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RESEARCH ARTICLE

An Updated Checklist of Tri-Trophic Associations of Aphidophagous Diptera and Neuroptera in Different Districts of Uttarakhand, India

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ABSTRACT

Tritrophic interactions among host plants, aphids, and their natural enemies form the foundation of ecological balance and biological control in agroecosystems. While plants provide resources for aphids, these pests inflict damage through phloem feeding and the transmission of plant viruses. In turn, a diverse guild of predators—including coccinellids, lacewings, syrphids, spiders, mites, hemipteran bugs, earwigs, and thrips—plays a pivotal role in regulating aphid populations. Documenting such interactions is vital for elucidating biodiversity patterns, food-web architecture, and identifying effective natural enemies for integrated pest management. The present study assembles a detailed checklist of tri-trophic associations involving aphidophagous flies (Diptera) and lacewings (Neuroptera), their aphid prey, and host plants in Uttarakhand, India. Altogether, 28 fly species were recorded preying on 52 aphid species across 57 host plants, and 25 lacewing species were observed feeding on 27 aphid species associated with 23 host plants, accounting for 216 and 59 tri-trophic associations, respectively, across 12 districts. Syrphidae (hover flies) and Chamaemyiidae emerged as dominant dipteran predators, with species such as *Episyrphus balteatus*, *Betasyrphus serarius*, *Eupeodes confrater*, and *Ischiodon scutellaris* exhibiting broad prey ranges. Among Neuroptera, Chrysopidae (green lacewings) were most prevalent, with *Chrysoperla zastrowi sillemi* and *Cunctochrysa jubingensis* displaying notable polyphagy. Records of anisopodids and eristaline flies were excluded due to their non-aphidophagous life histories. Aphid species such as *Brevicoryne brassicae*, *Lipaphis erysimi*, and *Sitobion roseiformis* supported the greatest diversity of predators. The resulting checklist underscores the ecological significance of syrphids and lacewings in aphid suppression, highlights their potential in sustainable pest management, and provides critical baseline data for food-web analyses, biodiversity monitoring, and the design of region-specific IPM programs. More broadly, this study establishes a foundational reference for predator-aphid-plant interactions in Uttarakhand, offering valuable insights for biodiversity conservation and for anticipating ecological shifts under climate change and agricultural intensification.

KEY WORDS: Aphidophagous, biological control, checklist, conservation, lacewings, ladybirds, tri-trophic associations, Uttarakhand.

INTRODUCTION

Tritrophic associations in aphid systems encompass interactions among plants, aphids, and aphidophagous arthropods (predators and parasitoids). At the primary trophic level, plants provide both habitat and nutritional resources for aphids, with their morphological and chemical attributes strongly influencing aphid abundance and spatial distribution. At the secondary level, aphids exploit these plant resources while simultaneously altering host physiology through continuous sap-feeding and by serving as vectors of viral pathogens. At the tertiary level, aphidophagous arthropods, including coccinellid beetles, lacewings, syrphid larvae, predatory bugs, spiders, and parasitoid wasps, exert top-down regulation on aphid populations, thereby maintaining a dynamic balance between pest outbreaks and crop performance (Singh & Singh, 2016). These interactions are further modulated by plant-mediated indirect defenses, such as the emission of

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herbivore-induced volatiles that attract natural enemies, reinforcing the effectiveness of biological control (Singh, 2003; Kishore *et al.,* 2024). Collectively, these tri-trophic associations underpin natural pest suppression, enabling diverse predator and parasitoid communities to regulate aphid populations without external inputs.

Aphids (Hemiptera: Aphididae) constitute a major group of phloem-feeding pests of global significance. In India, 794 species have been recorded, of which approximately 250 are recognized as serious pests of agricultural and horticultural crops (Singh & Singh, 2019; Singh *et al.,* 2023). Their ecological success can be attributed to their unique biological traits, including wide host range, plastic reproductive strategies, variable developmental patterns, and pronounced polymorphism (Singh & Singh, 2022). Persistent phloem extraction reduces plant vigour, induces leaf curling and shoots malformation, and ultimately suppresses plant growth. Furthermore, aphids act as highly efficient vectors of more than 200 plant viruses, many of which cause substantial yield losses across diverse cropping systems (Singh & Singh, 2021).

Comprehensive cataloguing of tri-trophic associations among aphidophagous arthropods, their aphid prey, and host plants is essential for advancing both ecological research and applied pest management. Such inventories provide critical insights into the biodiversity of predators and parasitoids, the structural complexity of local agroecosystems, and the functioning of natural habitats. By mapping predator-prey-plant interactions, catalogues reveal ecological networks, identify keystone species, and guide the selection of effective natural enemies for conservation and augmentative biological control. In addition, these resources serve as baselines for monitoring invasive species, tracking range expansions of natural enemies, and assessing shifts in host-natural enemies' dynamics under the influence of climate change (Singh, 2025a). They also inform agroecological practices by guiding habitat management strategies that enhance natural enemy services, while supporting comparative and biogeographical analyses across regions. Collectively, such catalogues provide a scientific foundation for strengthening sustainable aphid management through a biodiversity-driven and ecosystem-based approach (Singh, 2025b).

The present article contributes to this effort by compiling a checklist of tri-trophic associations involving aphidophagous flies (Diptera) and lacewings (Neuroptera), their aphid preys, and host plants in Uttarakhand, a northwest state of India. This inventory establishes baseline information on species diversity, host specificity, and distribution, which is vital for ecological studies and integrated pest management. By documenting predator-prey-plant linkages, the checklist highlights key natural regulatory interactions that suppress aphid populations. It further supports the identification of ecologically compatible natural enemies for targeted biological control, thereby reducing risks associated with the introduction of non-native species. Moreover, it provides a framework for developing region-specific IPM strategies, while contributing to analyses of food-web architecture, trophic dynamics, and biogeographical trends. Importantly, such inventories facilitate monitoring of changing species associations under climate variability, agricultural intensification, and habitat modification. Overall, the checklist serves as a valuable scientific resource for researchers, policymakers, and farmers, fostering ecologically sustainable pest management (Sharma *et al.,* 2025).

MATERIALS & METHODS

The checklist of tri-trophic associations of aphidophagous arthropods in Uttarakhand was compiled using information from recently published books, peer-reviewed journals, authenticated theses, and credible online databases available up to 30 September 2025. Earlier records contained inaccuracies in the scientific names of predators, aphids, and host plants, including some recent publications. Such inconsistencies largely stem from the rapid pace of taxonomic revisions and the tendency of users to rely on outdated sources. Additionally, continuing research on predator-prey relationships regularly generates new distributional records, nomenclatural updates, and revised species statuses. In this compilation, care has been taken to correct such errors by standardizing aphid nomenclature according to the Aphid Species File (https://aphid.speciesfile.org), and host plant names in accordance with World Flora Online (https://www.worldfloraonline.org) and the Global Biodiversity Information Facility (https://www.gbif.org).

Uttarakhand (30.0668°N, 79.0193°E), a Himalayan state of northern India, shares borders with the Tibet Autonomous Region of China to the north, Nepal to the east, Uttar Pradesh to the south, and Himachal Pradesh to the west and northwest. The state spans 53,483 km², of which approximately 86% is mountainous and 65% is under forest cover. Administratively, it is divided into two divisions: Kumaon (Almora, Bageshwar, Champawat, Nainital, Pithoragarh, Udham Singh Nagar) and Garhwal (Chamoli, Dehradun, Haridwar, Pauri Garhwal, Rudraprayag, Tehri Garhwal, Uttarkashi). The northern region is characterized by towering Himalayan peaks and glaciers, which serve as sources of the Ganges and Yamuna rivers. The state also harbors important protected areas,

including Jim Corbett National Park and the Valley of Flowers National Park. Climatic conditions range from subtropical in the lower elevations to temperate and alpine at higher altitudes, with mean annual rainfall of about 1,550 mm and temperatures fluctuating between -4°C and 43°C. This broad climatic and altitudinal gradient sustains a remarkable diversity of flora and fauna (Kharkwal, 2017).

RESULTS & DISCUSSION

Rao (1969) was likely the first to mention tri-trophic associations involving four species of hover flies in Uttarakhand. Subsequently, in the following years, Ghosh *et al.* (1985), Debnath *et al.* (1988), Chakrabarti *et al.* (1991, 2012), and others documented various species hover flies and lacewings feeding on different aphid species across the Garhwal Himalaya on a range of agricultural and horticultural crops. The first comprehensive faunistic survey of aphidophagous arthropods, along with their aphid prey and host plants, was carried out by Debnath (1991). This study compiled tri-trophic associations involving 14 hover flies and 10 lacewings preying on aphids infesting numerous economically important host plants across nearly all districts of Uttarakhand. Subsequent contributions came from Bhattacharya & Dey (2001), Bisht *et al.* (2001, 2006), and Dey (2015) who reported additional aphidophagous hover flies and lacewings from the region.

A. Order: Diptera

Members of four families of Diptera have been recorded as aphidophagous in Uttarakhand: Anisopodidae, Asilidae, Chamaemyiidae and Syrphidae. Sharma *et al.* (2006) recorded *Olbiogaster* sp. of Anisopodidae feeding on *Aphis aurantii* on *Camellia sinensis* in Dehradun. However, the larvae of anisopodids are not aphidophagous, instead, they are saprophagous or detritivorous and their adults are pollen feeder like hover flies (Marchiori, 2023). Hence, the record is excluded from this checklist. A total of 28 species of aphidophagous flies are recorded preying on 52 species of aphids infesting

Table 1: Number of species of aphidophagous order Diptera belonging to different families preying on different number of aphid species infesting different number of host plant species and triplets in different number of districts in Uttarakhand

Families	Species of predators	Number of			
		Species of aphid	Species of host plant	Triplets	Districts
Asilidae	*Machimus indianus*	7	7	7	1
Chamaemyiidae	*Leucopis* sp.	11	10	11	4
Syrphidae	*Asarkina ericetorum*	2	1	2	1
	Betasyrphus isaaci	3	3	3	2
	Betasyrphus serarius	17	14	17	6
	Betasyrphus sp.	2	2	2	1
	Episyrphus balteatus	30	35	46	10
	Eupeodes confrater	17	17	20	6
	Eupeodes corollae	11	11	13	6
	Eupeodes latifasciatus	6	4	6	5
	Eupeodes luniger	1	1	1	1
	Ischiodon scutellaris	17	22	27	10
	Melanostoma orientale	3	4	5	5
	Melanostoma univittatum	1	2	2	1
	Paragus politus	2	2	2	2
	Paragus serratus	3	3	3	3
	Paragus tibialis	8	7	8	6
	Paragus yerburiensis	1	1	1	1
	Scaeva pyrastri	1	1	1	1
	Scaeva selenitica	3	3	3	2
	Sphaerophoria indiana	7	7	8	3
	Sphaerophoria scripta	7	7	7	6
	Syritta pipiens	1	1	1	1
	Syrphus fulvifacies	6	5	7	6
	Syrphus ribesii	1	1	1	1
	Syrphus spp.	7	5	8	2
	Total	52	57	212	12

57 species of plants, mostly agricultural and horticultural crops with 216 tri-trophic associations in 12 districts of Uttarakhand (Table 1). A detailed account of aphidophagy of other families is given below.

i. Family: Asilidae

Bisht *et al.* (2001) recorded an asilid fly, commonly known as robber flies, *Machimus indianus* as aphidophagous feeding on 7 species of aphids on 7 food plants in Tehri Garhwal district. Indeed, it is a predatory robber fly that feeds on a variety of insects, primarily small to medium-sized soft-bodied prey (Naskar *et al.,* 2019). While not an aphid specialist, it has been reported to capture and consume aphids opportunistically, especially when they are abundant on crops and wild vegetation. The fly attacks aphids either in flight or directly from plant surfaces, piercing them with its proboscis and extracting body fluids. The detailed account of tri-trophic associations of the species is given below:

1. *Machimus indianus* Ricardo, 1919

- *Aphis gossypii* Glover, 1877
  - *Solanum melongena* L. - Tehri Garhwal (Bisht *et al.,* 2001)
- *Lipaphis erysimi* (Kaltenbach, 1843)
  - *Brassica rapa* L. - Tehri Garhwal (Bisht *et al.,* 2001)
- *Macrosiphoniella pseudoartemisiae* Shinji, 1933
  - *Artemisia* sp. - Tehri Garhwal (Bisht *et al.,* 2001)
- *Myzus persicae* (Sulzer, 1776)
  - *Brassica oleracea* L. - Tehri Garhwal (Bisht *et al.,* 2001)
- *Rhopalosiphum maidis* (Fitch, 1856)
  - *Zea mays* L. - Tehri Garhwal (Bisht *et al.,* 2001)
- *Rhopalosiphum padi* (Linnaeus, 1758)
  - *Triticum aestivum* L. - Tehri Garhwal (Bisht *et al.,* 2001)
- *Sitobion rosaeiformis* (Das, 1918)
  - *Rosa indica* L. - Tehri Garhwal (Bisht *et al.,* 2001)

ii. Family: Chamaemyiidae

The members of the family Chamaemyiidae, commonly known as silver flies are small dipterans whose larvae are specialised predators of soft-bodied Hemiptera, particularly aphids, adelgids, and scale insects. Adults generally feed on nectar, honeydew, or other plant exudates like hover flies. Because of their aphidophagy, several chamaemyiids are considered valuable biological control agents, especially in orchards, forests, and field crops where they help regulate aphid populations (Justesen *et al.,* 2023). An unidentified species of the genus *Leucopis* is recorded from 7 districts of Uttarakhand preying on 7 species of aphids infesting 7 species of food plants as mentioned below.

1. *Leucopis* sp.

- *Aphis ruborum* (Börner, 1931)
  - *Rubus ellipticus* Sm. - Almora (Debnath, 1991); Nainital (Debnath, 1991)
- *Brachycaudus helichrysi* (Kaltenbach, 1843)
  - *Prunus amygdalus* Batsch - Uttarkashi (Debnath, 1991)
- *Epipemphigus imaicus* (Cholodkovsky, 1912)
  - *Populus ciliata* Wall. ex Royle - Uttarkashi (Debnath, 1991)
- *Eriosoma lanigerum* (Hausmann, 1802)
  - *Malus domestica* (Suckow) Borkh. - Chamoli (Chakrabarti *et al.,* 1988); Uttarkashi (Debnath, 1991)
- *Macrosiphoniella pseudoartemisiae* Shinji, 1933
  - *Artemisia* sp. - Chamoli (Chakrabarti *et al.,* 1990); Uttarkashi (Debnath, 1991)
- *Macrosiphum rosae* (Linnaeus, 1758)
  - *Rosa* sp. - Uttarkashi (Debnath, 1991)
- *Melanaphis* nr. *arundinariae* (Takahashi, 1937)
  - *Pyrus pashia* Buch.- Ham. ex D. Don - Chamoli (Chakrabarti *et al.,* 1990); Uttarkashi (Debnath, 1991)
- *Myzus sorbi* Bhattacharya & Chakrabarti, 1982
  - *Sorbaria tomentosa* (Lindl.) Rehder - Chamoli (Chakrabarti *et al.,* 1990; Debnath, 1991); Uttarkashi (Debnath, 1991)
- *Prociphilus* sp.
  - *Lonicera quinquelocularis* Hardw. - Uttarkashi (Debnath, 1991)
- *Sappaphis* sp.
  - *Cotoneaster bacillaris* Wall. ex Lindl.- Uttarkashi (Debnath, 1991)
- *Sitobion rosaeiformis* (Das, 1918)
  - *Rosa* sp. - Uttarkashi (Debnath, 1991)

iii. Family: Syrphidae

Aphidophagous Syrphidae, commonly known as hover flies, are important ecological agents due to their dual roles as predators and pollinators. Their larvae consume large numbers of aphids, helping regulate pest populations and reduce crop damage, while adults feed

on nectar and pollen, contributing to plant pollination (Singh, 2026). They support natural pest control and integrated pest management (IPM), reducing reliance on chemical pesticides. Additionally, hover fly diversity and abundance reflect habitat quality, making them useful indicators of ecosystem health. Overall, they enhance biodiversity, ecosystem stability, and sustainable agricultural productivity. In India, only 49 species of hover flies belonging to 17 genera were recorded as aphidophagous feeding on 94 species of aphids infesting 149 species of food plants with 1025 tri-trophic associations across 27 states/union territories (Singh, 2026). Record of two species, *Eristalis cerealis* Fabricius as predators *Shinjia orientalis* (on *Pteris* sp., Debnath, 1991) and *Eristalis tenax* (Linnaeus) as predator of *Aphis aurantii* (on *Camellia sinensis*, Sharma *et al.,* 2006) and *Macrosiphum* sp. (on *Rosa* sp., Bisht *et al.,* 2006), in Dehradun, Tehri Garhwal and Uttarkashi districts, respectively, are doubtful as like other species of *Eristalis*, its larvae are aquatic saprophagous filter-feeders in polluted or organic-rich water bodies and they do not feed aphids or any other insects. Hence, these records are excluded from this checklist. In Uttarakhand, 24 species of hover flies are recorded preying on 52 species of aphids infesting 57 species of plants with 194 tri-trophic associations in 12 districts (Table 1). The highest number of associations has been documented from Uttarkashi (172 triplets), followed by Tehri Garhwal (129 triplets), Chamoli (89 triplets), Pauri Garhwal (79 triplets), and Rudraprayag (73 triplets), while fewer than 40 triplets were noted in remaining 8 districts (Fig. 1).

Among the most polyphagous species, *Episyrphus balteatus* exhibited the widest range, preying on 30 aphid species across 35 host plants in 10 districts. This was followed by *Betasyrphus serarius* (17 aphid species on 14 host plants across 6 districts), *Eupeodes confrater* (17 aphid species on 17 host plants across 6 districts), *Ischiodon scutellaris* (17 aphid species on 22 host plants across 10 districts), *Eupeodes corollae* (11 aphid species on 11 host plants across 6 districts), and Other species showed narrower prey ranges, feeding on 1-8 aphid species associated with varying numbers of host plants (Table 1). *Sitobion roseiformis* infesting roses, *Brevicoryne brassicae* and *Lipaphis erysimi* both infesting brassica

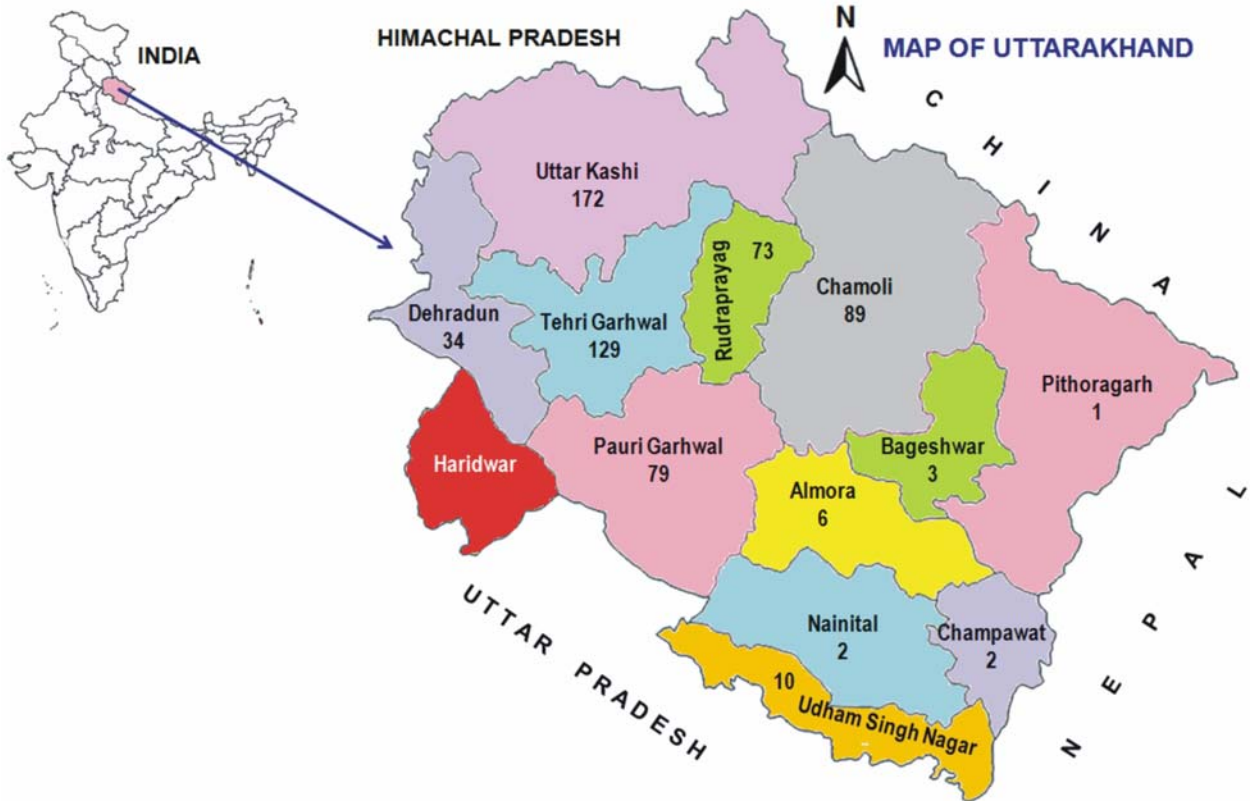

Fig. 1. Number of tri-trophic associations (triplets) of aphidophagous Syrphidae in different districts of Uttarakhand. No species of the predators were recorded in the red shaded district.

crops, supports the highest number of predators (10 species each). This is followed by *Eriosoma lanigerum* infesting apples (9 predator species), whereas other aphid species attract fewer than 9 predators.

Following is the detailed account of tri-trophic associations of aphidophagous hover flies in Uttarakhand.

1. *Asarkina ericetorum* (Fabricius, 1781)

- *Macrosiphum rosae* (Linnaeus, 1758)
  - *Rosa* sp. - Uttarkashi (Debnath, 1991)
- *Sitobion rosaeiformis* (Das, 1918)
  - *Rosa* sp. - Uttarkashi (Debnath, 1991)

2. *Betasyrphus isaaci* (Bhatia, 1933)

- *Aphis aurantii* Boyer de Fonsc., 1841
  - *Camellia sinensis* (L.) Kuntze - Dehradun (Sharma *et al.,* 2006)
- *Brevicoryne brassicae* (Linnaeus, 1758)
  - *Brassica oleracea* L. var. *capitata* - Tehri Garhwal (Bisht *et al.,* 2006)
- *Lipaphis erysimi* (Kaltenbach, 1843)
  - *Brassica rapa* L. - Tehri Garhwal (Bisht *et al.,* 2006)

3. *Betasyrphus serarius* (Wiedemann, 1830)

- *Aphis craccivora* Koch, 1854
  - Not mentioned - Uttarakhand (Rao, 1969)
- *Aphis kurosawai* Takahashi, 1921
  - *Artemisia* sp. - Uttarkashi (Debnath, 1991)
- *Aphis rhoicola* Hille Ris Lambers, 1954
  - Not mentioned - Uttarakhand (Rao, 1969)
- *Aphis solanella* Theobald, 1854
  - Not mentioned - Uttarakhand (Rao, 1969)
- *Capitophorus elaeagni* (del Guercio, 1894)
  - *Cirsium wallichii* DC. - Nainital (Chakrabarti *et al.,* 1990)
- *Eriosoma lanigerum* (Hausmann, 1802)
  - *Malus domestica* (Suckow) Borkh. - Chamoli (Chakrabarti *et al.,* 1988); Uttarkashi (Debnath, 1991)
- *Hyalopterus pruni* (Geoffroy, 1762)
  - *Prunus persica* (L.) Batsch - Uttarkashi (Debnath, 1991)
- *Hyperomyzus carduellinus* (Theobald, 1915)
  - *Sonchus arvensis* L.- Uttarkashi (Debnath, 1991); Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985)
- *Macrosiphoniella pseudoartemisiae* Shinji, 1933
  - *Artemisia vulgaris* L. - Uttarkashi (Debnath, 1991)
- *Macrosiphoniella sanborni* (Gillette, 1908)
  - *Chrysanthemum* sp. - Chamoli (Chakrabarti *et al.,* 1990); Uttarkashi (Debnath, 1991)
- *Macrosiphum rosae* (Linnaeus, 1758)
  - *Rosa* sp. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
- *Myzus dycei* Carver, 1961
  - *Urtica dioica* L. - Chamoli (Ghosh *et al.,* 1985; Chakrabarti *et al.,* 1990); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
- *Myzus sorbi* Bhattacharya & Chakrabarti, 1982
  - *Sorbaria tomentosa* (Lindl.) Rehder - Tehri Garhwal (Debnath, 1991); Uttarkashi (Debnath, 1991); Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985)
- *Sitobion rosaeiformis* (Das, 1918)
  - *Rosa* sp. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
- *Tumoranuraphis indica* (Chakrabarti & Maity, 1984)
  - *Prunus cornuta* (Wall. ex Royle) Steud. - Uttarkashi (Debnath, 1991)
- *Uroleucon parasonchi* (Raychaudhuri *et al.,* 1977)
  - *Sonchus arvensis* L. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985)
- *Uroleucon sonchi* (Linnaeus, 1767)
  - *Sonchus arvensis* L.- Uttarkashi (Debnath, 1991)

4. *Betasyrphus* sp.

- *Myzus persicae* (Sulzer, 1776)
  - *Prunus persica* (L.) Batsch - Tehri Garhwal (Bisht *et al.,* 2006)

- *Sitobion rosaeiformis* (Das, 1918)
  - *Rosa* sp. - Tehri Garhwal (Bisht *et al.,* 2006)

5. *Episyrphus balteatus* (De Geer, 1776)

- *Aphis aurantii* Boyer de Fonsc., 1841
  - *Camellia sinensis* (L.) Kuntze - Dehradun (Bisht *et al.,* 2006; Sharma *et al.,* 2006); Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)
- *Aphis citricidus* (Kirkaldy, 1907)
  - *Citrus* sp. - Almora (Debnath, 1991); Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
- *Aphis gossypii* Glover, 1877
  - *Capsicum annuum* L. - Dehradun (Bisht *et al.,* 2006); Dehradun (Bisht *et al.,* 2006); Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)
  - *Cucumis sativus* L. - Dehradun (Bisht *et al.,* 2006); Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)
  - *Solanum tuberosum* L. - Dehradun (Bisht *et al.,* 2006); Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)
- *Aphis kurosawai* Takahashi, 1921
  - *Artemisia vulgaris* L. - Chamoli (Ghosh *et al.,* 1985); Champawat (Debnath, 1991); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
- *Aphis spiraecola* Patch, 1914
  - *Solanum nigrum* L. - Almora (Debnath, 1991); Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985)
- *Brachycaudus helichrysi* (Kaltenbach, 1843)
  - *Anaphalis margaritacea* (L.) Benth. and Hook.f. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
  - *Erigeron bonariensis* L. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
  - *Prunus amygdalus* Batsch - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
  - *Prunus persica* (L.) Stokes - Chamoli (Chakrabarti *et al.,* 1990); Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
  - *Prunus* sp. - Chamoli (Chakrabarti *et al.,* 1990)
- *Brevicoryne brassicae* (Linnaeus, 1758)
  - *Brassica juncea* (L.) Czern. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985)
  - *Brassica oleracea* L. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985)
  - *Brassica oleracea* L. var. *capitata* - Dehradun (Bisht *et al.,* 2006); Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)
  - *Brassica rapa* L. - Chamoli (Chakrabarti *et al.,* 1990); Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Debnath, 1991)
  - *Raphanus sativus* L. - Dehradun (Bisht *et al.,* 2006); Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)
- *Epipemphigus imaicus* (Cholodkovsky, 1912)
  - *Populus alba* L. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985)
  - *Populus ciliata* Wall. ex Royle - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
- *Eriosoma lanigerum* (Hausmann, 1802)
  - *Malus domestica* (Suckow) Borkh. - Chamoli (Chakrabarti *et al.,* 1988); Dehradun (Bisht *et al.,* 2006); Pauri Garhwal (Maurya, 2011); Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Debnath, 1991; Bisht *et al.,* 2006)
- *Eumyzus hydrangi* Chakrabarti & Bhattacharya, 1985

- *Hydrangea scandens* (L.f.) Ser. - Bageshwar (Debnath, 1991); Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985)

• *Eumyzus pruni* Chakrabarti & Bhattacharya, 1985
- *Prunus cornuta* (Wall. ex Royle) Steud. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)

• *Hayhurstia atriplicis* (Linnaeus, 1761)
- *Chenopodium album* L. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)

• *Hyadaphis coriandri* (Das, 1918)
- *Coriandrum sativum* L. - Dehradun (Bisht *et al.,* 2006); Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)

• *Hyalopterus pruni* (Geoffroy, 1762)
- *Prunus persica* (L.) Batsch - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)

• *Lipaphis erysimi* (Kaltenbach, 1843)
- *Brassica rapa* L. - Dehradun (Bisht *et al.,* 2006); Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)

• *Macrosiphoniella pseudoartemisiae* Shinji, 1933
- *Artemisia vulgaris* L. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)

• *Macrosiphoniella sanborni* (Gillette, 1908)
- *Chrysanthemum* sp. - Dehradun (Bisht *et al.,* 2006); Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)

• *Macrosiphum rosae* (Linnaeus, 1758)
- *Rosa* sp. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)

• *Melanaphis* sp.
- *Pyrus pashia* Buch.- Ham. ex D. Don - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985)

• *Myzus cornutus* Medda & Chakrabarti
- *Prunus* sp. - Uttarkashi (Debnath, 1991)

• *Myzus dycei* Carver, 1961
- *Urtica dioica* L. - Chamoli (Ghosh *et al.,* 1985; Chakrabarti *et al.,* 1990); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)

• *Myzus persicae* (Sulzer, 1776)
- *Brassica oleracea* L. var. *capitata* - Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)
- *Prunus persica* (L.) Batsch - Dehradun (Bisht *et al.,* 2006); Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)
- *Solanum tuberosum* L. - Almora (Debnath, 1991); Chamoli (Ghosh *et al.,* 1985; Debnath, 1991); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985; Bisht *et al.,* 2006); Uttarkashi (Ghosh *et al.,* 1985)

• *Prociphilus* sp.
- *Lonicera quinquelocularis* Hardw. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
- *Lonicera* sp. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985)

• *Rhopalosiphum maidis* (Fitch, 1856)
- *Triticum aestivum* L. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985; Bisht *et al.,* 2006); Udham Singh Nagar (Gaur *et al.,* 2004); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
- *Zea mays* L. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)

- *Rhopalosiphum padi* (Linnaeus, 1758)
  - *Triticum aestivum* L. - Dehradun (Bisht *et al.,* 2006); Tehri Garhwal (Bisht *et al.,* 2006); Udham Singh Nagar (Gaur *et al.,* 2004); Uttarkashi (Bisht *et al.,* 2006)
- *Sappaphis* sp.
  - *Cotoneaster bacillaris* Wall. ex Lindl. - Chamoli (Ghosh *et al.,* 1985; Chakrabarti *et al.,* 1990); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
- *Shinjia orientalis* (Mordvilko, 1929)
  - *Pteris* sp. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
- *Sitobion avenae* (Fabricius, 1775)
  - *Triticum aestivum* L. - Udham Singh Nagar (Gaur *et al.,* 2004)
- *Sitobion miscanthi* (Takahashi, 1921)
- *Triticum aestivum* L. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985; Bisht *et al.,* 2006); Udham Singh Nagar (Gaur *et al.,* 2004); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
- *Sitobion rosaeiformis* (Das, 1918)
  - *Rosa* sp. - Bageshwar (Debnath, 1991); Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985; Bisht *et al.,* 2006); Uttarkashi (Ghosh *et al.,* 1985)
- *Uroleucon sonchi* (Linnaeus, 1767)
  - *Sonchus asper* (L.) Hill - Chamoli (Chakrabarti *et al.,* 1990)

8. *Eupeodes confrater* (Wiedemann, 1830)

- *Aphis craccivora* Koch, 1854
  - Unidentified plant - Uttarakhand (Rao, 1969)
- *Aphis gossypii* Glover, 1877
  - *Cucumis sativus* L. - Dehradun (Bisht *et al.,* 2006); Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)
- *Aphis rhoicola* Hille Ris Lambers, 1954
  - Unidentified plant - Uttarakhand (Rao, 1969)
- *Aphis solanella* Theobald, 1914
  - Unidentified plant - Uttarakhand (Rao, 1969)
- *Brachycaudus helichrysi* (Kaltenbach, 1843)
  - *Prunus amygdalus* Batsch - Chamoli (Chakrabarti *et al.,* 1990); Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
  - *Prunus persica* (L.) Batsch - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
- *Brevicoryne brassicae* (Linnaeus, 1758)
  - *Brassica rapa* L. - Dehradun (Bisht *et al.,* 2006); Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)
  - *Raphanus sativus* L. - Tehri Garhwal (Bisht *et al.,* 2001)
- *Epipemphigus imaicus* (Cholodkovsky, 1912)
  - *Populus ciliata* Wall. ex Royle - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991);
- *Cavariella aegopodii* (Scopoli, 1763)
  - *Salix babylonica* L. - Uttarkashi (Ghosh *et al.,* 1986a)
  - *Salix denticulata* Andersson - Uttarkashi (Ghosh *et al.,* 1986a)
  - *Salix tetrasperma* Roxb. - Uttarkashi (Ghosh *et al.,* 1986a)
- *Eriosoma lanigerum* (Hausmann, 1802)
  - *Malus domestica* (Suckow) Borkh. - Dehradun (Bisht *et al.,* 2006); Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Debnath, 1991; Bisht *et al.,* 2006)
- *Lachnus salicis* Chakrabarti & Raha, 1988
  - *Salix babylonica* L. - Uttarkashi (Debnath, 1991)
- *Liosomaphis himalayensis* Basu, 1964
  - *Berberis asiatica* DC. - Uttarkashi (Debnath, 1991)
- *Macrosiphoniella pseudoartemisiae* Shinji, 1933
  - *Artemisia vulgaris* L.- Uttarkashi (Debnath, 1991)
- *Macrosiphoniella sanborni* (Gillette, 1908)
  - Not mentioned - Uttarakhand (Rao, 1969)

- *Macrosiphum rosae* (Linnaeus, 1758)
  - *Rosa* sp. - Chamoli (Chakrabarti *et al.,* 1990); Uttarkashi (Chakrabarti *et al.,* 1990; Debnath, 1991)
- *Melanaphis nr. arundinariae* (Takahashi, 1937)
  - *Pyrus pashia* Buch.- Ham. ex D. Don - Chamoli (Chakrabarti *et al.,* 1990); Uttarkashi (Debnath, 1991)
- *Myzus dycei* Carver, 1961
  - *Urtica dioica* L. - Chamoli (Chakrabarti *et al.,* 1990); Uttarkashi (Debnath, 1991)
- *Myzus sorbi* Bhattacharya & Chakrabarti, 1982
  - *Sorbaria tomentosa* (Lindl.) Rehder - Uttarkashi (Debnath, 1991)
- *Prociphilus* sp.
  - *Lonicera quinquelocularis* Hardw. - Uttarkashi (Debnath, 1991)
- *Sitobion rosaeiformis* (Das, 1918)
  - *Rosa* sp. - Uttarkashi (Debnath, 1991)

9. *Eupeodes corollae* (Fabricius, 1794)

- *Aphis aurantii* Boyer de Fonsc., 1841
  - *Camellia sinensis* (L.) Kuntze - Dehradun (Sharma *et al.,* 2006)
- *Brachycaudus helichrysi* (Kaltenbach, 1843)
  - *Prunus persica* (L.) Stokes - Chamoli (Chakrabarti *et al.,* 1990); Uttarkashi (Debnath, 1991)
- *Brevicoryne brassicae* (Linnaeus, 1758)
  - *Brassica juncea* (L.) Czern. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
  - *Brassica oleracea* L. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985)
- *Eriosoma lanigerum* (Hausmann, 1802)
  - *Malus domestica* (Suckow) Borkh. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Pauri Garhwal (Maurya, 2011); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
- *Hyperomyzus carduellinus* (Theobald, 1915)
  - *Sonchus arvensis* L.- Uttarkashi (Debnath, 1991)
  - *Sonchus oleraceus* L. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985)
- *Liosomaphis himalayensis* Basu, 1964
  - *Berberis asiatica* DC. - Uttarkashi (Debnath, 1991)
- *Lipaphis erysimi* (Kaltenbach, 1843)
  - *Brassica rapa* L. - Dehradun (Bisht *et al.,* 2006); Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)
- *Macrosiphum rosae* (Linnaeus, 1758)
  - *Rosa* sp. - Uttarkashi (Debnath, 1991)
- *Macrosiphum* sp.
  - *Rosa* sp. - Dehradun (Bisht *et al.,* 2006); Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)
- *Myzus dycei* Carver, 1961
  - *Urtica dioica* L. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
- *Sitobion rosaeiformis* (Das, 1918)
  - *Rosa* sp. - Chamoli (Chakrabarti *et al.,* 1990); Uttarkashi (Chakrabarti *et al.,* 1990; Debnath, 1991)

10. *Eupeodes latifasciatus* (Macquart, 1829)

- *Capitophorus formosartemisiae* (Takahashi, 1921)
  - *Artemisia vulgaris* L.- Uttarkashi (Debnath, 1991)
- *Chaitophorus kapuri* Hille Ris Lambers, 1966
  - *Populus ciliata* Wall. ex Royle - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
- *Macrosiphoniella pseudoartemisiae* Shinji, 1933
  - *Artemisia vulgaris* L. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
- *Macrosiphum rosae* (Linnaeus, 1758)
  - *Rosa* sp. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh

et al., 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)

- *Myzus dycei* Carver, 1961
  - *Urtica dioica* L. - Uttarkashi (Debnath, 1991)
- *Sitobion rosaeiformis* (Das, 1918)
  - *Rosa* sp. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)

11. *Eupeodes luniger* (Meigen, 1822)

- *Sitobion rosaeiformis* (Das, 1918)
  - *Rosa* sp. - Uttarkashi (Debnath, 1991)

12. *Ischiodon scutellaris* (Fabricius, 1805)

- *Aphis aurantii* Boyer de Fonsc., 1841
  - *Camellia sinensis* (L.) Kuntze - Dehradun (Sharma *et al.,* 2006)
- *Aphis craccivora* Koch, 1854
  - *Vicia faba* L. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
- *Aphis gossypii* Glover, 1877
  - *Capsicum annuum* L. - Dehradun (Bisht *et al.,* 2006); Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)
  - *Chrysanthemum* sp. - Dehradun (Bisht *et al.,* 2006); Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)
  - *Cucumis* sp. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985; Bisht *et al.,* 2006); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
  - *Phaseolus vulgaris* L. - Dehradun (Bisht *et al.,* 2006); Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)
  - *Psidium guajava* L. - Dehradun (Bisht *et al.,* 2006); Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)
- *Aphis ruborum* (Börner, 1931)
  - *Rubus ellipticus* Sm. - Almora (Debnath, 1991); Chamoli (Ghosh *et al.,* 1985); Nainital (Debnath, 1991); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985)
- *Aphis verbasci* Schrank, 1801
  - *Verbascum thapsus* L. - Bageshwar (Debnath, 1991); Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985)
- *Brevicoryne brassicae* (Linnaeus, 1758)
  - *Brassica juncea* (L.) Czern. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
  - *Brassica oleracea* L. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
  - *Raphanus sativus* L. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985)
- *Capitophorus formosartemisiae* (Takahashi, 1921)
  - *Artemisia vulgaris* L. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
- *Hyadaphis coriandri* (Das, 1918)
  - *Coriandrum sativum* L. - Dehradun (Bisht *et al.,* 2006); Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)
- *Lipaphis erysimi* (Kaltenbach, 1843)
  - *Brassica rapa* L. - Udham Singh Nagar (Karnatak & Thorat, 2006)
- *Myzus persicae* (Sulzer, 1776)
  - *Prunus persica* (L.) Batsch - Dehradun (Bisht *et al.,* 2006); Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)
  - *Solanum tuberosum* L. - Almora (Debnath, 1991); Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
- *Myzus sorbi* Bhattacharya & Chakrabarti, 1982
  - *Sorbaria tomentosa* (Lindl.) Rehder - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985; Debnath, 1991); Rudraprayag

(Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985; Debnath, 1991); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)

- *Phorodon cannabis* Passerini, 1860
  - *Cannabis sativa* L. - Chamoli (Ghosh *et al.,* 1985; Chakrabarti *et al.,* 1990); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
- *Prociphilus* sp.
  - *Lonicera quinquelocularis* Hardw. - Uttarkashi (Debnath, 1991)
- *Rhopalosiphum maidis* (Fitch, 1856)
  - *Triticum aestivum* L. - Dehradun (Bisht *et al.,* 2006); Tehri Garhwal (Bisht *et al.,* 2006); Udham Singh Nagar (Gaur *et al.,* 2004); Uttarkashi (Bisht *et al.,* 2006)
  - *Zea mays* L. - Dehradun (Bisht *et al.,* 2006); Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)
- *Rhopalosiphum padi* (Linnaeus, 1758)
  - *Triticum aestivum* L. - Dehradun (Bisht *et al.,* 2006); Tehri Garhwal (Bisht *et al.,* 2006); Udham Singh Nagar (Gaur *et al.,* 2004); Uttarkashi (Bisht *et al.,* 2006)
  - *Zea mays* L. - Dehradun (Bisht *et al.,* 2006); Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)
- *Sitobion avenae* (Fabricius, 1775)
  - *Triticum aestivum* L. - Udham Singh Nagar (Gaur *et al.,* 2004)
- *Sitobion miscanthi* (Takahashi, 1921)
  - *Triticum aestivum* L. - Tehri Garhwal (Bisht *et al.,* 2006); Udham Singh Nagar (Gaur *et al.,* 2004); Uttarkashi (Debnath, 1991)
  - *Zea mays* L. - Dehradun (Bisht *et al.,* 2006); Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)

13. *Melanostoma orientale* (Wiedemann, 1824)

- *Brevicoryne brassicae* (Linnaeus, 1758)
  - *Brassica juncea* (L.) Czern. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
  - *Brassica oleracea* L. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
  - *Brassica rapa* L. - Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Debnath, 1991)
- *Lipaphis erysimi* (Kaltenbach, 1843)
  - *Brassica rapa* L. - Tehri Garhwal (Bisht *et al.,* 2006)
- *Rhopalosiphum maidis* (Fitch, 1856)
  - *Triticum aestivum* L. - Uttarkashi (Debnath, 1991); Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985)

14. *Melanostoma univittatum* (Wiedemann, 1824)

- *Lipaphis erysimi* (Kaltenbach, 1843)
  - *Brassica rapa* L. - Tehri Garhwal (Bisht *et al.,* 2006)
  - *Cucumis sativus* L. - Tehri Garhwal (Bisht *et al.,* 2006)

15. *Paragus politus* Wiedemann, 1830

- *Brachycaudus* sp.
  - *Synotis rufinervis* (DC.) C.Jeffrey and Y.L.Chen - Chamoli (Debnath, 1991)
- *Macrosiphoniella sanborni* (Gillette, 1908)
  - *Artemisia* sp. - Uttarkashi (Debnath, 1991)

16. *Paragus serratus* (Fabricius, 1805

- *Aphis craccivora* Koch, 1854
  - *Cirsium wallichii* DC. - Uttarakhand (Rao, 1969)
- *Myzus persicae* (Sulzer, 1776)
  - *Prunus persica* (L.) Batsch - Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)
  - Unknown aphid - *Cirsium wallichii* DC. - Uttarakhand (Rao, 1969)

17. *Paragus tibialis* (Fallén, 1817)

- *Aphis clematidis* Koch, 1854
  - *Clematis buchaniana* DC., 1817 - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
- *Aphis fabae* Scopoli, 1763
  - *Rumex nepalensis* Spreng. - Champawat (Debnath, 1991); Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)

- *Aphis kurosawai* Takahashi, 1921
  - *Artemisia vulgaris* L. - Uttarkashi (Ghosh *et al.,* 1985; Debnath, 1991)
- *Capitophorus formosartemisiae* (Takahashi, 1921)
  - *Artemisia vulgaris* L. - Chamoli (Debnath, 1991); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985)
- *Eriosoma lanigerum* (Hausmann, 1802)
  - *Malus domestica* (Suckow) Borkh. - Chamoli (Ghosh *et al.,* 1985; Chakrabarti *et al.,* 1988); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985)
- *Pemphigus mordwilkoi* Cholodkovsky, 1912
  - *Populus ciliata* Wall. ex Royle - Uttarkashi (Debnath, 1991)
- *Sappaphis* sp.
  - *Cotoneaster bacillaris* Wall. ex Lindl. - Uttarkashi (Debnath, 1991)
- *Sitobion miscanthi* (Takahashi, 1921)
  - *Triticum aestivum* L.- Uttarkashi (Debnath, 1991)

18. *Paragus yerburiensis* Stuckenberg, 1954

- *Aphis craccivora* Koch, 1854
  - *Vigna unguiculata* (L.) Walp. - Uttarakhand (Rao, 1969)

19. *Scaeva pyrastri* (Linnaeus, 1758)

- *Eriosoma lanigerum* (Hausmann, 1802)
  - *Malus domestica* (Suckow) Borkh. - Pauri Garhwal (Maurya, 2011)

20. *Scaeva selenitica* (Meigen, 1822)

- *Brevicoryne brassicae* (Linnaeus, 1758)
  - *Brassica oleracea* L. var. *capitata* - Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)
- *Lipaphis erysimi* (Kaltenbach, 1843)
  - *Brassica rapa* L. - Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)
- *Rhopalosiphum maidis* (Fitch, 1856)
  - *Triticum aestivum* L. - Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)

21. *Sphaerophoria indiana* Bigot, 1884

- *Brachycaudus helichrysi* (Kaltenbach, 1843)
  - *Prunus persica* (L.) Batsch - Chamoli (Chakrabarti *et al.,* 1990); Uttarkashi (Debnath, 1991)
- *Brevicoryne brassicae* (Linnaeus, 1758)
  - *Brassica juncea* (L.) Czern. - Uttarkashi (Debnath, 1991)
  - *Brassica rapa* L. - Chamoli (Chakrabarti *et al.,* 1990)
- *Liosomaphis himalayensis* Basu, 1964
  - *Berberis aristata* DC. - Uttarkashi (Debnath, 1991)
- *Lipaphis erysimi* (Kaltenbach, 1843)
  - *Brassica rapa* L. - Uttarkashi (Debnath, 1991)
- *Macrosiphum rosae* (Linnaeus, 1758)
  - *Rosa* sp. - Uttarkashi (Debnath, 1991)
- *Myzus persicae* (Sulzer, 1776)
  - *Solanum tuberosum* L. - Almora (Debnath, 1991)
- *Sitobion miscanthi* (Takahashi, 1921)
  - *Triticum aestivum* L.- Uttarkashi (Debnath, 1991)

22. *Sphaerophoria scripta* (Linnaeus, 1758)

- *Brevicoryne brassicae* (Linnaeus, 1758)
  - *Brassica juncea* (L.) Czern. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985)
- *Eriosoma lanigerum* (Hausmann, 1802)
  - *Malus domestica* (Suckow) Borkh. - Pauri Garhwal (Maurya, 2011)
- *Liosomaphis himalayensis* Basu, 1964
  - *Berberis asiatica* DC. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985)
- *Lipaphis erysimi* (Kaltenbach, 1843)
  - *Brassica rapa* L. - Tehri Garhwal (Bisht *et al.,* 2001); Dehradun (Bisht *et al.,* 2006); Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)
- *Macrosiphum rosae* (Linnaeus, 1758)
  - *Rosa* sp. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985)
- *Myzus persicae* (Sulzer, 1776)
  - *Solanum tuberosum* L. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal

(Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985)

- *Sitobion miscanthi* (Takahashi, 1921)
  - *Triticum aestivum* L. - Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985)

23. *Syritta pipiens* (Linnaeus, 1758)

- *Eriosoma lanigerum* (Hausmann, 1802)
  - *Malus domestica* (Suckow) Borkh. - Pauri Garhwal (Maurya, 2011)

24. *Syrphus fulvifacies* Brunetti, 1913

- *Aphis aurantii* Boyer de Fonsc., 1841
  - *Camellia sinensis* (L.) Kuntze - Dehradun (Sharma *et al.,* 2006)
- *Brevicoryne brassicae* (Linnaeus, 1758)
  - *Brassica juncea* (L.) Czern. - Uttarkashi (Debnath, 1991); Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985)
  - *Brassica oleracea* L. var. *capitata* - Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)
- *Macrosiphoniella pseudoartemisiae* Shinji, 1933
  - *Artemisia vulgaris* L. - Uttarkashi (Debnath, 1991); Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985)
- *Macrosiphum rosae* (Linnaeus, 1758)
  - *Rosa* sp. - Uttarkashi (Debnath, 1991); Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985)
- *Macrosiphum* spp.
  - *Rosa* sp. - Tehri Garhwal (Bisht *et al.,* 2006); Uttarkashi (Bisht *et al.,* 2006)
- *Sitobion rosaeiformis* (Das, 1918)
  - *Rosa* sp. - Uttarkashi (Debnath, 1991); Chamoli (Ghosh *et al.,* 1985); Pauri Garhwal (Ghosh *et al.,* 1985); Rudraprayag (Ghosh *et al.,* 1985); Tehri Garhwal (Ghosh *et al.,* 1985); Uttarkashi (Ghosh *et al.,* 1985)

25. *Syrphus ribesii* (Linnaeus, 1758)

- *Eriosoma lanigerum* (Hausmann, 1802)
  - *Malus domestica* (Suckow) Borkh. - Pauri Garhwal (Maurya, 2011)

26. *Syrphus* spp.

- *Aphis gossypii* Glover, 1877
  - *Abelmoschus esculentus* Moench - Udham Singh Nagar (Bhatt *et al.,* 2018)
  - *Chrysanthemum* sp. - Tehri Garhwal (Bisht *et al.,* 2006)
- *Lipaphis erysimi* (Kaltenbach, 1843)
  - *Brassica rapa* L. - Tehri Garhwal (Bisht *et al.,* 2001)
- *Myzus persicae* (Sulzer, 1776)
  - *Brassica rapa* L. - Tehri Garhwal (Bisht *et al.,* 2006)
- *Rhopalosiphum maidis* (Fitch, 1856)
  - *Triticum aestivum* L. - Tehri Garhwal (Bisht *et al.,* 2006)
- *Rhopalosiphum padi* (Linnaeus, 1758)
  - *Triticum aestivum* L. - Tehri Garhwal (Bisht *et al.,* 2006)
- *Sitobion miscanthi* (Takahashi, 1921)
  - *Triticum aestivum* L. - Tehri Garhwal (Bisht *et al.,* 2006)
- *Sitobion rosaeiformis* (Das, 1918)
  - *Rosa* sp. - Tehri Garhwal (Bisht *et al.,* 2006)

B. Order: Neuroptera

Neuroptera, an order comprising lacewings, mantidflies, antlions, and related groups, is globally distributed and predominantly carnivorous, with many species preying on soft-bodied insects such as aphids. In India, aphidophagy has been documented in the larvae of four families: Chrysopidae (green lacewings, commonly termed aphid-lions), Coniopterygidae (dusty wings), Dilaridae (pleasing lacewings), and Hemerobiidae (brown lacewings) (Singh *et al.,* 2024). Within agroecosystems, green and brown lacewings are widely regarded as key beneficial insects contributing to natural pest regulation (Devetak & Klokoèovnik, 2016). Notably, several species of Chrysopidae (larval stage) and Hemerobiidae (both larval and adult stages) are aphidophagous. Nevertheless, their ecological role as aphid predators has often been underrepresented compared to the extensively studied syrphids (hover flies) and coccinellids (ladybird beetles) (Bakthavatsalam & Varshney, 2023).

In India, 32 species of lacewings are recorded as aphidophagous belonging to 4 families, Chrysopidae being the largest one comprising 24 species under 11 genera followed by Hemerobiidae (6 species in 2 genera) and Dilaridae and Coniopterygidae (one species each) preying on 68 species of aphids belonging to 37 genera associated with 107 species of plants distributed in 23 states/union territories of India (Singh *et al.,* 2024). Table 2 displays that a total of 25 species of lacewings preying on 27 species of aphids infesting 23 species of host plants with 59 tri-trophic associations are distributed in 9 districts of Uttarakhand. Familywise detailed accounts are given below:

The highest number of tri-trophic associations has been documented from Uttarkashi (43 triplets), followed by Chamoli (19 triplets), Bageshwar (11 triplets), and Almora (10 triplets), while fewer than 40 triplets were noted in remaining 4 districts (Fig. 2).

i. Family: Chrysopidae

Chrysopidae (green lacewings) are key aphid predators in agroecosystems, with their larvae ("aphid-lions") consuming large numbers of aphids across diverse crops. While primarily aphidophagous, they also feed on other soft-bodied pests, ensuring survival under variable prey conditions. Adults, who feed on nectar, pollen, and honeydew, contribute indirectly to pollination while also serving as prey for other insectivores, helping maintain

Table 2: Number of species of aphidophagous Neuroptera belonging to different families preying on different number of aphid species infesting different number of host plant species and triplets in different number of districts in Uttarakhand

Families	Species of predators	Number of			
		Species of aphid	Species of host plant	Triplets	Districts
Chrysopidae	*Ankylopteryx octopunctata*	1	1	1	1
	Chrysopa himalayana	1	1	1	1
	Chrysopa pallens	2	1	2	1
	Chrysoperla orestes	1	1	1	1
	Chrysoperla zastrowi sillemi	15	10	16	7
	Cunctochrysa albolineata	2	2	2	2
	Cunctochrysa jubingensis	6	8	10	5
	Italochrysa aequalis	2	1	2	2
	Italochrysa lefroyi	1	1	1	1
	Mallada desjardinsi	1	1	1	1
	Mallada garhwalensis	1	1	1	1
	Mallada kinnaurensis	1	1	1	1
	Mallada murreensis	1	1	1	1
	Mallada obvius	2	2	2	2
	Mallada spp.	4	3	4	3
	Nothochrysa indigena	1	1	1	1
	Pseudomallada alcestes	1	1	1	1
	Retipenna dasyphlebia	2	2	2	3
	Tumeochrysa indica	1	1	1	1
	Sub total	28	22	51	9
Coniopterygidae	*Coniocompsa indica*	1	1	1	1
Dilridae	*Dilar indicus*	2	2	2	1
Hemerobiidae	*Hemerobius indicus*	1	1	1	1
	Hemerobius sp.	1	1	1	1
	Micromus timidus	3	3	3	3
	Micromus spp.	5	4	5	2
	Sub total	9	8	13	5
	Total	27	23	64	9

food web balance. Chrysopids play an essential role in natural biological control and are widely used in augmentative programs, with species like *Chrysoperla carnea* and *Chrysoperla zastrowi sillemi* integrated into IPM due to their adaptability (Nair *et al.,* 2020). They offer eco-friendly alternatives to chemical pesticides, aiding in resistance management and biodiversity conservation. However, their contribution is often overshadowed by more studied predators such as coccinellids and syrphids, and their effectiveness may be reduced by environmental stresses, intraguild predation, and pesticide exposure (Bakthavatsalam & Varshney, 2023).

In India, Chrysopidae comprises 24 aphidophagous species belonging to 10 genera. All these species prey upon 55 species of aphids infesting 84 species of food plants distributed in 22 states/union territories in India (Singh *et al.,* 2024). In Uttarakhand, 19 species of aphidophagous green lacewings were recorded feeding on 28 species of aphids infesting 22 species of host plants with 51 tri-trophic associations in 9 districts. Only two species of this family, *Chrysoperla zastrowi sillemi* and *Cunctochrysa jubingensis* are polyphagous feeding on 14 species of aphids infesting 9 species of food plants and 6 species of aphids infesting 10 species of food plants,

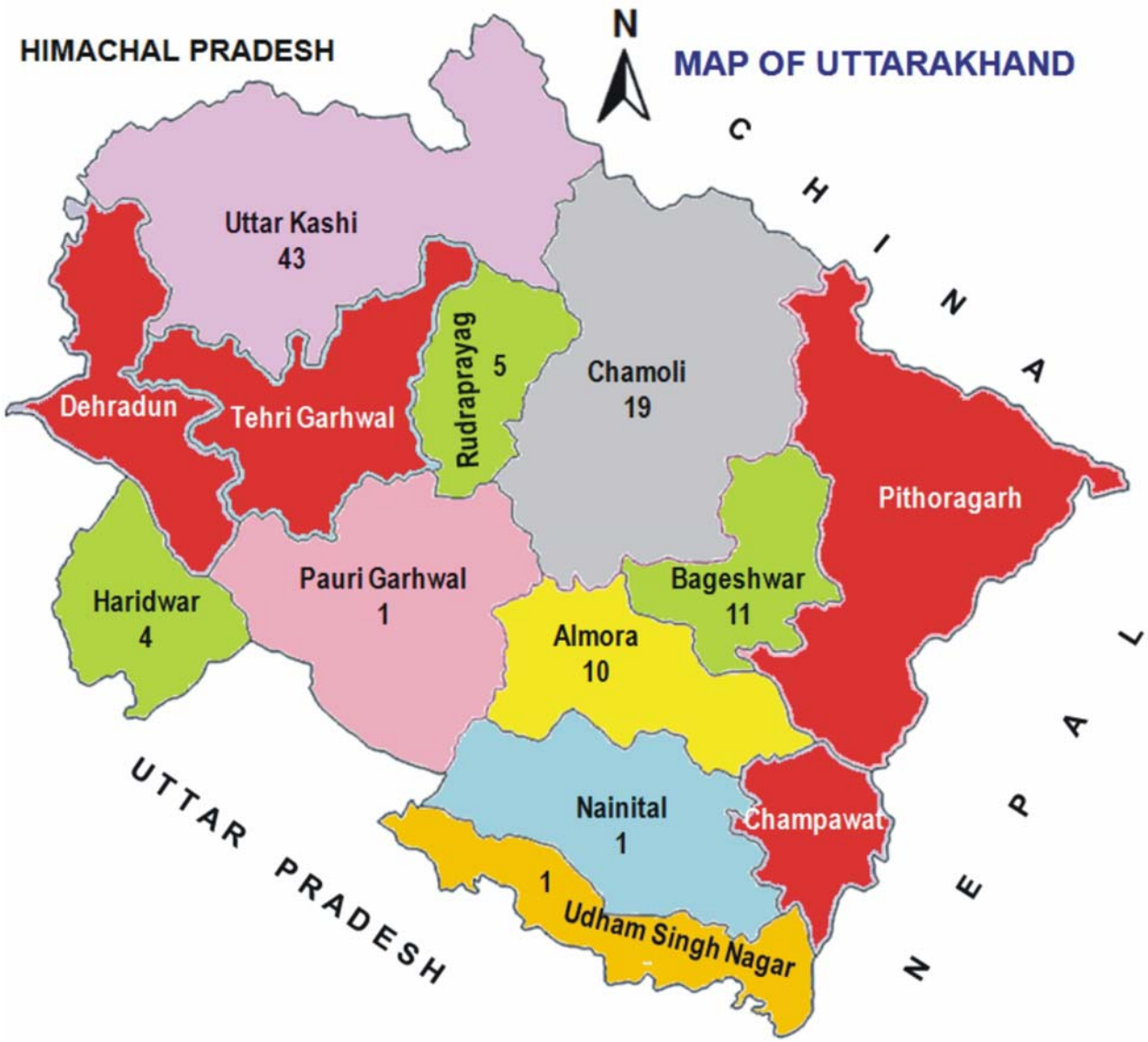

Fig. 2. Number of tri-trophic associations (triplets) of aphidophagous Neuroptera in different districts of Uttarakhand. No species of the predators were recorded in the red shaded district.

respectively (Table 2). The detail account of tri-trophic associations of Chrysopidae in different districts of Uttarakhand is given below:

1. ***Ankylopteryx octopunctata* (Fabricius, 1793)**
   - *Eriosoma ulmi* (Linnaeus, 1758)
     - *Ulmus* sp. - Almora (Bhattacharya & Dey, 2001; Dey, 2015)
2. ***Chrysopa himalayana* Ghosh, 1985**
   - *Chromaphis hirsutustibis* Kumar & Lavigne, 1970
     - *Juglans regia* L. - Chamoli (Bhattacharya & Dey, 2001; Dey, 2015)
3. ***Chrysopa pallens* (Rambur, 1838)**
   - *Chaitophorus kapuri* Hille Ris Lambers, 1966
     - *Populus ciliata* Wall. ex Royle - Uttarkashi (Bhattacharya & Dey, 2001; Dey, 2015)
   - *Pemphigus mordwilkoi* Cholodkovsky, 1912
     - *Populus ciliata* Wall. ex Royle - Uttarkashi (Bhattacharya & Dey, 2001; Dey, 2015)
4. ***Chrysoperla orestes* (Banks, 1911)**
   - *Myzus mumecola* (Matsumura, 1917)
     - *Prunus* sp. - Uttarkashi (Bhattacharya & Dey, 2001; Dey, 2015)
5. ***Chrysoperla zastrowi sillemi* (Esben-Petersen, 1935)**
   - *Aphis gossypii* Glover, 1877
     - *Abelmoschus esculentus* (L.) Moench - Udham Singh Nagar (Bhatt & Karnatak, 2018)
   - *Betacallis sikkimensis* Basu, Ghosh & Raychaudhuri, 1974
     - *Betula alnoides* Buch.-Ham. - Uttarkashi (Bhattacharya & Dey, 2001; Dey, 2015)
   - *Brevicoryne brassicae* (Linnaeus, 1758)
     - *Brassica juncea* (L.) Czern. - Haridwar (Verma *et al.,* 2023)
   - *Capitophorus formosartemisiae* (Takahashi, 1921)
     - *Artemisia vulgaris* L. - Chamoli (Bhattacharya & Dey, 2001; Dey, 2015); Uttarkashi (Debnath, 1991)
   - *Chaitophorus kapuri* Hille Ris Lambers, 1966
     - *Populus ciliata* Wall. ex Royle - Rudraprayag (Bhattacharya & Dey, 2001; Dey, 2015); Uttarkashi (Debnath, 1991)
   - *Eriosoma lanigerum* (Hausmann, 1802)
     - *Malus domestica* (Suckow) Borkh. - Chamoli (Bhattacharya & Dey, 2001; Dey, 2015); Pauri Garhwal (Maurya, 2011); Uttarkashi (Debnath, 1991)
   - *Lipaphis erysimi* (Kaltenbach, 1843)
     - *Brassica juncea* (L.) Czern - Haridwar (Verma *et al.,* 2023)
     - *Brassica rapa* L. - Haridwar (Joshi & Sharma, 2008)
   - *Macrosiphoniella kikungshana* Takahashi, 1937
     - *Artemisia* sp. - Chamoli (Bhattacharya & Dey, 2001; Dey, 2015); Uttarkashi (Debnath, 1991)
   - *Macrosiphoniella pseudoartemisiae* Shinji, 1933
     - *Artemisia vulgaris* L. - Chamoli (Bhattacharya & Dey, 2001; Dey, 2015); Uttarkashi (Debnath, 1991)
   - *Macrosiphum rosae* (Linnaeus, 1758)
     - *Brassica juncea* (L.) Czern. - Haridwar (Verma *et al.,* 2023)
   - *Myzus (Myzus) mumecola* (Matsumura, 1917)
     - *Prunus* sp. - Uttarkashi (Dey, 2015)
   - *Pemphigus siphunculatus* Hille Ris Lambers, 1973
     - *Populus ciliata* Wall. ex Royle - Almora (Debnath, 1991); Chamoli (Debnath, 1991); Rudraprayag (Bhattacharya & Dey, 2001; Dey, 2015)
   - *Rhopalosiphum maidis* (Fitch, 1856)
     - *Triticum aestivum* L. - Uttarkashi (Bhattacharya & Dey, 2001; Dey, 2015)
   - *Rhopalosiphum padi* (Linnaeus, 1758)
     - *Triticum aestivum* L. - Uttarkashi (Bhattacharya & Dey, 2001; Dey, 2015)
   - *Sitobion miscanthi* (Takahashi, 1921)
     - *Triticum aestivum* L. - Uttarkashi (Bhattacharya & Dey, 2001; Dey, 2015)
6. ***Cunctochrysa albolineata* (Killington, 1935)**
   - *Brevicoryne brassicae* (Linnaeus, 1758)
     - *Brassica rapa* L. - Uttarkashi (Bhattacharya & Dey, 2001; Dey, 2015)
   - *Rhopalosiphum padi* (Linnaeus, 1758)
     - *Triticum aestivum* L. - Chamoli (Bhattacharya & Dey, 2001; Dey, 2015)
7. ***Cunctochrysa jubingensis* (Hölzel, 1973)**
   - *Aphis kurosawai* Takahashi, 1921
     - *Artemisia absinthium* L. - Uttarkashi (Chakrabarti *et al.,* 1991)
     - *Artemisia vulgaris* L. - Almora (Debnath *et al.,* 1988); Bageshwar (Debnath *et al.,* 1988); Chamoli (Bhattacharya & Dey, 2001; Dey, 2015); Chamoli (Debnath *et al.,* 1988); Uttarkashi (Debnath, 1991)
   - *Brevicoryne brassicae* (Linnaeus, 1758)
     - *Brassica rapa* L. - Almora (Debnath *et al.,* 1988); Bageshwar (Debnath *et al.,* 1988); Chamoli

(Bhattacharya & Dey, 2001; Dey, 2015); Uttarkashi (Debnath, 1991; Bhattacharya & Dey, 2001)

- *Chaitophorus kapuri* Hille Ris Lambers, 1966
  - *Populus ciliata* Wall. ex Royle - Almora (Debnath *et al.,* 1988); Bageshwar (Debnath *et al.,* 1988); Chamoli (Debnath *et al.,* 1988 ; Dey, 2015); Uttarkashi (Debnath, 1991)
  - *Populus* sp. - Uttarkashi (Chakrabarti *et al.,* 1991)
- *Greenidea psidii* van der Goot, 1917
  - *Psidium guajava* L. - Almora (Debnath *et al.,* 1988); Bageshwar (Bhattacharya & Dey, 2001; Dey, 2015); Chamoli (Debnath *et al.,* 1988)
- *Mollitrichosiphum* sp.
  - *Alnus nepalensis* D. Don - Almora (Bhattacharya & Dey, 2001; Dey, 2015); Bageshwar (Debnath *et al.,* 1988; Debnath, 1991); Chamoli (Debnath *et al.,* 1988)
  - *Alnus* sp. - Uttarkashi (Chakrabarti *et al.,* 1990)
- *Pemphigus mordwilkoi* Cholodkovsky, 1912
  - *Populus ciliata* Wall. ex Royle - Almora (Debnath *et al.,* 1988); Bageshwar (Debnath *et al.,* 1988); Chamoli (Debnath *et al.,* 1988; Debnath, 1991); Rudraprayag (Bhattacharya & Dey, 2001; Dey, 2015); Uttarkashi (Debnath, 1991)
  - *Alnus* sp. - Uttarkashi (Chakrabarti *et al.,* 1990)

8. *Italochrysa aequalis* (Walker, 1853)

- *Greenidea parthenocissi* Saha & Chakrabarti, 1988
  - *Parthenocissus semicordata* Planch - Uttarkashi (Debnath *et al.,* 1988; Bhattacharya & Dey, 2001)
- *Greenidea* sp.
  - *Parthenocissus semicordata* Planch - Bageshwar (Debnath, 1991)

9. *Italochrysa lefroyi* (Needham, 1909)

- *Pemphigus mordwilkoi* Cholodkovsky, 1912
  - *Populus ciliata* Wall. ex Royle - Nainital (Bhattacharya & Dey, 2001; Dey, 2015)

10. *Mallada desjardinsi* (Navás, 1911)

- *Greenidea psidii* van der Goot, 1917
  - *Psidium guajava* L. - Bageshwar (Debnath *et al.,* 1988; Bhattacharya & Dey, 2001)

11. *Mallada garhwalensis* (Ghosh, 1985)

- *Lachnus* sp.
  - *Cedrus deodara* (Roxb. ex D. Don) G. Don - Uttarkashi (Debnath *et al.,* 1988; Bhattacharya & Dey, 2001)

12. *Mallada kinnaurensis* (Ghosh, 1977)

- *Rhopalosiphum maidis* (Fitch, 1856)
  - *Triticum aestivum* L. - Uttarkashi (Bhattacharya & Dey, 2001; Dey, 2015)

13. *Mallada murreensis* (Tjeder, 1963)

- *Lachnus* sp.
  - *Cedrus deodara* (Roxb. ex D. Don) G. Don - Uttarkashi (Debnath, 1991; Bhattacharya & Dey, 2001)

14. *Mallada obvius* (Hölzel, 1973)

- *Rhopalosiphum maidis* (Fitch, 1856)
  - Grass - Chamoli (Bhattacharya & Dey, 2001)
- *Rhopalosiphum* sp.
  - Grass - Uttarkashi (Debnath, 1991)

15. *Mallada* spp.

- *Chaitophorus kapuri* Hille Ris Lambers, 1966
  - *Populus ciliata* Wall. ex Royle - Uttarkashi (Bhattacharya & Dey, 2001; Dey, 2015)
- *Eriosoma* sp.
  - *Cotoneaster obtusus* Wall. ex Lindl. - Chamoli (Debnath, 1991)
- *Rhopalosiphum maidis* (Fitch, 1856)
  - *Triticum aestivum* L. - Uttarkashi (Debnath, 1991)
- *Sitobion miscanthi* (Takahashi, 1921)
  - *Triticum aestivum* L. - Almora (Bhattacharya & Dey, 2001; Dey, 2015)

16. *Nothochrysa indigena* Needham, 1909

- *Pemphigus mordwilkoi* Cholodkovsky, 1912
  - *Populus ciliata* Wall. ex Royle - Uttarkashi (Bhattacharya & Dey, 2001; Dey, 2015)

17. *Pseudomallada alcestes* (Banks, 1911)

- *Betacallis sikkimensis* Basu, Ghosh & Raychaudhuri, 1974
  - *Betula alnoides* Buch.-Ham. - Rudraprayag (Bhattacharya & Dey, 2001; Dey, 2015)

18. *Retipenna dasyphlebia* (McLachlan, 1894

- *Betacallis sikkimensis* Basu, Ghosh & Raychaudhuri, 1974
  - *Betula alnoides* Buch.-Ham. - Bageshwar (Debnath *et al.,* 1988; Bhattacharya & Dey, 2001); Chamoli (Debnath *et al.,* 1988)
- *Eumyzus pruni* Chakrabarti & Bhattacharya, 1985
  - *Prunus cornuta* (Wall. ex Royle) Steud. - Uttarkashi (Bhattacharya & Dey, 2001; Dey, 2015);

Bageshwar (Debnath *et al.,* 1988); Chamoli (Debnath *et al.,* 1988)

19. *Tumeochrysa indica* Needham, 1909

- *Chaitophorus kapuri* Hille Ris Lambers, 1966
  - *Populus ciliata* Wall. ex Royle - Uttarkashi (Bhattacharya & Dey, 2001; Dey, 2015)

ii. Family: Coniopterygidae

Coniopterygids are small, predatory insects whose larvae and adults suck fluids from tiny, soft-bodied arthropods (aphids, scales, mites, whiteflies, mealybugs, insect eggs). They are thus ecologically significant as biocontrol agents in both natural and managed ecosystems. The family includes only a single species of aphidophagous species in Uttarakhand, *Coniocompsa indica* feeding on a single species of aphid as mentioned below:

1. *Coniocompsa indica* Withycombe, 1925

- *Chromaphis hirsutustibis* Kumar & Lavigne, 1970
  - *Berberis* sp. - Uttarkashi (Bhattacharya & Dey, 2001; Dey, 2015)

iii. Family: Dilaridae

This family also includes only a single aphidophagous species, *Dilar indicus* feeding on two species of aphids associated with two different food plants distributed only in Uttarkashi as mentioned below:

1. *Dilar indicus* Monserrat, 1989

- *Eriosoma ulmi* (Linnaeus, 1758)
  - *Ulmus* sp. - Uttarkashi (Bhattacharya & Dey, 2001; Dey, 2015)
- *Prociphilus (Stagona) himalayaensis* Chakrabarti, 1976
  - *Lonicera quinquelocularis* Hardw. - Uttarkashi (Bhattacharya & Dey, 2001; Dey, 2015)

iv. Family: Hemerobiidae

Hemerobiidae (brown lacewings) is an important family with both larvae and adults acting as predators of aphids and other soft-bodied insects. Their predatory activity contributes significantly to the natural suppression of aphid populations in agroecosystems, particularly in temperate regions (Bakthavatsalam & Varshney, 2023). Unlike green lacewings, hemerobiids remain active in cooler conditions, allowing them to regulate aphid populations early in the season and under low-temperature environments (New, 1975). They also prey on a wide range of pests including whiteflies, scale insects, and mites, which enhances their role as generalist biological control agents (Canard, 2001). Despite their importance, their role has often been underestimated compared to coccinellids and syrphids, largely due to their smaller size and less conspicuous abundance (Devetak & Klokoèovnik, 2016). Nevertheless, their presence enhances ecosystem resilience, making them valuable allies in integrated pest management.

In India, six species from two genera, *Hemerobius* and *Micromus*, have been reported preying on 29 aphid species across 48 host plants in 14 states and union territories (Singh *et al.,* 2024). The species of genus *Micromus* have been used against aphids and other soft-bodied insect pests in several parts of the world (Bakthavatsalam & Varshney, 2023). In Uttarakhand, however, only two species are documented: *Hemerobius indicus*, which preys on a single aphid species and *Micromus timidus*, which feed on 3 aphid species associated with 4 plants. The detail accounts of these species are given below:

1. *Hemerobius indicus* Kimmins, 1938

- *Prociphilus (Stagona) himalayaensis* Chakrabarti, 1976
  - *Lonicera* sp. - Uttarkashi (Bhattacharya & Dey, 2001; Dey, 2015)

2. *Hemerobius* sp.

- *Pemphigus mordwilkoi* Cholodkovsky, 1912
  - *Populus ciliata* Wall. ex Royle - Almora (Debnath, 1991)

3. *Micromus timidus* Hagen, 1853

- *Aphis craccivora* Koch, 1854
  - *Cajanus cajan* (L.) Millsp. - Rudraprayag (Bhattacharya & Dey, 2001; Dey, 2015)
- *Brevicoryne brassicae* (Linnaeus, 1758)
  - *Brassica rapa* L. - Chamoli (Bhattacharya & Dey, 2001; Dey, 2015)
- *Lipaphis erysimi* (Kaltenbach, 1843)
  - *Raphanus* sp. - Uttarkashi (Bhattacharya & Dey, 2001; Dey, 2015)

4. *Micromus* spp.

- *Aphis gossypii* Glover, 1877
  - *Cucumis* sp. - Uttarkashi (Debnath, 1991)
- *Betacallis sikkimensis* Basu, Ghosh & Raychaudhuri, 1974
  - *Betula alnoides* Buch.-Ham. - Uttarkashi (Bhattacharya & Dey, 2001; Dey, 2015); Bageshwar (Debnath, 1991)
- *Brevicoryne brassicae* (Linnaeus, 1758)
  - *Brassica rapa* L. - Uttarkashi (Debnath, 1991)

- *Rhopalosiphum padi* (Linnaeus, 1758)
  - *Triticum aestivum* L. - Uttarkashi (Bhattacharya & Dey, 2001; Dey, 2015)
- *Rhopalosiphum rufiabdominale* (Sasaki, 1899)
  - *Betula alnoides* Buch.-Ham. - Uttarkashi (Bhattacharya & Dey, 2001; Dey, 2015)

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