

## Checklist of natural enemies of *Lipaphis erysimi* (Kaltenbach, 1843) and *Lipaphis pseudobrassicae* (Davis, 1914) (Hemiptera: Aphididae) and their host plant associations in India

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**Citation:** Singh, R. (2024). Checklist of natural enemies of *Lipaphis erysimi* (Kaltenbach, 1843) and *Lipaphis pseudobrassicae* (Davis, 1914) (Hemiptera: Aphididae) and their host plant associations in India. *Journal of Animal Diversity*, 6 (3): 1–25. <http://dx.doi.org/10.22034/JAD.2024.6.3.1>

### Abstract

The present study summarizes the predators and parasitoids of two species, the mustard aphid *Lipaphis erysimi* (Kaltenbach, 1843) and the turnip aphid *Lipaphis pseudobrassicae* (Davis, 1914) infesting various food plants distributed in various states and union territories of India. These predators belong to four orders of the class Insecta: Coleoptera (Coccinellidae), Diptera (Chamaemyiidae, Syrphidae), Hemiptera (Anthocoridae, Geocoridae, Reduviidae) and Neuroptera (Chrysopidae, Hemerobiidae), and one order of class Arachnida, the order Araneae (spiders) (6 families). A total of 100 species of predators were observed to feed on the mustard aphid on 23 food plant species distributed in 26 states/union territory of India. The greatest numbers of predators of both species belong to the families Coccinellidae (47 species) and Syrphidae (27 species). Four species of predatory bugs (Hemiptera), seven species of lacewings (Neuroptera) and fourteen species of spiders are reported to prey on *Lipaphis erysimi* in India. Most of the tritrophic associations (triplets, predators–preys–host plants) of these predators are reported from Uttar Pradesh (98 triplets) followed by West Bengal (58 triplets), Punjab (53 triplets), Manipur (48 triplets), Tripura (40 triplets) and other states/union territories (less than 40 triplets). A total of 16 species of predators belonging to Coccinellidae, Syrphidae and Chrysopidae are reported to prey on *Lipaphis pseudobrassicae* only in seven states/union territory of India, mostly in Jammu and Kashmir. Two families of the parasitoids, Aphelinidae and Braconidae (subfamily Aphidiinae) parasitize *L. erysimi* in India. Aphelinidae is represented by 5 species distributed in seven states/union territory and Braconidae by 17 species on 20 host plants in 24 states/union territory of India. Most of the tritrophic associations (triplets, parasitoids–hosts–host plants) of these parasitoids are reported from Manipur (15 triplets) followed by Uttar Pradesh (11 triplets) and less than 10 triplets in other states/union territories. Only two identified species of Braconidae were observed to parasitize *L. pseudobrassicae* in India on two host plant species distributed only in Jammu and Kashmir, Karnataka and Punjab.

**Editor-in-Chief:** Dr. Ali Gholamifard

**Assistant Editor:** Dr. Erica DeMilio

**Subject Editors:** Professor Oldřich Nedvěd  
Dr. John Caleb

**Received:** 8 August 2024

**Revised:** 29 August 2024

**Accepted:** 22 September 2024

**Published online:** 30 September 2024

**Key words:** Aphelinidae, biocontrol, Braconidae, Chrysopidae, Coccinellidae, mustard aphid, parasitoids, predators, spiders, Syrphidae

### Introduction

*Lipaphis* (*Lipaphis*) *erysimi* (Kaltenbach, 1843) (Hemiptera: Aphididae), commonly known as mustard

aphid, is a polyphagous sucking insect pest and is associated with 52 species of host plants belonging to 42 genera in 19 families in India (Singh and Singh, 2017; Singh et al., 2023; Tiwari et al., 2024a) of which

several plant species are highly economically important. It is considered a notorious and key pest of several brassica crops, particularly oil seed crops (rapeseed mustard, yellow mustard, black mustard) (Bakhtia and Sekhon, 1989) and vegetable crops (*Brassica oleracea* L. var. *botrytis*, *B. o.* var. *capitata*, *B. rapa* L., *Raphanus sativus* L.) (Shukla et al., 1994). Another allied species of the genus is *Lipaphis* (*Lipaphis*) *pseudobrassicae* (Davis, 1914), commonly known as turnip aphid, which is a little-known species feeding mostly on brassica plants along with the mustard aphid. In mustard fields, sometimes nothing remains to harvest after their infestation (Palial et al., 2022). Both species infest mostly the inflorescences, buds, and young leaves and stems of its host plants. Both nymphs and adults (wingless and winged forms) suck the sap of the host plant, which causes wilting and flower dropping. Infested parts are deformed and crinkled, which hinders plant growth. In addition to direct damage, the aphids also excrete a large amount of honeydew, on which a black fungus called sooty mould develops and interferes with the normal functioning of the photosynthetic activity of the plant (Singh, 2014a). In addition, like other aphid species, *L. erysimi* also transmits several viral diseases, e.g., cabbage black ringspot virus, radish mosaic virus, cauliflower mosaic virus and turnip mosaic virus (Capinera, 2001). Because of its pest status, several practices have been applied to manage the population of *L. erysimi* in fields such as cultural, biological and chemical techniques (Sachan, 1997; Mishra and Gaurav, 2022).

It is an established fact that anthropogenic activities have significantly reduced global biodiversity (Prodanova et al., 2023). Therefore, one of the most significant challenges facing our earth today is its conservation, which includes the information about availability of fauna and flora in a given ecosystem. Insects are one of important elements of the species diversity. They are not only pests but also play a critical role in pollination, maintaining soil structure and fertility, seed dispersal, nutrient cycling, producing useful compounds, scavenging, providing food for other animals and managing pest insect populations by parasitizing and consuming them (Singh, 2014a). The natural enemies (parasitoids and predators) of insect pests have an essential role in maintaining their population in equilibrium and thus their balance in the ecosystem. The importance of conserving the natural enemies of insect pests is globally emphasized as these insects not only act as bioagents in controlling the pest population naturally, but are also used in classical and conservation biocontrol programs (Heimpel and Mills, 2017).

Among the aphidophagous arthropods, ladybird beetles (Coleoptera: Coccinellidae) stand first due to their species diversity and having high foraging and predatory efficiencies (Pervez et al., 2020a). Other aphidophagous arthropods are the larvae of syrphid flies (Diptera: Syrphidae) (Joshi and Ballal, 2013; Joshi et al., 2023;

Ahmad and Kumari, 2024), lacewings (Neuroptera: Chrysopidae, Hemerobiidae) (Bakthavatsalam and Varshney, 2023; Singh et al., 2024a), spiders (Arachnida: Araneae) (Singh et al., 2024b), and some predatory bugs (Ballal et al., 2023). Among the parasitoids, only members of two families, Braconidae and Aphelinidae (Hymenoptera) are reported to parasitize aphids (Singh and Singh, 2016).

The main objective of this compilation is to prepare a checklist of natural enemies of *Lipaphis erysimi* and *Lipaphis pseudobrassicae* and their food plant associations across the country that may help in their natural conservation, aiming to reduce the pest population and to protect the crops infested by them. Some of them, e.g., *Coccinella septempunctata* Linnaeus (a predator, Shenhmar and Brar, 1995) and *Diaeretiella rapae* (M'Intosh, 1855) (a parasitoid, Rajput, 2022) have been successfully utilized in its biological control on brassica crops in India. Most of the natural enemies recorded to prey or parasitize *Lipaphis erysimi* are polyphagous.

The present checklist is based on the primary data of published literature on the natural enemies of *L. erysimi* and *L. pseudobrassicae* extracted from books, book chapters, journals, proceedings of conferences, Records and Fauna Series of the Zoological Survey of India, Kolkata, and a few authentic theses available on Shodhganga (<https://shodhganga.inflibnet.ac.in>) up to August 15, 2024. Records of aphidophagous arthropods that do not name their specific prey species were excluded from this checklist. In most of the recent previous literature, there are several errors in the scientific names of the insects, both predators as well as their preys (aphids), and food plants because of their modified status and other nomenclatural decisions and clarifications. The names of aphids, as well as plants that were misspelt in the original records have been corrected where we logically ascertained the intended species. In the present checklist, attempts have been made to provide the valid scientific names of the predators following GBIF (2024), WSC (2024), with aphids following Favret (2024) and for plants, following (WFO, 2024). For detailed synonymy of the valid species, the above references should be consulted.

The district map of the Indian states used in Figures 1–3 was taken from the website <https://www.mapsofindia.com> and numbers of triplets (predator–aphid prey–food plant) recorded in each state/union territories are illustrated.

## Results

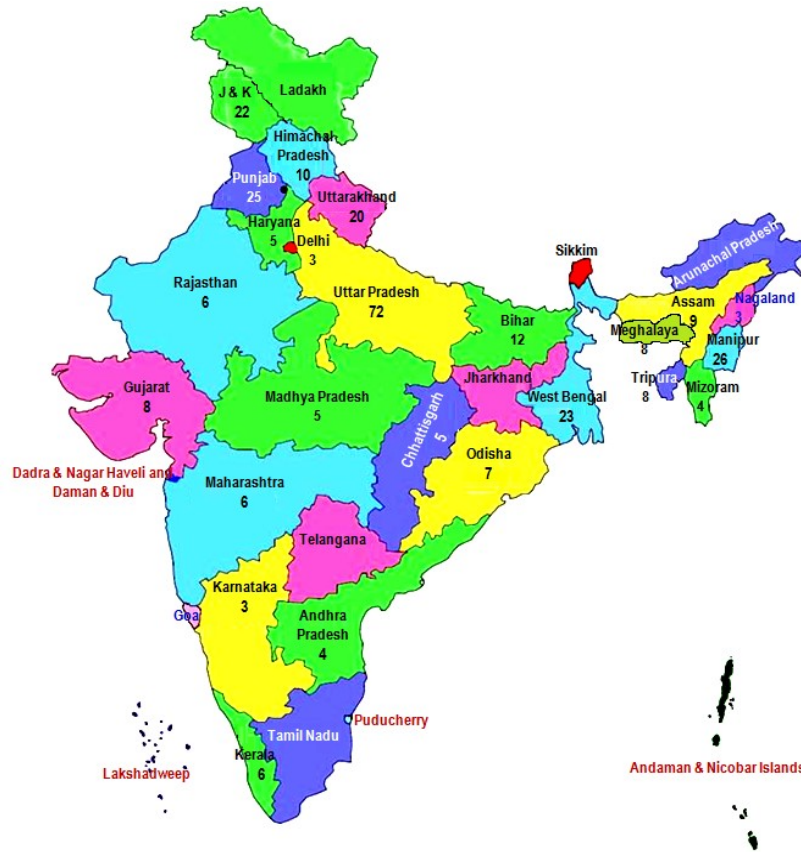
Predatory arthropods of *Lipaphis erysimi* mostly belong to four orders of the class Insecta: Coleoptera, Diptera, Hemiptera and Neuroptera and one order of class Arachnida: Araneae (spiders) (6 families). A total 100 species of predators were observed to prey the mustard aphid on 23 food plant species distributed in 26 states/union territory of India (Table 1).

**Table 1:** Number of *Lipaphis erysimi* predator species with numbers of host plant species, associations and presence in Indian state/union territories for each higher taxon.

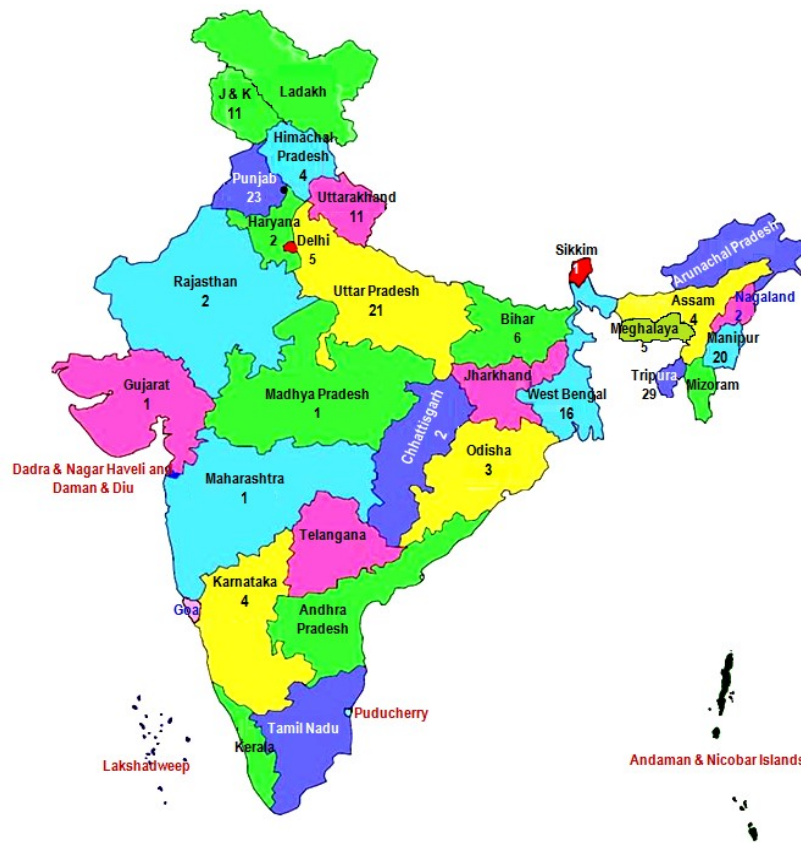
Class	Order	Families of predators	Number of predator species	Number of host plant species	Number of predator-prey-host plant associations	Number of states/union territories
Arachnida	Araneae	1. Araneidae	2	1	2	2
		2. Lycosidae	2	3	6	1
		3. Oxyopidae	1	2	2	1
		4. Salticidae	4	5	9	2
		5. Theridiidae	1	1	1	1
		6. Thomisidae	4	4	7	2
	<b>Subtotal</b>		<b>14</b>	<b>5</b>	<b>27</b>	<b>3</b>
Insecta	Coleoptera	1. Coccinellidae	47	19	154	25
	Diptera	1. Chamaemyiidae	1	1	1	3
		2. Syrphidae	27	15	87	22
	<b>Subtotal</b>		<b>28</b>	<b>15</b>	<b>88</b>	<b>22</b>
	Hemiptera	1. Anthocoridae	2	2	4	1
		2. Geocoridae	1	3	3	1
		3. Reduviidae	1	1	1	1
	<b>Subtotal</b>		<b>4</b>	<b>5</b>	<b>8</b>	<b>3</b>
	Neuroptera	1. Chrysopidae	4	8	15	13
		2. Hemerobiidae	3	5	7	5
<b>Subtotal</b>		<b>7</b>	<b>8</b>	<b>22</b>	<b>14</b>	
<b>Total</b>			<b>100</b>	<b>23</b>	<b>299</b>	<b>26</b>



**Figure 1:** Map showing the number of tritrophic associations (predator-aphid host-food plant) of aphidophagous arthropods preying on *Lipaphis erysimi* in different states and union territories of India. <https://www.mapsofindia.com>



**Figure 2:** Map showing the number of tritrophic associations of aphidophagous ladybird beetles preying on *Lipaphis erysimi* in different states and union territories of India. <https://www.mapsofindia.com>



**Figure 3:** Map showing the number of tritrophic associations of aphidophagous hover flies preying on *Lipaphis erysimi* in different states and union territories of India. <https://www.mapsofindia.com>

The observed predator species comprise 14 species of spiders, 47 species of ladybird beetles (Coleoptera: Coccinellidae), 1 species of Chamaemyiidae and 27 species of Syrphidae (Diptera), 2 species of Anthocoridae, 1 species of Geocoridae and 1 species of Reduviidae (Hemiptera), and 4 species of Chrysopidae and 3 species of Hemerobiidae (Neuroptera). Most of the tritrophic associations (triplets, predators–preys–host plants) of these predators were reported from Uttar Pradesh (98 triplets) followed by West Bengal (58 triplets), Punjab (53 triplets), Manipur (48 triplets), Tripura (40 triplets) and other states/union territories (less than 40 triplets) (Fig. 1). The actual number of species can be slightly lower due to identification of some species reported in literature only to genus level, but here treated as separate species.

### Checklist of predators of *Lipaphis erysimi* infesting food plants in India

#### A. Class: Arachnida; Order: Araneae

The order Araneae includes spiders, which are an important element of the earth's ecosystem. Being predatory, they consume mostly insects, keeping their population under control and hardly pose any danger to humans (Nyffeler and Birkhofer, 2017). However, unlike insect predators, their potential as biocontrol agents is less exploited to its fullest. Recently, Singh et al. (2024b) reported a total of 77 species of aphidophagous spiders in India preying on 53 species of aphids infesting 58 species of plants. Herewith, 14 species of spiders are listed belonging to six families that prey on the mustard aphid in only three states of India. Indeed, very limited attempts have been made to record these aphidophagous spiders in India and an intensive and extensive survey plan to record them in unexplored areas is required.

#### Family 1: Araneidae

##### *Eriovixia* sp.

*Brassica rapa* L. – Maharashtra (Kale et al., 2020)

##### *Neoscona* sp.

*Brassica rapa* L. – Uttarakhand (Debnath, 1991); Maharashtra (Kale et al., 2020)

#### Family 2: Lycosidae

##### *Pardosa pseudoannulata* (Bösenberg and Strand, 1906)

*Brassica oleracea* L. var. *capitata* – Maharashtra (Shaikh et al., 2020)

*Brassica rapa* L. – Maharashtra (Shaikh et al., 2020)

*Raphanus sativus* L. – Maharashtra (Shaikh et al., 2020)

##### *Wadicosa fidelis* (O. Pickard-Cambridge, 1872)

*Brassica oleracea* L. var. *capitata* – Maharashtra (Shaikh et al., 2020)

*Brassica rapa* L. – Maharashtra (Shaikh et al., 2020)

*Raphanus sativus* L. – Maharashtra (Shaikh et al., 2020)

#### Family 3: Oxyopidae

##### *Oxyopes javanus* Thorell, 1887

*Brassica juncea* (L.) Czern. – West Bengal (Ghosh, 1983)

*Brassica* sp. – West Bengal (Agarwala et al., 1981a)

#### Family 4: Salticidae

##### *Hasarius adansoni* (Audouin, 1826)

*Brassica oleracea* L. var. *capitata* – Maharashtra (Shaikh et al., 2020)

*Brassica rapa* L. – Maharashtra (Shaikh et al., 2020)

*Raphanus sativus* L. – Maharashtra (Shaikh et al., 2020)

##### *Marpissa* sp.

*Brassica rapa* L. – Uttarakhand (Debnath, 1991)

##### *Phintella vittata* (C. L. Koch, 1846)

*Brassica juncea* (L.) Czern. – West Bengal (Ghosh, 1983)

*Brassica* sp. – West Bengal (Agarwala et al., 1981a)

##### *Plexippus paykulli* (Audouin, 1826)

*Brassica oleracea* L. var. *capitata* – Maharashtra (Shaikh et al., 2020)

*Brassica rapa* L. – Maharashtra (Shaikh et al., 2020)

*Raphanus sativus* L. – Maharashtra (Shaikh et al., 2020)

#### Family 5: Theridiidae

##### *Theridion* sp.

*Brassica juncea* (L.) Czern. – West Bengal (Ghosh, 1983)

#### Family 6: Thomisidae

##### *Camaricus formosus* Thorell, 1887

*Brassica juncea* (L.) Czern. – West Bengal (Ghosh, 1983)

*Brassica rapa* L. – West Bengal (Agarwala et al., 1981a)

##### *Thomisus projectus* Tikader, 1960

*Brassica oleracea* L. var. *capitata* – Maharashtra (Shaikh et al., 2020)

*Brassica rapa* L. – Maharashtra (Shaikh et al., 2020)

*Raphanus sativus* L. – Maharashtra (Shaikh et al., 2020)

##### *Thomisus pugilis* Stoliczka, 1869

*Brassica juncea* (L.) Czern. – West Bengal (Ghosh, 1983)

##### *Thomisus* sp.

*Brassica rapa* L. – Maharashtra (Kale et al., 2020)

#### Class: Insecta; Order: Coleoptera

#### Family: Coccinellidae

These are commonly known as ladybird beetles. Though several species of this family are major agricultural pests, at least 260 species are insectivorous, feeding on soft insects like aphids, scale insects, mealy bugs, whiteflies, etc., in India (Omkar and Pervez, 2004). In this checklist, 47 species of coccinellids visiting 19 species of plants are reported, feeding on *Lipaphis erysimi* in 25 states/union territories of India (Table 1). Most of the tritrophic associations (triplets, predators–preys–host plant) of these ladybird beetles are reported from Uttar Pradesh (72 triplets) followed by Manipur (26 triplets), Punjab (25 triplet), West Bengal (23 triplets), Jammu and Kashmir (22 triplets), Uttarakhand (20 triplets), and less than 20 triplets in other states/union territories (Fig. 2). More than 60% species of these ladybird beetles prey on the mustard

aphid on oilseed brassica crops (*Brassica juncea* L., *Brassica napus* L., *Brassica nigra* (W.D.J. Koch, *Brassica rapa* L.) followed by brassica vegetables (*Brassica oleracea* L. – cabbage, cauliflower), and radish (*Raphanus sativus* L.). A checklist of ladybird beetles feeding on *Lipaphis erysimi* infesting food plants in different states of India follows:

***Adalia bipunctata* (Linnaeus, 1758)**

*Brassica napus* L. – Uttar Pradesh (Tiwari et al., 2024b)  
*Brassica oleracea* L. var. *capitata* – Uttar Pradesh (Tiwari et al., 2024b)  
*Brassica rapa* L. – Uttar Pradesh (Chaudhary and Singh, 2012; Tiwari et al., 2024b)

***Adalia tetraspilota* (Hope, 1831)**

*Brassica napus* L. – Manipur (Chakrabarti et al., 2012)  
*Brassica rapa* L. – Jammu and Kashmir (Bali, 1987; Mir, 2013)

***Anegleis cardoni* (Weise, 1892)**

*Brassica juncea* (L.) Czern. – Uttar Pradesh (Singh, 2009)  
*Brassica rapa* L. – Uttar Pradesh (Afroze, 1999; Omkar et al., 2009)  
*Brassica* sp. – Manipur (Chakrabarti et al., 2012); Uttarakhand (Pal and Bhatt, 2018)

***Brumoides suturalis* (Fabricius, 1798)**

*Brassica juncea* (L.) Czern. – Assam (Das, 2020); Punjab (Soni et al., 2004); Uttar Pradesh (Tiwari et al., 2024b); Uttarakhand (Sharma and Joshi, 2010); West Bengal (Ghosh, 1983)  
*Brassica rapa* L. – Himachal Pradesh (Gautam, 1990); Uttar Pradesh (Tiwari et al., 2024b)

***Brumus* sp.**

*Brassica carinata* A. Braun – Punjab (Kumar, 2015)  
*Brassica juncea* (L.) Czern. – Punjab (Kumar, 2015)  
*Brassica napus* L. – Punjab (Kumar, 2015)  
*Brassica nigra* W.D.J. Koch – Punjab (Kumar, 2015)  
*Brassica rapa* L. – Punjab (Kumar, 2015)  
*Eruca vesicaria* (L.) Cav. – Punjab (Kumar, 2015)

***Calvia punctata* (Mulsant, 1853)**

*Brassica rapa* L. – Jammu and Kashmir (Khan et al., 2009; Mir, 2013)

***Cheilomenes sexmaculata* (Fabricius, 1781)**

*Arivela viscosa* (L.) Raf. – Kerala (Thamilvel, 2009)  
*Brassica carinata* A. Braun – Punjab (Kumar, 2015)  
*Brassica juncea* (L.) Czern. – Assam (Das, 2020); Chhattisgarh (Ray, 1967; Kolhekar et al., 2019); Delhi (Pandi et al., 2012); Gujarat (Patel, 2015); Haryana (Kalra, 1988); Himachal Pradesh (Soni et al., 2021); Jammu and Kashmir (Mir, 2013); Karnataka (Joshi et al., 1999a); Madhya Pradesh (Mishra and Kanwat, 2018); Manipur (Rajeshwari and Singh, 2022); Meghalaya (Damitre, 2019); Punjab (Sharma et al., 1997; Soni et al., 2004); Rajasthan (Singh et al., 2009; Ram et al., 2022); Tripura (Datta, 2020); Uttar Pradesh (Shukla and Kumar,

2024; Tiwari et al., 2024b); Uttarakhand (Pal and Bhatt, 2018; Verma et al., 2023); West Bengal (Ghosh, 1983)  
*Brassica napus* L. – Manipur (Shantibala, 1989); Punjab (Kumar, 2015); Uttar Pradesh (Tiwari et al., 2024b)  
*Brassica nigra* W.D.J. Koch – West Bengal (Ghosh et al., 1981)

*Brassica oleracea* L. var. *botrytis* – Bihar (Prakash and Rani, 2015); Manipur (Devjani and Singh, 1998)

*Brassica oleracea* L. var. *capitata* – Andhra Pradesh (Rao et al., 1997); Gujarat (Varmora et al., 2009; Chakraborty, 2012); Odisha (Mandal and Patnaik, 2006); Manipur (Bijaya et al., 1996); Maharashtra (Shaikh et al., 2020); Nagaland (Waluniba et al., 2016); Uttar Pradesh (Tiwari et al., 2024b)

*Brassica rapa* L. – Bihar (Prabhakar and Roy, 2010; Kumar et al., 2016); Gujarat (Chakraborty, 2012); Haryana (Rana, 2006); Jammu and Kashmir (Mir, 2013; Bhat, 2017); Madhya Pradesh (Verma et al., 1983); Maharashtra (Kale et al., 2020; Shaikh et al., 2020); Odisha (Parija and Biswal, 2023); Punjab (Kumar, 2015; Shenhmar and Brar, 1995); Rajasthan (Sharma, 1973; Singh et al., 2008); Uttar Pradesh (Chaudhary and Singh, 2012; Tiwari et al., 2024b); Uttarakhand (Pervez and Chandra, 2018)

*Brassica* sp. – Jammu and Kashmir (Khan et al., 2009)

*Eruca vesicaria* (L.) Cav. – Punjab (Kumar, 2015)

*Raphanus sativus* L. – Kerala (Thamilvel, 2009); Maharashtra (Shaikh et al., 2020); Uttarakhand (Pervez and Chandra, 2018)

*Vigna unguiculata* (L.) Walp. – Andhra Pradesh (Rao et al., 1997)

Unknown plant sp. – Tripura (Agarwala et al., 1987)

***Chilocorus infernalis* Mulsant, 1853 [syn. *Chilocorus bijugus* Mulsant, 1853]**

*Raphanus sativus* L. – Himachal Pradesh (Sharma et al., 2015)

***Chilocorus nigritus* (Fabricius, 1798)**

*Brassica juncea* (L.) Czern. – Uttarakhand (Sharma and Joshi, 2010)  
*Brassica rapa* L. – Uttar Pradesh (Omkar and Bind, 1995)

***Coccinella californica* Mannerheim, 1843**

*Brassica rapa* L. – Odisha (Parija and Biswal, 2023)

***Coccinella luteopicta* (Mulsant, 1866)**

*Raphanus sativus* L. – Himachal Pradesh (Sharma et al., 2015)

***Coccinella magnopunctata* Rybakow, 1889**

*Brassica juncea* (L.) Czern. – Jammu and Kashmir (Mir, 2013)

***Coccinella repanda* Thunberg, 1781**

*Brassica juncea* (L.) Czern. – Uttar Pradesh (Kishor et al., 2023; Tiwari et al., 2024b)  
*Brassica juncea* (L.) Czern. – Assam (Saharia, 1981)  
*Brassica oleracea* L. var. *capitata* – Chhattisgarh (Singh, 2014b)  
*Brassica rapa* L. – Punjab (Srivastava et al., 1982); Uttar Pradesh (Tiwari et al., 2024b)

***Coccinella septempunctata* Linnaeus, 1758**

*Brassica carinata* A. Braun – Punjab (Kumar, 2015)  
*Brassica juncea* (L.) Czern. – Assam (Das, 2020); Bihar (Mishra and Mukharjee, 2020); Chhattisgarh (Kashyap et al., 2018; Patel et al., 2004); Delhi (Shankarganesh et al., 2015); Gujarat (Kulkarni and Patel, 2001; Patel et al., 2019); Haryana (Kalra, 1988; Singh and Singh, 1994); Himachal Pradesh (Soni et al., 2021); Karnataka (Joshi et al., 1999a); Madhya Pradesh (Lal et al., 2018; Mishra and Kanwat, 2018); Manipur (Chitra Devi et al., 1997, 2002); Meghalaya (Manpoong et al., 2016; Damitre, 2019); Punjab (Sharma et al., 1997; Kumar, 2015); Rajasthan (Chand et al., 2022; Yadav et al., 2023); Tripura (Gangopadhyay, 1980; Datta, 2020); Uttar Pradesh (Singh, 2013; Tiwari et al., 2024b); West Bengal (Ghosh, 1983)  
*Brassica napus* L. – Manipur (Shantibala, 1989); Punjab (Kumar, 2015); Uttar Pradesh (Tiwari et al., 2024b)  
*Brassica nigra* W.D.J. Koch – Jammu and Kashmir (Salalia and Isher, 2011); Manipur (Shantibala, 1989); Uttar Pradesh (Tiwari et al., 2024b); West Bengal (Ghosh et al., 1981)  
*Brassica oleracea* L. – Uttarakhand (Ghosh et al., 1991)  
*Brassica oleracea* L. var. *botrytis* – Bihar (Ahmad et al., 2012); Kerala (Ravi et al., 2014); Manipur (Devjani and Singh, 1998); Rajasthan (Choudhary et al., 2023); Uttar Pradesh (Tiwari et al., 2024b)  
*Brassica oleracea* L. var. *capitata* – Chhattisgarh (Singh, 2014b); Gujarat (Varmora et al., 2009; Chakraborty, 2012); Kerala (Ravi et al., 2014); Maharashtra (Shaikh et al., 2020); Manipur (Bijaya et al., 1996); Nagaland (Waluniba et al., 2016); Odisha (Mandal and Patnaik, 2006); Punjab (Atwal and Sethi, 1963); Rajasthan (Bana et al., 2012); Uttar Pradesh (Tiwari et al., 2024b); West Bengal (Gurung et al., 2019)  
*Brassica oleracea* L. var. *italica* – Mizoram (Boopathi et al., 2020)  
*Brassica rapa* L. – Bihar (Ahmad et al., 2012; Goswami et al., 2016); Delhi (Shankarganesh et al., 2015); Gujarat (Zalavadia and Kapadia, 2000); Haryana (Rana, 2006); Himachal Pradesh (Lakhanpal and Raj, 1998); Jammu and Kashmir (Khan et al., 2009; Mir, 2013); Maharashtra (Panchal et al., 2013; Shaikh et al., 2020); Manipur (Devjani and Singh, 2006); Meghalaya (Dwivedi et al., 2021); Punjab (Atwal et al., 1971; Shenhmar and Brar, 1995); Rajasthan (Gour and Pareek, 2003; Singh and Meghwal, 2010); Uttar Pradesh (Hugar et al., 2008; Chaudhary and Singh, 2012); Uttarakhand (Bisht et al., 2001; Pervez et al., 2020b); West Bengal (Gurung et al., 2019; Maji et al., 2023)  
*Brassica* sp. – Uttarakhand (Pal and Bhatt, 2018)  
*Eruca vesicaria* (L.) Cav. – Punjab (Kumar, 2015)  
*Ranunculus* sp. – Bihar (Ahmad et al., 2012)  
*Raphanus sativus* L. – Maharashtra (Shaikh et al., 2020); Manipur (Shantibala, 1989); Tripura (Gangopadhyay, 1980); Uttar Pradesh (Tiwari et al., 2024b); Uttarakhand (Ghosh et al., 1991)

***Coccinella transversalis* Fabricius, 1781**

*Arivela viscosa* (L.) Raf. – Kerala (Thamilvel, 2009)  
*Brassica carinata* A. Braun – Punjab (Kumar, 2015)  
*Brassica juncea* (L.) Czern. – Assam (Das, 2020; Pradhan et al., 2020a); Gujarat (Jadhav and Shukla, 2015); Karnataka (Joshi et al., 1999a); Madhya Pradesh (Mishra and Kanwat, 2018); Manipur (Chitra Devi et al., 2002; Rajeshwari and Singh, 2022); Meghalaya (Damitre, 2019); Punjab (Kumar, 2015); Tripura (Gangopadhyay, 1980; Ghosh et al., 2017); Uttar Pradesh (Kishor et al., 2023; Tiwari et al., 2024b); West Bengal (Ghosh, 1983)  
*Brassica napus* L. – Manipur (Shantibala, 1989); Punjab (Kumar, 2015); Uttar Pradesh (Tiwari et al., 2024b)  
*Brassica nigra* W.D.J. Koch – Manipur (Shantibala, 1989); Uttar Pradesh (Tiwari et al., 2024b); West Bengal (Ghosh et al., 1981)  
*Brassica oleracea* L. var. *botrytis* – Bihar (Ahmad et al., 2012; Prakash and Rani, 2015); Manipur (Bijaya et al., 1996; Devjani and Singh, 1998); Odisha (Mandal and Patnaik, 2006); Uttar Pradesh (Tiwari et al., 2024b); West Bengal (Gurung et al., 2019)  
*Brassica oleracea* L. var. *capitata* – Gujarat (Varmora et al., 2009); Nagaland (Waluniba et al., 2016); Uttar Pradesh (Tiwari et al., 2024b)  
*Brassica oleracea* L. var. *italica* – Mizoram (Boopathi et al., 2020)  
*Brassica rapa* L. – Assam (Borah and Dutta, 2010a); Bihar (Prabhakar and Roy, 2010; Goswami et al., 2016); Manipur (Devjani and Singh, 2006); Odisha (Parija and Biswal, 2023); Punjab (Kumar, 2015); Tripura (Gangopadhyay, 1980); Uttar Pradesh (Hugar et al., 2008; Tiwari et al., 2024b); West Bengal (Gurung et al., 2019; Maji et al., 2023)  
*Eruca vesicaria* (L.) Cav. – Punjab (Kumar, 2015)  
*Raphanus sativus* L. – Kerala (Thamilvel, 2009); Tripura (Gangopadhyay, 1980); Uttar Pradesh (Tiwari et al., 2024b)  
***Coccinella undecimpunctata* Linnaeus, 1758**  
*Brassica juncea* (L.) Czern. – Bihar (Rahman, 1940); Punjab (Rahman, 1940)  
*Brassica napus* L. – Jammu and Kashmir (Bhat, 2017)  
*Brassica oleracea* L. var. *botrytis* – Uttar Pradesh (Tiwari et al., 2024b)  
*Brassica oleracea* L. var. *capitata* – Uttar Pradesh (Tiwari et al., 2024b)  
*Brassica rapa* L. – Jammu and Kashmir (Bhagat and Matta, 2002); Uttar Pradesh (Chaudhary and Singh, 2012; Tiwari et al., 2024b)  
*Lagenaria siceraria* (Molino) Standl. – Jammu and Kashmir (Bhat, 2017)  
***Coccinella* sp.**  
*Brassica rapa* L. – Uttarakhand (Bisht et al., 2001)  
***Coelophora saucia* (Mulsant, 1850)**  
*Brassica napus* L. – Manipur (Shantibala, 1989)  
*Brassica oleracea* L. var. *botrytis* – Uttar Pradesh (Tiwari et al., 2024b)

*Brassica oleracea* L. var. *capitata* – Uttar Pradesh (Tiwari et al., 2024b)

***Harmonia axyridis* (Pallas, 1773)**

*Brassica juncea* (L.) Czern. – Assam (Pradhan et al., 2020b)

***Harmonia dimidiata* (Fabricius, 1781)**

*Brassica juncea* (L.) Czern. – Himachal Pradesh (Soni et al., 2021); Meghalaya (Damitre, 2019)

***Harmonia eucharis* (Mulsant, 1853)**

*Brassica juncea* (L.) Czern. – Jammu and Kashmir (Mir, 2013)

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

*Brassica rapa* L. – Jammu and Kashmir (Mir, 2013); Uttar Pradesh (Tiwari et al., 2024b); Uttarakhand (Bisht et al., 2001; Pervez et al., 2020b)

***Harmonia octomaculata* (Fabricius, 1787)**

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

*Brassica rapa* L. – Uttar Pradesh (Tiwari et al., 2024b)

***Hippodamia variegata* (Goeze, 1777)**

*Brassica juncea* (L.) Czern – Haryana (Kalra, 1988; Singh and Singh, 1994); Himachal Pradesh (Soni et al., 2021); Madhya Pradesh (Mishra and Kanwat, 2017); Uttar Pradesh (Tiwari et al., 2024b)

*Brassica napus* L. – Jammu and Kashmir (Bhat, 2017); Uttar Pradesh (Tiwari et al., 2024b)

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

*Brassica rapa* L. – Jammu and Kashmir (Bhagat and Matta, 2002; Mir, 2013); Uttar Pradesh (Tiwari et al., 2024b); Uttarakhand (Ghosh et al., 1991; Pervez et al., 2020c)

*Brassica* sp. – Uttarakhand (Pal and Bhatt, 2018)

*Raphanus sativus* L. – Uttar Pradesh (Tiwari et al., 2024b)

***Hippodamia variegata doubledayi* (Mulsant, 1850)**

*Brassica juncea* (L.) Czern. – Jammu and Kashmir (Mir, 2013)

*Brassica rapa* L. – Uttar Pradesh (Chaudhary and Singh, 2012)

***Hippodamia* sp.**

*Brassica rapa* L. – Uttarakhand (Bisht et al., 2001)

***Illeis cincta* (Fabricius, 1798)**

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

*Brassica oleracea* L. var. *gongylodes* – Jammu and Kashmir (Mir, 2013)

*Brassica rapa* L. – Uttar Pradesh (Tiwari et al., 2024b)

*Brassica* sp. – Uttarakhand (Pal and Bhatt, 2018)

***Illeis indica* Timberlake, 1943**

*Brassica juncea* (L.) Czern. – Jammu and Kashmir (Mir, 2013)

***Machimus indianus* Ricardo, 1919**

*Brassica rapa* L. – Uttarakhand (Bisht et al., 2001)

***Megalocaria dilatata* (Fabricius, 1775)**

*Brassica napus* L. – Manipur (Shantibala, 1989)

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

*Brassica rapa* L. – Uttar Pradesh (Tiwari et al., 2024b)

*Raphanus sativus* L. – Manipur (Shantibala, 1989)

***Micraspis allardi* (Mulsant, 1866)**

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

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

*Brassica rapa* L. – Uttar Pradesh (Tiwari et al., 2024b)

*Brassica* sp. – Manipur (Chakrabarti et al., 2012); Uttarakhand (Pal and Bhatt, 2018)

***Micraspis discolor* (Fabricius, 1798)**

*Brassica juncea* (L.) Czern. – Assam (Das, 2020); Meghalaya (Damitre, 2019); Tripura (Datta, 2020); West Bengal (Ghosh, 1983)

*Brassica nigra* W.D.J. Koch – West Bengal (Ghosh et al., 1981)

*Brassica oleracea* L. var. *italica* – Mizoram (Boopathi et al., 2020)

*Brassica oleracea* L. – Odisha (Mandal and Patnaik, 2006); West Bengal (Gurung et al., 2019)

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

*Brassica oleracea* L. var. *capitata* – Chhattisgarh (Singh, 2014b)

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

***Micraspis vincta* (Gorham, 1895)**

*Brassica juncea* (L.) Czern. – Uttar Pradesh (Singh, 2009; Omkar and Pervez, 2000)

*Brassica oleracea* L. – Andhra Pradesh (Rao et al., 1997)

*Brassica rapa* L. – Uttar Pradesh (Tiwari et al., 2024b)

*Vigna unguiculata* (L.) Walp. – Andhra Pradesh (Rao et al., 1997)

***Nephus regularis* (Sicard, 1929)**

*Brassica juncea* (L.) Czern. – Uttar Pradesh (Omkar and Pervez, 1999)

*Brassica* sp. – Manipur (Chakrabarti et al., 2012)

***Oenopia conglobata* (Linnaeus, 1758)**

*Brassica rapa* L. – Jammu and Kashmir (Bhat, 2017)

***Oenopia kirbyi* Mulsant, 1850**

*Brassica juncea* (L.) Czern. – Meghalaya (Damitre, 2019)

*Brassica napus* L. – Manipur (Shantibala, 1989)

*Raphanus sativus* L. – Uttar Pradesh (Tiwari et al., 2024b)

***Oenopia sexareata* (Mulsant, 1853)**

*Brassica juncea* (L.) Czern. – Meghalaya (Damitre, 2019)

***Priscibrum usropygialis* (Mulsant, 1853)**

*Brassica juncea* (L.) Czern. – Jammu and Kashmir (Mir, 2013)



*Brassica rapa* L. – Jammu and Kashmir (Mir, 2013)  
*Raphanus sativus* L. – Himachal Pradesh (Sharma et al., 2015)

***Propylea dissecta* (Mulsant, 1850)**

*Brassica juncea* (L.) Czern. – Uttar Pradesh (Singh, 2009)  
*Brassica oleracea* L. var. *botrytis* – Uttar Pradesh (Tiwari et al., 2024b)

*Brassica oleracea* L. var. *capitata* – Mizoram (Boopathi et al., 2020)

*Brassica rapa* L. – Uttar Pradesh (Omkar and Mishra, 2005; Tiwari et al., 2024b); Uttarakhand (Pervez and Kumar, 2017)

*Raphanus sativus* L. – Uttar Pradesh (Pervez and Omkar, 2004)

***Propylea japonica* (Thunberg, 1781)**

*Brassica juncea* (L.) Czern. – Uttar Pradesh (Omkar and Pervez, 1999; Tiwari et al., 2024b)

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

*Brassica rapa* L. – Uttar Pradesh (Chaudhary and Singh, 2012; Tiwari et al., 2024b)

*Brassica* sp. – Manipur (Chakrabarti et al., 2012)

***Propylea luteopustulata* (Mulsant, 1850)**

*Brassica juncea* (L.) Czern. – West Bengal (Ghosh, 1983)

*Brassica nigra* W.D.J. Koch – Uttar Pradesh (Tiwari et al., 2024b); West Bengal (Ghosh et al., 1981)

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

*Brassica oleracea* L. var. *capitata* – Manipur (Shantibala, 1989)

*Brassica rapa* L. – Jammu and Kashmir (Khan et al., 2009); Uttar Pradesh (Tiwari et al., 2024b)

*Raphanus sativus* L. – Himachal Pradesh (Sharma et al., 2015)

*Rosa* sp. – West Bengal (Agarwala et al., 1980)

***Propylea quatuordecimpunctata* (Linnaeus, 1758)**

*Zea mays* L. – West Bengal (Chakrabarti et al., 2012)

***Pseudaspidimerus trinotata* (Thunberg, 1781)**

*Brassica juncea* (L.) Czern. – West Bengal (Ghosh, 1983)

*Brassica nigra* W.D.J. Koch – West Bengal (Poddar and Ghosh, 1984)

***Psyllobora bisoetonotata* (Mulsant, 1850)**

*Brassica juncea* (L.) Czern. – Uttar Pradesh (Omkar and Pervez, 1999)

***Novius ruficollis* (Mulsant, 1850)**

*Brassica juncea* (L.) Czern. – Uttar Pradesh (Omkar and Pervez, 1999)

***Scymnus (Pullus) pyrocheilus* Mulsant, 1853**

*Brassica juncea* (L.) Czern. – West Bengal (Ghosh, 1983)

*Brassica nigra* W.D.J. Koch – West Bengal (Ghosh et al., 1981)

*Brassica rapa* L. – Bihar (Prabhakar and Roy, 2010)

***Scymnus fuscatus* Boheman, 1859**

*Brassica juncea* (L.) Czern. – Uttar Pradesh (Omkar and Pervez, 2000)

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

*Brassica rapa* L. – Uttar Pradesh (Tiwari et al., 2024b)

***Scymnus* sp.**

*Brassica juncea* (L.) Czern. – Assam (Das, 2020); Uttar Pradesh (Omkar and Pervez, 1999); Uttarakhand (Ghosh et al., 1991)

**II. Order: Diptera**

Among Diptera, the hover flies (Syrphidae) are the most common aphid predators, being widely distributed in the Nearctic, Neotropical and Palaearctic regions. Most of the Syrphidae provide dual service in nature, as an adult they help in crop pollination (Joshi et al., 2023) and as larvae, they consume several soft-bodied insects such as aphids, scale insects, mealy bugs, whiteflies, thrips, etc., and thus form an integral part of natural control of these insects. Syrphidae is the largest family with 27 aphidophagous species feeding on *Lipaphis erysimi* infesting 15 species of host plants distributed in 22 states/union territory of India (Table 1). The highest number of species of these hover flies prey on aphids on oilseed mustard crops followed by vegetable brassica crops. Most of the tritrophic associations (triplet, predators–prey–host plant) of these hover flies are reported from Tripura (29 triplets) followed by Punjab (23 triplets), Pradesh (21 triplets), Manipur (20 triplets), and less than 20 triplets in other states/union territories (Fig. 3). The representation of another family, Chamaemyiidae, is very poor. The detailed food plant associations of these flies are given below:

**Family 1: Chamaemyiidae**

***Leucopis* sp.**

*Brassica juncea* (L.) Czern – Punjab (Sharma et al., 1997); West Bengal (Ghosh, 1983); Haryana (Kalra, 1988)

**Family 2: Syrphidae**

***Allograpta javana* (Wiedemann, 1824)**

*Brassica juncea* (L.) Czern – Tripura (Agarwala et al., 1989; Datta, 2020)

*Brassica oleracea* L. var. *botrytis* – Tripura (Agarwala et al., 1989)

*Brassica oleracea* L. var. *capitata* – Tripura (Agarwala et al., 1989)

*Brassica rapa* L. – Uttar Pradesh (Tiwari et al., 2024b)

*Raphanus sativus* L. – Tripura (Agarwala et al., 1989)

***Baccha* sp.**

*Brassica nigra* W.D.J. Koch – West Bengal (Ghosh et al., 1981)

***Betasyrphus isaaci* (Bhatia, 1933)**

*Brassica juncea* (L.) Czern – Meghalaya (Manpoong et al., 2016); Bihar (Rahman, 1940)

*Brassica rapa* L. – Meghalaya (Dwivedi et al., 2021); Uttar Pradesh (Tiwari et al., 2024b); Uttarakhand (Bisht et al., 2006)

Unknown plant sp. – Tripura (Agarwala et al., 1987)

***Betasyrphus serarius* (Wiedemann, 1830)**

*Brassica juncea* (L.) Czern. – Manipur (Chitra Devi et al., 2002); Punjab (Sharma et al., 1997); Tripura (Agarwala et al., 1989; Datta, 2020)

*Brassica oleracea* L. var. *botrytis* – Bihar (Prakash and Rani, 2015); Manipur (Devjani and Singh, 1998; Singh et al., 2002); Tripura (Agarwala et al., 1989)

*Brassica oleracea* L. var. *capitata* – Manipur (Agarwala et al., 1984; Bijaya et al., 1996); Meghalaya (Agarwala et al., 1984); Tripura (Agarwala et al., 1989); West Bengal (Agarwala et al., 1982)

*Brassica rapa* L. – Jammu and Kashmir (Bhat and Bhagat, 2017); Uttar Pradesh (Tiwari et al., 2024b)

*Raphanus sativus* L. – Tripura (Agarwala et al., 1989)

***Betasyrphus* sp.**

*Brassica juncea* (L.) Czern. – Karnataka (Chinnu et al., 2023)

***Dideopsis aegrota* (Fabricius, 1805)**

Unknown aphid sp. – Tripura (Agarwala et al., 1987)

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

*Brassica carinata* A. Braun – Punjab (Kumar, 2015)

*Brassica juncea* (L.) Czern. – Haryana (Kalra, 1988; Singh and Singh, 1994); Himachal Pradesh (Soni et al., 2021); Manipur (Chitra Devi et al., 1997; Devi et al., 2011); Punjab (Sharma et al., 1997; Kumar et al., 1988); Tripura (Gangopadhyay, 1980; Agarwala et al., 1989); Uttar Pradesh (Singh, 2013; Tiwari et al., 2024b); West Bengal (Ghosh, 1983)

*Brassica napus* L. – Punjab (Kumar, 2015)

*Brassica nigra* W.D.J. Koch – West Bengal (Ghosh et al., 1981)

*Brassica oleracea* L. var. *botrytis* – Bihar (Prakash and Rani, 2015); Manipur (Devjani and Singh, 1998; Singh et al., 2002); Tripura (Agarwala et al., 1989); Uttar Pradesh (Tiwari et al., 2024b)

*Brassica oleracea* L. var. *capitata* – Manipur (Bijaya et al., 1996); Tripura (Agarwala et al., 1989)

*Brassica rapa* L. – Assam (Borah and Dutta, 2010b); Jammu and Kashmir (Bhagat and Matta, 2002; Bhat, 2008); Manipur (Devjani and Singh, 2006); Odisha (Parija and Biswal, 2023); Punjab (Kumar, 2015); Tripura (Gangopadhyay, 1980); Uttar Pradesh (Singh and Singh, 2013; Tiwari et al., 2024b); Uttarakhand (Bisht et al., 2006)

*Brassica* sp. – West Bengal (Roy and Basu, 1977)

*Eruca vesicaria* (L.) Cav. – Punjab (Kumar, 2015)

*Raphanus sativus* L. – Tripura (Gangopadhyay, 1980; Agarwala et al., 1989)

***Episyrphus viridaureus* (Wiedemann, 1824)**

*Brassica juncea* (L.) Czern. – Meghalaya (Manpoong et al., 2016); Punjab (Kumar et al., 1989; Sharma et al., 1997); Tripura (Agarwala et al., 1989; Datta, 2020)

*Brassica oleracea* L. var. *botrytis* – Tripura (Agarwala et al., 1989)

*Brassica oleracea* L. var. *capitata* – Tripura (Agarwala et al., 1989)

*Brassica rapa* L. – Meghalaya (Dwivedi et al., 2021); Punjab (Kumar et al., 1987)

*Raphanus sativus* L. – Tripura (Agarwala et al., 1989)

***Eristalis tenax* (Linnaeus, 1758)**

*Brassica juncea* (L.) Czern. – Chhattisgarh (Kashyap et al., 2018)

***Eumerus albifrons* Walker, 1852**

*Brassica oleracea* L. var. *capitata* – Odisha (Mandal and Patnaik, 2006)

***Eupeodes bucculatus* (Rondani, 1857)**

*Brassica juncea* (L.) Czern. – Punjab (Kumar et al., 1988; Sharma et al., 1997)

*Brassica rapa* L. – Punjab (Kumar et al., 1987)

***Eupeodes confrater* (Wiedemann, 1830)**

*Brassica juncea* (L.) Czern. – Manipur (Chitra Devi et al., 1996, 2002); Punjab (Kumar et al., 1988; Sharma et al., 1997); Tripura (Gangopadhyay, 1980; Datta, 2020); Uttar Pradesh (Singh, 2013); West Bengal (Ghosh, 1983)

*Brassica nigra* W.D.J. Koch – West Bengal (Ghosh et al., 1981)

*Brassica oleracea* L. var. *botrytis* – Bihar (Prakash and Rani, 2015); Manipur (Devjani and Singh, 1998; Singh et al., 2002); Tripura (Agarwala et al., 1989); Uttar Pradesh (Tiwari et al., 2024b)

*Brassica oleracea* L. var. *capitata* – Manipur (Bijaya et al., 1996); Tripura (Agarwala et al., 1989); Uttar Pradesh (Tiwari et al., 2024b)

*Brassica rapa* L. – Jammu and Kashmir (Bhat, 2008; Bhat and Bhagat, 2017); Manipur (Chitra Devi et al., 1996); Punjab (Kumar et al., 1987); Tripura (Gangopadhyay, 1980); Uttar Pradesh (Chaudhary and Singh, 2012; Tiwari et al., 2024b)

*Brassica* sp. – West Bengal (Roy and Basu, 1977)

*Raphanus sativus* L. – Tripura (Gangopadhyay, 1980; Agarwala et al., 1989)

***Eupeodes corollae* (Fabricius, 1794)**

*Brassica napus* L. – Jammu and Kashmir (Bhat and Bhagat, 2017)

*Brassica rapa* L. – Jammu and Kashmir (Bhat, 2008; Bhat and Bhagat, 2017); Uttarakhand (Bisht et al., 2006)

***Eupeodes* sp.**

*Brassica napus* L. – Himachal Pradesh (Lakhanpal and Raj, 1998)

*Brassica oleracea* L. var. *capitata* – Nagaland (Waluniba et al., 2016)

***Ischiodon scutellaris* (Fabricius, 1805)**

*Brassica juncea* (L.) Czern. – Assam (Pradhan et al., 2020b); Delhi (Lal and Gupta, 1953); Gujarat (Chouhan et al., 2011; Patel et al., 2019); Himachal Pradesh (Soni et al., 2021); Karnataka (Joshi et al., 1999b); Madhya Pradesh (Mishra and Kanwat, 2017); Manipur (Chitra Devi et al., 2002; Rajeshwari and Singh, 2022); Punjab (Kumar et al., 1988; Sharma et al., 1997); Rajasthan (Chand et al., 2022; Yadav et al., 2023); Tripura (Datta, 2020; Agarwala et al., 1989); Uttar Pradesh (Ali et al., 2009; Singh, 2013); West Bengal (Ghosh, 1983)

*Brassica nigra* W.D.J. Koch – West Bengal (Ghosh et al., 1981)

*Brassica oleracea* L. var. *botrytis* – Bihar (Prakash and Rani, 2015); Manipur (Devjani and Singh, 1998; Singh et al., 2002); Tripura (Agarwala et al., 1989); Uttar Pradesh (Tiwari et al., 2024b)

*Brassica oleracea* L. var. *capitata* – Manipur (Bijaya et al., 1996); Odisha (Mandal and Patnaik, 2006); Tripura (Agarwala et al., 1989)

*Brassica oleracea* L. var. *gongylodes* – Uttar Pradesh (Tiwari et al., 2024b)

*Brassica rapa* L. – Jammu and Kashmir (Bhat and Bhagat, 2017); Maharashtra (Kale et al., 2020); Manipur (Chitra Devi et al., 1996; Devjani and Singh, 2006); Punjab (Kumar et al., 1987); Uttar Pradesh (Singh and Singh, 2013; Tiwari et al., 2024b); Uttarakhand (Karnatak and Thorat, 2006)

*Brassica* sp. – West Bengal (Roy and Basu, 1977)

*Raphanus sativus* L. – Tripura (Agarwala et al., 1989)

***Melanostoma orientale* (Wiedemann, 1824)**

*Brassica juncea* (L.) Czern – Punjab (Sharma et al., 1997)

*Brassica rapa* L. – Uttarakhand (Bisht et al., 2006)

*Sinapis* spp. – Himachal Pradesh (Agarwala et al., 1984); Punjab (Agarwala et al., 1984); Sikkim (Agarwala et al., 1984)

***Melanostoma univittatum* (Wiedemann, 1824)**

*Brassica rapa* L. – Jammu and Kashmir (Ahmad and Bhat, 1986); Uttarakhand (Bisht et al., 2006)

*Cucumis sativus* L. – Uttarakhand (Bisht et al., 2006)

***Paragus crenulatus* Thomson, 1869**

Unknown plant sp. – Tripura (Agarwala et al., 1987)

***Paragus serratus* (Fabricius, 1805)**

*Brassica juncea* (L.) Czern. – Karnataka (Joshi et al., 1999b); Manipur (Chitra Devi et al., 2002); West Bengal (Ghosh, 1983)

*Brassica nigra* W.D.J. Koch – West Bengal (Ghosh et al., 1981)

*Brassica oleracea* L. var. *botrytis* – Manipur (Singh et al., 2002); Uttar Pradesh (Tiwari et al., 2024b)

*Brassica rapa* L. – Jammu and Kashmir (Bhat and Bhagat, 2017); Manipur (Devjani and Singh, 2006); Uttar Pradesh (Tiwari et al., 2024b)

*Raphanus sativus* L. – Uttar Pradesh (Tiwari et al., 2024b)

***Scaeva albomaculata* (Macquart, 1842)**

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

***Scaeva latimaculata* (Brunetti, 1923)**

*Brassica rapa* L. – Punjab (Kumar et al., 1987)

*Raphanus sativus* L. – Punjab (Sharma et al., 1997)

***Scaeva selenitica* (Meigen, 1822)**

*Brassica rapa* L. – Uttarakhand (Bisht et al., 2006)

*Sinapis* sp. – Delhi (Agarwala et al., 1984)

***Sphaerophoria indiana* Bigot, 1884**

*Brassica juncea* (L.) Czern – Punjab (Kumar et al., 1988; Sharma et al., 1997)

*Brassica oleracea* L. var. *botrytis* – Bihar (Prakash and Rani, 2015); Manipur (Devjani and Singh, 1998; Singh et al., 2002); Uttar Pradesh (Tiwari et al., 2024b)

*Brassica oleracea* L. var. *capitata* – Manipur (Bijaya et al., 1996)

*Brassica rapa* L. – Punjab (Kumar et al., 1987); Uttar Pradesh (Tiwari et al., 2024b); Uttarakhand (Debnath, 1991)

*Sinapis* sp. – Delhi, Uttar Pradesh, Punjab (Agarwala et al., 1984)

***Sphaerophoria scripta* (Linnaeus, 1758)**

*Brassica juncea* (L.) Czern. – Assam (Das, 2020); West Bengal (Ghosh, 1983)

*Brassica napus* L. – Jammu and Kashmir (Bhat and Bhagat, 2017)

*Brassica nigra* W.D.J. Koch – West Bengal (Ghosh et al., 1981; Agarwala et al., 1984)

*Brassica rapa* L. – Jammu and Kashmir (Ahmad and Bhat, 1986); Uttar Pradesh (Tiwari et al., 2024b); Uttarakhand (Bisht et al., 2001)

***Sphaerophoria* sp.**

*Brassica oleracea* L. var. *capitata* – Nagaland (Waluniba et al., 2016)

Unknown plant sp. – Karnataka (Agarwala et al., 1984)

***Syrphus* sp.**

*Brassica juncea* (L.) Czern. – Assam (Das, 2020)

*Brassica oleracea* L. var. *capitata* – Chhattisgarh (Singh, 2014b)

*Brassica rapa* L. – Jammu and Kashmir (Bhagat and Lone, 1984); Uttarakhand (Bisht et al., 2006)

***Xanthogramma* sp.**

*Brassica oleracea* L. – Rajasthan (Choudhary et al., 2023)

*Brassica* sp. – Delhi (Agarwala et al., 1984)

*Coriandrum* sp. – Delhi (Agarwala et al., 1984)

**Order: Hemiptera**

The order Hemiptera includes at least seven families of predatory bugs preying on aphids, scale insects, mealybugs, bugs, leaf hoppers, thrips, mites, caterpillars, etc., in India (Chellappan and Ranjith, 2023). However, only four hemipteran species belonging to three families (Anthocoridae, Geocoridae and Reduviidae) are reported as predators of *Lipaphis erysimi* in only West Bengal (Table 1) as mentioned below:

**Family 1: Anthocoridae*****Bilia castanea* (Carvalho, 1951)**

*Brassica nigra* W.D.J. Koch – West Bengal (Ghosh et al., 1981; Saxena, 1981)

*Brassica juncea* (L.) Czern. – West Bengal (Ghosh, 1983)

***Orius albidipennis* (Reuter, 1884)**

*Brassica nigra* W.D.J. Koch – West Bengal (Ghosh et al., 1981)

*Brassica juncea* (L.) Czern. – West Bengal (Ghosh, 1983)

**Family 2: Geocoridae*****Geocoris ochropterus* (Fieber, 1844)**

*Brassica oleracea* L. var. *capitata* – Maharashtra (Shaikh et al., 2020)

*Brassica rapa* L. – Maharashtra (Shaikh et al., 2020)

*Raphanus sativus* L. – Maharashtra (Shaikh et al., 2020)

**Family 2: Reduviidae*****Brassivola hystrix* Distant, 1904**

*Brassica juncea* (L.) Czern. – Delhi (Lakkundi, 1989)

**Order: Neuroptera**

Neuroptera includes lacewings, mantisflies, antlions and their relatives and both adults and larvae are predatory. They are globally distributed and generalist predators of soft-bodied insects. Recently, Singh et al. (2024a) listed 32 species of aphidophagous neuropterans from India belonging to four families. However, members of only two families, Chrysopidae and Hemerobiidae, were reported to prey on *Lipaphis erysimi* in India. Chrysopidae is the largest family of the order and its members are commonly known as green lacewings. In India, it comprises 24 aphidophagous species preying on 55 species of aphids infesting 84 species of food plants (Singh et al., 2024a). Among them, only four species of lacewings prey on *Lipaphis erysimi* feeding on eight species of food plants in 13 states/union territory. The hemerobiids are commonly known as brown lacewings. In India, two genera, *Hemerobius* and *Micromus*, are recorded as preying on 29 aphid species infesting 48 food plants (Singh et al., 2024a). However, only three species are recorded to prey on *Lipaphis erysimi* infesting five species of plants in India (Table 1). Details on prey and food plant associations are listed below:

**Family 1: Chrysopidae*****Chrysopa* sp.**

*Brassica juncea* (L.) Czern. – Tripura (Datta, 2020)

*Brassica nigra* W.D.J. Koch – West Bengal (Ghosh et al., 1981)

***Chrysoperla zastrowi sillemi* (Esben – Petersen, 1935)**

*Brassica carinata* A. Braun – Punjab (Kumar, 2015)

*Brassica juncea* (L.) Czern. – Assam (Pradhan et al., 2020b); Gujarat (Chakraborty and Korat, 2010); Haryana (Kalra, 1988); Punjab (Soni et al., 2004; Kumar, 2015; Belagalla et al., 2024); Rajasthan (Singh

et al., 2009; Naruka and Ameta, 2015); West Bengal (Ghosh, 1983); Uttarakhand (Verma et al., 2023)

*Brassica napus* L. – Punjab (Kumar, 2015)

*Brassica nigra* W.D.J. Koch – Uttar Pradesh (Tiwari et al., 2024b)

*Brassica oleracea* L. var. *capitata* – Chhattisgarh (Singh, 2014b); Maharashtra (Shaikh et al., 2020); Odisha (Mandal and Patnaik, 2006); Uttar Pradesh (Tiwari et al., 2024b)

*Brassica rapa* L. – Gujarat (Chaudhary et al., 2022); Maharashtra (Shaikh et al., 2020); Punjab (Kumar, 2015); Rajasthan (Singh et al., 2009); Telangana (Sheileja et al., 2022); Uttar Pradesh (Singh and Kumar, 2000; Tiwari et al., 2024b); Uttarakhand (Joshi and Sharma, 2008)

*Eruca vesicaria* (L.) Cav. – Punjab (Kumar, 2015)

*Raphanus sativus* L. – Maharashtra (Shaikh et al., 2020)

***Mallada desjardinsi* (Navás, 1911)**

*Brassica juncea* (L.) Czern. – Haryana (Kalra, 1988)

*Brassica rapa* L. – Gujarat (Nehare et al., 2004); Rajasthan (Bakthavatsalam et al., 1994)

***Tumeochrysa indica* Needham, 1909**

*Brassica oleracea* L. var. *capitata* – West Bengal (Dey and De, 2018)

*Raphanus sativus* L. – West Bengal (Dey and De, 2018)

**Family 1: Hemerobiidae*****Hemerobius indicus* Kimmins, 1938**

*Brassica rapa* L. – West Bengal (Dey et al., 2016)

***Micromus igorotus* Banks, 1920**

*Brassica rapa* L. – Uttar Pradesh (Tiwari et al., 2024b)

***Micromus timidus* Hagen, 1853 –**

*Brassica juncea* (L.) Czern. – Manipur (Chitra Devi et al., 2002); Tripura (Datta, 2020); West Bengal (Ghosh, 1983)

*Brassica nigra* W.D.J. Koch – West Bengal (Ghosh et al., 1981)

*Brassica oleracea* L. – Manipur (Singh et al., 2002)

*Brassica rapa* L. – Uttar Pradesh (Tiwari et al., 2024b)

*Raphanus* sp. – Uttarakhand (Dey, 2015)

**Checklist of predators of *Lipaphis pseudobrassicacae* infesting different food plants in India**

Predatory arthropods of *L. pseudobrassicacae* belong to three orders of the class Insecta: Coleoptera (Coccinellidae), Diptera (Syrphidae), and Neuroptera (Chrysopidae). A total of 16 species of predators belonging to different taxa were observed to feed on the turnip aphid on five food plant species distributed only in seven states/union territories of India, mostly in Jammu and Kashmir (Table 2). The greatest number of predators belong to the families Syrphidae (10 species) followed by ladybird beetles (5 species) (Table 1). Most of the tritrophic associations (triplets, predators–preys–host plants) of these predators are reported from Jammu and Kashmir.

**Class: Insecta****Order: Coleoptera; Family: Coccinellidae*****Cheilomenes sexmaculata* (Fabricius, 1781)***Brassica juncea* (L.) Czern – Jammu and Kashmir (Khan and Shah, 2017)*Brassica oleracea* L. var. *botrytis* – Jammu and Kashmir (Khan and Shah, 2017)*Brassica oleracea* L. var. *capitata* – Jammu and Kashmir (Khan and Shah, 2017)*Brassica rapa* subsp. *rapa* L. – Jammu and Kashmir (Khan and Shah, 2017)*Raphanus sativus* L. – Jammu and Kashmir (Khan and Shah, 2017)***Coccinella septempunctata* Linnaeus, 1758***Brassica juncea* (L.) Czern – Jammu and Kashmir (Khan and Shah, 2017)*Brassica oleracea* L. var. *botrytis* – Jammu and Kashmir (Khan and Shah, 2017)*Brassica oleracea* L. var. *capitata* – Jammu and Kashmir (Khan and Shah, 2017)*Brassica rapa* subsp. *rapa* L. – Jammu and Kashmir (Khan and Shah, 2017)*Raphanus sativus* L. – Jammu and Kashmir (Khan and Shah, 2017)***Coccinella transversalis* Fabricius, 1781***Brassica juncea* (L.) Czern. – Tripura (Ghosh et al., 2017)***Coccinella undecimpunctata* Linnaeus, 1758***Brassica juncea* (L.) Czern. – Bihar (Rahman, 1940)*Brassica juncea* (L.) Czern. – Punjab (Rahman, 1940)***Propylea luteopustulata* (Mulsant, 1850)***Brassica juncea* (L.) Czern – Jammu and Kashmir (Khan and Shah, 2017)*Brassica oleracea* L. var. *botrytis* – Jammu and Kashmir (Khan and Shah, 2017)*Brassica oleracea* L. var. *capitata* – Jammu and Kashmir (Khan and Shah, 2017)*Brassica rapa* subsp. *rapa* L. – Jammu and Kashmir (Khan and Shah, 2017)*Raphanus sativus* L. – Jammu and Kashmir (Khan and Shah, 2017)**Order: Diptera; Family: Syrphidae*****Betasyrphus isaaci* (Bhatia, 1933)***Brassica juncea* (L.) Czern. – Bihar (Rahman, 1940)***Betasyrphus* sp.***Brassica juncea* (L.) Czern. – Karnataka (Chinnu et al., 2023)***Episyrphus balteatus* (De Geer, 1776)***Brassica juncea* (L.) Czern. – Punjab (Kumar et al., 1988)***Episyrphus viridaureus* (Wiedemann, 1824)***Brassica juncea* (L.) Czern. – Punjab (Kumar et al., 1989)***Eupeodes bucculatus* (Rondani, 1857)***Brassica juncea* (L.) Czern. – Punjab (Kumar et al., 1988)***Eupeodes confrater* (Wiedemann, 1830)***Brassica juncea* (L.) Czern. – Punjab (Kumar et al., 1988)***Ischiodon scutellaris* (Fabricius, 1805)***Brassica juncea* (L.) Czern. – Delhi (Lal and Gupta, 1953)***Ischiodon scutellaris* (Fabricius, 1805)***Brassica juncea* (L.) Czern. – Punjab (Kumar et al., 1988)***Scaeva latimaculata* (Brunetti, 1923)***Brassica juncea* (L.) Czern. – Punjab (Kumar et al., 1988)***Sphaerophoria indiana* Bigot, 1884***Brassica juncea* (L.) Czern. – Punjab (Kumar et al., 1988)**Order: Neuroptera; Family: Chrysopidae*****Chrysoperla zastrowi sillemi* (Esben – Petersen, 1935)***Brassica juncea* (L.) Czern – Jammu and Kashmir (Khan and Shah, 2017)**Checklist of parasitoids of *Lipaphis erysimi* infesting different food plants in India**

The parasitoids of *Lipaphis erysimi* belong to two families of the order Hymenoptera, Aphelinidae (Superfamily Calcidoidea) and Braconidae (Superfamily Ichneumonoidea) (Tiwari et al., 2024a). A total of 22 species of parasitoids belonging to both families are recorded as parasitizing mustard aphid on 21 host plant species in 25 states/union territories of India. Aphelinidae is represented by 5 species parasitizing the mustard aphids in 7 states/union territory and Braconidae by 17 species parasitizing on 20 host plants in 24 states/union territories of India. These parasitoids were observed to parasitize the turnip aphid on 21 food plant species distributed in 25 states/union territories of India. Most of the tritrophic associations (triplets, parasitoids–hosts–host plants) of these parasitoids are reported from Manipur (15 triplets) followed by Uttar Pradesh (11 triplets) and less than 10 triplets in other states/union territories (Table 3). Detail checklist is given below:

**Family 1: Aphelinidae*****Aphelinus albipodus* Hayat and Fatima, 1992***Brassica* sp. – Andhra Pradesh (Hayat, 1998)***Aphelinus asychis* Walker, 1839***Brassica* sp. – Assam (Hayat, 1998); Kerala (Hayat, 1998); Meghalaya (Hayat, 1998); Uttar Pradesh (Hayat, 1998)***Aphelinus gossypii* Timberlake, 1924***Trifolium alexandrinum* L. – Uttar Pradesh (Ahmad and Singh, 1993)***Aphelinus* nr. *kurdjumovi* Mercet, 1930***Brassica* sp. – Odisha (Patro, 2007)***Aphelinus* sp.***Brassica juncea* (L.) Czern. – West Bengal (Ghosh, 1983)*Brassica nigra* (L.) W.D.J. Koch – West Bengal (Ghosh et al., 1981)

**Table 2:** Number of species of predators belonging to different taxa preying on *Lipaphis pseudobrassicae* infesting different number of host plants distributed in number of states/union territories of India.

Order	Families of predators	Number of predator species	Number of host plant species	Number of predator-prey-host plant associations	Number of states/union territories
Coleoptera	Coccinellidae	5	5	18	4
Diptera	Syrphidae	10	1	10	4
Neuroptera	Chrysopidae	1	1	1	1
<b>Total</b>		<b>16</b>	<b>5</b>	<b>29</b>	<b>7</b>

**Table 3:** Number of species of parasitoids belonging to different taxa parasitizing *Lipaphis erysimi* and *Lipaphis pseudobrassicae* infesting different number of host plants distributed in India.

Families of Parasitoids	Number of parasitoid species	Number of host plant species	Number of parasitoid-host-plant associations	Number of states/union territories
<i>Lipaphis erysimi</i>				
1. Aphelinidae	5	4	6	7
2. Braconidae	17	21	50	24
<i>Lipaphis pseudobrassicae</i>				
1. Braconidae	3	2	4	3
<b>Total</b>	<b>22</b>	<b>21</b>	<b>60</b>	<b>25</b>

**Family 2: Braconidae, subfamily: Aphidiinae*****Aphidius colemani* Viereck, 1912**

*Brassica oleracea* L. var. *acephala* – Uttar Pradesh (Rafi et al., 2010)

*Brassica oleracea* L. var. *botrytis* – Bihar (Ahmad and Singh, 2007); Manipur (Subhrani et al., 2010)

*Brassica oleracea* L. var. *capitata* – Manipur (Subhrani et al., 2006)

***Aphidius erysimi* (Stary, 1960)**

*Brassica* sp. – Mizoram (Sarkar, 1991)

*Emilia sonchifolia* L. (DC.) – Sikkim (Tamili, 1988); West Bengal (Tamili, 1988)

***Aphidius gifuensis* Ashmead, 1906**

*Brassica* spp. – Odisha (Patro, 2007)

***Aphidius hortensis* Marshall, 1896**

*Brassica juncea* (L.) Czern. – Manipur (Subhrani et al., 2006)

***Aphidius matricariae* (Haliday, 1834)**

*Brassica juncea* (L.) Czern. – Tripura (Datta, 2020)

*Brassica napus* L. – Meghalaya (Stary and Ghosh, 1978; Raychaudhuri et al., 1982); Mizoram (Sarkar, 1991)

*Brassica oleracea* L. var. *botrytis* – Bihar (Prakash and Rani, 2015)

*Brassica oleracea* L. var. *capitata* – Manipur (Bijaya et al., 1996; Devjani and Singh, 1998)

*Brassica rapa* L. – Uttarakhand (Bisht et al., 2001)

*Solanum melongena* L. – West Bengal (Tamili, 1988)

***Aphidius* sp.**

*Brassica oleracea* L. var. *capitata* – Chhattisgarh (Singh, 2014b)

*Eruca vesicaria* (L.) Cav. – Punjab (Bakhetia and Sharma, 1979)

***Binodoxys brevicornis* (Haliday, 1833)**

*Brassica* spp. – Odisha (Patro, 2007)

Unknown plant – Karnataka (Stary and Ghosh, 1983)

***Binodoxys eutrichosiphi* (Stary, 1975)**

*Brassica rapa* L. – Uttar Pradesh (Ahmad and Singh, 1995)

***Binodoxys indicus* (Subba Rao and Sharma, 1958)**

*Brassica napus* L. – Sikkim (Tamili, 1988)

*Brassica rapa* L. – Uttar Pradesh (Ahmad and Singh, 1995)

*Brassica* sp. – Karnataka (Rao et al., 1969)

*Calotropis procera* (Aiton) Dryand. – Uttar Pradesh (Ahmad and Singh, 1993)

*Emilia sonchifolia* L. (DC.) – West Bengal (Tamili, 1988)

***Diaeretiella rapae* (McIntosh, 1855)**

*Beta vulgaris* L. – West Bengal (Tamili, 1988)

*Brassica carinata* A. Braun – Punjab (Kumar, 2015)

*Brassica juncea* (L.) Czern – Assam (Pradhan et al., 2020b); Chhattisgarh (Kashyap et al., 2018); Delhi (Akhtar et al., 2010); Gujarat (Kulkarni and Patel, 2001; Patel et al., 2019); Haryana (Singh and Singh, 1994); Himachal Pradesh (Soni et al., 2021); Madhya Pradesh (Lal et al., 2018); Manipur (Subhrani et al., 2006; Rajeshwari and Singh, 2022); Meghalaya (Firake et al., 2013); Punjab (Kumar, 2015); Tripura (Datta, 2020); Uttar Pradesh (Halder et al., 2014); Uttarakhand (Verma et al., 2023)

*Brassica napus* L. – Meghalaya (Stary and Ghosh, 1978); Punjab (Kumar, 2015)

*Brassica nigra* (L.) W.D.J. Koch – Karnataka (Rao et al., 1969); Manipur (Singh and Singh, 1986); Meghalaya (Stary and Ghosh, 1978); Nagaland (Singh et al., 1991); Punjab (Atwal et al., 1969)

*Brassica oleracea* L. – Assam (Rao et al., 1970); Manipur (Devjani and Singh, 1998); Sikkim (Agarwala et al., 1980)

*Brassica oleracea* L. var. *botrytis* – Bihar (Ahmad and Singh, 1996; Prakash and Rani, 2015); Uttar Pradesh (Ahmad and Singh, 1995; Chaudhary and Singh, 2007); Uttarakhand (Akhtar et al., 2011)

*Brassica oleracea* L. var. *capitata* – Manipur (Subhrani et al., 2006); Bihar (Ahmad and Singh, 1996); Chhattisgarh (Gauraha, 2021); Manipur (Bijaya et al., 1996); Nagaland (Waluniba et al., 2016)

*Brassica rapa* L. – Bihar (Ahmad and Singh, 1997); Delhi (Akhtar et al., 2011); Gujarat (Kavad and Korat, 2013); Himachal Pradesh (Nayak et al., 1982; Raj and Sharma, 1993); Jammu and Kashmir (Bhagat and Ahmad, 1991; Ahmad and Ahmad, 2013); Madhya Pradesh (Singh and Rawat, 1981; Veda and Shaw, 1988); Maharashtra (Men and Kandalkar, 1997; Biradar and Dhanorkar, 2004); Meghalaya (Firake et al., 2013); Punjab (Atwal et al., 1969, Atwal et al., 1971); Rajasthan (Chandra and Kushwaha, 1987); Sikkim (Agarwala et al., 1980); Uttar Pradesh (Pandey et al., 1985; Akhtar et al., 2006); Uttarakhand (Kundu et al., 1965; Pervez et al., 2020b); West Bengal (Kundu et al., 1965)

*Brassica rapa* subsp. *rapa* L. – Uttar Pradesh (Rafi et al., 2010)

*Brassica* spp. – Himachal Pradesh (Saha et al., 1982); Jammu and Kashmir (Saha, 1988); Karnataka (Rao et al., 1969); Manipur (Singh and Singh, 1986); Meghalaya (Ghosh and Raychaudhuri, 1982; Stary and Ghosh, 1975); Mizoram (Sarkar, 1991); Punjab (Atwal et al., 1969); Uttarakhand (Chakrabarti and Debnath, 2009)

*Eruca vesicaria* (L.) Cav. – Punjab (Kumar, 2015)

*Raphanus sativus* L. – Uttar Pradesh (Rafi et al., 2010)

*Sinapis arvensis* L. – Jammu and Kashmir (Rakhshani et al., 2012)

*Trifolium alexandrinum* L. – Uttar Pradesh (Rakhshani et al., 2012)

*Zea mays* L. – Jammu and Kashmir (Rakhshani et al., 2012)

#### ***Ephedrus laevicollis* (Thomson, 1895)**

*Brassica juncea* (L.) Czern. – Manipur (Subhrani et al., 2006)

*Brassica nigra* (L.) W.D.J. Koch – Manipur (Singh, 1987)

#### ***Ephedrus minor* Stelfox, 1941**

*Brassica nigra* (L.) W.D.J. Koch – Manipur (Singh et al., 2011)

#### ***Ephedrus plagiator* (Nees, 1811)**

*Brassica oleracea* L. var. *capitata* – Manipur (Bijaya et al., 1996; Singh et al., 2011)

#### ***Ephedrus* sp.**

Unknown plant – Sikkim (Stary and Ghosh, 1983)

#### ***Lipolexis gracilis* Forster, 1862**

*Brassica rapa* L. – Punjab (Sharma and Subba Rao, 1964); Uttar Pradesh (Rafi et al., 2010)

*Brassica* spp. – Odisha (Patro, 2007)

#### ***Lysiphlebus testaceipes* (Cresson, 1880)**

*Brassica* sp. – Karnataka (Ramaseshiah et al., 1969)

#### ***Praon volucre* (Haliday, 1833)**

*Brassica napus* L. – West Bengal (Tamili, 1988)

*Brassica* spp. – Jammu and Kashmir (Stary and Bhagat, 1978); Meghalaya (Samanta, 1986); Mizoram (Sarkar, 1991); Odisha (Patro, 2007); Indet – Himachal Pradesh (Stary and Ghosh, 1983)

#### **Checklist of parasitoids of *Lipaphis pseudobrassiccae* infesting different food plants in India**

Only two identified species of Braconidae were observed to parasitize *Lipaphis pseudobrassiccae* in India on two host plant species distributed only in Jammu and Kashmir, Karnataka and Punjab (Table 3) as listed below:

#### **Family: Braconidae**

##### ***Aphidius erysimi* (Stary, 1960)**

*Brassica juncea* (L.) Czern – Jammu and Kashmir (Khan and Shah, 2017)

*Brassica oleracea* L. var. *capitata* – Jammu and Kashmir (Khan and Shah, 2017)

##### ***Aphidius* sp.**

*Brassica oleracea* L. var. *capitata* – Karnataka (Chinnu et al., 2023)

##### ***Diaeretiella rapae* (McIntosh, 1855)**

*Brassica juncea* L. – Punjab (Kumar et al., 1989)

## **Discussion**

There is a large number of arthropods that either feed on *L. erysimi* (predators) or parasitize it (parasitoids) in nature, keeping its population under control. Among them, few species of parasitoids such as *A. matricariae* and *D. rapae* and predators such as *C. septempunctata*, *C. zastrowi sillemi*, *I. scutellaris*, etc., have been used as bioagents in its biological control throughout the world (Singh and Singh, 2016). As natural control agents, all the recorded species of predators and parasitoids, particularly the ladybird beetles, play major roles because of their species diversity and by possessing high foraging performance, predatory efficiency and high reproductive potential (Chellappan and Ranjith, 2023). One hundred species of predators and 22 species of parasitoids of *L. erysimi* and *L. pseudobrassiccae* recorded may regulate the pests on brassica oilseed and vegetable crops, reducing the yield loss in India if they are properly managed in the field population via cultural practices.

## **Acknowledgements**

I would like to extend our gratitude to both the reviewers, Prof. Oldřich Nedvěd, Faculty of Science, University of South Bohemia, Institute of Entomology, Biological Center, Academy of Sciences of the Czech Republic and Dr. J. T. D. Caleb, Department of Anatomy, Saveetha Medical College & Hospital, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India for their valuable comments/suggestions that helped me to improve the manuscript. The author also thanks Dr. Erica DeMilio, Department of Zoology, School of Natural Sciences, Ryan Institute, National University of

Ireland Galway, Ireland for her valuable scientific comments and language editing.

### Author contributions

The author himself collected all the data from different resources and prepares the manuscript.

### Funding

No specific grant was received from any funding agency.

### Conflict of interest

The author declares that there are no conflicting issues related to this review article.

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