus persicae* (Sulzer) and *Rhopalosiphum maidis* (Fitch), which infest both field crops (e.g., cereals, pulses, oilseeds, sugarcane, vegetables) and horticultural crops (e.g., citrus, mango, almond, oak, peach). It is important to note that the documentation of these aphidophagous ladybirds in India remains limited, and many states like Arunachal Pradesh, Gujarat, Haryana, Jammu and Kashmir, Jharkhand, Ladakh, and Madhya Pradesh are yet to be thoroughly surveyed, underlining the need for their systematic exploration.

Keywords aphid; biological control; checklist; Coccinellidae; distribution; *Micraspis*; predator; tri-trophic associations.

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1 Introduction

The family Coccinellidae (Coleoptera: Insecta), commonly known as ladybird beetles or ladybugs, comprises a diverse group of small to medium-sized beetles. Globally, the family includes over 6,000 described species

distributed across approximately 360 genera, with representatives found in nearly all terrestrial habitats, from agricultural fields and forests to grasslands and even alpine zones (Hodek et al., 2012). Poorani (2019) reported 550 species in 90 genera within India. However, only 148 coccinellid species were recorded as aphidophagous, preying on 181 aphid species across 350 host plants, resulting in 3,102 tri-trophic associations documented from 31 states and union territories (Singh, 2025). They are known for their predatory habits during larval and adult stages. Many species are aphidophagous, feeding primarily on aphids, while others prey on scale insects, whiteflies, mealybugs, and mites. Some species are fungivorous or phytophagous, though these are relatively few (Obrycki et al., 2009). The aphidophagous coccinellids play a vital role in natural and agroecosystems as biological control agents (Kumar and Omkar, 2023). Their predatory behaviour helps regulate populations of major insect pests, particularly aphids, which are vectors of numerous plant viruses (Singh and Singh, 2016, 2021, 2022). As such, they contribute significantly to integrated pest management (IPM) programs, reducing the need for chemical pesticides. Additionally, their adaptability to diverse environments and ability to colonise new habitats make them excellent indicators of ecosystem health and biodiversity. Thus, they are not only taxonomically and biologically fascinating but also ecologically indispensable allies in sustainable agriculture and biodiversity conservation (Sharma et al., 2025a).

Checklists of aphidophagous ladybirds serve as essential tools in understanding and enhancing the role of these natural predators in the biological control of aphid pests. By systematically documenting the diversity, distribution, host plant associations, and prey preferences of ladybird species, such checklists provide a scientific foundation for ecologically sound pest management strategies (Sharma et al., 2025b). The checklists also help in assessing the regional and national diversity of aphidophagous ladybirds, thereby identifying species richness and endemism. This information is critical for conserving beneficial insects and their habitats, especially in areas undergoing ecological stress or agricultural intensification. By mapping the relationships among ladybird beetles, aphid species, and host plants, checklists facilitate a deeper understanding of tri-trophic interactions (Singh et al., 2025a). Such insights are crucial for selecting suitable predator species for targeted biological control in specific agroecosystems. In addition, the checklists serve as a guide to identify locally adapted, effective predatory species that can be harnessed for classical, augmentative, or conservation biological control. They enable pest management practitioners to avoid reliance on exotic or generalised agents and instead promote the use of native predators, which are more likely to establish and perform effectively (Singh et al., 2025b).

The genus *Micraspis* Chevrolat, 1837 is a member of the tribe Coccinellini (Coccinellinae: Coccinellidae). It includes small to medium-sized, often brightly colored beetles with smooth, convex bodies. These species are found in various parts of Asia, Australasia, and the Indo-Pacific, including India, Southeast Asia, and Australia (Poorani, 2023). Most aphidophagous *Micraspis* species are facultative predators, meaning they consume both pollen (especially rice and maize) and soft-bodied insects like aphids. This pollenophagy supports survival during periods of low aphid density (Rattanapun, 2012; Huang et al., 2022). Their dual feeding habits, adaptability to various habitats, and effectiveness against key aphid pests make them valuable allies in sustainable pest management (Roy and Rahman, 2014). Aphidophagous *Micraspis* are found in several Indian states and union territories, according to surveys of the species (Agarwala and Ghosh, 1988; Omkar and Pervez, 2000a, 2004; Poorani, 2023; Ahmad et al., 2024). However, these surveys do not fully account for their tri-trophic interactions in these states and union territories. The present article examines the tri-trophic relationships involving six species of *Micraspis* across different states and union territories of India. The study reveals that in many parts of the country, these interactions between aphid feeding predators and their prey are still poorly understood. To support the effective use of these natural enemies in aphid management through biological or ecological methods, the provided checklist will be a valuable tool for taxonomists, researchers, scholars, conservation planners, and policymakers.

2 Materials and Methods

This checklist is prepared by using empirical data derived from the existing literature on the association of aphidophagous species of *Micraspis* Chevrolat predators. It includes books, book chapters, journals, conference memoirs, proceedings, government and institutional reports, review articles, and trustworthy theses available until July 25, 2025. The scientific names of the predators, along with their aphid prey and food plants, have been corrected for accuracy following Poorani (2023) for predators, Favret (2025) for aphids, and WFO (2025) for plants.

3 Results and Discussion

Among the seven *Micraspis* species reported from India, five have been identified as aphidophagous (Poorani, 2023): *Micraspis allardi* (Mulsant), *Micraspis discolor* (Fabricius), *Micraspis tenuilinea* (Walker), *Micraspis univittata* (Hope), and *Micraspis yasumatsui* Sasaji. These species are predominantly associated with agroecosystems in northeastern and southern regions of India. *Micraspis discolor* is the most polyphagous, feeding on 33 aphid species, followed by *Micraspis univittata* (21 aphid species), *Micraspis allardi* (11 species), *Micraspis yasumatsui* (8 species), and *Micraspis tenuilinea*, which has been recorded preying on a single aphid species. Detailed information on their morphology, distribution, and prey associations is provided by Poorani (2023). Collectively, these five species have been observed feeding on 40 aphid species that infest 82 host plants across 22 Indian states and union territories, resulting in a total of 200 documented tri-trophic associations (Table 1).

Most of the tri-trophic associations involving *Micraspis* species have been documented from Uttar Pradesh (54 triplets), followed by West Bengal (48 triplets), Manipur (28 triplets), Odisha (23 triplets), and Bihar (21 triplets), with other states reporting between 1 and 15 triplets (Fig. 1). These *Micraspis* species are primarily linked to aphids infesting both agricultural crops, such as cereals, oilseeds, pulses, and vegetables and horticultural crops including almond, citrus, mango, oak, and peach. In addition to predating on aphids, these beetles are also known to feed on pollen in crops like rice and maize (Rattanapun, 2012).

Recently, Ahmad et al. (2024) enlisted 11 species of *Micraspis* in India, two of them *Micraspis guerini* Mulsant and *Micraspis vincta* Gorhum are now recognised as synonyms of *Oenopia guerini* (Mulsant) and *Micraspis univittata* (Hope), respectively. Two other species, *Micraspis crocea* (Mulsant), which is confined to the Philippines, and *Micraspis shaffeei* Afroze and Haider, are likely misidentifications and probably refer to *Micraspis yasumatsui* Sasaji (Poorani, 2023); hence, they are excluded from the current list.

Table 1 Number of species of aphidophagous *Micraspis* preying on aphids infesting different number of host plants in different states/union territories of India.

Predator species	Aphid species	Host plant species	Triplets	States/union territories
1. *Micraspis allardi*	11	19	30	5
2. *Micraspis discolor*	33	73	108	21
3. *Micraspis tenuilinea*	1	1	1	1
4. *Micraspis univittata*	21	29	40	8
5. *Micraspis yasumatsui*	8	8	13	4
6. *Micraspis* spp.	7	10	11	6
Total	**41**	**82**	**203**	**23**

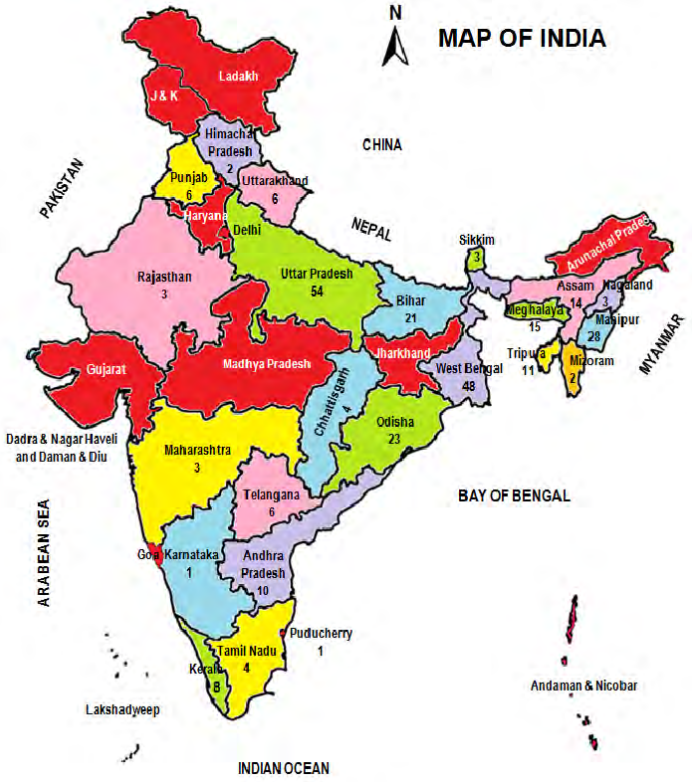

Fig. 1 Map showing the number of tri-trophic associations (triplets) of *Micraspis* species preying on different species of aphids in different states/union territories of India. No species of the predators was recorded in the red shaded states/union territories of India.

Following is the checklist of aphidophagous *Micraspis* species along with their prey aphid species infesting different food plants in several states and union territories of India.

3.1 *Micraspis allardi* (Mulsant, 1866) [syn. *Lemnia allardi* Mulsant, 1866; *Verania allardi* var. *malaccensis* Crotch, 1874; *Verania allardi* (Mulsant, 1866); *Verania malaccensis* Crotch, 1874]

Micraspis allardi measures 3.7-5.2 mm in length and 3.4-4.0 mm in width. The body is subcircular, glabrous and moderately convex. The head is creamy yellow to orange-yellow. Pronotum is creamy yellow or pinkish with a pair of black spots on either side of the scutellar shield on the posterior margin. The elytra are bright pink in live specimens and yellow in preserved specimens, with four black spots (Fig. 2). This is one of the least-studied ladybird species, with limited work on its ecological distribution as a biological control agent. Though it is recorded as preying on leaf hoppers, psyllids and aphids from several states of India, like Bihar, Kerala, Manipur, Meghalaya, Nagaland, Punjab, Sikkim, Tamil Nadu, Uttar Pradesh and Uttarakhand. Elsewhere, it was reported from Afghanistan, Bhutan, China, Indonesia, Myanmar, Nepal, New Guinea, Pakistan, Sri Lanka and the Philippines (Poorani, 2023).

Fig. 2 Photograph of *Micraspis allardi* showing elytral colour variation. Courtsey: Poorani (2023) and Asrar et al. (2023).

In India, the aphidophagy of this species was recorded only in 5 states, Manipur, Punjab, Uttar Pradesh, Uttarakhand and West Bengal, preying on 11 species of aphids feeding on 19 species of plants with 30 tri-trophic associations as mentioned below.

3.1.1 *Aphis aurantii* (Boyer de Fonsc., 1841)

- *Citrus* ×*sinensis* (L.) Osbeck - Punjab (Singh and Sharma, 2010)
- *Citrus reticulata* Blanco - Punjab (Singh and Sharma, 2010)

3.1.2 *Aphis craccivora* Koch, 1854

- *Lablab purpureus* (L.) Sweet - Uttar Pradesh (Omkar and Pervez, 1999; Tiwari et al., 2024)

3.1.3 *Aphis gossypii* Glover, 1877

- *Chrysanthemum indicum* L. - Uttar Pradesh (Tiwari et al., 2024)
- *Citrus* ×*sinensis* (L.) Osbeck - Punjab (Singh and Sharma, 2010)
- *Citrus reticulata* Blanco - Punjab (Singh and Sharma, 2010)
- *Lagenaria siceraria* (Molino) Standl. - Uttar Pradesh (Omkar and Pervez, 1999)
- *Luffa aegyptiaca* Mill. - Uttar Pradesh (Chaudhary and Singh, 2012)
- *Mangifera indica* L. - Uttar Pradesh (Tiwari et al., 2024)
- *Psidium guajava* L. - Uttar Pradesh (Tiwari et al., 2024)
- *Solanum tuberosum* L. - Uttar Pradesh (Raj, 1989; Tiwari et al., 2024)
- Unknown plant - Manipur (Chakrabarti et al., 2012)

3.1.4 *Aphis solanella* Theobald, 1854

- *Capsicum frutescens* L. - Uttar Pradesh (Chaudhary and Singh, 2012)

3.1.5 *Brevicoryne brassicae* (Linnaeus, 1758)

- *Brassica oleracea* L. var. *capitata* - Uttar Pradesh (Omkar and Pervez, 1999)
- *Brassica* sp. - Manipur (Chakrabarti et al., 2012)
- *Brassica rapa* L. - Uttar Pradesh (Tiwari et al., 2024)

3.1.6 *Lipaphis erysimi* (Kaltenbach, 1843)

- *Brassica juncea* (L.) Czern. - Uttar Pradesh (Singh, 2009; Omkar and Pervez, 1999)

• *Brassica oleracea* L. var. *botrytis* - Uttar Pradesh (Tiwari et al., 2024)
• *Brassica rapa* L. - Uttar Pradesh (Tiwari et al., 2024)
• *Brassica* sp. - Manipur (Chakrabarti et al., 2012); Uttarakhand (Pal and Bhatt, 2018)

3.1.7 *Macrosiphum rosae* (Linnaeus, 1758)

• *Rosa indica* L. - Uttar Pradesh (Singh, 2009)

3.1.8 *Myzus persicae* (Sulzer, 1776)

• *Brassica juncea* (L.) Czern. - Uttar Pradesh (Singh, 2009)
• *Citrus* ×*sinensis* (L.) Osbeck - Punjab (Singh and Sharma, 2010)
• *Citrus reticulata* Blanco - Punjab (Singh and Sharma, 2010)
• *Solanum melongena* L.- Uttar Pradesh (Tiwari et al., 2024)
• *Solanum nigrum* L. - West Bengal (Chakrabarti et al., 2012)
• *Solanum tuberosum* L. - Uttar Pradesh (Raj, 1989)

3.1.9 *Rhopalosiphum maidis* (Fitch, 1856)

• *Triticum aestivum* L. - Uttarakhand (Karki et al., 2024)

3.1.10 *Sitobion alopecuri* (Takahashi, 1921)

• *Triticum aestivum* L. - Uttarakhand (Karki et al., 2024)

3.1.11 *Sitobion rosaeiformis* (Das, 1918)

• *Rosa indica* L. - Uttar Pradesh (Singh, 2009)

3.2 *Micraspis discolor* (Fabricius, 1798) [syn. *Coccinella discolor* Fabricius, 1798; *Verania discolor* (Fabricius, 1798)]

Micraspis discolor measures 3.5-5.0 mm in length and 3.0-3.7 mm in width. The body is subcircular to oval, dorsum subhemispherical and convex. The ground colour is orange yellow to reddish. A black marking is present on the posterior half of the head, reaching up to the lower margin of the eyes. Elytral suture is with a thin black stripe (Fig. 3). It is distributed in India, Bangladesh and Sri Lanka (Poorani, 2023). It is very common in rice fields. It mostly preys on aleyrodids, aphids, cicadellids, delphacids, coccids, and eggs of pyralids in sugarcane fields. Being pollenophagous, its role as a predator is rather limited (Shanker et al., 2013). *Micraspis discolor* is well studied ladybird and its biology, food relations and feeding potential (Agarwala et al., 1988; Patro and Behera, 2000; Omkar and Pervez, 2002), development (Omkar et al., 2005; Roy and Rahman, 2014), prey preference (Omkar and Pervez, 2000b) were documented in much detail.

Fig. 3 Photograph of *Micraspis discolor* showing elytral colour variation (Courtsey: https://www.inaturalist.org).

In India, *Micraspis discolor* is widely distributed and its aphidophagy was recorded in 21 states, preying on 33 species of aphids feeding on 70 species of plants with 107 tri-trophic associations (Table 1). Most of the tri-trophic associations were recorded in the northeast states of India (54 triplets), West Bengal (39 triplets), Uttar Pradesh (19 triplets) and Bihar (18 triplets). It is primarily associated to aphids infesting mostly agricultural crops, such as cereals, oilseeds, pulses, and vegetables and horticultural crops including almond, citrus, mango, etc. The detailed account of its tri-trophic associations is mentioned below.

3.2.1 *Acyrthosiphon pisum* (Harris, 1776)

- *Pisum sativum* L. - Manipur (Devi, 1989); West Bengal (Maji et al., 2023)
- *Trigonella foenum-graecum* L. - West Bengal (Bindhani et al., 2020)
- *Vicia faba* L. - Manipur (Devi, 1989)

3.2.2 *Aphis aurantii* Boyer de Fonsc., 1841

- *Camellia sinensis* (L.) Kuntze - Assam (Das et al., 2010; Roy and Rahman, 2014); West Bengal (Das et al., 2010)
- *Citrus limon* (L.) Osbeck - West Bengal (Gurung et al., 2019)

3.2.3 *Aphis citricidus* (Kirkaldy, 1907)

- *Citrus limon* (L.) Osbeck - West Bengal (Gurung et al., 2019; Maji et al., 2023)

3.2.4 *Aphis craccivora* Koch, 1854

- *Arachis hypogaea* L. - Odisha (Shailaja et al., 2014)
- *Cicer arietinum* L. - Bihar (Sharma et al., 1991)
- *Gliricidia maculata* (Kunth) Steud. - Karnataka (Megha et al., 2015)
- *Glycine max* (L.) Merr. - Maharashtra (Muley and Chavan, 2024)
- *Lablab purpureus (*L.) Sweet - Bihar (Prabhakar and Roy, 2010; Ahmad et al., 2020); Manipur (Devi, 1989); Odisha (Patro and Behera, 2000); Sikkim (Chakrabarti et al., 2012); Uttar Pradesh (Omkar et al., 2005; Tiwari et al., 2024); Uttarakhand (Pervez et al., 2020); West Bengal (Poddar, 1982; Gurung et al., 2019)
- *Lathyrus sativus* L. - Bihar (Sharma and Yadav, 1994)
- *Lens culinaris* Medik. - West Bengal (Poddar, 1982)
- *Mussaenda acuminata* Blume - West Bengal (Maji et al., 2023)
- *Phaseolus vulgaris* L. - Bihar (Prabhakar and Roy, 2010); Uttarakhand (Pervez et al., 2020)
- *Psophocarpus tetragonolobus* (L.) DC. - Kerala (Thamilvel, 2009)
- *Solanum melongena* L. - West Bengal (Satpathi and Mandal, 2006)
- *Vicia faba* L. - Bihar (Sharma and Yadav, 1994); Manipur (Devi, 1989); Nagaland (Devi, 1989); Tripura (Agarwala et al., 1988); Uttar Pradesh (Tiwari et al., 2024)
- *Vicia lens* (L.) Coss. and Germ. - Bihar (Sharma and Yadav, 1994)
- *Vigna mungo* (L.) Hepper - Assam (Borah et al., 2012); Odisha (Dash et al., 2023)
- *Vigna radiata* (L.) R. Wiczek - West Bengal (Maji et al., 2023)
- *Vigna unguiculata* (L.) Walp. - Kerala (Thamilvel, 2009); Odisha (Shailaja et al., 2014)

3.2.5 *Aphis gossypii* Glover, 1877

- *Abelmoschus esculentus* (L.) Moench - Bihar (Prabhakar and Roy, 2010); Kerala (Thamilvel, 2009); Odisha (Mohapatra et al., 2022); Tamil Nadu (Shanthi et al., 2020); West Bengal (Gurung et al., 2019; Maji et al., 2023)
- *Acmella uliginosa* (Sw.) Cass. - Telangana (Shanker et al., 2018)
- *Ageratum conyzoides* L. - Manipur (Chakrabarti et al., 2012)
- *Amaranthus tricolor* L. - Kerala (Thamilvel, 2009)

- *Brassica oleracea* L. var. *botrytis* - Manipur (Singh et al., 2002)
- *Capsicum annuum* L. - Kerala (Thamilvel, 2009)
- *Capsicum chinense* Jacq. - Assam (Begam et al., 2016; Thangjam et al., 2020)
- *Capsicum frutescens* L. - West Bengal (Gurung et al., 2019); Uttar Pradesh (Tiwari et al., 2024)
- *Cucumis sativus* L. - Tripura (Agarwala et al., 1988)
- *Glycine max* (L.) Merr. - Maharashtra (Muley and Chavan, 2024)
- *Gossypium hirsutum* L. - Tripura (Saha and Mitra, 2016); West Bengal (Maji et al., 2023)
- *Lagenaria siceraria* (Molino) Standl. - Uttar Pradesh (Omkar et al., 2005); West Bengal (Saha et al., 2016)
- *Momordica charantia* L. - West Bengal (Maji et al., 2023)
- *Phaseolus vulgaris* L. - Bihar (Ahmad et al., 2012)
- *Solanum lycopersicum* L. - Assam (Harshita et al., 2019)
- *Solanum melongena* L. - Assam (Kalita et al., 1998; Borah and Saikia, 2017); Meghalaya (Boruah and Pathak, 2023); Uttar Pradesh (Tiwari et al., 2024); West Bengal (Satpathi and Mandal, 2006; Gurung et al., 2019)
- *Solanum tuberosum* L. - Manipur (Nonita et al., 2002)

3.2.6 *Aphis odinae* (van der Goot, 1917)

- *Lageneria siceraria* (seems misidentification) - Bihar (Ahmad et al., 2012)
- *Mangifera indica* L. - Manipur (Chakrabarti et al., 2012); West Bengal (Maji et al., 2023)

3.2.7 *Aphis pomi*

- *Lagenaria siceraria* (Molino) Standl.- - Bihar (Ahmad et al., 2012)

3.2.8 *Aphis punicae* Passerini, 1863

- *Punica granatum* L. - West Bengal (Maji et al., 2023)

3.2.9 *Aphis solanella* Theobald, 1914

- *Vicia faba* L. - Uttar Pradesh (Chaudhary and Singh, 2012)

3.2.10 *Aphis spiraecola* Patch, 1914

- *Ageratum conyzoides* L. - Tripura (Agarwala et al., 1988)
- *Chromolaena odorata* (L.) R.M.King and H.Rob. - Tripura (Agarwala et al., 1988)
- *Sonchus* sp. - Manipur (Chakrabarti et al., 2012)

3.2.11 *Brachycaudus helichrysi* (Kaltenbach, 1843)

- *Duranta erecta* L. - Manipur (Devi, 1989)

3.2.12 *Brevicoryne brassicae* (Linnaeus, 1758)

- *Brassica oleracea L. var. alboglabra* - Meghalaya (Firake et al., 2012)
- *Brassica oleracea* L. var. *botrytis* - Manipur (Singh et al., 2002); Meghalaya (Firake et al., 2012); Mizoram (Boopathi et al., 2020); Odisha (Shailaja et al., 2014); Rajasthan (Saranya et al., 2022); Uttar Pradesh (Tiwari et al., 2024)
- *Brassica oleracea* L. var. *capitata* - Assam (Sarma et al., 2021); Chhattisgarh (Singh, 2014); Meghalaya (Firake et al., 2012); Odisha (Mandal and Patnaik, 2008); West Bengal (Maji et al., 2023)
- *Brassica oleracea* L. var. *gongylodes* - Meghalaya (Firake et al., 2012)
- *Brassica oleracea* L. var. *italica* - Meghalaya (Firake et al., 2012)
- *Brassica* sp. - Manipur (Chakrabarti et al., 2012)
- *Brassica rapa* L. - Uttar Pradesh (Tiwari et al., 2024)

3.2.13 *Capitophorus elaeagni* (del Guercio, 1894)

- *Cirsium wallichii* DC. - Uttarakhand (Ghosh et al., 1991)

3.2.14 *Ceratovacuna lanigera* Zehntner, 1897

• *Saccharum officinarum* L. - West Bengal (Kumar and Pal, 2022)

3.2.15 *Cervaphis rappardi indica* Basu, 1961

• *Cajanus cajan* (L.) Millsp. - West Bengal (Maji et al., 2023)

3.2.16 *Hayhurstia atriplicis* (Linnaeus, 1761)

• *Chenopodium album* L. - West Bengal (Maji et al., 2023)

3.2.17 *Hyadaphis coriandri* (Das, 1918)

• *Coriandrum sativum* L. - West Bengal (Maji et al., 2023)

3.2.18 *Hyalopterus pruni* (Geoffroy, 1762)

• *Prunus amygdalus* Batsch - Manipur (Devi, 1989)

3.2.19 *Hysteroneura setariae* (Thomas, 1878)

• *Dactyloctenium aegyptium* (L.) Willd. - Kerala (Thamilvel, 2009)

3.2.20 *Lipaphis erysimi* (Kaltenbach, 1843)

• *Brassica juncea* (L.) Czern. - Assam (Das, 2020); Meghalaya (Firake et al., 2012; Damitre, 2019); Odisha (Shailaja et al., 2014); Tripura (Datta, 2020); West Bengal (Ghosh, 1983)

• *Brassica nigra* L. - West Bengal (Ghosh et al., 1981)

• *Brassica oleracea* L. var. *botrytis* - Uttar Pradesh (Tiwari et al., 2024)

• *Brassica oleracea* L. var. *capitata* - Chhattisgarh (Singh, 2014); Mizoram (Boopathi et al., 2020); Rajasthan (Saranya et al., 2022); Uttar Pradesh (Tiwari et al., 2024)

• *Brassica oleracea* L. var. *capitata* - Odisha (Mandal and Patnaik, 2006a); West Bengal (Gurung et al., 2019)

• *Brassica rapa* L. - Bihar (Prabhakar and Roy, 2010; Goswami et al., 2016); Meghalaya (Firake et al., 2012); Tripura (Agarwala et al., 1988); Uttar Pradesh (Tiwari et al., 2024); West Bengal (Gurung et al., 2019; Maji et al., 2023)

3.2.21 *Melanaphis bambusae* (Fullaway, 1910)

• Unknown plant - Uttar Pradesh (Omkar and Pervez, 2002b)

3.2.22 *Melanaphis sacchari* (Zehntner, 1897)

• *Sorghum bicolor* (L.) Moench - Andhra Pradesh (Sharma and Dhillon, 2005); Odisha (Patnaik et al., 1977)

• *Zea mays* L. - Odisha (Patnaik et al., 1977); Uttar Pradesh (Tiwari et al., 2024)

3.2.23 *Myzus persicae* (Sulzer, 1776)

• *Abelmoschus esculentus* Moench - Telangana (Roy and Raghavender, 2024); West Bengal (Gurung et al., 2019)

• *Ageratum conyzoides* L. - Telangana (Shanker et al., 2018)

• *Brassica juncea* (L.) Czern. - Bihar (Prabhakar and Roy, 2010); Meghalaya (Firake et al., 2012)

• *Brassica oleracea* L. var. *alboglabra* - Meghalaya (Firake et al., 2012)

• *Brassica oleracea* L. var. *botrytis* - Manipur (Singh et al., 2002); Meghalaya (Firake et al., 2012); Rajasthan (Saranya et al., 2022)

• *Brassica oleracea* L. var. *capitata* - Meghalaya (Firake et al., 2012); Odisha (Mandal and Patnaik, 2006b)

• *Brassica oleracea* L. var. *gongylodes* - Meghalaya (Firake et al., 2012)

• *Brassica oleracea* L. var. *italica* - Meghalaya (Firake et al., 2012)

• *Brassica rapa* L. - Meghalaya (Firake et al., 2012); West Bengal (Gurung et al., 2019)

• *Capsicum chinense* Jacq. - Assam (Thangjam et al., 2020)

- *Capsicum frutescens* L. - Uttar Pradesh (Tiwari et al., 2024); West Bengal (Gurung et al., 2019)
- *Glycine max* (L.) Merr. - Maharashtra (Muley and Chavan, 2024)
- *Helianthus annuus* L. - West Bengal (Maji et al., 2023)
- *Linum usitatissimum* L. - West Bengal (Gurung et al., 2019)
- *Machilus gamblei* King ex Hook.f. - Assam (Deori et al., 2021)
- *Pisum sativum* L. - Bihar (Ahmad et al., 2012; Parween et al., 2023)
- *Solanum melongena* L. - Assam (Borah and Saikia, 2017); Bihar (Ahmad et al., 2012; Parween et al., 2023); Uttar Pradesh (Tiwari et al., 2024); West Bengal (Satpathi and Mandal, 2006; Gurung et al., 2019)
- *Solanum tuberosum* L. - Bihar (Ahmad et al., 2012; Parween et al., 2023); Manipur (Devi, 1989; Nonita et al., 2002); West Bengal (Nayak et al., 2019; Maji et al., 2023)

3.2.24 *Myzus persicae nicotianae* Blackman, 1987

- *Nicotiana tabacum* L. - Andhra Pradesh (Joshi et al., 1979)

3.2.25 *Pentalonia nigronervosa* Coquerel, 1859

- *Colocasia esculenta* (L.) Schott - Sikkim (Chakrabarti et al., 2012)

3.2.26 *Phorodon cannabis* Passerini, 1860

- *Cannabis sativa* L. - Bihar (Ahmad et al., 2012)

3.2.27 *Rhopalosiphum maidis* (Fitch, 1856)

- *Cenchrus americanus* (L.) Morrone - Uttar Pradesh (Tiwari et al., 2024)
- *Oryza sativa* L. - Andhra Pradesh (Shanker et al., 2013)
- *Triticum aestivum* L. - West Bengal (Gurung et al., 2019)
- *Urochloa ramosa* (L.) T.Q.Nguyen - Telangana (Roy and Raghavender, 2024)
- *Zea mays* L. - Bihar (Kumar and Ahmad, 2017); Odisha (Shailaja et al., 2014); Tamil Nadu (Rekha et al., 2009); Telangana (Roy and Raghavender, 2024); Uttar Pradesh (Omkar et al., 2005; Tiwari et al., 2024); West Bengal (Gurung et al., 2019; Maji et al., 2023)

3.2.28 *Rhopalosiphum nymphaeae* (Linnaeus, 1761)

- *Euryale ferox* Salisb. - Bihar (Saraswati and Ghosh, 1996)
- *Salvinia molesta* D. Mitch. - Sikkim (Chakrabarti et al., 2012)

3.2.29 *Sitobion avenae* (Fabricius, 1775)

- *Triticum aestivum* L. - West Bengal (Maji et al., 2023)

3.2.30 *Sitobion miscanthi* (Takahashi, 1921)

- *Cenchrus americanus* (L.) Morrone - Uttar Pradesh (Tiwari et al., 2024)
- *Triticum aestivum* L. - Bihar (Ahmad et al., 2012); West Bengal (Gurung et al., 2019)

3.2.31 *Sitobion* sp.

- *Zea mays* L. - West Bengal (Maji et al., 2023)

3.2.32 *Tuberculatus paiki* Hille Ris Lambers, 1974

- *Quercus serrata* Murray - Manipur (Devi, 1989)

3.2.33 *Uroleucon compositae* (Theobald, 1915)

- *Carthamus tinctorius* L. - Telangana (Roy and Raghavender, 2024)
- Not mentioned - Uttar Pradesh (Omkar and Pervez, 2002b)

3.2.34 Unknown aphid

- *Moringa oleifera* Lam. - Odisha (Shailaja et al., 2014)
- *Ziziphus mauritiana* Lam. - Odisha (Shailaja et al., 2014)

3.3 *Micraspis tenuilinea* (Walker, 1856) [syn. *Coccinella tenuilinea* Walker, 1859]

Micraspis tenuilinea is a small ladybird measuring 2.7-3.0 mm in length and 2.3-3.0 mm in width. The body is broad, oval to circular, with convex dorsum. The head is silvery white pubescence. The head has a black transverse macula in the posterior half. A pair of triangular black maculae is present on the posterior margin of the pronotum on either side of the scutellar shield. The elytra are orange-yellow to reddish (Fig. 4).

Fig. 4 Photograph of *Micraspis tenuilinea* showing elytral colour variation. Courtsey: https://www.inaturalist.org; Poorani (2023).

It is distributed in Andhra Pradesh, Karnataka, Kerala, Pondicherry, and Tamil Nadu in India, and Sri Lanka (Poorani, 2023). However, *Micraspis tenuilinea* was observed to feed on na single species of aphid in sugarcane fields as mentioned below.

3.3.1 *Melanaphis sacchari* (Zehntner, 1897)

• *Saccharum officinarum* L. - Tamil Nadu (Poorani, 2023)

3.4 *Micraspis univittata* (Hope, 1831) [syn. *Alesia univittata* (Hope, 1831); *Coccinella univittata* Hope, 1831; *Micraspis vincta* (Gorham, 1895); *Tytthaspis univittata* (Hope, 1831); *Verania vincta* Gorham, 1895]

Micraspis univittata is a moderate-sized ladybird measuring 3.0-4.5 mm in length and 2.8-4.4 mm in width. The body is almost circular with a convex and glabrous dorsum. The body is bright carmine red, orange or yellow, while the head and pronotum are reddish or yellowish. A transverse black macula is present on the basal half of the head, reaching up to the posterior margin of the eyes, while a transverse basal black macula and two discal spots above it are present on the pronotum. A pair of thin curved black stripes is present on the elytra, sometimes broken or faint (Fig. 5).

Fig. 5 Photograph of *Micraspis univittata* showing elytral colour variation)Courtsey: https://www.inaturalist.org).

Micraspis univittata is widely distributed almost throughout India, Bhutan, Nepal, China and Myanmar. Like other species, it also preys on aleyrodids, aphids, eggs and larvae of moths on rice, sugarcane, cotton, groundnut, tea, potato, mustard, etc. (Poorani, 2023). Easwaramoorthy et al. (2001) studied its biology and predatory potential on sugarcane pests in Tamil Nadu. In India, aphidophagy of *Micraspis univittata* was recorded in 8 states, preying on 21 species of aphids feeding on 29 species of plants with 40 tri-trophic associations (Table 1). It is primarily associated with aphids infesting mostly agricultural crops, such as cereals, oilseeds, pulses, and vegetables and horticultural crops, including almond, citrus, mango, etc., like *Micraspis discolor*. The detailed account of its tri-trophic associations is mentioned below.

3.4.1 *Acyrthosiphon pisum* (Harris, 1776)

- *Pisum sativum* L. - Manipur (Devi, 1989); Nagaland (Devi, 1989)
- *Vicia faba* L. - Manipur (Devi, 1989); Nagaland (Devi, 1989)
- *Prunus persica* (L.) Stokes - Manipur (Devi and Singh, 1987)
- *Zea mays* L. - Odisha (Patnaik et al., 1977)

3.4.2 *Aphis aurantii* Boyer de Fonsc., 1841

- *Camellia sinensis* (L.) Kuntze - Assam (Das, 1974; Das and Kakoty, 1992)

3.4.3 *Aphis craccivora* Koch, 1854

- *Arachis hypogaea* L. - Odisha (Shailaja et al., 2014)
- *Lablab purpureus (*L.) Sweet - Uttar Pradesh (Omkar and Pervez, 2002b)
- *Vicia faba* L. - Andhra Pradesh (Rao et al., 1997)
- *Vigna unguiculata* (L.) Walp. - Andhra Pradesh (Rao et al., 1997); Odisha (Shailaja et al., 2014); Uttar Pradesh (Tiwari et al., 2024)

3.4.4 *Aphis gossypii* Glover, 1877

- *Capsicum chinense* Jacq. - Assam (Thangjam et al., 2020)
- *Solanum melongena* L. - Andhra Pradesh (Rao et al., 1997); Uttar Pradesh (Omkar and Pervez, 2002b; Tiwari et al., 2024)
- *Vigna mungo* (L.) Hepper - Odisha (Dash et al., 2023)

3.4.5 *Brevicoryne brassicae* (Linnaeus, 1758)

- *Brassica oleracea* L. var. *botrytis* - Uttar Pradesh (Tiwari et al., 2024)
- *Brassica oleracea* L. var. *capitata* - Uttar Pradesh (Omkar and Pervez, 2002b)

3.4.6 *Cervaphis quercus* Takahashi, 1918

- *Quercus serrata* Murray - Manipur (Shantibala et al., 2009)

3.4.7 *Greenidea (Trichosiphum) psidii* van der Goot, 1917

- *Psidium guajava* L. - Uttar Pradesh (Tiwari et al., 2024)

3.4.8 *Hyadaphis coriandri* (Das, 1918)

- *Coriandrum sativum* L. - Uttar Pradesh (Omkar and Pervez, 2002b; Tiwari et al., 2024)

3.4.9 *Hyalopterus pruni* (Geoffroy, 1762)

- *Prunus amygdalus* Batsch - Manipur (Devi and Singh, 1987; Shantibala and Singh, 1987)

3.4.10 *Lipaphis erysimi* (Kaltenbach, 1843)

- *Brassica juncea* (L.) Czern. - Uttar Pradesh (Singh, 2009; Omkar and Pervez, 2002b)
- *Brassica oleracea* L. var. *capitata* - Andhra Pradesh (Rao et al., 1997)
- *Brassica rapa* L. - Uttar Pradesh (Tiwari et al., 2024)
- *Vigna unguiculata* (L.) Walp. - Andhra Pradesh (Rao et al., 1997)

3.4.11 *Macrosiphum rosae* (Linnaeus, 1758)

- *Rosa indica* L. - Uttar Pradesh (Singh, 2009)

3.4.12 *Melanaphis sacchari* (Zehntner, 1897)

- *Saccharum officinarum* L. - Tamil Nadu (Easwaramoorthy et al., 2001)
- *Sorghum bicolor* (L.) Moench - Odisha (Patnaik et al., 1977)
- *Zea mays* L. - Uttar Pradesh (Tiwari et al., 2024)

3.4.13 *Myzus persicae* (Sulzer, 1776)

- *Brassica juncea* (L.) Czern. - Uttar Pradesh (Singh, 2009)
- *Capsicum chinense* Jacq. - Assam (Thangjam et al., 2020)
- *Capsicum frutescens* L. - Uttar Pradesh (Tiwari et al., 2024)
- *Machilus gamblei* King ex Hook.f. - Assam (Deori et al., 2021)
- *Solanum tuberosum* L. - Manipur (Shantibala and Singh, 1985)

3.4.14 *Myzus persicae nicotianae* Blackman, 1987

- *Nicotiana tabacum* L. - Andhra Pradesh (Rao and Jagdishchandra, 1985)

3.4.15 *Rhopalosiphum maidis* (Fitch, 1856)

- *Cenchrus americanus* (L.) Morrone - Uttar Pradesh (Tiwari et al., 2024)
- *Zea mays* L. - Odisha (Shailaja et al., 2014)

3.4.16 *Sitobion miscanthi (Takahashi, 1921)*

- *Cenchrus americanus* (L.) Morr. - Uttar Pradesh (Tiwari et al., 2024)

3.4.17 *Sitobion rosaeiformis* (Das, 1918)

- *Rosa indica* L. - Uttar Pradesh (Singh, 2009)

3.4.18 *Tuberculatus nervatus* Chakrabarti and Raychaudhuri, 1976

- *Quercus serrata* Murray - Manipur (Shantibala et al., 2009)

3.4.19 *Tuberculatus paiki* Hille Ris Lambers, 1974

- *Quercus serrata* Murray - Manipur (Singh et al., 1985)

3.4.20 *Uroleucon compositae* (Theobald, 1915)

- *Carthamus tinctorius* L. - Chhattisgarh (Khandekar et al., 2023)

3.4.21 Unknown aphid

- *Ziziphus mauritiana* Lam. - Odisha (Shailaja et al., 2014)

3.5 *Micraspis yasumatsui* Sasaji, 1968 [syn. *Micraspis shafeei* Afroze and Haider, 1998; *Micraspis crocea* (Mulsant) - misidentified]

Micraspis yasumatsui is a moderately large ladybird measuring 6.2 mm in length and 4.5 mm in width. The body is slightly longer than broad, with a moderately convex glabrous dorsum. The head and pronotum are yellowish-orange. The elytra are brighter reddish or orange and lack the black sutural stripe like other *Micraspis* species (Fig. 6).

Fig. 6 Photograph of *Micraspis yasumatsui* showing elytral colour variation (Courtsey: https://www.inaturalist.org).

Micraspis yasumatsui is commonly found in rice and sugarcane fields in eastern and northeastern India preying on several soft-bodied insects and eggs of pyralid pests. Its aphidophagy was recorded in 4 states of India, preying on 8 species of aphids feeding on 8 species of plants with 13 tri-trophic associations (Table 1). It is primarily associated with aphids infesting mostly agricultural crops, such as cereals, oilseeds, pulses, sugarcane and vegetables. The detailed account of its tri-trophic associations is mentioned below.

3.5.1 *Acyrthosiphon pisum* (Harris, 1776)

• *Pisum sativum* L. - Uttar Pradesh (Afroze, 1997; Afroze and Haider, 1998)

3.5.2 *Aphis craccivora* Koch, 1854

• *Gliricidia maculata* (Kunth) Steud. - Kerala (Reji Rani, 1995)

• *Solanum melongena* L. - West Bengal (Satpathi and Mandal, 2006)

• *Vigna unguiculata* (L.) Walp. - Kerala (Reji Rani, 1995; Sheena, 2003)

3.5.3 *Aphis gossypii* Glover, 1877

• *Capsicum frutescens* L. - West Bengal (Gurung et al., 2019)

• *Solanum melongena* L. - West Bengal (Satpathi and Mandal, 2006; Gurung et al., 2019)

3.5.4 *Ceratovacuna lanigera* Zehntner, 1897

• *Saccharum officinarum* L. - West Bengal (Maji et al., 2023)

3.5.5 *Lipaphis erysimi* (Kaltenbach, 1843)

• *Brassica rapa* L. - Bihar (Karthik et al., 2022)

3.5.6 *Myzus persicae* (Sulzer, 1776)

• *Brassica rapa* L. - Bihar (Karthik et al., 2022)

• *Capsicum frutescens* L. - West Bengal (Gurung et al., 2019)

• *Solanum melongena* L. - West Bengal (Satpathi and Mandal, 2006; Gurung et al., 2019)

3.5.7 *Rhopalosiphum maidis* (Fitch, 1856)

• *Triticum aestivum* L. - West Bengal (Gurung et al., 2019)

3.5.8 *Sitobion miscanthi* (Takahashi, 1921)

• *Triticum aestivum* L. - West Bengal (Gurung et al., 2019)

3.6 *Micraspis* spp.

3.6.1 *Aphis craccivora* Koch, 1854

• *Vigna unguiculata* (L.) Walp. - Puducherry (Angayarkanni and Nadarajan, 2008)

3.6.2 *Aphis gossypii* Glover, 1877

• *Abelmoschus esculentus* (L.) Moench - Chhattisgarh (Chaturvedani et al., 2023)

• *Cucurbita maxima* Duchesne - Tripura (Ghosh et al., 2017)

• *Leucas aspera* (Willd.) Link - Tripura (Ghosh et al., 2017)

• *Melastoma* sp. - Tripura (Ghosh et al., 2017)

• *Solanum melongena* L. - Odisha (Singh et al., 2023)

3.6.3 *Aphis spiraecola* Patch, 1914

• *Leucas aspera* (Willd.) Link - Tripura (Ghosh et al., 2017)

3.6.4 *Eutrichosiphum khasyanum* (Ghosh and Raychaudhuri, 1962)

• *Quercus serrata* Murray - Manipur (Devi, 1989)

3.6.5 *Macrosiphum rosae* (Linnaeus, 1758)

• *Rosa* sp. - Himachal Pradesh (Agarwala et al., 1981a)

3.6.6 *Myzaphis rosarum* (Kaltenbach, 1843)

• *Rosa* sp. - Himachal Pradesh (Agarwala et al., 1981a)

3.6.7 *Myzus persicae nicotianae* Blackman, 1987

• *Nicotiana tabacum* L. - Andhra Pradesh (Joshi et al., 1979)

4 Conclusion

The family Coccinellidae represents one of the most ecologically and economically significant groups of predatory beetles, with aphidophagous species playing a central role in regulating pest populations and supporting sustainable agriculture. In India, despite the remarkable diversity of coccinellids, only a fraction are documented as aphidophagous, underscoring the need for systematic surveys and comprehensive checklists. Such checklists are invaluable for mapping tri-trophic associations, identifying effective native predators, and guiding ecologically sound pest management strategies. The catalogue documents tri-trophic interactions of five aphidophagous Micraspis species in India, primarily in agricultural and orchard ecosystems. Micraspis discolor is the most polyphagous, feeding on 33 aphid species, followed by Micraspis univittata with 21 aphid species. Overall, these ladybirds prey on 41 aphid species across 82 food crops in 23 states and union territories, resulting in 203 tri-trophic associations, with Uttar Pradesh showing the highest number. Their dual role as predators and pollen feeders enhances their adaptability and persistence in agroecosystems, making them reliable allies in integrated pest management programs. However, gaps remain in the documentation of their tri-trophic interactions across several regions of India. The present synthesis highlights the critical importance of continued taxonomic research, biodiversity documentation, and ecological studies to optimize the role of Micraspis and other aphidophagous coccinellids in pest suppression, biodiversity conservation, and the advancement of sustainable agriculture.

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