



## FIRST REPORT ON NATURAL ENEMIES OF *PIERIS BRASSICAE* (LINNAEUS) FROM THE TERAI KUMAUN REGION OF UTTARAKHAND

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### ABSTRACT

Significant agricultural losses result from the rapidly growing pest of *Pieris brassicae* Linnaeus, also known as the cabbage white butterfly, which attacks cruciferous farmland. This report examines the wide assortment of parasitoids and predators that are linked to *P. brassicae* in the Kumaun terai ecosystems of Uttarakhand, North India. Through our fieldwork, we encountered fifteen species that are effective for suppressing the infestation of *P. brassicae* at different stages of life, four of which have never been documented from the Kumaun terai. The data on the biological indices suggest that natural enemies of *P. brassicae* are in adequate numbers with high species richness and evenness. Highest number of species and individuals are reported from Nainital district of Kumaun region of Uttarakhand followed by Udham Singh Nagar and Champawat. This suggest mountainous and hilly regions are more appropriate to host species richness and the quantitative availability of the natural enemies of *P. brassicae* than the plain and terai areas of Kumaun region of Uttarakhand. The finding reveals an innovative relationship between predators and it proposes that biocontrol methodologies in organic farming may be amplified. To establish Integrated Pest Management strategies that can counteract *P. brassicae* effects while retaining ecological equilibrium, it's imperative to know the variety and potency of these natural enemies.

**Keywords:** *Pieris brassicae*, natural enemies, host plants, Kumaun

### INTRODUCTION

Dazzling around flowers, where they feed on honeydew, cabbage white butterflies are a familiar sight, whose larvae possess immense potential of destroying the harvests (Mane et al. 2020). As a mechanism for controlling *Pieris brassicae* Linnaeus communities, certain natural enemies including insects and birds innately preyed upon them (Sharma et al. 2017). Some parasitic wasps that lay their eggs in the larvae have the potential to affect the species, helping to suppress its population (Rana et al. 2021). Abundant natural enemies including parasitoids and predators of *P. brassicae* exist worldwide (Venkateswarlu et al. 2011; El-Fakharany et al. 2014). Many coccinellid predators also attack the larvae of this pest in the crop fields (Pervez et al. 2020a).

With a wide range of plants and animals, the Kumaun terai in Uttarakhand is praised for its rich biodiversity. But economic fallout arises from farmers' recurring struggles to track pest populations. Just a few natural enemies of *P. brassicae* have also been

confirmed from India, interestingly there hasn't been an extensive published documentation of natural enemies in Uttarakhand. However, its positive role in the ecosystem has been addressed as pollinators (Arya et al. 2023). The clear overview of an ecosystem is amplified by looking into the connections between *P. brassicae* and its natural enemies. Therefore, it was needed to conduct research to validate data on natural enemies of *P. brassicae*, and examine their parasitism in this new and unexplored area.

### MATERIALS AND METHODS

#### Area selection

In three districts of Uttarakhand terai region (Nainital, Champawat, and Udham Singh Nagar), the field data collection in the years 2022-2023 in cruciferous and other host plants in their growing season's areas (Table-1). Samples from the multiple locations in the suggested districts were randomly picked. The report is mainly

executed to explore the natural enemies and their host plants.

**Collection and identification**

Using insect net, and hand picking, the natural enemies of *P. brassicae* were recorded. Depending on how convenient the area was and how long the natural enemies were active, each district was visited. For any observations on parasitoids, and predators, if any, the subjected larvae were brought to the lab. By using taxonomic keys from the relevant literature, comparing the collected insects to standard collections, and receiving advice from the experts, when needed, the specimens were identified up to the family level.

**Table-1: Different geographical attributes of various Zoogeographical sites of Kumaun region of Uttarakhand.**

Zoogeographical site	Altitude (m)	Latitude (°N)	Longitude (°E)
Nainital	1985	29.38	79.46
Champhawat	1559	29.33	80.09
Udham Singh Nagar	230	28.98	79.38

**Statistical analysis**

Following the identification of natural enemies, data were employed to determine the percentage of each species' relative abundance. Along these, diversity indices were generated by methodology illustrated by Shannon, 1948 (Shannon, 2014).

**RESULT AND DISCUSSION**

The investigation into *P. brassicae* natural enemies indicating that the ecosystem's biodiversity influences are incredibly diverse (Mirfakhraie and Dey, 2012). *Cotesia glomerata* was the most prevalent parasitoid among the natural enemies noted, showing the highest incidence across sampling sites. This genus is well known for its function as a biocontrol agent, placing more emphasis on *P. brassicae* larval stages (Sadozai and Khan 2021).

Certain attributes of host plants bring in natural enemies while preventing the pest (Sadozai et al., 2016). Just like some major crops generate volatile components that can notify predators of the existence of pests (Rather & Azim, 2009). For pest management in farming to be compelling, host plants and their natural enemies must coexist. While interpretations about the natural enemies of *P. brassicae* Hymenoptera, Coleoptera, Araneae, and Diptera arranged by relative abundance in descending orders, have also been noted,

the paper's primary aim was to examine the diversity of natural enemies (Table-2 & 3).

The statistical results prove that *Cotesia* species are present in prominent fractions. Other natural enemies apart from *Cotesia* were also recognized, including *Coccinella septempunctata* Linnaeus (Omkar and Pervez 2002; Gupta et al. 2012), *Hippodamia variegata* Goeze (Pervez et al. 2019, 2020b) and *Eumenes* sp. being the least diverse and abundant. *Oomyzus sokolowskii*, *Polistes hebraeus*, *Eumenes*, and *Myrmica* sp. have been documented for the first time in the Kumaun terai region (Figure-1). These results reveal the dimension of tropic interactions within this agroecosystem and illustrate the need to have better support for a varied population of natural enemies in biocontrol initiatives.

There's a higher probability of pest management when host plants stabilize a diversified community of natural enemies (Thakur et al., 2023). Substantial efficacy in monitoring pest populations can lead to many predators and parasitoids. Comparatively speaking to the other zones survey, the Nainital district showed a notably higher diversity among natural enemies. A rich recording of natural enemies of *P. brassicae* is typically a sign of their vibrant natural vegetation, which is depicted by its range of altitudes and microclimates. The data presented in the Table-4 regarding biological indices suggest that natural enemies of *P. brassicae* have been found in adequate numbers with high species richness and evenness. Highest number of species and individuals are reported from Nainital district of Kumaun region of Uttarakhand followed by Udham Singh Nagar and Champawat (Figure-2). This suggest mountainous and hilly regions are more appropriate to host species richness and the quantitative availability of the natural enemies of *P. brassicae* than the plain and terai areas of Kumaun region of Uttarakhand.

**CONCLUSION**

By implementing local biodiversity, the terai regions of Uttarakhand introduce different growing conditions that can complement pest control. The fact that only three zoogeographical areas have been researched thus far suggests that Uttarakhand still has a resource of biodiversity to be found. Only a tiny fraction of the wide spectrum of *P. brassicae* natural enemies in this position are marked in the available record. Exploring how these natural predators engage and enhance their practicability in managing *P. brassicae*, requires long-term research and observation. To find uncharted natural enemies diversity hotspots, more survey is requested. This paper helps farmers and researchers, to expand a more grounded pest management strategy that

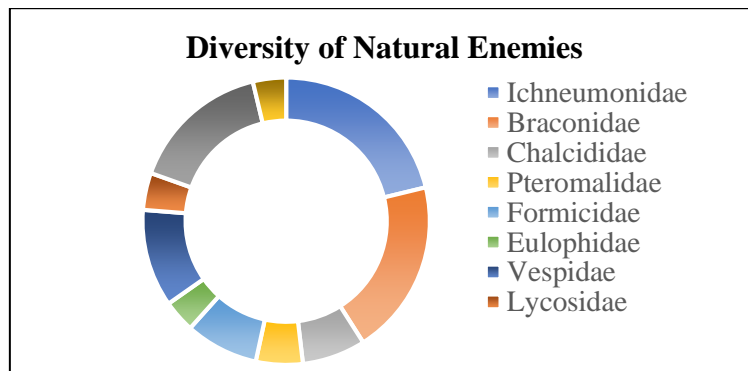


will achieve crop productivity and manage the community environment by about these beneficial insects and incorporating them into practices.

**Table-2: Diversity of hymenopteran & dipteran parasitoids and coccinellid predators of *P. brassicae* in Kumaun region of Uttarakhand.**

Scientific name	Order	Family	Host plant	No. of Individuals	Relative abundance % 2022-2023
<i>Hypesoter ebeninus</i>	Hymenoptera	Ichneumonidae	Mustard Cabbage Knol khol Turnip Cauliflower Kale	80	8.79
<i>Diadegma forster</i>	Hymenoptera	Ichneumonidae	Potato Mint	53	5.82
<i>Pimpla</i>	Hymenoptera	Ichneumonidae	Knol khol Coriander	60	6.59
<i>Cotesia</i> sp	Hymenoptera	Braconidae	Cabbage, Wheat Cauliflower	180	19.78
<i>Brachymeria Iasus</i>	Hymenoptera	Chalcididae	Cauliflower Cabbage Rice	65	7.14
<i>Pteromalus puparum</i>	Hymenoptera	Pteromalidae	Cabbage Mint, Wheat	48	5.27
<i>Myrmica</i> sp	Hymenoptera	Formicidae	Kale, Coriander Cabbage	75	8.24
<i>O. sokoloswkii</i>	Hymenoptera	Eulophidae	Cabbage Mint, Coriander	33	3.62
<i>Polistes hebraeus</i>	Hymenoptera	Vespidae	Mustard Cabbage Coriander,	41	4.50
<i>Vespa orientalis</i>	Hymenoptera	Vespidae	Cabbage Mustard, Potato	53	5.82
<i>Pardosa milvina</i>	Araneae	Lycosidae	Cabbage Coriander	38	4.17
<i>Coccinella septempunctata</i>	Coleoptera	Coccinellidae	Cabbage Potato Cauliflower Brinjal	57	6.26
<i>Hippodamia variegata</i>	Coleoptera	Coccinellidae	Cabbage Turnip Brinjal	87	9.56
Syrphid fly	Diptera	Syrphidae	Cabbage Coriander	34	3.73
<i>Eumenes</i> sp.	Hymenoptera	Vespidae	Cauliflower Mint Cabbage Coriander	6	0.65

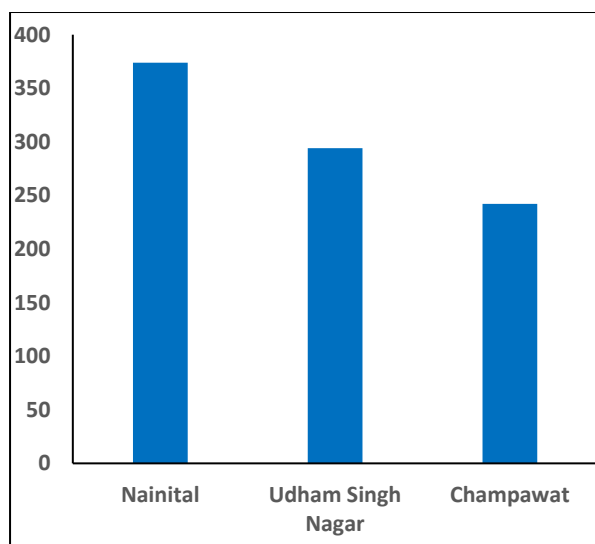
**Fig.1 Families Diversity of Natural Enemies of *P. brassicae***



**Table-3: Number of different natural enemies of *P. brassicae* in Kumaun region of Uttarakhand.**

Scientific name	Nainital	Udham Singh Nagar	Champawat
<i>Hypesoter ebeninus</i>	40	26	14
<i>Diadegma forster</i>	29	17	7
<i>Pimpla</i>	28	22	10
<i>Cotesia</i> sp	75	60	45
<i>Brachymeria Iasus</i>	22	14	29
<i>Pteromalus puparum</i>	15	22	11
<i>Myrmica</i> sp	21	25	29
<i>O. sokoloswkii</i>	15	9	9
<i>Polistes hebraeus</i>	16	19	6
<i>Vespa orientalis</i>	25	17	11
<i>Pardosa milvina</i>	13	4	21
<i>Coccinella septempunctata</i>	19	18	20
<i>Hippodamia variegata</i>	37	29	21
Syrphid fly	18	12	4
<i>Eumenes</i> sp.	1	0	5
<b>Total</b>	<b>374</b>	<b>294</b>	<b>242</b>

**Fig. 2 Species Richness Across Three Districts of Kumaun**



**Table-4: Various diversity indices of *P. brassicae* in Kumaun region of Uttarakhand.**

Diversity indices	
Shannon- Weiner index (H)	1.08
Simpson’s index (D)	0.34
Simpson’s index of diversity(1-D)	0.65
Reciprocal Index (1/D)	2.90
Species richness	3
Evenness (E)	0.98

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