www.nesa-india.org • E-mail: nesapublications@gmail.com
International Journal on Biological Sciences

International Journal on Biological Sciences
ISSN No.: 0976-4518 • Vol. 16 (Iss. 1) January-June 2025, Pp. 31-55
https://doi.org/10.53390/IJBS.2025.16105

TRITROPHIC ASSOCIATIONS OF APHIDOPHAGOUS HOVER FLIES *MELANOSTOMA, PARAGUS* AND *SPHAEROPHORIA* SPECIES (SYRPHINAE: SYRPHIDAE: DIPTERA) IN DIFFERENT STATES AND TERRITORIES OF INDIA

Rajendra Singh[1]* and Raina Nivedita Samuel[2]

[1]Department of Zoology, DDU Gorakhpur University, Gorakhpur (U.P.), India
[2]Deparetment of Zoology, St. Andrews College, Gorakhpur (U.P.), India

Research Paper

Received: 18.05.2025 **Revised:** 10.06.2025 **Accepted:** 20.06.2025

ABSTRACT

This article examines the tri-trophic interactions involving hover flies that prey on aphids. *Melanostoma orientale* (Wiedemann) and *Melanostoma univittatum* (Wiedemann) consume 9 and 3 aphid species, respectively. All *Paragus* Latreille species have been documented on 38 aphid species that infest 81 food plant species across 18 states and union territories of India. Among them, the most polyphagous was *Paragus serratus* (Fabricius), which consumes 23 species of aphids feeding on 59 species of plants, while *Paragus tibialis* (Fallén) preys on 17 species of aphids infesting 20 species of plants. Similarly, all species of *Sphaerophoria* Lepeletier & Serville have been documented on 22 aphid species that infest 41 food plant species across 15 states/union territories in India. Among them, the most polyphagous *Sphaerophoria indiana* Bigot consumes 15 species of aphids that live on 20 species of plants, while *Sphaerophoria scripta* (Linnaeus) feeds on 13 species of aphids from 27 species of plants. It is noteworthy that documentation efforts for these aphidophagous hover flies in India have been minimal. Numerous regions remain unassessed, emphasising the necessity for a comprehensive survey plan to discover these species in those areas.

No. of Pages: 25 **References: 142**

Keywords: Aphid, *Melanostoma, Paragus, Sphaerophoria*, Tri-trophic associations.

INTRODUCTION

While biological control and pollination can influence crop yield and interact with each other, they are often researched separately since different groups of arthropods typically deliver each ecosystem service; for instance, bees and butterflies are effective pollinators (productive by nature) (Bartomeus *et al.,* 2014), while ladybird beetles, lacewings, and spiders act as insect predators (protective by nature) (Omkar, 2023). From the viewpoint of sustainable crop management, it would be extremely advantageous to obtain both pollination and biological pest control services from the same insect species simultaneously. Hover flies, also known as flower flies (Syrphidae: Diptera), are notably strong contenders for providing dual ecosystem services as they play a crucial role in providing biological pest control and pollination services in natural and agricultural ecosystems at the same time (Wahengbam *et al.,* 2019). These ecosystem services can greatly affect crop yield while also providing the advantage of naturally controlling pests without the need for harmful pesticides. Nonetheless, to the best of our understanding, the concurrent delivery of biological control and pollination by the

*Corresponding author: *rsinghgpu@gmail.com*

same species of hover fly has not been properly investigated.

The hover flies include more than 6,600 species, primarily found in the Neotropical, Nearctic, and Palaeotropical regions across the globe (Dunn *et al.,* 2020). The mature individuals of many hover fly species depend on flowers for nectar and pollen, which act as an energy source; thus, they contribute to the pollination of numerous plant species, including vital crops. Approximately one-third of hover fly species have larvae that are ferocious predators, mainly feeding on aphids and other soft-bodied agricultural pests (Ghorpadé, 1981). Although insect pollination and natural biological control provide major benefits, growing evidence shows that human-driven factors like pollution, land use changes, habitat fragmentation, and climate change are adversely affecting insect populations globally, including important crop pollinators such as wild bees (Wahengbam *et al.,* 2019; Prakash and Verma, 2022; Singh *et al.,* 2023). Tackling these problems demands an all-encompassing approach that involves safeguarding alternative crop pollinators and their natural adversaries. The recent checklists of Indian Syrphidae illustrate their presence in various states and union territories, omitting details about their prey or host plants (Mitra *et al.,* 2015; Sengupta et al., 2016, 2024).

The aphids (Hemiptera: Aphididae) are soft-bodied sap-feeding insects. Nearly 250 species of aphids are significant pests for both agricultural and horticultural plants (Singh and Singh, 2016). Their achievements can be credited to numerous unique characteristics, such as polyphagy, an atypical reproductive method, development, and polymorphism. They can reproduce through parthenogenesis, zygogenesis, or pedogenesis, depending on environmental conditions and the presence of food plants. They might exhibit both viviparity and oviparity (Singh and Singh, 2022). Under appropriate conditions, the population of aphids quickly exceeds economically critical levels. They attack all parts of the plants, including the roots. They harm the plants directly by extracting their nutrients, resulting in the curling and twisting of delicate shoots and an overall weakening of plants, particularly those significant to agriculture and horticulture (Singh and Singh, 2019). Various aphid species serve as vectors for more than 200 viruses that detrimentally affect plants (Singh and Singh, 2021). In nature, numerous species of parasitoids and predators control their population (Singh, 2001). In addition to hover flies, ladybird beetles (Coccinellidae: Coleoptera), lacewings (Neuroptera), predatory bugs (Anthocoridae: Hemiptera) and spiders (Araneae: Arachnida) are some of the most promising predators. In biological pest control initiatives, numerous species of these insects have been utilized as biological agents to tackle different aphid pest species (Singh, 2001; Ballal and Yamada, 2016; Singh and Singh, 2022; Omkar, 2023).

The current article addresses the tri-trophic relationships involving species from three genera of aphid-eating hover flies, *Melanostoma* Schiner, 1860*; Paragus* Latreille, 1804 and *Sphaerophoria* Lepeletier and Serville, 1828. *Melanostoma* Schiner species are widely distributed, covering much of Europe, the Near East, North Africa, and some areas of the Afrotropical region. It is also distributed in the Indomalayan region, reaching New Guinea. In the Palearctic area, it extends from the Atlantic Ocean to the Pacific Ocean comprising 60 valid species; *Paragus* Latreille species have broad distribution, encompassing most continents except South America and Antarctica consisting 108 species (Thompson and Ghorpadé, 1988); and the genus *Sphaerophoria* Lepeletier and Serville has a wide distribution, encompassing the Oriental, Holarctic, Northern Afrotropical, and Australian regions including 73 species (GBIF Secretariat, 2025). The larvae of hover flies from these genera consume aphids and various other soft-bodied insects (Ghorpadé, 1981; Joshi *et al.,* 2023). Recently, Ahmad and Kumari (2024) documented aphid prey along with their host plants for several species in these genera, but did not discuss their distribution.

The main objective of this article is to describe the tri-trophic interactions among species of these three genera across different states and union territories in India. From this information, the tri-trophic relationship involving these aphid-eating predators is still mostly unclear in many regions of India. This checklist acts as a vital resource for taxonomists, researchers, academics, conservation managers, and policymakers to ensure that these natural enemies are utilized in the natural or biological management approaches for these aphids.

MATERIAL AND METHODS

This checklist relies on the primary data from existing literature regarding aphidophagous predators, such as books, chapters from books, journals, conference proceedings, review articles, and several credible theses up to April 10, 2025. The mistakes in the

scientific names of the predators, their aphid prey, and food plants are rectified due to their altered status and various nomenclatural decisions and clarifications. The names of aphids and plants that were incorrectly spelled in the original records have been amended wherever we reasonably determine the intended species. The current checklist aims to present the accurate scientific names of the predators in accordance with GBIF Secretariat (2025), aphids as per Favret (2025), and the plants based on WFO (2025). Only the synonymy of aphid predators is provided, and for the synonymy of aphids and their host plants, referenced sources can be checked. Mulitple references are avoided.

RESULTS AND DISCUSSION

[I] Species of *Melanostoma* Schiner, 1860

A largely reduced, spearhead-shaped metasternum is a diagnostic character for the genus *Melanostoma*. Also, the female *Melanostoma* species have distinctive inverted yellow triangle abdominal markings (Mengual, 2019). Only three species of *Melanostoma*: *Melanostoma orientale* (Wiedemann), *Melanostoma pedium* (Walker, 1852), and *Melanostoma univittatum* (Wiedemann), were observed in India (Ghorpadé, 1981; Sengupta et al., 2016; Singh and Samuel, 2024); however, the aphid prey is not known for *Melanostoma pedium*. Other two species can be identified by observing their face; if face in profile with two distinct small bumps, it belongs to *Melanostoma orientale* and if face in profile forming a single bumps it belongs to *Melanostoma univittatum*. Also, *Melanostoma orientale* typically has a glossy black body with yellow patches or bands on the abdomen while *Melanostoma univittatum* has a similar glossy black body but shows distinct yellow or brown stripes and bands.

The most polyphagous of them, *Melanostoma orientale* (Wiedemann), feeds on 9 species of aphids, whereas *Melanostoma univittatum* (Wiedemann) feeds on only 3 species of aphids. All these species are recorded on 12 species of aphids infesting 15 species of food plants in 8 states/union territories of India (Table 1). Most of the tri-trophic associations (triplets) of species of *Melanostoma* Schiner are reported in Uttarakhand (8 triplets) followed by Himachal Pradesh (7 triplets), Punjab (5 triplets), Sikkim (4 triplets), West Bengal (3 triplets) and Bihar (only one triplet). Sengupta et al. (2016, 2020) reported both species from 14 states and union territories of India based on the collections of adult flies using insect sweep nets, different type of traps like malaise trap, pan trap and UV light traps in both agricultural and wild habitats without giving identity of their preys.

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

Predator species	Number of			
	Species of aphid preys	Species of host plants	Triplets	States/union territories
Melanostoma orientale	9	10	15	6
Melanostoma univittatum	3	5	5	2
Melanostoma spp.	3	2	3	1
Total	**12**	**15**	**23**	**8**

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

A. *Melanostoma orientale* (Wiedemann, 1824) [syn. *Syrphus orientalis* Wiedemann, 1824; Type locality: India]

Melanostoma orientale (Fig. 1) is found in Bhutan, China, India, Japan, Nepal, Pakistan, the Russian Federation, and Sri Lanka (Shehzad *et al.,* 2017; Sengupta *et al.,* 2016; Yang *et al.,* 2020; Dyola *et al.,* 2024). In India, it is recorded in 11 states/union territories (Sengupta et al., 2016); however, instances of aphidophagy in its larvae have been documented only in 6 states, Bihar, Himachal Pradesh, Punjab, Sikkim, Uttarakhand, and West Bengal. The biology of *Melanostoma orientale* is not well understood.

Fig. 1. Photographs of adult *Melanostoma orientale*. Courtsey: https://inaturalist.org

Its larvae were noted to consume 9 species of aphids that feed 10 species of plants predominantly in northwest India (Punjab, Himachal Pradesh, Uttarakhand). The specific tri-trophic relationships are described below.

1. ***Aphis clematidis* Koch, 1854**
   - *Clematis buchananiana* Wall. - Uttarakhand (Ghosh *et al.,* 1985)
2. ***Aphis craccivora* Koch, 1854**
   - *Solanum melongena* L. - West Bengal (Satpathi and Mandal, 2006)
3. ***Aphis gossypii* Glover, 1877**
   - *Solanum melongena* L. - West Bengal (Satpathi and Mandal, 2006)
4. ***Brevicoryne brassicae* (Linnaeus, 1758)**
   - *Brassica juncea* (L.) Czern. - Uttarakhand (Ghosh et al., 1985; Debnath, 1991)
   - *Brassica oleracea* L. - Uttarakhand (Ghosh *et al.,* 1985; Debnath, 1991)
   - *Brassica rapa* L. - Uttarakhand (Bisht *et al.,* 2006; Debnath, 1991)
5. ***Lipaphis erysimi* (Kaltenbach, 1843)**
   - *Brassica juncea* (L.) Czern - Punjab (Sharma *et al.,* 1997)
   - *Brassica rapa* L. - Uttarakhand (Bisht *et al.,* 2006)
   - *Sinapis* sp. - Himachal Pradesh (Agarwala et al., 1984); Punjab (Agarwala *et al.,* 1984); Sikkim (Agarwala *et al.,* 1984)
6. ***Melanaphis sacchari* (Zehntner, 1897)**
   - *Saccharum officinarum* L. - Himachal Pradesh (Agarwala et al., 1984); Punjab (Agarwala et al., 1984); Sikkim (Agarwala et al., 1982)
7. ***Myzus persicae* (Sulzer, 1776)**
   - *Brassica rapa* L. - Bihar (Parween et al., 2023)
   - *Solanum melongena* L. - West Bengal (Satpathi and Mandal, 2006)
8. ***Rhopalosiphum maidis* (Fitch, 1856)**
   - *Hordeum vulgare* L. - Himachal Pradesh (Agarwala et al., 1984); Punjab (Agarwala et al., 1984); Sikkim (Agarwala et al., 1982)
   - *Triticum aestivum* L. - Uttarakhand (Ghosh et al., 1985; Debnath, 1991)
9. ***Sitobion rosaeiformis* (Das, 1918)**
   - *Rosa* sp. - Himachal Pradesh (Agarwala et al., 1981); Punjab (Agarwala et al., 1984); Sikkim (Agarwala et al., 1984)

B. *Melanostoma univittatum* (Wiedemann, 1824) [syn. *Syrphus cyathifer* Walker, 1856; *Syrphus planifacies* Macquart, 1848; *Syrphus univittatum* Wiedemann, 1824; Type locality: India]

Melanostoma univittatum (Fig. 2) is a slender hover fly, characterized by a consistently shiny dark green face and large red eyes that touch at the top in males and are broadly apart in females. It is commonly found in southeast Asia (India, Indonesia, Nepal, Sri Lanka, Thailand), New Caledonia, and Australia (GBIF Secretariat, 2025). In India, it is extensively found across 17 states and union territories (Mitra et al., 2015; Sengupta et al., 2016; Maruthadurai, 2023). The biology of this species is not well understood.

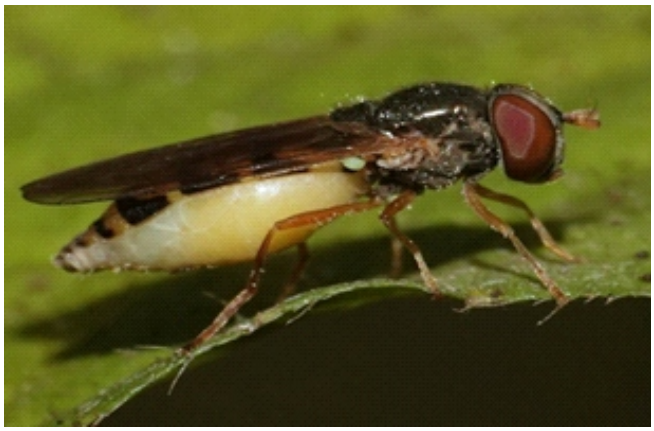

Fig. 2: Photographs of adult *Melanostoma univittatum*. Courtsey: https://www.gbif.org

The aphid prey of its larvae has only been recorded in Jammu and Kashmir and Uttarakhand. It was noted to target solely 3 aphid species that feed on 5 plant species. The specific tri-trophic relationships are provided below.

1. ***Acyrthosiphon pisum* (Harris, 1776)**
   - *Pisum sativum* L. - Jammu and Kashmir (Bhat and Bhagat, 2017)
2. ***Aphis craccivora* Koch, 1854**
   - *Phaseolus vulgaris* L. - Jammu and Kashmir (Bhat and Bhagat, 2017)
     Rumex nepalensis Spreng. - Jammu and Kashmir (Bhat and Bhagat, 2017)
3. ***Lipaphis erysimi* (Kaltenbach, 1843)**
   - *Brassica rapa* L. - Jammu and Kashmir (Ahmad and Bhat, 1986; Bhat and Bhagat, 2017); Uttarakhand (Bisht et al., 2006)
     Cucumis sativus L. - Uttarakhand (Bisht et al., 2006)

C. *Melanostoma* spp.

It may consist either of the above species. The tri-trophic associations are mentioned below.

1. ***Rhopalosiphum padi* (Linnaeus, 1758)**
   - *Triticum aestivum* L. - Himachal Pradesh (Dixit et al., 2019)
2. ***Sitobion avenae* (Fabricius, 1775)**
   - *Triticum aestivum* L. - Himachal Pradesh (Dixit et al., 2019)
3. ***Rhopalosiphum maidis* (Fitch, 1856)**
   - *Zea mays* L. - Himachal Pradesh (Ankita et al., 2021)

[II] Species of *Paragus* Latreille, 1804

The genus *Paragus* comprises 108 valid species and is widely distributed on all continents except for South America and Antarctica (Vujić et al., 2008), including 54 species from the Palaearctic (Khaghaninia and Hosseini, 2013) and 24 species from the entire Oriental region (Sorokina, 2009). *Paragus* species are recognized for their small to moderately sturdy size, slender structure, and unique characteristics such as a black or light-tipped thorax, typically featuring a vibrant red-orange to black abdomen, and a yellow face (Hassan et al., 2018). Twelve species of *Paragus* were recorded in India (Ghorpadé, 1981; Sengupta et al., 2016); however, the aphid prey is known only for following 8 species: *Paragus auritus* Stuckenberg, *Paragus bicolor* (Fabricius), *Paragus crenulatus* Thomson, *Paragus indicus* (Brunetti), *Paragus rufocinctus* (Brunetti), *Paragus serratus* (Fabricius), *Paragus tibialis* (Fallén) and *Paragus yerburiensis* Stuckenberg (Table 2).

The most polyphagous of them, *Paragus serratus*, feeds up on 23 species of aphids feeding on 59 species of plants, whereas *Paragus tibialis* feeds up on 17 species of aphids feeding on 20 species of plants. All these species are recorded on 38 species of aphids infesting 81 species of food plants in 18 states/union territories of India (Table 2). Most of the tri-trophic associations (triplets) of *Paragus* species are reported in Karnataka (36 triplets) followed by West Bengal (26 triplets), Manipur (22 triplets), Tamil Nadu (20 triplets), Uttar Pradesh (19 triplets), Uttarakhand and Bihar (15 triplets each) and in other states 1-11 triplets (Fig. 3).

Table 2: Number of species of *Paragus* preying on aphids infesting different number of host plants in different states/union territories of India.

Sl. No.	Predator species	Number of			
		Species of aphid preys	Species of host plants	Triplets	States/union territories
1.	*aP. ragus auritus*	3	6	7	2
2.	*P P. aragus bicolor*	1	1	1	1
3.	*P P. aragus crenulatus*	7	7	8	4
4.	*P P. aragus politus*	10	10	13	4
5.	*P P. aragus rufocinctus*	7	7	7	2
6.	*P P. aragus serratus*	23	59	75	13
7.	*P P. aragus tibialis*	17	20	30	10
8.	*P P. aragus yerburiensis*	11	13	18	7
	Total	**38**	**81**	**159**	**18**

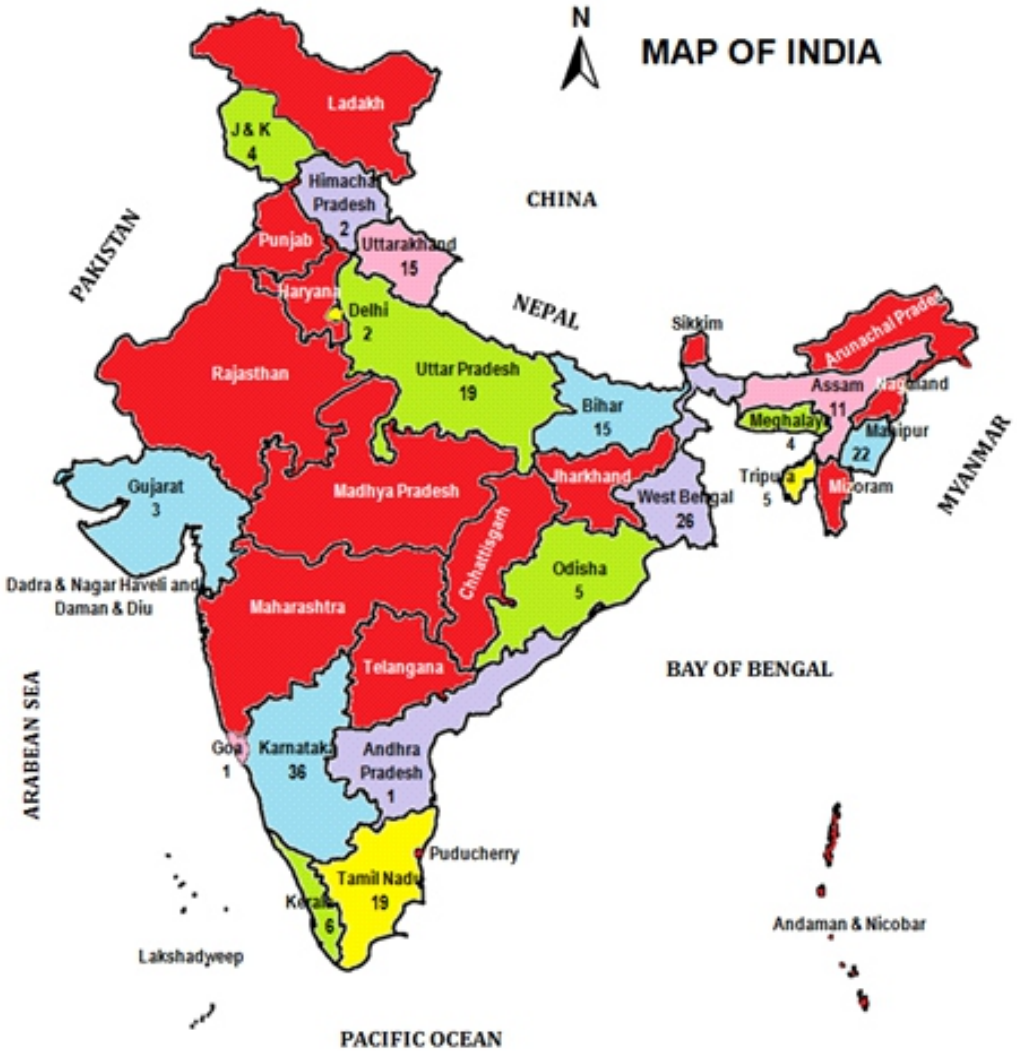

Fig. 3: Map showing the number of tri-trophic associations (triplets) of *Paragus* species preying on different species of aphids in different states/union territories of India. No species of the predators was recorded in the red shaded states/union territories of India.

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

A. *Paragus auritus* Stuckenberg, 1954 [Type locality: Sri Lanka]

Paragus auritus (Fig. 4) is widespread in India, Kenya, Nepal and Sri Lanka (Thompson and Ghorpadé, 1988; GBIF Secretariat, 2025).

Fig. 4. Photographs of adult *Paragus auritus*. Courtsey: https://inaturalist.org

In India, it is distributed in Andhra Pradesh, Karnataka, Odisha, Tamil Nadu and West Bengal (Sengupta et al., 2016) but its aphidophagy was observed only in Karnataka and Tamil Nadu preying on 3 species of aphids infesting 6 species of plants as mentioned below.

1. ***Aphis* (*Toxoptera*) *aurantii* Boyer de Fonsc., 1841**
   - *Camellia sinensis* (L.) Kuntze - India (Rau, 1936)
2. ***Forda orientalis* George, 1928**
   - *Eleusine coracana* (L.) Gaertn. - Karnataka (Ali and Sharatchandra, 1985)
3. ***Tetraneura (Tetraneurella) nigriabdominalis* (Sasaki, 1899)**
   - *Eleusine coracana* (L.) Gaertn. - Tamil Nadu (Thompson and Ghorpadé, 1988)
   - *Gossypium* sp. - Tamil Nadu (Thompson and Ghorpadé, 1988)
   - *Ipomoea batatas* (L.) Lam. - Tamil Nadu (Ghorpadé et al., 2011)
   - *Oryza sativa* L. - Tamil Nadu (Thompson and Ghorpadé, 1988)
   - *Sorghum bicolor* L. - Tamil Nadu (Thompson and Ghorpadé, 1988)

B. *Paragus bicolor* (Fabricius, 1794) [syn. *Musca cruentatus* Geoffroy, 1785; *Paragus arcuatus* Meigen, 1822; *Paragus ater* Meigen, 1822; *Paragus ruficauda* Zetterstedt, 1843; *Paragus tacchettii* Rondani, 1865; *Paragus taeniatus* Meigen, 1822; *Paragus testaceus* Meigen, 1822; *Syrphus bicolor* Fabricius, 1794; Type locality: North Africa]

Paragus bicolor (Fig. 5) is widely distributed in Nearctic and Palaearctic region of the world

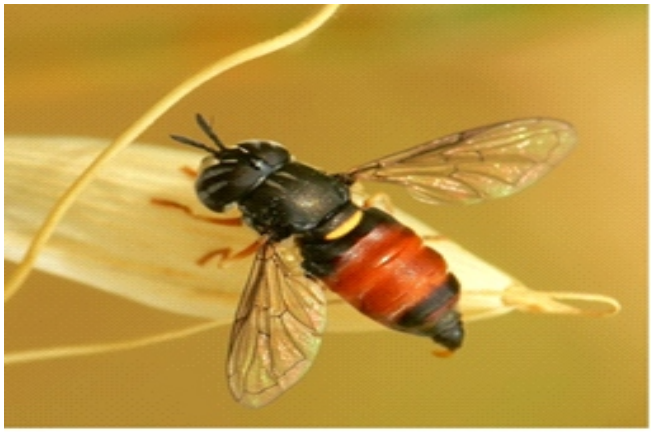

Fig. 5: Photographs of adult *Paragus bicolor* . Courtsey: https://inaturalist.org

(Thompson and Ghorpadé, 1988; Ghorpadé, 2014; Dousti, 2023). In India, it is only distributed in Jammu and Kashmir as mentioned below.

1. ***Aphis craccivora* Koch, 1854**
   - *Solanum nigrum* L. - Jammu and Kashmir (Thompson and Ghorpadé, 1988)

C. *Paragus crenulatus* Thomson, 1869 [Type locality: China]

Paragus crenulatus (Fig. 6) is distributed in Oriental and Palaearctic China, India, Nepal and Sri Lanka (Ghorpadé, 2014; Dyola et al., 2024).

Fig. 6: Photographs of adult *Paragus crenulatus*. Courtsey: https://inaturalist.org

In India, it is distributed in 8 states (Sengupta et al., 2016). However, its larvae were observed feeding 7 species of aphids infesting 7 species of plants only in 4 states of India (Table 1), mostly in Tripura as mentioned below.

1. ***Aphis craccivora* Koch, 1854**
   - *Vigna unguiculata* (L.) Walp. - Tripura (Agarwala et al., 1987)
2. ***Aphis gossypii* Glover, 1877**
   - Unknown plant - Tripura (Agarwala et al., 1987)
3. ***Aphis spiraecola* Patch, 1914**
   - Unknown plant - Tripura (Agarwala et al., 1987)
4. ***Aphis* (*Toxoptera*) *aurantii* Boyer de Fonsc., 1841**
   - *Camellia sinensis* (L.) Kuntze - Tamil Nadu (Thompson and Ghorpadé, 1988)

- Unknown plant - Tripura (Agarwala et al., 1987)

5. ***Lipaphis erysimi*** **(Kaltenbach, 1843)**
   - Unknown plant - Tripura (Agarwala et al., 1987)
6. ***Myzus persicae (Sulzer, 1776)***
   - *Capsicum chinense* Jacq. - Assam (Thangjam et al., 2021)
7. ***Pentalonia nigronervosa Coquerel, 1859***
   - *Musa sinensis* - Karnataka (Thompson and Ghorpadé, 1988)

D. *Paragus politus* Wiedemann, 1830 [syn. *Paragus rufiventris* Brunetti, 1913; *Paragus indicus* (Brunetti, 1908); *Pipizella indicus* Brunetti, 1908; Type locality: China]

Paragus politus (Fig. 7) is an Oriental and Palaearctic species distributed in Afghanistan, Australia, China, India, Indonesia, Malaysia, Nepal, Pakistan, Philippines, Sri Lanka and Thailand (Thompson and Vockeroth, 1989; Sorokina and Cheng, 2007; Ghorpadé, 2015; Dyola et al., 2024). Mostly it is confused with *Paragus tibialis* (Fallén, 1817) and some of the tri-trophic associations of it recorded in India may be associated with *Paragus politus* (Thompson and Ghorpadé, 1988).

Fig. 7: Photographs of adult *Paragus poiltus*. Courtsey: https://inaturalist.org

In India, 10 species of aphids were reported as prey infesting 10 species of plants in 4 states mostly in West Bengal as mentioned below.

1. ***Aphis* (*Toxoptera*) *aurantii* Boyer de Fonsc., 1841**
   - *Camellia sinensis* (L.) Kuntze - Assam (Das, 1974; Das and Kakoty, 1992)
2. ***Aphis craccivora* Koch, 1854**
   - *Solanum melongena* L. - West Bengal (Satpathi and Mandal, 2006)
3. ***Aphis gossypii* Glover, 1877**
   - *Coccinia grandis* (L.) Voigt. - India (Agarwala et al., 1984)
   - *Gossypium* sp. - India (Agarwala et al., 1984)
   - *Leucas aspera* (Willd.) Link - India (Agarwala et al., 1984)
   - *Solanum melongena* L. - West Bengal (Satpathi and Mandal, 2006)
4. ***Aphis spiraecola* Patch, 1914**
   - *Bidens pilosa* L. - West Bengal (Raychaudhuri et al., 1978)
5. ***Aphis* (*Toxoptera*) *aurantii* Boyer de Fonsc., 1841**
   - *Camellia sinensis* (L.) Kuntze - India (Ghorpadé, 1981; Thompson and Ghorpadé, 1988)
6. ***Brachycaudus* sp.**
   - *Synotis rufinervis* (DC.) Jeffrey and Chen - Uttarakhand (Debnath, 1991)
7. ***Lipaphis erysimi* (Kaltenbach, 1843)**
   - *Brassica napus* L. – Punjab (Mathur, 1983)
8. ***Macrosiphoniella (Macrosiphoniella) sanborni* (Gillette, 1908)**
   - *Artemisia* sp. - Uttarakhand (Debnath, 1991)
9. ***Myzus persicae* (Sulzer, 1776)**
   - *Osbeckia crinita* Benth. - West Bengal (Rao, 1969)
10. ***Myzus persicae* (Sulzer, 1776)**
    - *Solanum melongena* L. - West Bengal (Satpathi and Mandal, 2006)

E. *Paragus rufocinctus* (Brunetti, 1908) [syn. *Pipizella rufocincta* Brunetti, 1908; Type locality: Myanmar]

Paragus rufocinctus (Fig. 8) is also an oriental species and is distributed in China, India, Myanmar, Nepal and Sri Lanka (Thompson and Ghorpadé, 1988; Sorokina and Cheng, 2007; Ghorpadé, 2014).

Fig. 8: Photographs of adult *Paragus rufocinctus*. Courtsey: v4.boldsystems.org

It is reported from 8 states/union territories of India, however, its aphidophagy was observed only in 2 states, Himachal Pradesh and Tamil Nadu preying on 7 species of aphids feeding on 7 species of plants as mentioned below.

1. ***Aphis spiraecola* Patch, 1914**
   - *Bidens pilosa* L. - India (Agarwala et al., 1984)
2. ***Aphis (Toxoptera) aurantii* (Boyer de Fonscolombe, 1841)**
   - *Camellia sinensis* (L.) Kuntze - Tamil Nadu (Thompson and Ghorpadé, 1988)
3. ***Brachycaudus (Thuleaphis) rumexicolens* (Patch, 1917)**
   - Unknown plant - Himachal Pradesh (Das and Raychaudhuri, 1983)
4. ***Metopolophium* sp.**
   - *Stephania hernandiifolia* Walp. - Himachal Pradesh (Das and Raychaudhuri, 1983)
5. ***Myzus persicae* (Sulzer, 1776)**
   - *Osbeckia crinita* Benth. - India (Agarwala et al., 1984)
6. ***Myzus persicae nicotianae* Blackman, 1987**
   - *Nicotiana tabacum* L. - India (Agarwala et al., 1984)
7. ***Pentalonia nigronervosa* Coquerel, 1859**
   - *Musa* sp. - Tamil Nadu (Ghorpadé, 1981)

F. *Paragus serratus* (Fabricius, 1805) [syn. *Mulio serratus* Fabricius, 1805; Type locality: India]

Paragus serrata (Fig. 9) is also an Oriental and Palaearctic species distributed in China, India, Nepal, and Pakistan (Hassan et al., 2018; Sengupta et al., 2019; Yang et al., 2020).

Fig. 9: Photographs of adult *Paragus serratus*. Courtsey: https://inaturalist.org

It is an extremely polyphagous species that preys on 23 aphid species that feed on 59 plant species across 13 states/union territories in India, forming 75 tri-trophic associations (Table 2), mostly in Manipur (22 triplets) followed by Karnataka (19 triplets) and Bihar (15 triplets). Nonetheless, Sengupta et al. (2016, 2020) documented it from 16 states and union territories in India by collecting adult flies with insect sweep nets and various traps, including malaise traps, pan traps, and UV light traps, in both agricultural and natural environments, without specifying the identity of their prey. The detailed tri-trophic associations in India are given below:

1. ***Acyrthosiphon pisum* (Harris, 1776)**
   - *Pisum sativum* L. - Uttar Pradesh (Chaudhary and Singh, 2012)
2. ***Aphis craccivora* Koch, 1854**
   - *Arachis hypogaea* L. - Manipur (Singh, 2002)
   - *Cajanus cajan* (L.) Millsp. - Karnataka (Joshi et al., 1997; Chinnu et al., 2023)
   - *Cirsium wallichii* DC. - Uttarakhand (Rao, 1969)
   - *Cyamopsis tetragonoloba* (L.) Taub. - Karnataka (Chinnu et al., 2023)
   - *Gliricidia maculata* (Kunth) Steud. - Karnataka (Chinnu et al., 2023)
   - *Lablab purpureus* (L.) Sweet - Bihar (Ahmad et al., 2020); Delhi (Kapur, 1942); Karnataka (Joshi et al., 1997); Manipur (Singh, 2002); Odisha (Patro and Behera, 1992); Uttar Pradesh (Chaudhary and Singh, 2012; Tiwari et al., 2024); West Bengal (Ghosh et al., 1981)
   - *Lens culinaris* Medik. - West Bengal (Poddar, 1982)
   - *Phaseolus mungo* Wall. - Manipur (Singh, 2002)
   - *Phaseolus vulgaris* L. - Bihar (Ahmad et al., 2020); Jammu and Kashmir (Bhat and Bhagat, 2017)
   - *Pisum sativum* L. - West Bengal (Poddar, 1982)
   - *Senna tora* (L.) Roxb. - West Bengal (Poddar, 1982)
   - *Senna* sp. - Tamil Nadu (Baskaran et al., 2009)
   - *Vicia faba* L. - Manipur (Raychaudhuri et al., 1978; Singh, 2002); West Bengal (Ghosh et al., 1981)
   - *Vigna mungo* (L.) Hepper - Bihar (Ahmad et al., 2020) ; West Bengal (Poddar, 1982)

- *Vigna umbellata* (Thunb.) Ohwi and Ohashi - Manipur (Singh, 2002)
- *Vigna unguiculata* (L.) Walp. - Karnataka (Joshi et al., 1997; Joshi et al., 1999); Manipur (Singh, 2002); Odisha (Mishra et al., 2013); Tamil Nadu (Baskaran et al., 2009); West Bengal (Poddar, 1982)

3. *Aphis glycines* Matsumura, 1917
- *Glycine max* L. - Manipur (Singh and Singh, 2000)

4. *Aphis gossypii* Glover, 1877
- *Ageratum conyzoides* L. - Bihar (Ahmad et al., 2020)
- *Brassica oleracea* L. var. *botrytis* - Manipur (Singh et al., 2002)
- *Cajanus cajan* (L.) Millsp. - Bihar (Ahmad et al., 2020)
- *Cucumis saivus* L. - Uttar Pradesh (Tiwari et al., 2024)
- *Cucurbita maxima* Duchesne - Uttar Pradesh (Tiwari et al., 2024)
- *Gossypium herbacium* L. - Uttar Pradesh (Tiwari et al., 2024)
- *Gossypium hirsutum* L. - Karnataka (Joshi et al., 1999)
- *Hibiscus rosasinensis* L. - Bihar (Ahmad et al., 2020)
- *Lagenaria siceraria* (Molino) Standl. - Bihar (Ahmad et al., 2020)
- *Medicago sativa* L. - Uttar Pradesh (Tiwari et al., 2024)
- *Psidium guajava* L. - Karnataka (Mani and Krishnamoorthy, 1989); Tamil Nadu (Baskaran et al., 2009); Uttar Pradesh (Tiwari et al., 2024)
- *Solanum melongena* L. - Manipur (Devi et al., 2002; Shah et al., 2013) ; Uttar Pradesh (Chaudhary and Singh, 2012)
- *Solanum tuberosum* L. - Manipur (Nonita et al., 2002)
- Unknown plant - Odisha (Basu and Patro, 2007); Kerala (Rao, 1969)

5. *Aphis nerii* Boyer de Fonsc., 1841
- *Calotropis gigantea* (L.) Aiton - Karnataka (Joshi et al., 1999)

6. *Aphis odinae* (van der Goot, 1917)
- *Anacardium occidentale* L. - Goa (Maruthadurai and Singh, 2017; Maruthadurai, 2019); Karnataka (Mulimani and Rajanna, 2014; Vanitha et al., 2022)

7. *Aphis punicae* Passerini, 1863
- *Punica granatum* L. - Karnataka (Sreedevi and Verghese, 2007)

8. *Aphis solanella* Theobald, 1914
- *Solanum nigrum* L. - Karnataka (Thompson and Ghorpadé, 1988)

9. *Aphis spiraecola* Patch, 1914
- *Ageratum conyzoides* L. - Bihar (Ahmad et al., 2020)
- *Coccinia grandis* (L.) Voigt. - Kerala (Vijayasree, 2006)
- *Lagenaria siceraria* (Molino) Standl. - Bihar (Ahmad et al., 2020)
- Unknown plant - India (Agarwala et al., 1984)

10. *Aphis* (*Toxoptera*) *aurantii* Boyer de Fonsc., 1841
- *Camellia sinensis* (L.) Kuntze - Manipur (Devi et al., 2010)
- *Citrus* sp. - Karnataka (Singh, 1993)

11. *Aphis (Toxoptera) citricidus* (Kirkaldy, 1907)
- *Citrus* sp. - Karnataka (Ghorpadé, 1973; Chinnu et al., 2023)

12. *Brevicoryne brassicae* (Linnaeus, 1758)
- *Brassica oleracea* L. var. *botrytis* - Manipur (Singh et al., 2002)
- *Brassica oleracea* L. var. *capitata* - Manipur (Bijaya et al., 2011)

13. *Hyadaphis coriandri* (Das, 1918)
- *Foeniculum vulgare* Mill. - Karnataka (Udayakumar et al., 2023)

14. *Lipaphis erysimi* (Kaltenbach, 1843)
- *Brassica juncea* (L.) Czern - Karnataka (Joshi et al., 1999); Manipur (Chitra Devi et al., 2002) ; West Bengal (Ghosh, 1983)
- *Brassica nigra* (L.) K. Koch - West Bengal (Ghosh et al., 1981)
- *Brassica oleracea* L. var. *botrytis* - Manipur (Singh et al., 2002); Uttar Pradesh (Tiwari et al., 2024)
- *Brassica rapa* L. - Jammu and Kashmir (Bhat and Bhagat, 2017); Manipur (Devjani and Singh, 2006; Bijaya et al., 2011); Uttar Pradesh (Tiwari et al., 2024)

15. *Melanaphis sacchari* (Zehntner, 1897)
- *Saccharum officinarum* L. - Delhi (Bhatia and Shaffi, 1933)

16. *Myzus persicae* (Sulzer, 1776)
- *Brassica oleracea* L. var. *botrytis* - Manipur (Singh et al., 2002)
- *Brassica oleracea* L. var. *capitata* - Manipur (Bijaya et al., 2006)
- *Brassica oleracea* L. var. *gongylodes* - Manipur (Bijaya, 1998)
- *Brassica rapa* L. - Manipur (Bijaya et al., 2001; Devjani and Singh, 2006)
- *Brassica rapa* L. var. *pekinensis* - Manipur (Bijaya, 1998)
- *Prunus persica* (L.) Batsch - Uttarakhand (Bisht et al., 2006)
- *Solanum tuberosum* L. - Manipur (Nonita et al., 2002); Uttar Pradesh (Tiwari et al., 2024)

17. *Myzus persicae nicotianae* Blackman, 1987
- *Nicotiana tabacum* L. - Andhra Pradesh (Rao et al., 1984)

18. *Rhopalosiphum maidis* (Fitch, 1856)
- *Cenchrus americanus* (L.) Morrone - Uttar Pradesh (Tiwari et al., 2024)
- *Solanum tuberosum* L. - Bihar (Kumar and Ahmad, 2017)
- *Triticum aestivum* L. - Uttar Pradesh (Tiwari et al., 2024)
- *Zea mays* L. - Karnataka (Joshi et al., 1999; Chinnu et al., 2023)

19. *Schoutedenia emblica* (Patel and Kulkarni, 1952)?
- *Phyllanthus emblica* L. - Bihar (Bhatia and Shaffi, 1933); Tamil Nadu (Baskaran et al., 2009)

20. *Tetraneura (Tetraneurella) nigriabdominalis* (Sasaki, 1899)
- *Eleusine coracana* (L.) Gaertn. ? - Tamil Nadu (Cherian, 1934; Vadivelu et al., 1976)

21. *Therioaphis trifolii* subsp. *trifolii (Monell, 1882)*
- Unknown plant - Karnataka (Ghorpade, 1973)

22. *Uroleucon (Uromelan) compositae* (Theobald, 1915)
- *Carthamus tinctorius* L. - Karnataka (Joshi et al., 1999)

23. Unknown aphid species
- *Brassica* sp. - Bihar (Bhatia and Shaffi, 1933)
- *Cicer arietinum* L. - India (Agarwala et al., 1984)
- *Cirsium wallichii* DC. - Uttarakhand (Rao, 1969)
- *Citrullus lanatus* (Thunb.) Matsum. and Nakai
- Karnataka (Bhatia and Shaffi, 1933)
- *Eleusine coracana* (L.) Gaertn. - Bihar (Bhatia and Shaffi, 1933); Tamil Nadu (Fletcher, 1916)
- *Gossypium* spp. - Bihar (Bhatia and Shaffi, 1933)
- *Lablab purpureus* (L.) Sweet ssp. *purpureus* - Bihar (Bhatia and Shaffi, 1933)

G. *Paragus tibialis* (Fallén, 1817) [syn. *Ascia analis* Macquart, 1839; *Orthonevra varipes* Bigot, 1880; *Paragus aeneus* Meigen, 1822; *Paragus dispar* Schummel, 1841; *Paragus femoratus* Meigen, 1822; *Paragus meridionalis* Becker, 1921; *Paragus monogolicus* Kanervo, 1938; *Paragus mundus* Wollaston, 1858; *Paragus numida* Macquart, 1847; *Paragus obscurus* Meigen, 1822; *Paragus zonatus* Meigen, 1822; *Pipiza tibialis* Fallén, 1817; Type locality: Sweden]

Paragus tibialis (Fig. 10) is another species found in the Afrotropical, Oriental and Palaearcticn regions such as Austria, China, France, India, Iran, Japan, Kazakhstan, Kirghizia, Mongolia, Sweden, Russia, Tajikistan, Turkmenistan (Ghorpadé, 2014; Sorokina, 2009; Yang et al., 2020; Dousti, 2023). It favours drier regions. Thompson and Ghorpadé (1988) observed part of the material identified and recorded as *Paragus tibialis* are indeed *Paragus politus*.

Fig. 10. Photographs of adult *Paragus tibialis*. Courtsey: https://inaturalist.org

Paragus tibialis is also a polyphagous species that hunts 17 aphid species feeding on 20 plant species across 10 states/union territories in India, creating 30 tri-trophic associations (Table 1), predominantly in Uttarakhand (11 triplets), then in West Bengal (5

triplets) and Assam, Karnataka, Kerala, and Meghalaya (each 4 triplets). The intricate tri-trophic relationships in India are outlined below.

1. ***Aphis clematidis*** **Koch, 1854**
   - *Clematis buchananiana* DC. - Uttarakhand (Ghosh et al., 1985)
2. ***Aphis craccivora*** **Koch, 1854**
   - *Phaseolus vulgaris* L. - Jammu and Kashmir (Bhat and Bhagat, 2017)
3. ***Aphis fabae*** **Scopoli, 1763**
   - *Pyrus communis* L. - India (Sarkar and Chakrabarti, 2015)
   - *Rumex nepalensis* Spreng. - Uttarakhand (Debnath, 1991)
4. ***Aphis gossypii*** **Glover, 1877**
   - *Fagopyrum esculentum* Moench - Gujarat (Bhat et al., 1986)
   - *Fagopyrum kashmirianum* Munshi - Gujarat (Bhat et al., 1986)
   - *Fagopyrum tataricum* (L.) Gaertn. - Gujarat (Bhat et al., 1986)
5. ***Aphis kurosawai*** **Takahashi, 1921**
   - *Artemisia vulgaris* L. - Uttarakhand (Debnath, 1991)
6. ***Aphis spiraecola*** **Patch, 1914**
   - *Bidens pilosa* L. - West Bengal (Agarwala et al., 1983)
   - *Unknown plant* - Assam (Rao, 1969); Karnataka (Rao, 1969); Kerala (Rao, 1969); Meghalaya (Rao, 1969); West Bengal (Rao, 1969)
7. ***Aphis*** **(Toxoptera) aurantii Boyer de Fonsc., 1841**
   - *Camellia sinensis* (L.) Kuntze - Assam (Das, 1974); Karnataka (Radhakrishnan and Muraaledharan, 1995); Kerala (Radhakrishnan and Muraaledharan, 1991); Tamil Nadu (Muraleedharan and Radhakrishnan, 1989; Radhakrishnan and Muraaledharan, 1993)
8. ***Capitophorus formosartemisiae***
   - *Artemisia vulgaris* - Uttarakhand (Ghosh et al., 1985)
9. ***Eriosoma lanigerum*** **(Hausmann, 1802)**
   - *Malus domestica* (Suckow) - Uttarakhand (Ghosh et al., 1985; Chakrabarti et al., 1988)
10. ***Melanaphis sacchari*** **(Zehntner, 1897)**
    - Unknown plant - Assam (Rao, 1969); Karnataka (Rao, 1969); Kerala (Rao, 1969); Meghalaya (Rao, 1969); West Bengal (Rao, 1969)
11. ***Myzus persicae*** **(Sulzer, 1776)**
    - Unknown plant - West Bengal (Rao, 1969)
12. ***Pemphigus*** **(Pemphigus) mordwilkoi Cholodkovsky, 1912**
    - *Populus ciliata* Wall. ex Royle - Uttarakhand (Debnath, 1991)
13. ***Rhopalosiphum maidis*** **(Fitch, 1856)**
    - *Sorghum bicolor* (L.) Moench - Uttar Pradesh (Chaudhary and Singh, 2012); Karnataka (Rao, 1969); Kerala (Rao, 1969); Meghalaya (Rao, 1969); West Bengal (Rao, 1969)
    - *Triticum aestivum* L. - Uttar Pradesh (Tiwari et al., 2024)
    - Unknown plant - Assam (Rao, 1969)
14. ***Sappaphis*** **sp.**
    - *Cotoneaster bacillaris* Wall. ex Lindl. - Uttarakhand (Debnath, 1991)
15. ***Sitobion miscanthi*** **(Takahashi, 1921)**
    - *Triticum aestivum* L. - Uttarakhand (Debnath, 1991)
16. **Unidentified aphid**
    - *Osbeckia crinita* Benth. - Meghalaya (Rao, 1969)

H. Paragus yerburiensis Stuckenberg, 1954 [Type locality: Sri Lanka]

Paragus yerburiensis (Fig. 11) is distrtibuted in the Palaearcticn regions such as India, Nepal, and Sri Lanka (Ghorpadé, 2014; Dyola et al., 2024). It is a small hover fly species, mainly black with tergites 3-5 ranging from red-orange to dark yellow. The species has uniquely furred eyes featuring vertical stripes of contrasting hues.

Fig. 11. Photographs of adult *Paragus yerburiensis* (F). Courtsey: https://inaturalist.org

Its larvae are also polyphagous, consuming 11 aphid species that infest 13 plant species across 7 states in India (Table 1), primarily in Karnataka (10 triplets), followed by West Bengal (7 triplets) and Assam (5 triplets). The tri-trophic associations of the species in India are detailed below.

1. ***Aphis craccivora*** **Koch, 1854**
   - *Cajanus cajan* (L.) Millsp. - Karnataka (Joshi et al., 1997)
   - *Lablab purpureus* (L.) Sweet - Karnataka (Joshi et al., 1997)
   - *Solanum melongena* L. - West Bengal (Satpathi and Mandal, 2006)
   - *Vigna unguiculata* (L.) Walp. - Assam (Agarwala et al., 1984); Karnataka (Joshi et al., 1997); Tamil Nadu (Agarwala et al., 1984); Uttar Pradesh (Agarwala et al., 1984); Uttarakhand (Rao, 1969); West Bengal (Agarwala et al., 1984)
2. ***Aphis gossypii*** **Glover, 1877**
   - *Gossypium hirsutum* L. - Karnataka (Jalali et al., 2000)
   - *Gossypium* sp. - Assam (Agarwala et al., 1984); Karnataka (Rao, 1969); Tamil Nadu (Agarwala et al., 1984); Uttar Pradesh (Agarwala et al., 1984); West Bengal (Agarwala et al., 1984
   - *Solanum melongena* L. - West Bengal (Satpathi and Mandal, 2006)
3. ***Aphis odinae*** **(van der Goot, 1917)**
   - *Anacardium occidentale* L. - Karnataka (Mulimani and Rajanna, 2014)
4. ***Aphis spiraecola*** **Patch, 1914**
   - *Bidens pilosa* L. - Assam (Agarwala et al., 1984); Tamil Nadu (Agarwala et al., 1984); Uttar Pradesh (Agarwala et al., 1984); West Bengal (Agarwala et al., 1982)
5. ***Aphis* (*Toxoptera*) *aurantii*** **Boyer de Fonsc., 1841**
   - *Camellia sinensis* (L.) Kuntze - Assam (Das, 1974; Das and Kakoty, 1992)
6. ***Aphis* (*Toxoptera*) *citricidus***
   - Unknown plant - Karnataka (Ghorpadé, 1973)
7. ***Cerataphis brasiliensis*** **(Hempel, 1901)**
   - *Areca catechu* L. - Karnataka (Vanavasan, 2008)
8. ***Melanaphis sacchari*** **(Zehntner, 1897)**
   - *Sorghum bicolor* (L.) Moench - Odisha (Patnaik and Bhagat, 1976; Patnaik et al., 1977)
   - *Zea mays* L. - Odisha (Patnaik and Bhagat, 1976; Patnaik et al., 1977)
   - Unknown plant - Karnataka (Ghorpadé, 1973)
9. ***Myzus persicae*** **(Sulzer, 1776)**
   - *Solanum melongena* L. - West Bengal (Rao, 1969; Satpathi and Mandal, 2006)
10. ***Myzus persicae nicotianae*** **Blackman, 1987**
    - *Nicotiana tabacum* L. - Assam (Agarwala et al., 1984); Tamil Nadu (Agarwala et al., 1984); Uttar Pradesh (Agarwala et al., 1984); West Bengal (Agarwala et al., 1984)
11. ***Uroleucon (Uromelan) compositae*** **(Theobald, 1915)**
    - Unknown plant - Karnataka (Ghorpadé, 1973)

[III] Species of *Sphaerophoria* Lepeletier and Serville, 1828

The genus *Sphaerophoria* comprises 73 valid species and is widely distributed on all continents but is common in North America, Europe, Asia and Australia (GBIF Secretariat, 2025). *Sphaerophoria* species are smaller and slender with body brightly coloured, sometimes completely black. Ten species of the genus were recorded in India (Sengupta et al., 2016); however, the aphid prey is known only for following 5 species: *Sphaerophoria bengalensis* Macqaurt, *Sphaerophoria indiana* Bigot, *Sphaerophoria macrogaster* (Thomson), *Sphaerophoria philantha* (Meigen) and *Sphaerophoria scripta* (Linnaeus). The most polyphagous of them, *Sphaerophoria indiana*, feeds up on 15 species of aphids feeding on 20 species of plants, whereas *Sphaerophoria scripta* feeds up on 13 species of aphids feeding on 27 species of plants. All these species are recorded on 22 species of aphids infesting 41 species of food plants in 15 states/union territories of India (Table 3). Most of the tri-trophic associations (triplets) of *Sphaerophoria* species are reported in Jammu and Kashmir (18 triplets) followed by West Bengal and Uttarakhand (15 triplets each), Uttar Pradesh (11 triplets), Manipur (10 triplets) and in other states 1-9 triplets (Fig. 12).

Table 3: Number of species of *Sphaerophoria* preying on aphids infesting different number of host plants in different states/union territories of India.

Sl. No.	Predator species	Number of			
		Species of aphid preys	Species of host plants	Triplets	States/union territories
1.	*Sphaerophoria bengalensis*	3	5	5	2
2.	*Sphaerophoria indiana*	15	20	31	11
3.	*Sphaerophoria macrogaster*	1	1	1	1
4.	*Sphaerophoria philantha*	1	1	1	1
5.	*Sphaerophoria scripta*	13	27	30	6
6.	*Sphaerophoria* spp.	7	5	11	5
	Total	**22**	**41**	**79**	**15**

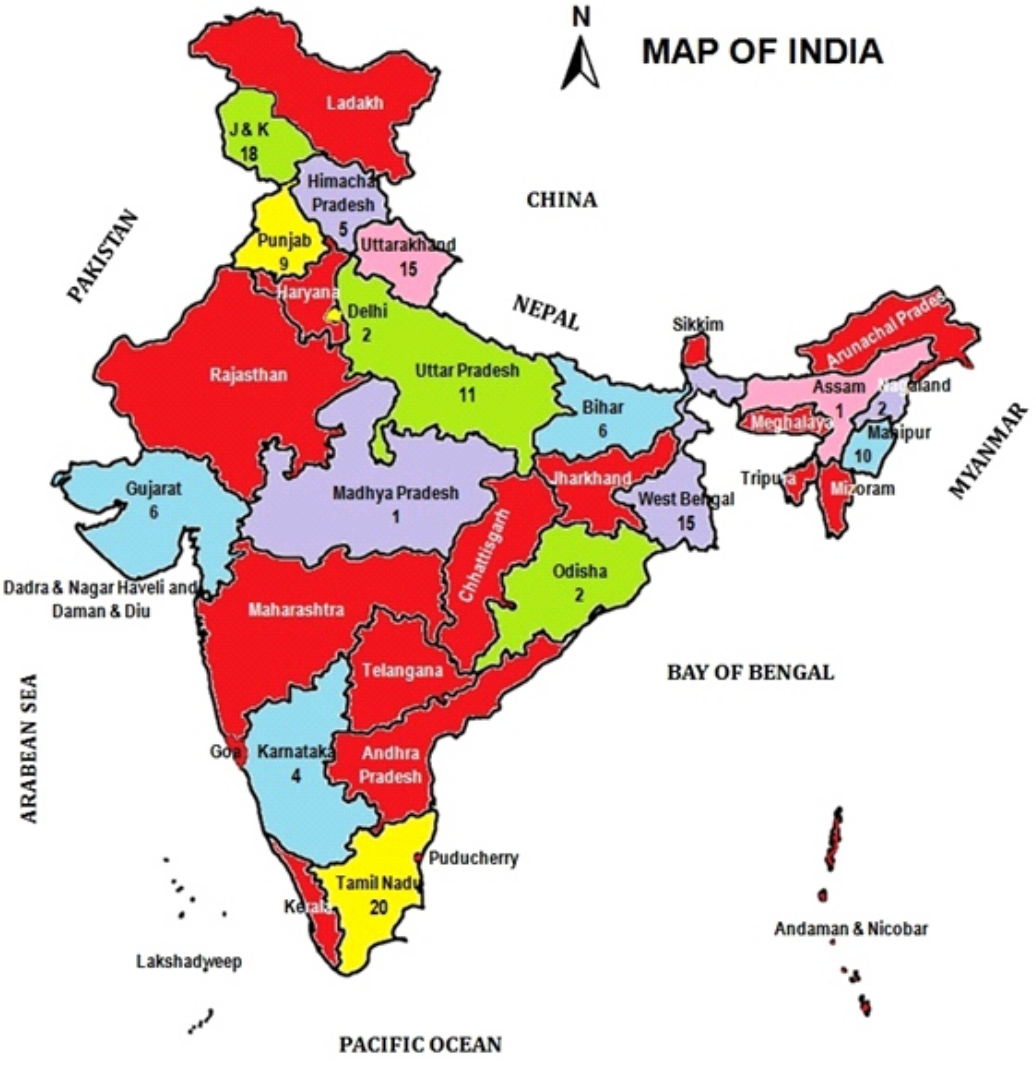

Fig. 12: Map showing the number of tri-trophic associations (triplets) of *Paragus* species preying on different species of aphids in different states/union territories of India. No species of the predators was recorded in the red shaded states/union territories of India.

A. *Sphaerophoria bengalensis* Macqaurt, 1842 [syn. *Sphaerophoria flavoabdominalis* Brunetti, 1915]
Sphaerophoria bengalensis (Fig. 13) is somewhat yellowish hover fly distributed in Afghanistan, Bangladesh, China, India, Iran, Japan, Korea, Nepal and North Caucasus (Ghorpadé, 2015; Subhan and Shah, 2016; Yang et al., 2020; Dyola et al., 2024).

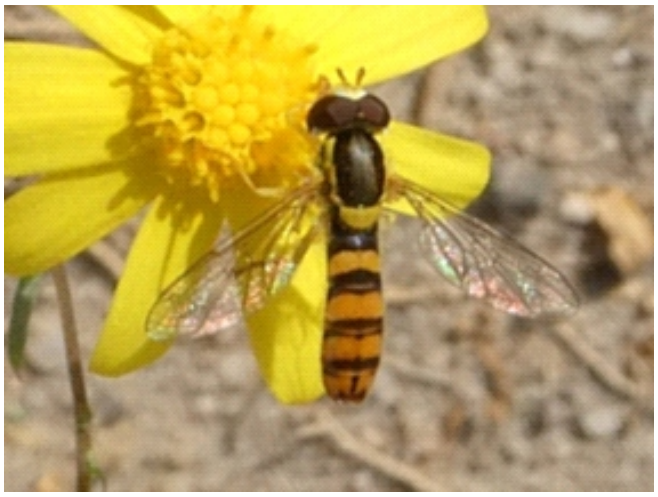

Fig. 13: Photographs of adult *Sphaerophoria bengalensis*. Courtsey: https://inaturalist.org.

In India, it is distributed in 10 states/union territories (Mitra et al., 2015) but only 2 species of aphids feeding on 5 food plant species are known as its prey in Gujarat and Jammu and Kashmir.

1. ***Aphis gossypii* Glover, 1877**
   - *Fagopyrum esculentum* Moench - Gujarat (Bhat et al., 1986)
   - *Fagopyrum kashmirianum* Munshi - Gujarat (Bhat et al., 1986)
   - *Fagopyrum tataricum* (L.) Gaertn. - Gujarat (Bhat et al., 1986)
2. ***Aphis pomi* De Geer, 1773**
   - *Malus domestica* (Suckow) Borkh. - Jammu and Kashmir (Bhagat et al., 1988)
3. ***Aphis punicae* Passerini, 1863**
   - *Punica granatum* L. - Jammu and Kashmir (Mohi-ud-din et al., 2019)

B. *Sphaerophoria indiana* Bigot, 1884
Sphaerophoria indiana (Fig. 14) is noted for its long body, vivid hues on its head, thorax, and abdomen, and a prominent, dome-shaped male terminalia. Although many species exhibit yellow or vivid markings, a few possess a black abdomen.

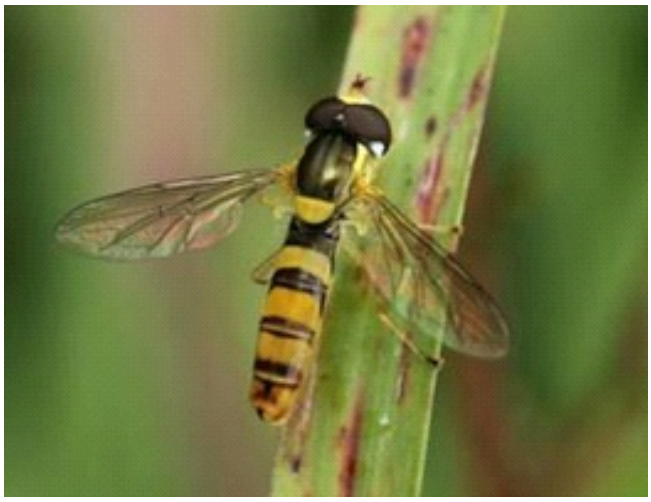

Fig. 14: Photographs of adult *Sphaerophoria indiana*. Courtsey: https://inaturalist.org

It is distributed in Oriental and Palaearctic India, Japan, Nepal and Pakistan (Ghorpadé, 2015; Shehzad et al., 2017; Yang et al., 2020; Dyola et al., 2024). In India, it has been documented in 16 states/union territories (Mitra et al., 2015), but aphid preys are known only in 11 states. It is the most polyphagous species within the genus, feeding on 15 aphid species that invade 20 food plant species, resulting in 31 tri-trophic associations as detailed below (Table 1).

1. ***Acyrthosiphon pisum* (Harris, 1776)**
   - *Pisum sativum* L. - Himachal Pradesh (Rahman, 1940)
2. ***Aphis craccivora* Koch, 1854**
   - *Solanum melongena* L. - West Bengal (Satpathi and Mandal, 2006)
3. ***Aphis gossypii* Glover, 1877**
   - *Brassica oleracea* L. var. *botrytis* - Bihar (Prakash and Rani, 2015); Manipur (Devjani and Singh, 1998; Singh et al., 2002)
   - *Solanum melongena* L. - West Bengal (Satpathi and Mandal, 2006)
4. ***Brachycaudus (Brachycaudus) helichrysi* (Kaltenbach, 1843)**
   - *Prunus persica* (L.) Batsch - Uttarakhand (Debnath, 1991)
5. ***Brevicoryne brassicae* (Linnaeus, 1758)**
   - *Brassica juncea* (L.) Czern. - Punjab (Kumar et al., 1988); Uttarakhand (Debnath, 1991)
   - *Brassica oleracea* L. var. *botrytis* - Bihar (Prakash and Rani, 2015); Himachal Pradesh (Sharma et al., 2020; Palial et al., 2025);

Manipur (Devjani and Singh, 1998); Uttar Pradesh (Tiwari et al., 2024)

- *Brassica oleracea* L. var. *capitata* - Manipur (Bijaya et al., 1996; Singh et al., 2002)
- *Brassica rapa* L. - Punjab (Kumar et al., 1987)

6. *Hyalopterus gracilis* (Walker, 1852)

- *Prunus* sp. - Jammu and Kashmir (Bhagat and Masoodi, 1988)

7. *Hyalopterus pruni* (Geoffroy, 1762)

- *Prunus domestica* L. - Jammu and Kashmir (Bhagat and Lone, 1984)

8. *Liosomaphis himalayensis* Basu, 1964

- *Berberis aristata* DC. - Uttarakhand (Debnath, 1991)

9. *Lipaphis erysimi* (Kaltenbach, 1843)

- *Brassica juncea* (L.) Czern. - Punjab (Sharma et al., 1997)
- *Brassica oleracea* L. *capitata* - Manipur (Bijaya et al., 1996)
- *Brassica oleracea* L. var. *botrytis* - Bihar (Prakash and Rani, 2015); Manipur (Devjani and Singh, 1998; Singh et al., 2002); Uttar Pradesh (Tiwari et al., 2024)
- *Brassica rapa* L. - Punjab (Kumar et al., 1987); Uttarakhand (Debnath, 1991)
- *Sinapis* sp. - Delhi (Agarwala et al., 1984); Punjab (Agarwala et al., 1984); Uttar Pradesh (Agarwala et al., 1984)

10. *Lipaphis pseudobrassicae* (Davis, 1914)

- *Brassica juncea* (L.) Czern. - Punjab (Kumar et al., 1988)

11. *Macrosiphum (Macrosiphum) rosae* (Linnaeus, 1758)

- *Rosa* sp. - Uttarakhand (Debnath, 1991)

12. *Melanaphis sacchari* (Zehntner, 1897)

- *Sorghum bicolor* (L.) Moench - Odisha (Patnaik et al., 1977)
- *Zea mays* L. - Odisha (Patnaik et al., 1977)

13. *Myzus persicae* (Sulzer, 1776)

- *Brassica juncea* (L.) Czern. - Punjab (Kumar et al., 1988)
- *Brassica oleracea* L. var. *botrytis* - Bihar (Prakash and Rani, 2015); Himachal Pradesh (Sharma et al., 2020); Karnataka (Rao et al., 1969); Manipur (Devjani and Singh, 1998; Singh et al., 2002); Uttar Pradesh (Tiwari et al., 2024)
- *Brassica oleracea* L. var. *capitata* - Manipur (Bijaya et al., 2006)
- *Brassica oleracea* L. var. *gongylodes* - Manipur (Bijaya, 1998)
- *Brassica rapa* L. - Manipur (Bijaya et al., 2001); Uttarakhand (Debnath, 1991); Punjab (Kumar et al., 1987); Uttar Pradesh (Tiwari et al., 2024)
- *Brassica rapa* L.var. *pekinensis* - Manipur (Bijaya, 1998)
- *Solanum melongena* L. - Uttar Pradesh (Tiwari et al., 2024); West Bengal (Satpathi and Mandal, 2006)
- *Solanum tuberosum* L. - Uttarakhand (Debnath, 1991)

14. *Myzus persicae nicotianae* Blackman, 1987

- *Nicotiana tabacum* L. - Delhi (Agarwala et al., 1984); Punjab (Agarwala et al., 1984); Uttar Pradesh (Agarwala et al., 1984)

15. *Sitobion miscanthi* (Takahashi, 1921)

- *Triticum aestivum* L. - Uttarakhand (Debnath, 1991)

C. *Sphaerophoria macrogaster* (Thomson, 1869) [syn. *Melithreptus hirayamae* Matsumura, 1916; *Melithreptus shibatensis* Matsumura, 1916; *Melithreptus takasagensis* Matsumura, 1916; *Mesograpta pallida* Bigot, 1884; *Mesograpta quinquevittata* Bigot, 1884; *Sphaerophoria kerteszi* Klöcker, 1924; *Sphaerophoria koreana* Bakowska, 1964; *Sphaerophoria poonaensis* Joseph, 1967; *Syrphus macrogaster* Thomson, 1869]

Sphaerophoria macrogaster (Fig. 15) is distinguished by its elongated body, bright colours on its head, thorax, and abdomen. It displays yellow and black markings on the abdomen. It is distributed in Australia, China, India, Japan, Nepal, North Korea and Sri Lanka (Ghorpadé, 2015; Yang et al., 2020; Dyola et al., 2024).

Fig. 15: Photographs of adult *Sphaerophoria macrogaster*. Courtsey: https://inaturalist.org

In India, it is distributed in 12 states/union territories (Mitra et al., 2015; Thangjam et al., 2019), but only a single species of aphid was observed as its prey in Karnataka as mentioned below.

1. ***Aphis gossypii*** **Glover, 1877**
   - *Gossypium hirsutum* L. - Karnataka (Jalali et al., 2000)

D. *Sphaerophoria philantha* (Meigen, 1822) (Fig. 16)

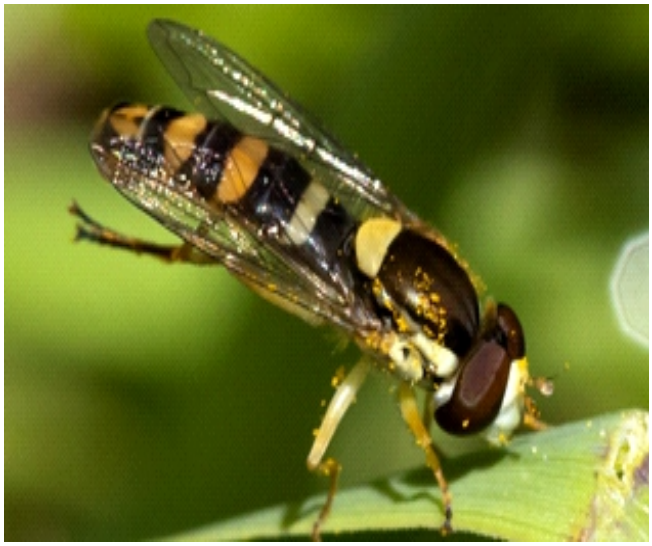

Fig. 16: Photographs of adult *Sphaerophoria philantha*. Courtsey: https://inaturalist.org

1. ***Aphis gossypii*** **Glover, 1877**
   - *Lycopersicum esculentum* L. - Madhya Pradesh (Netwal et al., 2023)

E. *Sphaerophoria scripta* (Linnaeus, 1758) [*Musca invisito* Harris, 1780; *Musca libatrix* Scopoli, 1763; *Musca menthastri* Linnaeus, 1758; *Musca scripta* Linnaeus, 1758; *Sphaerophoria brunettii* Joseph, 1967; *Sphaerophoria invisio* (Harris, 1780); *Sphaerophoria invisito* (Harris, 1780); *Sphaerophoria menthastri* (Linnaeus, 1758); *Sphaerophoria reducta* Lucas, 1969; *Sphaerophoria scutellata* Portevin, 1909; *Sphaerophoria strigata* Staeger, 1845; *Sphaerophoria violacea* Santos Abreu, 1924; Type locality: Sweden]

Sphaerophoria scripta (Fig. 17), often referred to as the long hoverfly, is a cosmopolitan species and is distributed in all geographical regions (Ghorpadé, 2015). It is a small to medium-sized hover fly with a long, narrow body, transparent wings, and a pattern of yellow and black bands.

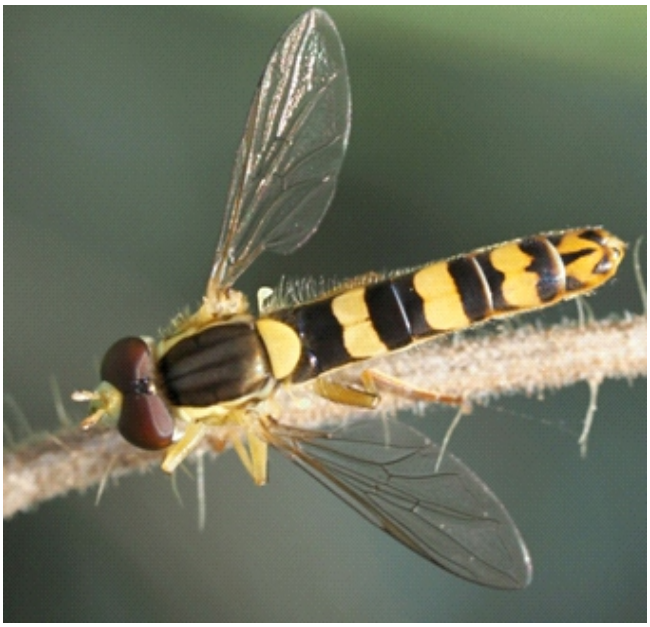

Fig. 17: Photograph of adult *Sphaerophoria scripta*. Courtsey: https://inaturalist.org

The larvae of *Sphaerophoria scripta* are also a polyphagous predator devouring 13 species of aphids feeding on 27 species of plants with 30 tri-trophic associations in 6 states/union territories of India (Table 3). The detailed account is given below.

1. ***Aphis craccivora*** **Koch, 1854**
   - *Lablab purpureus* (L.) Sweet - Uttar Pradesh (Tiwari et al., 2024); West Bengal (Agarwala et al., 1982; Agarwala et al., 1984)
   - *Phaseolus vulgaris* L. - Jammu and Kashmir (Bhat and Bhagat, 2017)
   - *Rumex acetosella* L. - Jammu and Kashmir (Bhat and Bhagat, 2017)
   - *Solanum lycopersicum* L. - Jammu and Kashmir (Bhat and Bhagat, 2017)
   - *Solanum melongena* L. - Jammu and Kashmir (Bhat and Bhagat, 2017)
2. ***Aphis gossypii*** **Glover, 1877**
   - *Capsicum annuum* L. - West Bengal (Agarwala et al., 1982)
   - *Capsicum frutescens* L. - West Bengal (Agarwala et al., 1984)
   - *Cucurbita maxima* Duchesne - Jammu and Kashmir (Bhat, 2008)
   - *Fagopyrum kashmirianum* Munshi - Gujarat (Bhat et al., 1986)
   - *Fagopyrum tataricum* (L.) Gaertn. - Gujarat (Bhat et al., 1986)

- *Solanum melongena* L. - Gujarat (Bhat et al., 1986); Jammu and Kashmir (Bhat, 2008); Uttar Pradesh (Tiwari et al., 2024)

3. ***Aphis pomi* De Geer, 1773**
   - *Malus domestica* (Suckow) Borkh. - Jammu and Kashmir (Khan et al., 2016; Khan and Shah, 2018)
4. ***Brachycaudus (Brachycaudus) helichrysi* (Kaltenbach, 1843)**
   - *Ageratum conyzoides* L. - West Bengal (Agarwala et al., 1982; Agarwala et al., 1984)
5. ***Brevicoryne brassicae* (Linnaeus, 1758)**
   - *Brassica juncea* (L.) Czern. - Uttarakhand (Ghosh et al., 1985)
   - *Brassica oleracea* L. var. *acephala* - Jammu and Kashmir (Bhat and Bhagat, 2017)
   - *Brassica oleracea* L. var. *botrytis* - Jammu and Kashmir (Bhat, 2008; Bhat and Bhagat, 2017); Uttar Pradesh (Tiwari et al., 2024)
   - *Brassica oleracea* L. var. *capitata* - Jammu and Kashmir (Bhat, 2008; Bhat and Bhagat, 2017)
   - *Brassica oleracea* L. var. *gongylodes* - Jammu and Kashmir (Bhat, 2008; Bhat and Bhagat, 2017)
   - *Brassica* sp. - Jammu and Kashmir (Ahmad and Bhat, 1986)
6. ***Eriosoma lanigerum* (Hausmann, 1802)**
   - *Malus domestica* (Suckow) Borkh. - Uttarakhand (Maurya, 2011)
7. ***Liosomaphis himalayensis* Basu, 1964**
   - *Berberis asiatica* DC. - Uttarakhand (Ghosh et al., 1985)
8. ***Lipaphis erysimi* (Kaltenbach, 1843)**
   - *Brassica juncea* (L.) Czern. - Assam (Das, 2020); West Bengal (Ghosh, 1983)
   - *Brassica napus* L. - Jammu and Kashmir (Bhat and Bhagat, 2017)
   - *Brassica nigra* (L.) K. Koch - West Bengal (Agarwala et al., 1984; Chakrabarti et al., 2012)
   - *Brassica rapa* L. - Jammu and Kashmir (Ahmad and Bhat, 1986; Bhat and Bhagat, 2017); Uttar Pradesh (Tiwari et al., 2024); Uttarakhand (Bisht et al., 2001; 2006)
9. ***Macrosiphum (Macrosiphum) rosae* (Linnaeus, 1758)**
   - *Rosa* sp. - Uttarakhand (Ghosh et al., 1985); West Bengal (Raychaudhuri et al., 1979; Agarwala et al., 1982)
10. ***Mollitrichosiphum (Metatrichosiphon) nandii* Basu, 1964**
    - *Alnus nepalensis* D. Don - West Bengal (Agarwala et al., 1982)
11. ***Myzus persicae* (Sulzer, 1776)**
    - *Solanum tuberosum* L. - Uttarakhand (Ghosh et al., 1985)
12. ***Sitobion miscanthi* (Takahashi, 1921)**
    - *Triticum aestivum* L. - Uttarakhand (Ghosh et al., 1985)
13. ***Sitobion rosaeiformis* (Das, 1918)**
    - *Rosa* sp. - West Bengal (Agarwala, 1983; Agarwala et al., 1982)

F. *Sphaerophoria* spp.

It may account more than one species in different states.

1. ***Aphis craccivora* Koch, 1854**
   - *Solanum melongena* L. - West Bengal (Satpathi and Mandal, 2006)
2. ***Aphis gossypii* Glover, 1877**
   - *Solanum melongena* L. - West Bengal (Satpathi and Mandal, 2006)
3. ***Brevicoryne brassicae* (Linnaeus, 1758)**
   - *Brassica oleracea* L. var. *capitata* - Nagaland (Waluniba et al., 2016)
4. ***Lipaphis erysimi* (Kaltenbach, 1843)**
   - *Brassica oleracea* L. var. *capitata* - Nagaland (Waluniba et al., 2016)
   - *Brassica rapa* L. - Bihar (Karthik et al., 2022)
   - Unknown plant - Karnataka (Agarwala et al., 1984)
5. ***Myzus persicae* (Sulzer, 1776)**
   - *Brassica rapa* L. - Bihar (Karthik et al., 2022)
   - *Solanum melongena* L. - West Bengal (Satpathi and Mandal, 2006)
   - Unknown plant - Karnataka (Agarwala et al., 1984)
6. ***Rhopalosiphum padi* (Linnaeus, 1758)**
   - *Triticum aestivum* L. - Himachal Pradesh (Dixit et al., 2019)
7. ***Sitobion avenae* (Fabricius, 1775)**
   - *Triticum aestivum* L. - Himachal Pradesh (Dixit et al., 2019)

REFERENCES

1. **Agarwala B.K., Ghosh D., Das S.K., Poddar S.C. and Raychaudhuri D.N.** (1981). Parasites and predators of aphids (Homoptera: Aphididae) from

India. V. New records of two aphidiid parasites, nine arachnids and one dipteran predator from India. *Entomon*. 6(3): 233-238.

2. **Agarwala B.K., Dutta S. and Raychaudhuri D.N.** (1982). An account of syrphid (Diptera: Syrphididae) predators of aphids (Homoptera: Aphididae) available in Darjeeling district of West Bengal and Sikkim. *Pranikee*. 3: 15-21.
3. **Agarwala B.J.C., Dutta S. and Raychaudhurl D.N.** (1983). An account of syrphid (Diptera: Syrphidae) predators of aphids available in Darjeeling district of West Bengal and Sikkim. pp. 238-244. In: B.K. Behura (Ed.) The Aphids (Recent trends in aphidological studies): Proceedings of Symposium held at Ulkal University, Bhubaneswar, 440 pp. The Zoological Society of Orissa, Bhubaneswar.
4. **Agarwala B.K., Laska P. and Raychaudhuri D.N.** (1984). Prey records of aphidophagous syrphid flies from India (Diptera: Syrphidae). *Acta Entomologica. Bohemslovaka*. 81: 15-21.
5. **Agarwala B.K., Das S. and Bhaumik A.K.** (1987). Natural food range and feeding habits of aphidophagous insects in north east India. *Journal of Aphidology*. 1: 18-22.
6. **Agarwala B.K.** (1983). Parasites and predator of rose infesting aphids (Homoptera: Aphididae) in India. *Entomon*. 8: 35-39.
7. **Ahmad D. and Bhat M.R.** (1986). Distribution and host range of some aphidophagous syrphid flies in Kashmir. Geobios New Reports. 5:165-166.
8. **Ahmad M.E. and Kumari K.** (2024). Prey records of aphidophagous syrphids with their prey and host plants in India: A review. *Journal of Biological Control*. 38(2): 117-137. https://doi.org/10.18311/jbc/2024/35964
9. **Ahmad M.E., Kumar S., Parween N. and Rakhshan** (2020). Bio-ecological study of few species of *Aphis* Linn. in northeast Bihar and their association with food plants and natural enemies for possible use in the biological control. *Journal of Advanced Zoology*. 41: 103-116.
10. **Ali T.M. and Sharatchandra H.C.** (1985) A new record of *Paragus auritus* (Syrphidae: Diptera) on root aphid (Forda orientalis). *Milwai Newsletter*. 4: 18.
11. **Omkar** (2023). Insect Predators in Pest Management (Ed.), CRC Press, Taylor and Francis Group, LLC, 320 pp. https://doi.org/10.1201/9781003354239
12. **Ballal C.R. and Yamada K.** (2016). Anthocorid Predators. In. Omkar (Ed.). Ecofriendly Pest Management for Food Security Academic Press, pp. 183–216. https://doi.org/10.1016/B978-0-12-803265-7.00006-3
13. **Baskaran R.K.M., Sasikumar S., Rajavel D.S. and Suresh K.** (2009). Biology and predatory potential of aphidophagous syrphids on guava aphid, *Aphis gossypii* Glover (Hemiptera: Aphididae). *Journal of Biological Control.* 23(1): 53-56. https://doi.org/10.18311/jbc/2009/3616
14. **Basu M. and Patro B.** (2007). New records of host plants and natural enemies of *Aphis gossypii* Glover (Aphididae: Homoptera) from Orissa India. *Journal of Plant Protection and Environment.* 4(2): 74-80.
15. **Bhagat R.C. and Lone M.A.** (1984). New records and host range of predators of aphids (Aphididae: Homoptera) in Kashmir valley India. *Science and Culture*. 50: 364-366.
16. **Bhagat K.C. and Masoodi M.A.** (1988). Natural enemies of mealy plum aphid *Hyalopterus arundinis* Fabricius (Aphididae: Homoptera) in Kashmir, India. *Journal of Advanced Zoology.* 9(2): 145-147.
17. **Bhagat K.C., Masoodi M.A. and Koul V.K.** (1988). Some observations on the incidence of arthropod natural enemies of *Aphis pomi* deGeer (Homoptera: Aphididae) occurring in apple orchard ecosystem. *Journal of Aphidology*. 2: 80-89.
18. **Bhat D.M.** (2008). Studies on insect parasites and predators of some insect pests of vegetable crops of Kashmir Valley. Ph.D. thesis, P.G. Department of Zoology, University of Kashmir, Srinagar, J&K (India), 193 pp. http://hdl.handle.net/10603/72857
19. **Bhat D.M. and Bhagat R.C.** (2017). Host range and diversity of syrphid predators (Insecta: Diptera) of aphids on vegetable crops of Kashmir, with new host aphid/plant records. *Trends in Biosciences*. 10 (6): 1446-1448.
20. **Bhat M.R., Bali R.K. and Tahir I.** (1986). Predator complex of melon aphid (*Aphis gossypii* Glov.), a serious pest of buckwheat (*Fagopyrum* sp.) in Kashmir (India). *Fagopyrum*. 6: 12.
21. **Bhatia M.L. and Shaffi M.** (1933). Life histrories

of some Indian Syrphidae. *Indian Journal of Agricultural Science*. 2(1932): 543-569.

22. **Bijaya P.D.** (1998). Bioecology of *Myzus persicae* (Sulzer) (Homoptera: Aphididae) on certain cole crops in Manipur. Ph. D. thesis, Manipur University, Imphal, India, 331 pp. http://hdl.handle.net/10603/148203
23. **Bijaya P.D., Devi C., Varatharajan R. and Singh T.K.** (1996). On the density and composition of natural enemies of cabbage aphids from Manipur. *Journal of Advanced Zoology*. 17(2): 74-78.
24. **Bijaya P., Singh T.K. and Surjalata Ng. D.** (2001). Natural enemy complex of *Myzus persicae* (Sulzer) (Homoptera: Apiddidae) on cabbage in Manipur. *Journal of Aphidology*. 15: 181-183.
25. **Bijaya P., Singh T.K. and Subharani S.** (2006). Prey-predator and intra-guild interaction in cabbage agroecosystem in Manipur. *Journal of Aphidology.* 20(2): 51-56.
26. **Bijaya P., Sharmila M. and Singh T.K.** (2011). Biodiversity and abundance of syrphid fauna on major cruciferous crops in Manipur. *Journal of Advanced Zoology*. 32(1): 12-18.
27. **Bisht R.S., Rana D.S. and Mishra P.N.** (2001). Bio-Ecology of predators and parasitoids of aphids in Garhwal Hills. *Journal of Aphidology*. 15: 123-128.
28. **Bisht R.S., Sharma R.K. and Dev P.** (2006). Vertical distribution and activity of aphidophagous syrphids (Diptera: Syrphidae) in Garhwal Himalayas. *Journal of Aphidology.* 20: 25-29.
29. **Bartomeus I., Potts S.G., Steffan-Dewenter I., Vaissière B.E., Woyciechowski M. *et al.*** (2014). Contribution of insect pollinators to crop yield and quality varies with agricultural intensification. *Peer J.* 27; 2: e328. https://doi.org/10.7717/peerj.328.
30. **Chakrabarti S., Ghosh D. and Debnath N.** (1988). Development rate and larval voracity in *Harmonia (Leis) dimidiata* (Col.: Coccinellidae), a predator of *Eriosoma lanigerum* (Hom.: Aphididae) in western Himalay. *Acta Entomologica Bohcmoslovaca*. 85: 335-339.
31. **Chakrabarti S., Sarkar S. and Debnath M** (2012). Diversity, bioecology and biosystematics of aphidophagous predators of eastern Himalaya and northeast India. In: Hartmann, M. and Weipert, J. (Eds.). Biodiversitat und Naturausstattung im Himalaya, IV, Naturkundemuseum Erfurt, pp. 129-147.
32. **Chaudhary H.C. and Singh R.** (2012). Records of the predators of aphids (Homoptera: Aphididae) in eastern Uttar Pradesh. *Journal of Aphidology*. 25/26: 13-30.
33. **Cherian M.C.** (1934). Notes on some Indian Syrphidae. *Journal of the Bombay Natural History Society*. 37: 697-699.
34. **Chinnu V.S. Mulimani V., Shanas S. and Sumithramma N.** (2023). Exploration of natural enemy fauna of aphids and associated ant species from eastern dry zone of Karnataka, India. *Entomon*. 48(4): 545–552. https://doi.org/10.33307/entomon/v48i4/990
35. **Chitra Devi L., Singh T.K. and Varatharajan R.** (2002). Role of natural enemies in the management of *Lipaphis erysimi* (Kalt.) on *Brassica juncea* var. *rugosa* (Linn.). *Journal of Biological Control*. 16: 27-30. https://doi.org/10.18311/jbc/2002/4009
36. **Das R.** (2020). A field study on insect pest complex of brassicaceous crops in some areas of Cachar, Assam. *Journal of Entomology and Zoology Studies*. 8(4): 2043-2045.
37. **Das S.C.** (1974). Parasites and predators of pests of tea, shade trees and ancillary crops in Jorhat circle in North East India, Two and a Bud. 21: 17-21.
38. **Das S.C. and Kakoty N.N.** (1992). Biological studies on tea aphis, *Toxoptera aurantii* Boyer and its natural enemy complex. Two and a Bud. 39(1): 29-33.
39. **Das S.K and Raychaudhuri D.** (1983). Parasitoids and predators of aphids (Homoptera: Aphididae) from India VI. New records of seven arachnids, one dipteran and neuropteran predators from Himachal Pradesh, India. *Entomon*. 8(1): 27-34.
40. **Debnath N.** (1991). Studies on some aphidophagous insects in northwest and western Himalays. Ph.D. thesis, University of Kalyani. http://hdl.handle.net/10603/211339
41. **Devi N.M., Singh T.K. and Devi C.** (2002). Field density of *Aphis gossypii* Glover on brinjal in relation to predatory and biotic factors. *Uttar Pradesh Journal of Zoology*. 22(1): 67-71.
42. **Devi K.D., Maisnam S. and Varatharajan R.** (2010). Density, diversity and differential feeding

potentials of aphidophagous insects in the tea ecosystem. *Journal of Biopesticides.* 3(1 Spl. Issue): 58–61.

43. Devjani P. and Singh T.K. (1998). Ecological succession of aphids and their natural enemies on cauliflower in Manipur. *Journal of Aphidology*. 12: 45-51.

44. Devjani P. and Singh T.K. 2006. Larval development and prey consumption of five aphidophagous predators in relation to two aphid species. Advances in Indian Entomology: Productivity and Health a Silver Jubilee, Supplement No. 3, Volume-II, Insect Environment, pp. 121–125.

45. Dixit, Sharma P.K., Jayaram C.S., Rana A. (2019). Population dynamics of wheat aphids and their natural enemies. *Indian Journal of Entomology.* 81(4): 916-920. https://doi.org/10.5958/0974-8172.2019.00144.5

46. Dousti A.F. (2023). An updated checklist of Syrphidae (Diptera, Brachycera) from Iran. *Journal of Insect Biodiversity and Systematics*. 9 (2): 207–264. https://doi.org/10.52547/jibs.9.2.207

47. Dunn L., Lequerica M., Reid C. and Latty T. (2020). Dual ecosystem services of syrphid flies (Diptera: Syrphidae): Pollinators and biological control agents. *Pest Management Science*. 76: 1973-1979. https://doi.org/10.1002/ps.5807

48. Dyola U., Pandey A., Sheikh T., Subedi P. and Hassan M.A. (2024) An updated checklist of the hoverflies of Nepal (Diptera: Syrphidae). *Journal of Insect Biodiversity and Systematics.* 10(3): 485-533. https://doi.org/10.61186/jibs.10.3.485

49. Favret C. (2025). Aphid Species File: https://Aphid.SpeciesFile.org, retrieved on April 15, 2025.

50. Fletcher T.B. (1916). One hundred notes on Indian insects. Bulletin of the Agricultural Research Institute, Pusa No. 59: 1-39.

51. GBIF Secretariat (2025). GBIF Backbone Taxonomy. Checklist dataset https://doi.org/10.15468/39omei accessed via GBIF.org on April 15, 2025.

52. Ghorpadé K.D. (1973). A faunistic study of the hover flies (Diptera: Syrphidae) of Bangalore, southern India, 208 pp. M.Sc, University of Agricultural Sciences, Bangalore, India.

53. Ghorpadé K.D. (1981). Insect prey of Syrphidae (Diptera) from India and neighbouring countries: a review and bibliography. *Tropical Pest Management*. 27: 62-82. https://doi.org/10.1080/09670878109414173

54. Ghorpadé K. (2014). An updated check-list of the hover-flies (Diptera-Syrphidae) recorded in the Indian subcontinent. *Colemania*. 44: 1-30.

55. Ghorpadé K. (2015). Hoverflies (Diptera: Syrphidae) documented from the Northwest Frontier of the Indian sub-continent: a circumstantial history and inclusive bibliography. *Colemania*. 50: 1-151.

56. Ghorpadé K., Durga P.K and Pavan S. (2011) Hover-flies (Diptera: Syrphidae) of the Coromandel Coast in Andhra Carnatic, Peninsular India. *Bionotes*. 13: 78-86.

57. Ghosh D. (1983). Studies on mustard aphid *Lipaphis erysimi* (KLTB.) (Homoptera: Insecta) and its natural enemy complex in some parts of West Bengal. Ph. D. thesis, Calcutta University, Kolkata, West Bengal, 207 pp. http://hdl.handle.net/10603/163460

58. Ghosh D., Debnath N. and Chakrabarti S. (1985). Predators and parasites of aphids (Homoptera: Aphididae) from northwest Himalaya: Ten species of syrphids (Diptera: Syrphidae) from Garhwal range. *Entomon*. 10: 301-303.

59. Ghosh D., Poddar S.C. and Raychaudhuri D.N. (1981). Natural enemy complex of *Aphis craccivora* Koch and *Lipaphis erysimi* (Kalt.) in and around Calcutta. *Science and Culture*. 47: 58-60.

60. Hassan M.A., Ghorpadé K., Bodlah I., Mahmood K. and Iqbal Z. (2018). Additional notes on the genus *Paragus* Latreille (Diptera: Syrphidae) from Pakistan with a new country record. *The Journal of Animal and Plant Sciences*. 28(3): 708-714.

61. Jalali S.K., Singh S.P. and Biswas S.R. (2000). Population dynamics of *Aphis gossypii* Glover (Homoptera: Aphididae) and its natural enemies in the cotton ecosystem. *Journal of Aphidology*. 14: 25-32.

62. Joshi S., Ballal C.R. and Rao N.S. (1999). Species complex, population density and dominance structure of aphidophagous syrphids in cowpea ecosystem. *Entomon*. 24: 203-213.

63. Joshi S., Venkatesan T. and Rao N.S. (1997). Host range and predatory fauna of *Aphis craccivora*

Koch (Homoptera: Aphididae) in Bangalore, Karnataka. *Journal of Biological Control*. 11: 59-63.

64. **Joshi S., David K.J. and Sachin K.** (2023). Syrphid predators (Diptera: Brachycera), pp. 229-244. In: Omkar (Ed.). Insect Predators in Pest Management, CRC Press, Taylor and Francis Group, LLC. https://doi.org/10.1201/9781003370864-9

65. **Kapur A.P.** (1942). Bionomics of some Coccinellidae, predacious on aphids and coccids in North India. *Indian Journal of Entomology*. 4(1): 49-66.

66. **Karthik S., Mukherjee U., Yahaswini G., Abhishek B.M. and Sai Reddy M.S.** (2022). Abundance and diversity of insect pests and their natural enemies in *Brassica campestris* (L.) crop ecosystem. *Journal of Entomology Research*. 46(3): 597-602. https://doi.org/10.5958/0974-4576.2022.00104.9

67. **Khaghaninia S. and Hosseini C.** (2013): Taxonomic study of *Paragus* Latreille (Diptera: Syrphidae) in the East Azerbaijan and Kordestan provinces of Iran. *Efflatounia*. 13: 8–18.

68. **Khan A.A. and Shah M.A.** (2018). Population dynamics of green apple aphid *Aphis pomi* de Geer (Homoptera: Aphididae) and its natural enemies in apple orchard of Kashmir. *Indian Journal of Entomology*. 80(2): 320-329. https://doi.org/10.5958/0974-8172.2018.00050.0

69. **Khan A.A., Shah M.A. and Majid S.** (2016). Functional response of four syrphid predators associated with green apple aphid (Hemiptera: Aphididae) in laboratory. *Journal of Economic Entomology*. 109(1): 78-83. https://doi.org/10.1093/jee/tov264

70. **Kumar A., Kapoor V.C. and Lriska P.** 1987. Immature stages of some aphidophagous syrphid flies of India (Insecta, Diptera, Syrphidae). *Zoologica Scripta*. 16: 83-88.

71. **Kumar A., Kapoor V.C. and Mahal M.S.** 1988. Population buildup and dispersion of immature stages of aphidophagous syrphids (Syrphidae: Diptera) on Raya, *Brassica juncea* Coss. *Journal of Insect Science*. 1: 39-84.

72. **Mani M. and Krishnamoorthy A.** (1989). Impact of insect predators in the control of *Aphis gossypii* Glover on guava. *Journal of Biological Control*. 3:128-129.

73. **Maruthadurai, R.** (2019). Diversity of predators and management of *Aphis odinae* (van Der Goot) in cashew. *Indian Journal of Entomology*. 81(4): 909-912. https://doi.org/10.5958/0974-8172.2019.00200.1

74. **Maruthadurai, R.** (2023). Biodiversity of hoverflies (Insecta: Diptera: Syrphidae) of the protected areas of Goa. https://forest.goa.gov.in/

75. **Maruthadurai R. and Singh N.P.** (2017). A report on occurrence of aphidophagous predators of *Aphis odinae* (Van der Goot) (Hemiptera: Aphididae) in cashew ecosystem from Goa, India. *Journal of Threatened Taxa*. 9(2): 9858-9861. https://doi.org/10.11609/jott.2435.9.2.9858-9861

76. **Mathur K.C.** (1983). Aphids of agricultural importance and their natural enemies at Jalandhar (Punjab), pp: 229-233. In: B.K.Behura (Ed.). The aphids (Recent Trends in Aphidological Studies): Proceedings of Symposium held at Utkal University, Bhubaneswar,440 pp. The Zoological Society of Orissa, Bhubaneswar.

77. **Maurya R.P.** (2011). Natural enemies of apple woolly aphid, *Eriosoma lanigerum* Hausmann and their population dynamics in a mid hill apple orchard. *Indian Journal of Entomology*. 73(1): 15-18.

78. **Mengual X.** (2019). Phylogenetic relationships of the bacchine flower flies (Diptera: Syrphidae) based on molecular characters, with a description of a new species of *Melanostoma* (Schiner, 1860). *Contributions to Zoology*. 1-35. https://doi.org/10.1163/18759866-20191410

79. **Mishra I., Mandal S.M.A. and Mishra B.K.** (2013). Comparative biology and feeding potentiality of three species of syrphid flies on *Aphis craccivora* Koch. *Journal of Plant Protection and Environment*. 10(2): 28-33.

80. **Mitra B., Roy S., Imam I. and Ghosh M.** (2015). A review of the hover flies (Syrphidae: Diptera) from India. *International Journal of Fauna and Biological Studies*. 2 (3): 61-73.

81. **Mohi-ud-din S., Anjum N., Wani A.R., Ahmad M.J., Khan A.A., Mir S.A. and Hassan G.** (2019). Seasonal incidence and natural enemy complex of aphid, *Aphis punicae* Passerini (Hemiptera: Aphididae) infesting pomegranate in Kashmir. *Journal of Biological Control*. 33(2): 122-126. https://doi.org/10.18311/jbc/2019/22717

82. **Mulimani V. and Rajanna K.M.** (2014). Role of insect predators in the control of *Toxoptera odinae* (Hemiptera: Aphididae) in cashew plantation. *Biopesticides International*. 10(1): 112-115. http://www.connectjournals.com/bi

83. **Muraleedharan N. and Radhakrishnan B.** (1989). Syrphid predators of the tea aphid, *Toxoptera aurantii* (Boyer de Fonscolombe), in the Annamalais. *Indian Journal of Agricultural Sciences*. 56(4): 307.

84. **Netwal M, Patel Y, Arvind R.M. and Saini A.** (2023). Population dynamics of arthropods on tomato (*Lycopersicum esculentum* L.) in Vindhya plateau region of Madhya Pradesh. *Journal of Agriculture and Ecology*. 17: 58-65. https://doi.org/10.58628/JAE-2317-310

85. **Nonita M., Subharani S., Bijaya P., Singh T.K. and Singh P.M.** (2002). Seasonal incidence of aphids (Homoptera: Aphididae) infesting potato in relation to biotic and abiotic factors in Manipur. *Journal of Aphidology*. 16: 103-108.

86. **Palial S., Verma S.C., Sharma P.L., Chauhan N. and Singh C.** (2025). Biological attributes and population growth parameters of five dominant syrphids against *Brevicoryne brassicae* infesting cabbage. Phytoparasitica 53. 39. https://doi.org/10.1007/s12600-025-01263-w

87. **Parween N., Kumar S., Kumari K. and Ahmad M. E.** (2023). Interaction of *Myzus* spp. (Hemiptera: Aphididae) with their food plants, parasitoids and predators in northeast Bihar. *Journal of Advanced Zoology*. 44(2): 95–100. https://doi.org/10.17762/jaz.v44i2.83

88. **Patnaik N.C. and Bhagat K.C.** 1976. Observations on the syrphid fauna of Puri district (Orissa) and bio-ecology of *Ischiodon scutellaris* Fabr., and *Eumerus* sp., nr *albifrons* 20 F.

89. **Patnaik N.C., Satpathy J.M. and Bhagat K.C.** (1977). Note on the occurrence of aphidophagous insect predators in Puri district (Orissa) and their predation on the sorghum aphid, *Longiunguis sacchari* (Zhnt.). *Indian Journal of Agricultural Sciences*. 47(11): 585-586.

90. **Patro B. and Behera M.K.** (1992). Bionomics of *Paragus* (*Paragus*) *serratus* (Fabricius) (Diptera: Syrphidae), a predator of the bean aphid, *Aphis craccivora* Koch. *Tropical Science*. 33: 131–135.

91. **Poddar S.C.** (1982). Studies on *Aphis craccivora* Koch and its natural enemies in some parts of India. Ph. D. thesis, Calcutta University, Kolkata, West Bengal, 245 pp. http://hdl.handle.net/10603/162498

92. **Prakash S. and Rani P.** (2015). Ecological succession of aphids and their natural enemies of cauliflower. *Research Spectra*. 1(2-3): 89-90.

93. **Prakash S. and Verma A.K.** (2022). Anthropogenic activities and Biodiversity threats. *International Journal of Biological Innovations*. 4(1): 94-103. https://doi.org/10.46505/IJBI.2022.4110

94. **Radhakrishnan B. and Muraaledharan N.** (1991). Bio-ecology of the aphid, *Toxoptera aurantii* (Boyer de Fonscolombe) (Homoptera: Aphididae) infesting tea in southern India. *Journal of Aphidology*. 5: 97-110.

95. **Radhakrishnan B. and Muraleedharan N.** (1993). Bioecology of six species of syrphid predators of the aphid, *Toxoptera aurantii* in Southern India. *Entomon*. 18: 175-180.

96. **Radhakrishnan B. and Muraaledharan N.** (1995). Records of natural enemies *Toxoptera aurantii* (Boyor de Fonscolombe) (Homoptera: Aphididae) infesting tea plantations in South India. *Journal of Aphidology*. 9: 87-91.

97. **Rahman K.A.** (1940). Important insect predators of India. *Proceedings of the Indian Academy of Sciences*. 12: 67-74. https://doi.org/10.1007/BF03049103

98. **Rao R.S.N., Joshi B.G. and Satyanarayna S.V.V.** (1984). New record of *Aphelinus* sp. (Homoptera: Aphididae) as parasite of *Myzus persicae* Sulz. On Lanka tobacco. *Tobacco Research*. 10(1): 76.

99. **Rao V.P.** 1969. Survey of natural enemies of aphids in India. Final Report of the Commonwealth Institute of Biological Control. 480: 1-93.

100. **Rao V.P., Dharmadhikari P.R., Ramaseshiah G., Phalak V.R. and Madhavan T.V.S.** (1969). Study of natural enemies of aphids (for the U.S.A.). Report of the Commonwealth Institute of Biological Control. 1968: 45-47.

101. **Rau, S.A.** (1936). Report of the Entomologist. Report Tea Department United Planters Association of South India, 1935-1936, pp. 35-45.

102. **Raychaudhuri D.N., Dutta S., Agarwala B.K., Raychaudhuri D. and Raha S.K.** (1978). Some

parasites and predators of aphids from Northeast India and Bhutan. *Entomon*. 3: 91-94.

103. Raychaudhuri D.N., Dutta S., Agarwala B.K., Raha S.K. and Raychaudhuri D. (1979). Some parasites and predators of aphids in Northeastern India and Bhutan. II. Entomon. 4: 163-166.

104. Sarkar S. and Chakrabarti S. (2015). Aphid (Hemiptera: Aphididae) diversity on the fruit yielding plants in India. *Journal of Applied Biosciences*. 41(2): 86-109.

105. Satpathi C.R. and Mandal A. (2006). Brinjal aphids and their insect predators in West Bengal. *Journal of Aphidology*. 20: 37-41.

106. Sengupta J., Naskar A., Maity A., Hazra S., Mukhopadhyay E., Banerjee D. and Ghosh S. (2016). An updated distributional account of indian hover flies (Insecta: Diptera: Syrphidae). *Journal of Entomology and Zoology Studies*. 4(6): 381-396.

107. Sengupta J., Naskar A., Homechaudhuri S. and Banerjee D. (2020). A taxonomic account of hover flies (Insecta: Diptera: Syrphidae) with 2 new records from mid hill zone of Himachal Pradesh, India. *International Journal of Advancement in Life Sciences Research*. 3(3): 30-49. https://doi.org/https://doi.org/10.31632/ijalsr.20.v03i03.004

108. Sengupta J., Naskar A. and Banerjee D. (2024). A catalogue of Indian hoverflies (Insecta: Diptera: Syrphidae), Zoological Survey ofd India, Kolkata, Occasional Paper No. 420, 198 pp.

109. Shah M.S., Chanu M.C. and Singh T. (2013). Population trends of *Aphis gossypii* Glover (Homopetra: Aphididae) on brinjal in relation to climatic factors and activity of predators. *Uttar Pradesh Journal of Zoology*. 33(3): 301–305. https://mbimph.com/index.php/UPJOZ/article/view/759

110. Sharma D.K., Varma G.C. and Kishore L. (1997). Feeding capacity of predators of mustard aphid, *Lipaphis erysimi*. *Journal of Aphidology*. 11(2): 171-174.

111. Sharma S., Verma S.C., Sharma P.L. and Chandel R.S. (2020). Diversity of inset-pests and their natural enemies in cauliflower under mid hills of Himachal Pradesh. *Journal of Entomology and Zoology Studies*. 8(2): 1204-1209.

112. Shehzad A., Ghorpadé K., Rafi M.A., Zia A., Bhatti A.R., Ilyas M. and Shah S.W. (2017). Faunistic study of hover flies (Diptera: Syrphidae) of Pakistan. *Oriental Insects*. 51(3): 197-220. https://doi.org/10.1080/00305316.2016.1274275

113. Singh A. and Samuel R.N. (2024). First record of chequered hover fly *Melanostoma scalare* (Fabricius, 1794) (Diptera: Syrphidae) from India. *Journal of Entomology and Zoology Studies*. 12(5): 33-35. https://doi.org/10.22271/j.ento.2024.v12.i5a.9379

114. Singh H.J. (2002). Bioecology of *Aphis craccivora* Koch (Homoptera: Aphididae) on certain pulse crops in Manipur. Ph. D. thesis, Manipur University, Manipur, 242 pp. http://hdl.handle.net/10603/148860

115. Singh H.J. and Singh T.K. (2000). Role of biotic and abiotic factors on the population trend of *Aphis glycines* (Matsumura) (Homoptera: Aphididae) on soybean in Manipur. *Journal of Aphidology*. 14: 77-82.

116. Singh R. (2001). Biological control of the aphids by using their parasitoids, pp. 57-73. In: Upadhyay R.K., Mukerji K.G. and Chamola B.P. (Eds.). Biocontrol Potential and its Exploitation in Sustainable Agriculture, Volume 2; Kulwer Academic/Plenum Publishers, USA. https://doi.org/10.1007/978-1-4615-1377-3_5

117. Singh R. and Singh G. (2016). Aphids and their biocontrol, pp. 63–108. In: Omkar (Ed.), Ecofriendly Pest Management for Food Security. Academic Press, https://doi.org/10.1016/B978-0-12-803265-7.00003-8

118. Singh R. and Singh G. (2019). Species diversity of Indian aphids (Hemiptera: Aphididae). *International Journal of Biological Innovations*. 1(1): 23-29. https://doi.org/10.46505/IJBI.2019.1105

119. Singh R. and Singh G. (2021). Aphids, pp. 105-182. In: Omkar (ed.), Polyphagous Pests of Crops, Springer Nature Singapore. https://doi.org/10.1007/978-981-15-8075-8_3

120. Singh R. and Singh G. (2022). Reproductive Strategies in Aphids, pp. 259-282. In: Omkar and Mishra G. (Eds.), Reproductive strategies in insects Taylor and Francis Group, LLC. https://doi.org/10.1201/9781003043195-13

121. Singh R., Verma A.K. and Prakash S. (2023). The web of life: Role of pollution in biodiversity decline. *International Journal of Fauna and*

Biological Studies. 10(3): 49-52. 10.22271/23940522.2023.v10.i3a.1003

122. Singh S.P. (1993). Biological control of insect pests, pp. 1591-1615. In. Chadha K.L. and Pareek O.P. (Eds.), Advances in Horticulture Vol. 3-Fruit crops: Part 3. Malhotra Publishing House, New Delhi, India.

123. Singh T.K., Devjani P. and Bijaya P. (2002). Predator complex of major aphids in cauliflower agro-ecosystem in Manipur. *Journal of Aphidology.* 16: 97-102.

124. Sorokina V.S. (2009). Hoverflies of the genus *Paragus* Latr. (Diptera, Syrphidae) of Russia and Adjacent Countries. *Entomological Review*. 89(3): 351-366.

125. Sorokina V.S. and Cheng X.Y. (2007). New species and new distributional records of the genus *Paragus* Latr. (Diptera, Syrphidae) from China. *Volucella*. 8: 1-33.

126. Sreedevi K. and Verghese A. (2007). Ecology of aphidophagous predators in pomegranate ecosystem in India. *Communications in Agricultural and Applied Biological Sciences.* 72(3): 509-516.

127. Subhan F. and Shah M. (2016). Taxonomic study of genus *Sphaerophoria* LePeletier et Serville (Diptera: Syrphidae) with threespecies from Northern Dry Mountains region of Pakistan. *Journal of Entomology and Zoology Studies*. 4(4): 1192-1198.

128. Thangjam R., Kadam V., Ningthoujam K. and Sorokhaibam M. (2019). Hoverflies of Assam (Diptera: Syrphidae): New records and their diversity. *Journal of Entomology and Zoology Studies.* 7(4): 965-969

129. Thangjam R., Kadam V., Borah R.K., Saikia D.K. and Singh H.R. (2021). Diversity of arthropod fauna in king chilli (*Capsium chinense* Jacq.) ecosystem in northeast India. *Indian Journal of Entomology*. 83(4): 535-541. https://doi.org/10.5958/0974-8172.2021.00078.X

130. Thompson F.C. and Ghorpadé K. (1988). A new coffee aphid predator, with notes on other Oriental species of *Paragus* (Diptera: Syrphidae). *Colemania*. 5: 1–24.

131. Thompson C. and Vockeroth J.R. (1989). Family Syrphidae. pp. 437-458. In. Evenhuis N.L. (Ed.). Catalog of the Diptera of the Australasian and Oceanian Regions. Honolulu and Leiden, Bishop Museum Press and E.J. Brill, 1155 pp.

132. Tiwari K.M., Tripathi P.N. and Singh R. (2024). Biodiversity of aphidophagous predators in Ayodhya district, Uttar Pradesh, India. *Arthropods*. 13(3): 120-156.

133. Udayakumar A., Chandramanu K.G.R., Joshi S. and Shivalingaswamy T.M. (2023). Fennel, *Foeniculum vulgare* as banker crop for syrphids to promote aphidophagy and myophily. *Current Science.* 124(12): 1469-1472. https://doi.org/10.18520/cs/v124/i12/1469-1472

134. Vadivelu S., Mohanasundaram M. and Subba Rao P.V. (1976). Record of parasites and predators of some south Indian crop pests. *Indian Journal of Entomology*. 37: 100-101.

135. Vanavasan N.K. (2008). Bionomics of the palm aphid *Cerataphis brasiliensis* Hempel Homoptera - Aphididae infesting areca palm *Areca catechu* Linn., Ph. D. thesis, Mangalore University, Mangalore, Karnataka, pp. 238. http://hdl.handle.net/10603/131917

136. Vanitha K., Ravoprasad T.N., Rajashekara H. and Mog B. (2022). Occurrence of *Aphis odinae* van der Goot and its natural enemies in cashew. *Pest Management in Horticultural Ecosystems.* 28(2): 53-57.

137. Vijayasree V. (2006). Pests of coccinia (*Coccinia grandis* (L.) Vogt.) and their management. M. Sc. thesis, Kerala Agriculture University, Thrissur, India, 146 pp. http://krishikosh.egranth.ac.in/handle/1/5810109753

138. Vujić A., Ståhls G., Rojo S., Radenković S. and Šimić S. (2008). Systematics and phylogeny of the tribe Paragini (Diptera: Syrphidae) based on molecular and morphological characters. *Zoological Journal of the Linnean Society.* 152: 507–536.

139. Wahengbam J., Raut A.M. and Bano A.N. (2019). Syrphid fly: A potential bioagents and pollinators. *Think India Journal*. 22(34): 779-785.

140. Waluniba, Ao M.A., Singh H.K., Neog P. and Lytan D. (2016). Bio-diversity of insect pests and its natural enemies in cabbage ecosystem of Nagaland, north east India. *Environment and Ecology*. 34(3B): 1346-1350.

141. WFO (2025). The World Flora Online, https://www.worldfloraonline.org, accessed on April 15, 2025.

142. Yang D., Wang M.Q. and Li W.L. (2020). Species catalog of China. Vol. 2. Animals, Insecta (VII), Diptera (3), Brachycera Cyclorrhaphous. Science Press, Beijing. 1312 pp.