

Updated checklist of tri-trophic associations of arthropod predators of aphids (*Hemiptera: Aphididae*) in Meghalaya, India

Rajendra Singh

Department of Zoology, Deen Dayal Upadhyaya Gorakhpur University, Gorakhpur, Uttar Pradesh, India

DOI: <https://doi.org/10.66856/ijer.2026.11.2.11190>

Abstract

The present checklist documented 23 aphidophagous predator species belonging to Coleoptera (Coccinellidae) and Diptera (Syrphidae) in Meghalaya, associated with 15 aphid taxa infesting 24 host plant species, forming 123 tri-trophic associations. Coccinellid beetles exhibited greater diversity and broader prey ranges than syrphid flies. Among predators, *Coccinella septempunctata* was the most generalized species, associated with eight aphid species on 15 host plants, accounting for the highest number of triplets (17). *Oenopia sexareata*, *Oenopia kirbyi*, and *Harmonia eucharis* also showed broad trophic associations, preying upon 7–8 aphid species. Among syrphids, *Syrphus torvus* exhibited the widest host range, feeding on three aphid species across eight host plants, particularly within brassicaceous crops. Among aphids, *Brevicoryne brassicae* supported the highest predator diversity, being associated with 12 predator species on seven host plants, resulting in 47 triplets. Likewise, *Aphis gossypii* and *Lipaphis erysimi* formed extensive associations with 10 and 11 predator species, respectively. Host plant analysis revealed that brassicaceous crops formed the major ecological centre of predator–aphid interactions in Meghalaya, particularly involving *Brassica juncea*, *Brassica rapa*, and cultivars of *Brassica oleracea*. In contrast, forest and wild plants such as *Pinus kesiya*, *Quercus serrata*, and *Osbeckia crinita* supported only isolated associations, reflecting limited records from natural ecosystems. The comparatively lower recorded diversity of aphidophagous predators in Meghalaya, despite its rich flora and fauna, is likely due to limited documentation rather than actual ecological scarcity.

Keywords: Aphid, biological control, checklist, ladybirds, hover flies, distribution, predator, tri-trophic associations

Introduction

Aphids (Hemiptera: Aphididae) are among the most destructive groups of phytophagous insects in agricultural and natural ecosystems owing to their rapid reproductive potential, polyphenism, and capacity to exploit a wide range of host plants [18, 31]. By extracting phloem sap, aphids impair plant growth, reduce crop yield and quality, and induce physiological disorders in host plants. More importantly, aphids serve as vectors of numerous economically important plant viruses, making them major pests of cereals, vegetables, horticultural crops, and forest plantations worldwide [23, 30, 32]. Their frequent population outbreaks significantly alter trophic interactions and ecosystem functioning in agricultural landscapes.

In terrestrial food webs, aphids occupy an important ecological position as prey for a diverse assemblage of natural enemies, including parasitoids, predators, and entomopathogenic fungi [7, 14]. Among aphidophagous predators, ladybird beetles (Coleoptera: Coccinellidae) and hover flies (Diptera: Syrphidae) are recognised as highly effective biological control agents in both cultivated and semi-natural ecosystems [13, 19, 20]. Coccinellids are voracious predators whose larvae and adults consume large numbers of aphids, thereby regulating pest populations and contributing substantially to natural pest suppression [14]. Similarly, syrphid larvae play a significant role in aphid regulation, while adults contribute to pollination, thus providing dual ecological services in agroecosystems [16].

The ecological relationships among aphids, their predators, and host plants constitute a tri-trophic interaction network that strongly influences species abundance, distribution, prey selection, and predator efficiency [1, 21]. Host plants directly affect aphid colonisation, nutritional quality, and

defensive chemistry, which subsequently influence predator assemblages and their foraging behaviour [10]. Therefore, understanding predator–aphid–host plant associations is essential for elucidating ecological interactions, conserving beneficial insects, and designing ecologically sustainable integrated pest management programmes [12].

Meghalaya, situated in northeastern India and forming part of the Indo-Burma biodiversity hotspot, encompasses diverse agroecosystems ranging from subtropical and temperate cropping systems to forest-associated agricultural landscapes. The region harbours rich floral diversity and varied climatic conditions that potentially support a wide spectrum of aphids and their natural enemies. However, despite its ecological significance, information on aphidophagous ladybirds and hover flies in Meghalaya remains fragmented and dispersed across taxonomic, faunistic, and crop-specific studies.

Investigations on tri-trophic associations among aphidophagous predators, aphids, and host plants in Meghalaya began with the pioneering work of Rao [22], who reported several syrphid predators associated with aphids such as *Aphis spiraeicola*, *Aphis gossypii*, *Melanaphis sacchari*, and *Rhopalosiphum maidis*, although host plant information remained largely incomplete. Later, Agarwala et al. [2] documented syrphid predators on aphids infesting rose, cotton, maize, and cruciferous crops. A significant contribution was made by Thakur & Barwal [35], who recorded several coccinellid predators, including *Coccinella septempunctata*, *Harmonia eucharis*, *Oenopia kirbyi*, and *Oenopia sexareata*, associated with aphids on diverse crops. Subsequent studies further expanded these records, including *Coelophora bissellata* on *Cervaphis quercus* infesting oak [6]. In recent years, studies have increasingly

focused on brassica-based agroecosystems, documenting diverse predator assemblages associated with *Lipaphis erysimi*, *Brevicoryne brassicae*, *Myzus persicae*, and *Aphis gossypii* on mustard, cabbage, cauliflower, broccoli, turnip, radish, and brinjal [4, 5, 8, 9, 15, 17]. Overall, studies in Meghalaya indicate a transition from preliminary faunistic records to more detailed ecological documentation of predator–aphid–host plant associations.

In view of these limitations, the preparation of a consolidated checklist of tri-trophic associations involving aphidophagous ladybirds and hover flies, their aphid prey, and host plants in Meghalaya is timely and necessary. Such a checklist would provide baseline information on species diversity and ecological interactions facilitate future biodiversity assessments, identify gaps in current knowledge, and support biological control and conservation-based pest management strategies in the agroecosystems of Meghalaya.

Materials & Methods

Site of study

Meghalaya, one of the northeastern states of India and

among the wettest regions of the world, was formed in 1972 following the reorganisation of Assam, incorporating the erstwhile United Khasi and Jaintia Hills district and the Garo Hills district. The state was subsequently reorganised into 11 administrative districts (Figure 1). Bordered by Assam in the north and east and Bangladesh in the south and west, Meghalaya occupies an area of approximately 22,429 km² and lies between 20.1°–26.5°N latitude and 85.49°–92.52°E longitude. The terrain is predominantly mountainous, comprising undulating plateaus, valleys, and elevated highlands that contribute to a highly heterogeneous landscape. The southern Khasi Hills experience exceptionally heavy rainfall, reaching nearly 1,200 cm annually, thereby ranking among the wettest regions on Earth. More than two-thirds of the state is covered by subtropical forests, sustaining remarkable floral and faunal diversity. The landscape is further enriched by an extensive river network that gives rise to numerous waterfalls, particularly in the Khasi Hills. In recognition of its ecological richness, Meghalaya also encompasses four wildlife sanctuaries and two national parks, underscoring its considerable biodiversity and conservation significance.

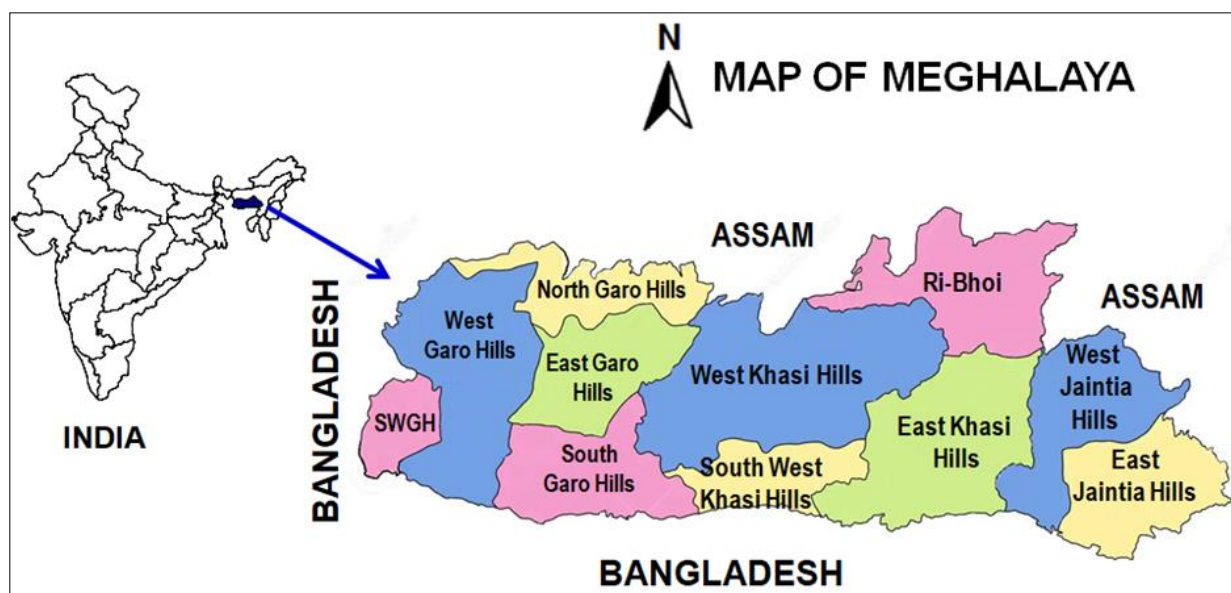


Fig 1: The district map of Meghalaya and its geographic location within India is highlighted in blue shading

The present checklist of tri-trophic associations involving aphidiine parasitoids in Meghalaya was prepared through a comprehensive review of literature published up to 31 May 2026, including monographs, peer-reviewed research articles, theses, and authenticated online resources. A critical assessment of both historical and recent records revealed considerable inconsistencies in the nomenclature of aphids, parasitoids, and host plants, largely attributable to taxonomic revisions, changes in classification systems, and the persistence of outdated synonymies. In addition, recent investigations have documented new host–parasitoid associations and introduced revisions in species identities and nomenclature, highlighting the need for systematic consolidation and standardisation of existing information. To minimise taxonomic ambiguities and ensure the reliability of the dataset, aphid nomenclature was standardised following the Aphid Species File (<https://aphid.speciesfile.org>). Similarly, host plant taxonomy and parasitoid identities were independently

validated using World Flora Online (<https://www.worldfloraonline.org>) and Global Biodiversity Information Facility (<https://www.gbif.org>), respectively. The adoption of this integrative taxonomic verification framework ensured nomenclatural consistency, enhanced taxonomic accuracy, and improved comparability across datasets, thereby strengthening the scientific reliability and robustness of the compiled checklist.

Results & Discussion

The data displayed in Table 1 demonstrate tri-trophic associations between arthropod predators, aphid prey, and host plants in Meghalaya and revealed the occurrence of 23 predator species belonging to only two insect orders, namely Coleoptera and Diptera, represented by the families Coccinellidae and Syrphidae, respectively. Collectively, these predators were associated with 14 aphid species infesting 23 host plant species, forming a total of 123 predator–aphid–host plant triplets.

Table 1: Number of species of predators preying on different number of aphid species infesting different number of host plant species and triplets in Meghalaya

Order/Family	Species of the predators	Number of		
		Aphid species	Plant species	Triplets
Coleoptera/ Coccinellidae	1. <i>Bothrocalvia albolineata</i>	1	1	1
	2. <i>Cheilomenes propinqua</i>	1	1	1
	3. <i>Cheilomenes sexmaculata</i>	2	2	2
	4. <i>Coccinella septempunctata</i>	8	15	17
	5. <i>Coccinella transversalis</i>	2	6	6
	6. <i>Coelophora bissellata</i>	2	2	2
	7. <i>Harmonia dimidiata</i>	1	1	1
	8. <i>Harmonia eucharis</i>	7	8	9
	9. <i>Micraspis discolor</i>	2	2	2
	10. <i>Micraspis</i> sp.	1	5	5
	11. <i>Oenopia kirbyi</i>	8	9	10
	12. <i>Oenopia sexareata</i>	8	10	11
	13. <i>Oenopia</i> sp.	1	5	5
Diptera/Syrphidae	14. <i>Allograpta javana</i>	3	3	3
	15. <i>Betasyrphus isaaci</i>	1	2	2
	16. <i>Betasyrphus serarius</i>	4	4	5
	17. <i>Episyrphus viridaureus</i>	2	7	7
	18. <i>Episyrphus</i> sp.	1	1	1
	19. <i>Eupeodes confrater</i>	2	2	2
	20. <i>Melanostoma orientale</i>	1	5	5
	21. <i>Paragus tibialis</i>	4	4	4
	22. <i>Sphaerophoria macrogaster</i>	1	5	5
	23. <i>Syrphus torvus</i>	3	8	17
Total		14	23	123

Although the documented tri-trophic associations in Meghalaya encompass multiple ecological guilds, the state exhibits comparatively lower taxonomic diversity and interaction complexity than several northwest and northeast Indian states and union territories. The currently known records from Meghalaya are substantially fewer than those reported from Uttar Pradesh (1,098 triplets involving 70 predator species) [24], Uttarakhand (760 triplets and 135 predator species) [25, 33], Jammu & Kashmir (716 triplets and 71 predator species) [27, 34], Manipur (630 triplets and 60 predator species) [26], West Bengal (612 triplets and 125 predator species) [28], and Himachal Pradesh (358 triplets and 74 predator species) [29]. This apparent disparity, however, likely reflects differences in sampling intensity and research effort rather than actual ecological impoverishment, considering Meghalaya's high habitat heterogeneity and exceptional biodiversity.

The coccinellid predators exhibited greater diversity and broader trophic associations than syrphid predators. *Coccinella septempunctata* emerged as the most polyphagous predator, preying upon eight aphid species associated with 15 host plant species and contributing the highest number of tri-trophic interactions (17 triplets). Similarly, *Oenopia sexareata* and *Oenopia kirbyi* demonstrated broad prey ranges, each associated with eight aphid species feeding on 10 and 9 host plant species,

respectively, accounting for 11 and 10 triplets. *Harmonia eucharis* also showed substantial trophic breadth, being linked with seven aphid species on eight host plants, forming nine triplets. In contrast, species such as *Bothrocalvia albolineata*, *Cheilomenes propinqua*, and *Harmonia dimidiata* exhibited narrow host associations, each recorded from a single aphid species on one host plant. The syrphid predators displayed variable degrees of trophic specificity. *Syrphus torvus* represented the most widely associated hover fly species, interacting with three aphid species across eight host plant species and accounting for 17 triplets, reflecting its ecological importance in brassica-based agroecosystems. *Episyrphus viridaureus* was associated with two aphid species on seven host plants, whereas *Betasyrphus serarius* and *Paragus tibialis* preyed upon four aphid species each across four host plant species. Predators such as *Betasyrphus isaaci* showed comparatively restricted associations, being linked with only one aphid species, though occurring on multiple host plants in some instances.

The data displayed in Table 2 documented 15 aphid species infesting 23 host plant species and associated with 23 predator species, forming a total of 123 tri-trophic interactions (triplets) in Meghalaya. Considerable variation was observed in host range and predator associations among aphid species.

Table 2: Number of species of aphids infesting different numbers of host plant species consumed by different numbers of predator species along with tri-trophic associations (triplets) in Meghalaya

Aphid species	Number of		
	Plant species	Predator species	Triplets
1. <i>Acyrtosiphon pisum</i>	1	4	4
2. <i>Aphis craccivora</i>	2	5	5
3. <i>Aphis gossypii</i>	5	10	16
4. <i>Aphis pomi</i>	1	4	4
5. <i>Aphis spiraeicola</i>	4	4	4

6. <i>Brevicoryne brassicae</i>	7	12	47
7. <i>Cervaphis quercus</i>	1	1	1
8. <i>Eulachnus thunbergii</i>	1	1	1
9. <i>Lipaphis erysimi</i>	4	11	16
10. <i>Macrosiphum rosae</i>	1	1	1
11. <i>Melanaphis sacchari</i>	1	1	1
12. <i>Myzus persicae</i>	9	5	15
13. <i>Rhopalosiphum maidis</i>	2	6	6
14. <i>Sitobion rosaeiformis</i>	1	1	1
15. Unidentified aphid	1	1	1
Total	23	23	123

Brevicoryne brassicae exhibited the broadest trophic associations, occurring on seven host plant species and being preyed upon by 12 predator species, resulting in the highest number of triplets (47). *Aphis gossypii* and *Lipaphis erysimi* also showed wide ecological associations, forming 16 triplets each, while *Myzus persicae*, despite infesting the highest number of host plants (9), was associated with only five predator species and 15 triplets. *Rhopalosiphum maidis* and *Aphis craccivora* displayed moderate associations, whereas *Acyrtosiphon pisum*, *Aphis pomi*, and *Aphis spiraeicola* were linked with four predator species each. In contrast, *Cervaphis quercus*, *Eulachnus thunbergii*, *Macrosiphum rosae*, *Melanaphis sacchari*, *Sitobion rosaeiformis*, and an unidentified aphid species exhibited narrow ecological ranges; each associated with a single host plant and predator species. Overall, the results indicate that

a few economically important aphids support diverse predator assemblages and complex tri-trophic interactions, while several aphids maintain highly specialised associations in Meghalaya.

Among the host plants, *Brassica oleracea* var. *capitata* supported the highest predator diversity (12 species) and formed the maximum number of triplets (14), despite being infested by only two aphid species. *Brassica juncea* also exhibited broad trophic associations, harbouring three aphid species and 10 predator species, accounting for 12 triplets (Table 3). Similarly, *Brassica oleracea* var. *alboglabra*, var. *botrytis*, var. *gongylodes*, and var. *italica* each supported two aphid species and eight predator species, contributing nine triplets each. *Brassica rapa* hosted three aphid species and four predator species, forming six triplets.

Table 3: Number of species of plants infested by different numbers of aphid species consumed by different numbers of predator species along with tri-trophic associations (triplets) in Meghalaya

Plant species	Number of		
	Aphid species	Predator species	Triples
1. <i>Bidens pilosa</i>	1	1	1
2. <i>Brassica juncea</i>	3	10	12
3. <i>Brassica oleracea</i>	1	1	1
4. <i>Brassica oleracea</i> var. <i>alboglabra</i>	2	8	9
5. <i>Brassica oleracea</i> var. <i>botrytis</i>	2	8	9
6. <i>Brassica oleracea</i> var. <i>capitata</i>	2	12	14
7. <i>Brassica oleracea</i> var. <i>gongylodes</i>	2	8	9
8. <i>Brassica oleracea</i> var. <i>italica</i>	2	8	9
9. <i>Brassica rapa</i>	3	4	6
10. <i>Colocasia esculenta</i>	1	4	4
11. <i>Gossypium</i> sp.	1	1	1
12. <i>Malus sylvestris</i>	1	4	4
13. <i>Osbeckia crinita</i>	1	1	1
14. <i>Pinus kesiya</i>	1	1	1
15. <i>Pisum sativum</i>	1	4	4
16. <i>Quercus serrata</i>	1	1	1
17. <i>Raphanus sativus</i>	1	1	1
18. <i>Rosa</i> sp.	3	2	3
19. <i>Solanum betaceum</i>	2	4	8
20. <i>Solanum melongena</i>	1	6	6
21. <i>Solanum tuberosum</i>	1	4	4
22. <i>Vicia faba</i>	1	4	4
23. <i>Zea mays</i>	1	5	5
24. Unknown plant	4	3	6
Total	14	23	123

Among non-brassicaceous plants, *Solanum betaceum* supported two aphid species and four predator species, accounting for eight triplets, whereas *Solanum melongena* was associated with one aphid species but six predator species. *Zea mays*, *Pisum sativum*, *Vicia faba*, *Colocasia esculenta*, and *Malus sylvestris* supported moderate trophic interactions.

In contrast, several plants, including *Bidens pilosa*, *Gossypium* sp., *Osbeckia crinita*, *Pinus kesiya*, *Quercus*

serrata, and *Raphanus sativus*, showed narrow associations, each supporting a single aphid and predator species. Overall, brassicaceous crops supported the most complex tri-trophic interactions, highlighting their importance in sustaining aphid predator diversity in Meghalaya agroecosystems.

The comparatively low documented diversity of aphidophagous predators in Meghalaya, despite the state's remarkable floral and faunal richness, is more likely

attributable to inadequate documentation than to actual ecological paucity. In contrast to other north (Jammu & Kashmir, Uttarakhand, Himachal Pradesh), and eastern Himalayan states (Sikkim, Manipur), Meghalaya has been subjected to relatively limited systematic investigations on aphid predators and their tri-trophic associations, with available information largely derived from scattered reports and crop-based studies.

Moreover, Meghalaya's extensive subtropical forests, rugged topography, and diverse natural habitats remain insufficiently explored, while most existing records are concentrated in crucifer-dominated agroecosystems. The state's exceptionally high rainfall and persistent humidity may further suppress aphid populations through wash-off effects, thereby indirectly influencing predator abundance and detectability. In addition, traditional shifting cultivation (jhum) and fragmented agricultural systems may provide less stable habitats for aphids and their associated natural enemies compared with intensively cultivated regions. Therefore, the apparently lower diversity of aphidophagous predators in Meghalaya most likely reflects limited sampling effort and taxonomic underexploration, indicating the potential existence of a substantially richer, yet undocumented, predator fauna in the region.

A detailed account of tri-trophic associations of aphidophagous predators is listed below.

a. Order: Coleoptera: Coccinellidae

1. *Bothrocalvia albolineata* (Gyllenhal, 1808)

- *Eulachnus thunbergii* (Wilson, 1919)
- *Pinus kesiya* Royle ex Gordon ^[11]

2. *Cheilomenes propinqua* (Mulsant, 1850)

- *Aphis gossypii* Glover, 1977
- *Solanum melongena* L. ^[4]

3. *Cheilomenes sexmaculata* (Fabricius, 1781)

- *Aphis gossypii* Glover, 1977
- *Solanum melongena* L. ^[4]
- *Lipaphis erysimi* (Kaltenbach, 1843)
- *Brassica juncea* (L.) Czern ^[5]

4. *Coccinella septempunctata* Linnaeus, 1758

- *Acyrtosiphon pisum* (Harris, 1776)
- *Pisum sativum* L. ^[35]
- *Aphis craccivora* Koch, 1854
- *Vicia faba* L. ^[35]
- *Aphis gossypii* Glover, 1977
- *Colocasia esculenta* (L.) Schott ^[35]
- *Solanum betaceum* Cav. ^[35]
- *Solanum melongena* L. ^[4]
- *Aphis pomi* De Geer, 1773
- *Malus sylvestris* (L.) Mill. ^[3]
- *Brevicoryne brassicae* (Linnaeus, 1758)
- *Brassica oleracea* L. var. *alboglabra* ^[15]
- *Brassica oleracea* L. var. *botrytis* ^[15]
- *Brassica oleracea* L. var. *capitata* ^[35]
- *Brassica oleracea* L. var. *capitata* ^[15]
- *Brassica oleracea* L. var. *gongylodes* ^[15]
- *Brassica oleracea* L. var. *italica* ^[15]
- *Lipaphis erysimi* (Kaltenbach, 1843)
- *Brassica juncea* (L.) Czern ^[5]
- *Brassica rapa* L. ^[8]
- *Myzus persicae* (Sulzer, 1776)
- *Solanum betaceum* Cav. ^[35]
- *Solanum tuberosum* L. ^[35]

- *Rhopalosiphum maidis* (Fitch, 1856)
- *Zea mays* L. ^[35]

5. *Coccinella transversalis* Fabricius, 1781

- *Brevicoryne brassicae* (Linnaeus, 1758)
- *Brassica oleracea* L. var. *alboglabra* ^[15]
- *Brassica oleracea* L. var. *botrytis* ^[15]
- *Brassica oleracea* L. var. *capitata* ^[15]
- *Brassica oleracea* L. var. *gongylodes* ^[15]
- *Brassica oleracea* L. var. *italica* ^[15]
- *Lipaphis erysimi* (Kaltenbach, 1843)
- *Brassica juncea* (L.) Czern ^[5]

6. *Coelophora bissellata* Mulsant, 1850

- *Aphis gossypii* Glover, 1977
- *Solanum melongena* L. ^[4]
- *Cervaphis quercus* Takahashi, 1918
- *Quercus serrata* Murray ^[6]

7. *Harmonia dimidiata* (Fabricius, 1781)

- *Lipaphis erysimi* (Kaltenbach, 1843)
- *Brassica juncea* (L.) Czern ^[5]

8. *Harmonia eucharis* (Mulsant, 1853)

- *Acyrtosiphon pisum* (Harris, 1776)
- *Pisum sativum* L. ^[35]
- *Aphis craccivora* Koch, 1854
- *Vicia faba* L. ^[35]
- *Aphis gossypii* Glover, 1977
- *Colocasia esculenta* (L.) Schott ^[35]
- *Solanum betaceum* Cav. ^[35]
- *Aphis pomi* De Geer, 1773
- *Malus sylvestris* (L.) Mill. ^[3]
- *Brevicoryne brassicae* (Linnaeus, 1758)
- *Brassica oleracea* L. var. *capitata* ^[35]
- *Myzus persicae* (Sulzer, 1776)
- *Solanum betaceum* Cav. ^[35]
- *Solanum tuberosum* L. ^[35]
- *Rhopalosiphum maidis* (Fitch, 1856)
- *Zea mays* L. ^[35]

9. *Micraspis discolor* (Fabricius, 1798)

- *Aphis gossypii* Glover, 1977
- *Solanum melongena* L. ^[4]
- *Lipaphis erysimi* (Kaltenbach, 1843)
- *Brassica juncea* (L.) Czern ^[5]

10. *Micraspis* spp.

- *Brevicoryne brassicae* (Linnaeus, 1758)
- *Brassica oleracea* L. var. *alboglabra* ^[15]
- *Brassica oleracea* L. var. *botrytis* ^[15]
- *Brassica oleracea* L. var. *capitata* ^[15]
- *Brassica oleracea* L. var. *gongylodes* ^[15]
- *Brassica oleracea* L. var. *italica* ^[15]

11. *Oenopia kirbyi* Mulsant, 1850

- *Acyrtosiphon pisum* (Harris, 1776)
- *Pisum sativum* L. ^[35]
- *Aphis craccivora* Koch, 1854
- *Vicia faba* L. ^[35]
- *Aphis gossypii* Glover, 1977
- *Colocasia esculenta* (L.) Schott ^[35]
- *Solanum betaceum* Cav. ^[35]
- *Aphis pomi* De Geer, 1773
- *Malus sylvestris* (L.) Mill. ^[3]

- *Brevicoryne brassicae* (Linnaeus, 1758)
- *Brassica oleracea* L. var. *capitata* [35]
- *Lipaphis erysimi* (Kaltenbach, 1843)
- *Brassica juncea* (L.) Czern [5]
- *Myzus persicae* (Sulzer, 1776)
- *Solanum betaceum* Cav. [35]
- *Solanum tuberosum* L. [35]
- *Rhopalosiphum maidis* (Fitch, 1856)
- *Zea mays* L. [35]

12. *Oenopia sexareata* (Mulsant, 1853)

- *Acyrtosiphon pisum* (Harris, 1776)
- *Pisum sativum* L. [35]
- *Aphis craccivora* Koch, 1854
- *Vicia faba* L. [35]
- *Aphis gossypii* Glover, 1977
- *Colocasia esculenta* (L.) Schott [35]
- *Solanum betaceum* Cav. [35]
- *Solanum melongena* L. [4]
- *Aphis pomi* De Geer, 1773
- *Malus sylvestris* (L.) Mill. [3]
- *Brevicoryne brassicae* (Linnaeus, 1758)
- *Brassica oleracea* L. var. *capitata* [35]
- *Lipaphis erysimi* (Kaltenbach, 1843)
- *Brassica juncea* (L.) Czern [5]
- *Myzus persicae* (Sulzer, 1776)
- *Solanum betaceum* Cav. [35]
- *Solanum tuberosum* L. [35]
- *Rhopalosiphum maidis* (Fitch, 1856)
- *Zea mays* L. [35]

13. *Oenopia* spp.

- *Brevicoryne brassicae* (Linnaeus, 1758)
- *Brassica oleracea* L. var. *alboglabra* [15]
- *Brassica oleracea* L. var. *botrytis* [15]
- *Brassica oleracea* L. var. *capitata* [15]
- *Brassica oleracea* L. var. *gongylodes* [15]
- *Brassica oleracea* L. var. *italica* [15]

b. Order: Diptera, Family: Syrphidae

1. *Allograpta javana* (Wiedemann, 1824)

- *Aphis craccivora* Koch, 1854
- *Rosa* sp. [2]
- *Aphis gossypii* Glover, 1977
- *Gossypium* sp. [2]
- *Rhopalosiphum maidis* (Fitch, 1856)
- *Zea mays* L. [2]

2. *Betasyrphus isaaci* (Bhatia, 1933)

- *Lipaphis erysimi* (Kaltenbach, 1843)
- *Brassica juncea* (L.) Czern [17]
- *Brassica rapa* L. [8]

3. *Betasyrphus serarius* (Wiedemann, 1830)

- *Aphis spiraecola* Patch, 1914
- *Bidens pilosa* L. [2]
- Not mentioned [22]
- *Lipaphis erysimi* (Kaltenbach, 1843)
- *Brassica oleracea* L. [2]
- *Macrosiphum rosae* (Linnaeus, 1758)
- *Rosa* sp. [2]
- *Sitobion rosaeiformis* (Das, 1918)
- *Rosa* sp. [2]

4. *Episyrphus viridaureus* (Wiedemann, 1824)

- *Brevicoryne brassicae* (Linnaeus, 1758)
- *Brassica oleracea* L. var. *alboglabra* [15]

- *Brassica oleracea* L. var. *botrytis* [15]
- *Brassica oleracea* L. var. *capitata* [15]
- *Brassica oleracea* L. var. *gongylodes* [15]
- *Brassica oleracea* L. var. *italica* [15]
- *Lipaphis erysimi* (Kaltenbach, 1843)
- *Brassica juncea* (L.) Czern [17]
- *Brassica rapa* L. [8]

5. *Episyrphus* sp.

- *Brevicoryne brassicae* (Linnaeus, 1758)
- *Brassica oleracea* L. var. *capitata* [35]

6. *Eupeodes confrater* (Wiedemann, 1830)

- *Aphis gossypii* Glover, 1977
- Unknown plant [22]
- *Aphis spiraecola* Patch, 1914
- Unknown plant [22]

7. *Melanostoma orientale* (Wiedemann, 1824)

- *Brevicoryne brassicae* (Linnaeus, 1758)
- *Brassica oleracea* L. var. *alboglabra* [15]
- *Brassica oleracea* L. var. *botrytis* [15]
- *Brassica oleracea* L. var. *capitata* [15]
- *Brassica oleracea* L. var. *gongylodes* [15]
- *Brassica oleracea* L. var. *italica* [15]

8. *Paragus tibialis* (Fallén, 1817)

- *Aphis spiraecola* Patch, 1914
- Not mentioned [22]
- *Melanaphis sacchari* (Zehntner, 1897)
- Not mentioned [22]
- *Rhopalosiphum maidis* (Fitch, 1856)
- Not mentioned [22]
- Unidentified aphid
- *Osbeckia crinita* Benth. [22]

9. *Sphaerophoria macrogaster* (Thomson, 1869)

- *Brevicoryne brassicae* (Linnaeus, 1758)
- *Brassica oleracea* L. var. *alboglabra* [15]
- *Brassica oleracea* L. var. *botrytis* [15]
- *Brassica oleracea* L. var. *capitata* [15]
- *Brassica oleracea* L. var. *gongylodes* [15]
- *Brassica oleracea* L. var. *italica* [15]

10. *Syrphus torvus* Osten Sacken, 1875

- *Brevicoryne brassicae* (Linnaeus, 1758) - *Brassica juncea* (L.) Czern [9]
- *Brassica oleracea* L. var. *alboglabra* [9]
- *Brassica oleracea* L. var. *botrytis* [9]
- *Brassica oleracea* L. var. *capitata* [9]
- *Brassica oleracea* L. var. *gongylodes* [9]
- *Brassica oleracea* L. var. *italica* [9]
- *Brassica rapa* L. [9]
- *Lipaphis erysimi* (Kaltenbach, 1843)
- *Brassica juncea* (L.) Czern [9]
- *Brassica rapa* L. [9]
- *Raphanus sativus* L. [9]
- *Myzus persicae* (Sulzer, 1776)
- *Brassica juncea* (L.) Czern [9]
- *Brassica oleracea* L. var. *alboglabra* [9]
- *Brassica oleracea* L. var. *botrytis* [9]
- *Brassica oleracea* L. var. *capitata* [9]
- *Brassica oleracea* L. var. *gongylodes* [9]
- *Brassica oleracea* L. var. *italica* [9]
- *Brassica rapa* L. [9]

Conclusion

The tri-trophic associations among aphidophagous predators, aphids, and host plants in Meghalaya remains fragmentary despite the state's rich biodiversity and ecological heterogeneity. Available records reveal that coccinellid beetles and syrphid flies constitute the principal aphid predators, with a few generalist species, particularly *Coccinella septempunctata*, *Oenopia kirbyi*, *Oenopia sexareata*, and *Syrphus torvus*, playing important roles in regulating aphid populations across different cropping systems. The predominance of interactions in brassicaceous crops further underscores the ecological importance of these agroecosystems in sustaining predator diversity and natural biological control services. The economically important aphids such as *Brevicoryne brassicae*, *Aphis gossypii*, *Lipaphis erysimi*, and *Myzus persicae* support comparatively complex predator assemblages, whereas several other aphid species exhibit highly specialised and poorly documented associations. However, the currently known diversity of aphidophagous predators in Meghalaya is likely an underestimate, reflecting limited surveys, scattered records, and inadequate exploration of the state's diverse natural and agricultural habitats. Given Meghalaya's varied topography, extensive subtropical forests, and wide range of agroecological conditions, there is substantial scope for uncovering additional predator diversity and previously undocumented trophic linkages. Future investigations integrating systematic field surveys, taxonomic studies, and ecological network analyses across both cultivated and natural ecosystems are essential to improve our understanding of aphid-predator interactions and to strengthen conservation biological control strategies in the region.

References

1. Agrawal AA. Mechanisms, ecological consequences and agricultural implications of tri-trophic interactions. *Current Opinion in Plant Biology*,2000;3(4):329-35. doi: 10.1016/s1369-5266(00)00089-3.
2. Agarwala BK, Laska P, Raychaudhuri DN. Prey records of aphidophagous syrphid flies from India (Diptera: Syrphidae). *Acta Entomologica Bohemoslovaca*,1984;81:15-21.
3. Biswas D, Azad Thakur NS, Gogoi J, Nakambam S. Study on the biodiversity of insects in apple in mid hills of Meghalaya. *Journal of Entomology and Zoology Studies*,2020;8(3):818-823.
4. Boruah S, Pathak M. Insect pests and natural enemy complex of brinjal, *Solanum melongena* L. in Meghalaya. *Indian Journal of Hill Farming*,2023;36(1):62-71.
5. Damitre L. Effect of different temperatures and pesticides on the biological attributes of major coccinellid beetles predating on mustard aphid, *Lipaphis erysimi* Kalténbach. Ph. D. thesis, Nagaland University, Medziphema, Nagaland, 2019, 78. <http://hdl.handle.net/10603/315226>
6. Devi SS. Studies on taxonomy and biology of aphidophagous coccinellids (Coleoptera: Coccinellidae) of Manipur and Nagaland. Ph.D. thesis, Manipur University, Canchipur, Imphal, India, 1989, 263. <http://hdl.handle.net/10603/150284>
7. Dixon AFG. *Aphid Ecology: An Optimization Approach* (2nd ed.). Chapman & Hall, London, 1998, 300.
8. Dwivedi SA, Nameirakpam L, Tomer A. *Brassica-Aphid Interaction*. In: *Brassica-aphid interaction: modulated challenges and sustainable approach for management*, 2021, 21. doi: 10.5772/intechopen.96903
9. Firake DM, Lytan D, Behere GT. Bio-diversity and seasonal activity of arthropod fauna in brassicaceous crop ecosystems of Meghalaya, North East India. *Molecular Entomology*,2012;3(4):18-22. doi: 10.5376/me.2012.03.0004
10. Gebretsadik KG, Liu Z, Yang J, Yang J, Liu H, Qin A, et al. Plant-aphid interactions: recent trends in plant resistance to aphids. *Stress Biology*,2025;5:28. doi: 10.1007/s44154-025-00214-z
11. Ghosh AK, Biswas S, Lahiri AR. A preliminary study of the insect fauna of Meghalaya. 7. Coleoptera: Coccinellidae. *Bulletin of the Meghalaya Science Society*,1977;2:11-15.
12. Gurr GM, Wratten SD, Landis DA, You M. Habitat management to suppress pest populations: Progress & prospects. *Annual Review of Entomology*,2017;62:91-109. doi: 10.1146/annurev-ento-031616-035050
13. Hodek I, Honěk A. *Ecology of Coccinellidae*. Kluwer Academic Publishers, Dordrecht, The Netherlands, 1996, 480.
14. Hodek I, Van Emden HF, Honek I. *Ecology and behavior of ladybird beetles (Coccinellidae)*. Blackwell Publishing Ltd., 2012, 650. doi:10.1002/9781118223208
15. Larinfeli R, Behere GT, Firake DM, Sharma B, Banerjee A, Rajesh T. Biodiversity of natural enemies of cole crops insect pests in mid hills of Meghalaya. *International Journal of Chemical Studies*,2019;7(4):754-758.
16. Li H, Wyckhuys KAG, Wu K. Hoverflies provide pollination and biological pest control in greenhouse-grown horticultural crops. *Frontiers in Plant Science*,2023;14:1118388. doi: 10.3389/fpls.2023.1118388
17. Manpoong NS, Firake DM, Behere GT, Rajesh T. Biological attributes and feeding potential of three dominant predators of *Lipaphis erysimi* (Kaltenbach). *Journal of Biological Control*,2016;30(3):190-194. doi: 10.18311/jbc/2016/15601
18. Ogawa K, Miura T. Aphid polyphenisms: trans-generational developmental regulation through viviparity. *Frontiers in Physiology*,2014;5:1. doi: 10.3389/fphys.2014.00001
19. Omkar, Mishra G. *Syrphid Flies (The Hovering Agents)*. In: Omkar (Ed.), *Ecofriendly Pest Management for Food Security*. Academic Press, 2016, 259-279. doi: 10.1016/B978-0-12-803265-7.00008-7
20. Pervez A, Omkar, Harsue MA. Coccinellids on crops: nature's gift for farmers. In: *Innovative Pest Management Approaches for the 21st century* (Ed. Chakravarthy, A.K.), Springer Nature Singapore Pte Ltd, 2020, 429-460. doi: 10.1007/978-981-15-0794-6_21
21. Price PW, Bouton CE, Gross P, McPherson BA, Thompson JN, Weise AE. Interaction among three trophic levels: Influence of plants on interactions between insect herbivores and natural enemies. *Annual Review of Ecology, Evolution, and Systematics*,1980;11:41-65.
22. Rao VP. Survey of natural enemies of aphids in India. *Final Report of the Commonwealth Institute of Biological Control*,1969;480:1-93.

23. Simon JC, Peccoud J. Rapid evolution of aphid pests in agricultural environments. *Current Opinion in Insect Science*,2018;26:17-24. doi: 10.1016/j.cois.2017.12.009.
24. Singh R. A catalogue of tri-trophic associations of aphidophagous arthropods in Uttar Pradesh, India. *Uttar Pradesh Journal of Zoology*,2025;46(19):158-179. doi: 10.56557/upjoz/2025/v46i195276
25. Singh R. An updated checklist of tri-trophic associations of aphidophagous ladybirds (Coccinellidae: Coleoptera) in different districts of Uttarakhand, India. *Munis Entomology & Zoology*,2026;21(1):537-567.
26. Singh R. Catalogue of tri-trophic associations among aphids (Hemiptera: Aphididae), their predators, and host plants across the districts of Manipur, India. *Munis Entomology & Zoology*,2026;21(2):1870-1915.
27. Singh R, Bhagat RC. An updated checklist of tri-trophic associations of aphidophagous ladybirds (Coleoptera: Coccinellidae) in Jammu Kashmir and Ladakh territories of India. *Munis Entomology & Zoology*,2026;21(1):795-833.
28. Singh R, Shukla A. A catalogue of tri-trophic associations of arthropod predators of aphids (Homoptera: Aphididae) in different districts of Himachal Pradesh, India. *Journal of Fauna Biodiversity*,2026;3(1):1-44.
29. Singh R, Shukla A. An updated checklist of tri-trophic associations of the aphidophagous arthropods in West Bengal, India. *Arthropods*,2026;15(2):90-135.
30. Singh R, Singh G. Aphids and their biocontrol. In: *Ecofriendly Pest Management for Food Security* (Ed. Omkar), Academic Press, 2016, 63–108. doi: 10.1016/B978-0-12-803265-7.00003-8
31. Singh R, Singh G. Reproductive Strategies in Aphids. In: *Reproductive strategies in insects* (Eds. Omkar & Mishra G.), Taylor. & Francis Group, LLC, 2022, 259-282. doi: 10.1201/9781003043195-13
32. Singh R, Srivastav AK. An updated checklist of tri-trophic associations of aphidophagous arthropods in different districts of Uttarakhand, India. *International Journal of Zoological Investigations*,2025;11(2):810-826. doi: 10.33745/ijzi.2025.v11i02.079
33. Singh R, Bhagat RC, Singh A. An updated checklist of tri-trophic associations of aphidophagous predatory arthropods in Jammu & Kashmir and Ladakh, India. *Uttar Pradesh Journal of Zoology*,2025;46(21):177-198. doi: 10.56557/upjoz/2025/v46i215339.
34. Thakur NSA, Barwal RN. Record of parasites and predators on some insect pests in Meghalaya, India. *Journal of Biological Control*,1987;1(2):144. doi: 10.18311/jbc/1987/15432