

Annotated checklist of aphid parasitoids of the leaf-curling plum aphid *Brachycaudus helichrysi* (Kaltenbach, 1843) (Hemiptera: Aphididae) and their distribution in India

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Abstract

Brachycaudus helichrysi (Kaltenbach) is an economically important aphid infesting numerous cultivated and wild plants in India. The present study compiles the first comprehensive checklist of its parasitoids, host plant associations, and geographical distribution in the country. A total of 21 parasitoid species belonging to Aphelinidae and Braconidae were recorded parasitising *Brachycaudus helichrysi* on 27 host plant species across 16 states and union territories. Braconidae was the dominant family, represented by 19 species in 10 genera, while Aphelinidae was represented by *Aphelinus gossypii* and *Aphelinus polaszeki*. *Aphidius matricariae* exhibited the widest host range and distribution, whereas *A. gossypii* showed the broadest geographical occurrence but was restricted to peach. Host plants of Rosaceae, particularly *Prunus persica*, *Prunus amygdalus*, *Prunus domestica* and *Prunus* spp., supported the richest parasitoid assemblages. Most tri-trophic associations were recorded from Sikkim, Meghalaya, Jammu & Kashmir, Uttarakhand and Manipur, highlighting the importance of the Himalayan region as a centre of parasitoid diversity. The uneven distribution of records among states indicates substantial survey gaps and suggests that the parasitoid fauna of *Brachycaudus helichrysi* remains inadequately documented in many parts of India. The checklist provides a baseline for future studies on aphid–parasitoid interactions and biological control.

Keywords: *Brachycaudus helichrysi*, parasitoids, Aphidiinae, host plants, tri-trophic associations, biological control, India

Introduction

Aphids (Hemiptera: Aphididae) constitute one of the most economically important groups of phytophagous insects, causing substantial losses in agricultural and horticultural crops through direct feeding damage and the transmission of numerous plant viruses [19, 48]. Among them, *Brachycaudus helichrysi* (Kaltenbach, 1843), commonly known as the leaf-curling plum aphid, is a widely distributed and polyphagous species recorded from Europe, Asia, Africa, Australia, and the Americas [6, 13, 27]. Owing to its broad host range, adaptability, and pest status on several cultivated plants, the species has attracted considerable attention from taxonomists, ecologists, and agricultural entomologists.

Brachycaudus helichrysi, variable in colour, ranging from yellow to green to pink to white, often shiny with a slight wax dusting, is characterised by morphological features including relatively antennae shorter than body; pale, short and tapering siphunculi; a pale, short, and broadly blunt cauda, and distinct dorsal sclerotisation patterns, although considerable phenotypic variation may occur among host-associated populations. Accurate identification is important because morphological similarities among congeners may lead to misidentifications, particularly in regions where several species occur sympatrically [22]. Its extensive host range, ecological adaptability, and ability to infest economically important fruit crops and herbaceous plants have contributed to its status as a significant agricultural pest [4, 6]. In India, *Brachycaudus helichrysi* has been reported from diverse host plants and agro-climatic regions, feeding on 184 species of plants belonging to 45 families mostly on Asteraceae (71 species), Rosaceae (21 species), Solanaceae (14 species) [47, 52]. It is regarded as an important pest of peach and almond, where infestations cause leaf curling, distortion of young foliage, sap depletion,

premature fruit drop, production of undersized fruits and consequent reduction in fruit yield [4, 15].

Host plant associations constitute a key factor in the ecology and distribution of *Brachycaudus helichrysi*. It is characterised by cyclical parthenogenesis and, in many regions, host alternation between woody primary hosts and herbaceous secondary hosts [15, 49, 63]. In temperate climates, the aphid generally overwinters as eggs on species of *Prunus*, while spring and summer generations develop rapidly through viviparous parthenogenesis before migrating to a wide range of secondary hosts [15]. Such reproductive flexibility contributes significantly to its ecological success and geographical expansion.

The economic importance of *Brachycaudus helichrysi* arises from both direct feeding injury and its capacity to transmit plant viruses [19]. Infestations can induce leaf curling, chlorosis, reduced shoot growth, and diminished crop yields in fruit trees and herbaceous crops [34]. Furthermore, the species has been implicated in the transmission of several economically important plant viruses, increasing its significance as an agricultural pest [21]. Consequently, effective management of *Brachycaudus helichrysi* requires a thorough understanding of its life history, ecology, host, and natural enemies relationships.

Among the natural enemies of aphids, aphelinid parasitoids (Hymenoptera: Aphelinidae) and aphidiine parasitoids (Hymenoptera: Braconidae: Aphidiinae) are recognised as some of the most specialised and efficient biological control agents owing to their intimate host associations, high host specificity, and remarkable host-location capabilities [46, 58, 59, 62]. These solitary endoparasitoids oviposit within aphid hosts, where larval development proceeds internally, ultimately resulting in host death and the formation of a characteristic aphid “mummy” from which the adult

parasitoid emerges [16, 42, 58, 59]. Through their capacity to impose substantial mortality on aphid populations, these parasitoids contribute significantly to the natural regulation of aphid outbreaks and constitute key components of integrated pest management programmes. Their effectiveness in suppressing aphid populations has led to the successful deployment of several species in both classical and augmentative biological control programmes targeting economically important aphids in agricultural, horticultural, ornamental, and forest ecosystems [7, 23, 46].

Despite the agricultural importance of *Brachycaudus helichrysi*, information on its parasitoids in India remains scattered across taxonomic descriptions, faunistic surveys, host catalogues, and biological control studies. As a result, knowledge of parasitoid diversity, host plant associations, and geographical distribution is fragmented and lacks synthesis. The preparation of a comprehensive checklist is therefore necessary to consolidate available records, verify host associations, update nomenclature, and identify gaps in current knowledge. Accordingly, the present review compiles and critically examines all available records of parasitoids associated with *Brachycaudus helichrysi* in India, with special emphasis on parasitoid diversity, host plant associations and tri-trophic interactions.

Materials and Methods

Published records of *Brachycaudus helichrysi* and its associated parasitoids in India were compiled through an extensive review of the available literature up to 1 May 2026, including research articles, books, monographs, catalogues, review papers, faunistic surveys, and technical reports. Information on aphid species, predators, parasitoids, host plants, state-wise distribution, and relevant references was extracted and critically evaluated. Original sources were consulted wherever necessary to verify host associations and distributional records.

The nomenclature and taxonomic status of aphid species were validated using the Aphid Species File (<https://Aphid.SpeciesFile.org>), whereas parasitoid names were verified through current taxonomic databases, including GBIF (<https://www.gbif.org>). Host plant nomenclature was standardised according to World Flora Online (<https://www.worldfloraonline.org>). Synonyms and outdated names were updated to their currently accepted valid names.

The checklist is arranged in family-wise, and species-wise manner, providing information on associated parasitoid species, host plants, state-wise distribution, and supporting references. Duplicate, doubtful, and inadequately documented records were carefully examined before inclusion.

Results

The parasitoids of *Brachycaudus helichrysi* belong to two families of the order Hymenoptera, Aphelinidae (Superfamily Calcidoidea) and Braconidae (Superfamily Ichneumonoidea). A total of 21 species of parasitoids belonging to both families are recorded parasitising leaf-curling plum aphid on 27 host plant species in 16 states/union territory of India. Aphelinidae is represented by two species, *Aphelinus gossypii* and *Aphelinus polaszeki* parasitising it in 8 states/union territory and Braconidae by 11 species parasitising on 27 host plants in 11 states/union territory of India. Braconidae constituted the dominant

family, represented by the genera *Aphidius*, *Binodoxys*, *Diaeretiella*, *Ephedrus*, *Lipolexis*, *Lysiphlebia*, *Neoephedrus*, *Praon*, *Toxares* and *Trioxys*, whereas Aphelinidae was represented by *Aphelinus*.

Among the recorded parasitoids, *Aphidius matricariae* exhibited the broadest host plant range and geographical distribution, being associated with *Brachycaudus helichrysi* on 13 plant species, including *Prunus amygdalus* and *Prunus persica*, across Jammu & Kashmir, Meghalaya, Manipur, Mizoram, Nagaland, Sikkim and Uttarakhand. In contrast, *Aphelinus gossypii* was recorded exclusively from peach, *Prunus persica*, but showed the widest geographical occurrence, being reported from the Andaman & Nicobar Islands, Bihar, Jammu & Kashmir, Karnataka, Meghalaya, Odisha and Tamil Nadu.

Several parasitoids displayed moderate host breadth. *Binodoxys indicus* was associated with *Brachycaudus helichrysi* on *Bidens pilosa*, *Crassocephalum crepidioides*, *Helianthus annuus*, *Prunus persica* and *Pyrus* spp. in Meghalaya, Mizoram, Sikkim and Uttarakhand, while *Diaeretiella rapae* parasitised the aphid on *Anaphalis* sp., *Bidens pilosa*, *Chromolaena odorata*, *Prunus amygdalus* and *Prunus persica* across Meghalaya, Mizoram, Sikkim, Uttar Pradesh, Uttarakhand and Jammu & Kashmir. Similarly, *Toxares macrosiphophagum* was recorded from *Capsicum annuum*, *Capsicum* sp. and unidentified hosts in Arunachal Pradesh, Meghalaya, Sikkim and West Bengal.

Host plants belonging to Rosaceae, particularly *Prunus persica*, *Prunus amygdalus*, *Prunus domestica* and *Prunus* spp., supported the richest parasitoid assemblages, highlighting the importance of rosaceous hosts in maintaining parasitoid diversity associated with *Brachycaudus helichrysi*. Nevertheless, numerous parasitoid species were also recorded from aphid populations occurring on wild and cultivated members of Asteraceae, Brassicaceae, Fabaceae, Poaceae and Solanaceae, indicating the broad ecological amplitude of parasitoid–host plant interactions involving *Brachycaudus helichrysi* in India.

Most of the tritrophic associations (triplets, parasitoids–hosts–host plants) of these parasitoids are reported from Sikkim and Meghalaya (each 10 triplets) followed by Jammu & Kashmir (8 triplets), Uttarakhand (7 triplets), Manipur (6 triplets) and less than 5 triplets in other states/union territories (Figure 1). Most of the parasitoids (11 species) parasitise *Brachycaudus helichrysi* on *Prunus* spp. (almond and peach).

Discussion

The predominance of braconid parasitoids (Aphidiinae) among the 21 recorded parasitoid species agrees with previous studies identifying these parasitic wasps as the principal parasitoids in agroecosystems due to their broad host range and high parasitisation capacity as observed with other economically aphid species; such as pea aphid, *Acyrtosiphon pisum* (Harris, 1776) [37]; cotton aphid, *Aphis gossypii* Glover, 1877 [38]; mustard aphid, *Lipaphis erysimi* (Kaltenbach, 1843) [36], green peach aphid, *Myzus persicae* (Sulzer, 1776) [39], and corn leaf aphid, *Rhopalosiphum maidis* (Fitch, 1856) [40]. The wide distribution of *Aphidius matricariae* and *Diaeretiella rapae* reflects their ecological adaptability and ability to exploit aphids on diverse host plants [41].

A notable feature of the dataset is the concentration of parasitoid records on rosaceous hosts, especially *Prunus*

persica, *Prunus amygdalus*, *Prunus domestica* and unidentified *Prunus* species. These hosts occur predominantly in the temperate and sub-temperate regions of Jammu & Kashmir, Himachal Pradesh and Uttarakhand in northwest Himalaya and Manipur, Meghalaya and Sikkim in northeast Himalaya, which constitute the principal peach, plum and almond-growing belts of India. The abundance of parasitoid records from these states is therefore likely associated with the widespread cultivation of stone fruits and the economic importance of *Brachycaudus helichrysi* as a pest of orchard crops [14, 24, 34].

The predominance of nearly 86% of the documented tri-trophic associations in Uttarakhand [50], Jammu & Kashmir [43], Himachal Pradesh [44], and Manipur [45] emphasises the significance of the northwestern and northeastern Himalayan region as a major centre of diversity for *Brachycaudus helichrysi*, its host plants, and associated natural enemies. The region's heterogeneous topography, wide altitudinal range, temperate climatic conditions, and rich floristic diversity provide a mosaic of ecological niches that favour the establishment and persistence of aphid populations and their parasitoid assemblages. Furthermore, the relatively high number of records from these states is likely influenced by the extensive aphidological and parasitoid surveys historically undertaken in the Himalayan region [10, 20, 53]. Conversely, the comparatively lower diversity and fewer associations reported from many other states may not necessarily indicate true biological scarcity, but rather reflect differences in host-plant distribution, local abundance of *Brachycaudus helichrysi*, and, more importantly, the paucity of systematic faunistic surveys and host-association studies in those regions.

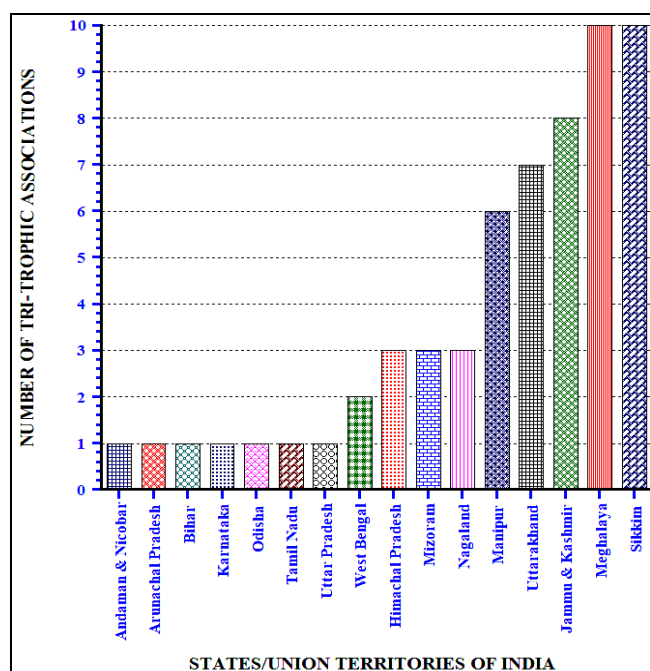


Fig 1: Number of tri-trophic associations of the parasitoids of leaf-curling plum aphid, *Brachycaudus helichrysi* in different states and union territories of India.

Following is the detailed account of tri-trophic associations of *Brachycaudus* species in India:

Family 1: Aphelinidae

1. *Aphelinus gossypii* Timberlake, 1924

- *Prunus persica* (L.) Batsch - Andaman & Nicobar [17]; Bihar [17]; Jammu & Kashmir [18]; Karnataka [17]; Meghalaya [18]; Odisha [17]; Tamil Nadu [17]

2. *Aphelinus polaszeki* Hayat, 1998

- Unknown plant - Himachal Pradesh [17]

Family 2: Braconidae, subfamily: Aphidiinae

1. *Aphidius ervi* Haliday, 1834

- *Prunus* sp. - Sikkim [61]

2. *Aphidius hortensis* Marshall, 1896

- *Chromolaena odorata* (L.) R.M. King & H. Rob. - Manipur [35]
- *Gynura bicolor* DC. - Manipur [35]

3. *Aphidius matricariae* Haliday, 1834

- *Brassica napus* L. - Mizoram [32]
- *Chrysanthemum* sp. - Sikkim [61]
- *Gynura bicolor* DC. - Manipur [35]
- *Gynura* sp. - Manipur [35]
- *Helichrysum luteoalbum* (L.) Rchb. - Meghalaya [30]
- *Ageratum conyzoides* L. - Jammu & Kashmir [5]; Nagaland [51]; Sikkim [2, 26]
- *Brassica oleracea* L. var. *botrytis* - Jammu & Kashmir [20]
- *Brassica oleracea* L. var. *capitata* - Jammu & Kashmir [20]
- *Erigeron canadensis* L. - Jammu & Kashmir [20]
- *Kleinia grandiflora* (Wall. ex DC.) N. Rani - Jammu & Kashmir [20]
- *Lablab purpureus* (L.) Sweet ssp. *purpureus* - Uttarakhand [9, 12]
- *Prunus amygdalus* Batsch - Uttarakhand [10]
- *Prunus persica* (L.) Batsch - Uttarakhand [10, 33]
- *Prunus* sp. - Meghalaya [54]

4. *Aphidius qadrii* (Shuja-Uddin, 1977)

- *Anaphalis* sp. - Himachal Pradesh [8]; Uttarakhand [11]

5. *Aphidius similis* Stary & Carver, 1980

- *Ageratum conyzoides* L. - Sikkim [2]
- *Gynura bicolor* DC. - Sikkim [1, 26]

6. *Aphidius* sp.

- *Rosa webbiana* Wall. ex Royle - Sikkim [25]
- Unidentified plant - Nagaland [25]

7. *Binodoxys indicus* (Subba Rao & Sharma, 1958)

- *Bidens pilosa* L. - Sikkim [61]
- *Helianthus annuus* L. - Mizoram [32]
- *Crassocephalum crepidioides* (Benth.) S. Moore - Meghalaya [55]
- *Pyrus* sp. - Uttarakhand [10]

8. *Diaeretiella rapae* (McIntosh, 1855)

- *Cirsium wallichii* DC. - Jammu & Kashmir [28]
- *Anaphalis* sp. - Meghalaya [30]
- *Bidens pilosa* L. - Mizoram [32]
- *Chromolaena odorata* (L.) R. M. King & H. Rob. - Sikkim [61]
- *Prunus amygdalus* Batsch - Uttar Pradesh [3]; Uttarakhand [10, 33]
- *Prunus persica* (L.) Batsch - Jammu & Kashmir [4]

9. *Ephedrus plagiator* (Nees, 1811)

- *Crassocephalum crepidioides* (Benth.) S. Moore - Meghalaya [55]
- *Cucurbita* sp. - Sikkim [61]

10. *Ephedrus* sp.

- *Pyrus pashia* Buch. Ham. ex D. Don - Uttarakhand [8]

11. *Lipolexis oregmae* (Gahan, 1932)

- *Mikania scandens* (L.) Willd. - Manipur [35]

12. *Lysiphlebia japonica* (Ashmead, 1906)

- *Prunus* sp. - Nagaland [51]

13. *Lysiphlebia rugosa* Stary & Schlinger, 1967

- *Gnaphalium* sp. - Himachal Pradesh [8, 29]

14. *Lysiphlebia* sp.

- *Gnaphalium* sp. - Manipur [60]

15. *Neophedrus helichrysi* Samanta, Tamili, Saha & Raychaudhuri, 1983

- Unidentified grass - West Bengal [31]

16. *Praon* sp.

- *Prunus domestica* L. - Meghalaya [54]

17. *Toxares deltiger* (Haliday, 1833)

- *Prunus domestica* L. - Meghalaya [56]

18. *Toxares macrosiphophagum* Shuja-Uddin, 1974

- *Capsicum annuum* L. - Sikkim [61]; West Bengal [61]
- *Capsicum* sp. - Arunachal Pradesh [30]
- Unknown plant - Meghalaya [57]

19. *Toxares shigai* Takada, 1965

- *Prunus* sp. - Meghalaya [54]

Conclusion

This review provides the first consolidated checklist of parasitoids associated with *Brachycaudus helichrysi* in India, documenting 21 species belonging to Aphelinidae and Braconidae from 27 host plant species across 16 states and union territories. Braconid parasitoids, particularly *Aphidius matricariae*, *Diaeretiella rapae*, and *Binodoxys indicus*, dominated the parasitoid complex and exhibited broad host plant associations. Rosaceous hosts, especially *Prunus* species, supported the highest parasitoid diversity, emphasising the importance of temperate fruit-growing regions. The concentration of records in the Himalayan states highlights both the ecological significance of this region and the influence of intensive survey efforts. The uneven distribution of records across India indicates substantial knowledge gaps and underscores the need for systematic surveys and ecological studies to better understand parasitoid diversity and strengthen biological control strategies against *Brachycaudus helichrysi*.

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