International Journal of Agriculture Innovations and Research
Volume 10, Issue 4, ISSN (Online) 2319-1473
Manuscript Processing Details (dd/mm/yyyy):
Received: 15/01/2022 | Accepted on: 27/01/2022 | Published: 08/02/2022

Incidence and Host Association of Primary Parasitoids (Hymenoptera: Braconidae: Aphidiinae) of Aphids Infesting Economically Important Plants in Kumaon-Garhwal Ranges of Western Himalaya

Sanjay Sarkar
Entomology Research Unit, Department of Zoology (UG & PG Studies), Serampore College, William Carey Road, West Bengal, India.
Corresponding author email id: montabhaloto@gmail.com

Abstract **– Aphids (Homoptera, Aphididae) are considered as an important group amongst insect pests that attack various economically important plants. Among Aphidophagous insects Aphiddine parasitoids (Hymenoptera: Braconidae) exclusively attack aphids. In this study a survey was made on aphids associated primary parasitoid wasp on economically useful plants collected at different localities of Western Himalaya. Taxonomic studies of Aphid parasitoids based on available literature and previously collected materials and also the data directly collected from Garhwal and Kumaon ranges of Western Himalaya (29.8688° N and 78.8383° E) reveals that altogether 36 species under 12 genera parasitize 30 host aphids infesting 39 plants of economic importance. A Maximum number of species (10) are found under the genus Aphidius Nees. Of these species, 30 have host aphids under subfamily Aphidinae, 2 under Lachninae, 1 each under subfamilies Drepanosiphinae, Greenidinae, Pemphiginae and Pterocomatinae. Collection of aphids and associated primary parasitoids are done from mostly medicinal plants. The incidence of these parasitoid species and their host association are discussed in this paper.**

Keywords **– Aphidiinae, Parsitoids, Pest, Host Association, Host Plant, Seasonal Occurrence, Distribution, Aphid Biocontrol, Western Himalya.**

I. INTRODUCTION

In Kumaon and Garhwal ranges of western Himalaya (29.8688° N and 78.8383° E), aphid is no doubt a serious pest of several economically important plant species including wheat which is a major crop that is being cultivated in the mountain terrace. Several medicinal plants, fruit plants, timber yielding plants of Himalayan region are also infested by these aphid pests. It is seen that farmers use minimum pesticide for aphid control due to its high density of aphidophagous Hymenopteran parasitoid. Here almost 90 % of the aphid pests are naturally controlled by these parasitod species. Among the natural enemy complex of aphids, aphidiines occupy an important position as a group of primary parsitoids. These parasitoid species are very small sized Hymenopteran insects which lay their eggs in the viscera of aphids by pricking the abdomen of the aphids by their ovipositors. The larval stages of the parasitoids consume the tissues of aphid host and ultimately turn into pupa inside the host body making the host into an empty mummy. These mummified aphid containing pupa stage of the parasitod die when the imago comes out of the mummified aphids. Aphidiine parasitoids are particularly interesting and attractictive among all aphidophagous insects because its members exclusively attack aphids [11]. Besides they have high fecundity, small host range and can easily find their host over a broad range of densities. Their utilization in aphid bio-control has given significant results. Though there are so many earlier reports on this group from different part of India, exploration for these parsitoids from western Himalaya dates back to 1981 when Das and Chakrabarti [3-9] extensively studied on this group. Subsequently, Bisht et al

[1] reported a few species from this area. Then in 2002, Chakrabarti, Sarkar and Das [2] again made their survey on this fauna. After a pretty long time present author took an attempt to survey on these group in this area from 2016 to 2018. In this study emphasis was given to the aphids and the associated aphidiid parasitoids occurring on the plants having economic values. Here a comprehensive account of information available on aphidiine parasitoids collected from Kumaunon and Garhwal ranges of Uttarakhand having diverse physiography, climate and vegetation is presented.

II. Material and Methods

Collections of these parasitoids are done by rearing of the parasitized host aphids or mummified aphids from the field and emerged adult parasitoids are preserved for taxonomic study. Sample of live aphids and mummies were collected in various localities (altitudes ranging from 500 m to 3500 m) of western Himalayas at periodical intervals and whenever available these were collected and put within rearing containers to have adult parasitoids as described by Stary [11] and Stary & Ghosh [12]. Parsitoids thus preserved for identification. Samples of live aphids and mummies previously collected and reported material in different literature constitutes the study materials of this work.

III. Result and Discussion

A. *Diversity:*

After extensive studies from this area it appears that altogether 36 species under 12 genera of the Aphidiinae parasitize different aphid pests (Table 1). Maximum number of parasitoids are found under the genus *Aphidius* Nees which is followed by *Trioxys* (Haliday) and *Ephedrus* Haliday having 6 and 5 species respectively.

B. *Host Association*:

Study shows (Table 1) that that maximum (32) parasitoids species have the host aphids under the subfamily Aphidinae, 2 under Lachninae, only 1 each under the subfamilies Drepanosiphinae, greenidinae, pemphiginae and Pterocomatinae. Based on available data, parasitoids of this area can be grouped in under 3 categories: Polyphagous-parasitizing more than one host genus, Oligophagous-parasitizing different species of single host species and monophagous-parasitizing single host species. Altogether 30 species are found monophagous. Majority of the monophagous species belong to the genus Aphidius (7 out of 10). Besides, all the species under the following 7 genera namely *Archaphidus, Betulexis, Cristicaudaus, Kashmiria, Pausea (Paraphidus), Praon* and *Toxars.* are found as strictly monophagous. Only one species *Aphidius absinthi* is found oligophagous in this area. Seven species are found Polyphagous of which *Trioxys* (*Binodoxys*) is also known to be extremely polyphagous in other localities (10]. Among 14 parasitoid genera, *Aphidius* (having 10 species) attacks 13 host Aphid species under 9 genera. *Trioxys* (having 6 species) comes next attacking 8 host species under 7 genera. The host range of polyphagous species shows that all the parasitoids cannot attack more than two genera of host aphids in this area. Amongst the host plants from which aphids are collected (table 1) almost all have medicinal uses and few have other importance such as timber yielding, fruit yielding ornamental and crop plants.

Table 1. Parasitoids: their host aphids and host plant with their economic importance.

Parasitoids	Host aphids	Host plants	Importance of Plants
Aphidius absinthi Marshal	*Macrosiphoniella kikungshana* Takahashi	*Artemisia* sp.	Medicinal

Parasitoids	Host aphids	Host plants	Importance of Plants
	Macrosiphoniella sp.		
Aphidius cingulatus Ruth	*Pterocomma* sp.	*Salix tetrasperma* *Populus ciliata*	Timber yielding Medicinal
Aphidius colemani Viereck	*Hyalopterus pruni* (Geoffroy) *Aphis* sp.	*Prunus persica* *Rumex sp.*	Medicinal Medicinal
Aphidius eglanteriae Haliday	*Myzus sorbi* Bhattachary & Chakrabarti	*Sorbaria tomentosa*	Medicinal
Aphidius matricariae Haliday	*Brachicaudus helichrysi* (Kalt.)	*Prunus persica*	Medicinal
Aphidius polycostularie Das & Chakrbarti	*Sitobion* sp.	*Rosa sp.*	Ornamental
Aphidius rhopalosiphi de Stefani	*Sitobion miscanthi* Takahashi *Schizaphis sp.*	*Triticum aestivum* *Bothriochola sp.*	Crop Medicinal
Aphidius rosae Haliday	*Macrosiphoniella rosae* (Linn)	*Rosa sp.*	Ornamental
Aphidius staryi Das & Chakrbarti	*Myzus cornutab* Medda & Chakrabarti	*Prunus cornuta*	Bird cherry fruit
Aphidius urticae Haliday	*Acyrthosiphon* sp	*Euphorbia pilosa*	Medicinal
Archaphidus sp.	*Eutricosiphum* sp.	*Quercus sp.*	Timber yielding
Betuloxys intermedius Suja-uddin	*Capitophorus* sp.	*Artemisia sp.* *Aremisia vulgaris*	Medicinal Medicinal.
Cristicaudus garhwalensis Das & Chakrabarti	*Capitophorus* sp.	*Artemisia vestita*	Medicinal
Cristicaudus indicu Das & Chakrabarti	*Aphis* sp.	*Glochidion velutinum*	Medicinal
Diaeerteilla rapae (M'Intosh)	*Brachicaudus helichrysi* (Kalt.) *Hayhurstia atriplicis* (Linn)	*Prunus amygdalus* *Chenopodium album*	Medicinal Vegetable, Medicinal
Ephedrus lacertosus (Haliday)	*Takecalis affinis* Ghosh	*Bamboo*	Timber and ornamental
Ephedrus minor Stelfox	*Caveriella aegopodii* (Scopoli)	*Salix hastana*	Medicinal
Ephedrus nacheri Quilis	*Hayhurstia atriplicis* (Linn) *Melanaphis aurundinariae* (Takah)	*Chenopodium album* *Pyrus pashia*	Vegetable, Medicinal Medicinal
Ephedruspersicae Frogatt	*Myzus sorbi* Bhattachary & Chakrabarti	*Sorbaria tomentosa*	Medicinal
Ephedrus srinagarensis Stary & Bhagat	*Prociphilus himalayensis* Chakrbarti	*Cotoneaster sp.* *Lonicera quinquelocularis*	Medicinal Medicinal
Kashmiria aphidis Stary & Bhagat	*Prociphilus himalayensis* Chakrbarti	*Lonicera quinquelocularis*	Medicinal
Lipolexis scutellaris Mackauer	*Aphis gossypii* Glover *Liosomaphis himalayensis* Basu	*Rumex* sp. *Berberis* sp.	Medicinal
Lysahidus quadrii Shuja-uddin	*Brachicaudus* sp.	*Gnaphalium* sp.	Medicinal

Parasitoids	Host aphids	Host plants	Importance of Plants
	Brachicaudus helichrysi (Kalt.) *Capitophorus* sp.	*Anaphalis* sp. *Anaphelis cinnamomea*	Medicinal Medicinal
Pausea (Paraphidus) orentalis Das & Chakrabrti	*Cinara maculipes* Hille Tis Lambers	*Pinus excelsa*	Soft wood, Medicinal
Pausea (Paraphidus) lachniella Das & Chakrabrti	*Lachnus tropicalis* (V.D. Goot)	*Quercus dealbata*	Timber, Medicinal
Praon himalyaensis Das & Chakrbarti	*Callaphis juglandis* (Goeze)	*Juglandis regia*	Fruit
Praon orietale Stary & Schlinger	*Uroleucon* sp.	*Sonchus arvensis* *Sonchus* sp.	Medicinal Medicinal
Praon pubescence Stary	*Nasonovia* sp.	*Strobilanthes* sp.	Medicinal
Praon volucre (Haliday)	*Sitobion* sp.	*Rosa* sp.	Ornamental
Toxares sp	*Schinjia orientalis* (Mordvilko)	Fern	Ornamental
Trioxys (Binodoxys) indicus Subba Rao & Sharma	*Brachicaudus helichrysi* (Kalt.) *Aphis sp.* *Aphis fabae Scopoli*	*Pyrus* sp. *Solanum sp.* *Solanum nigrum*	Medicinal Crop Crop
Trioxys (Binodoxys) josimathensis Das & Chakrbarti	*Sitobion miscanthi* Takahashi	*Bothriocola* sp.	Medicinal
Trioxys (Binodoxys) mackaueri Das & Chakrbarti	*Melanaphis meghalayensis* Raychoudhury & Banerjee	Bamboo	Wood, Medicinal
Trioxys (Binodoxys) rubicola Shuja-uddin	*Aphis ruborum longisetosum* Basu	*Rubus ellipticus*	Medicinal
Trioxys (Binodoxys) tomentosae Das & Chakrbarti	*Myzus sorbi* Bhattachary & Chakrabarti	*Sorbaria tomentosa*	Medicinal
Trioxys (Binodoxys) takecalis Das & Chakrbarti	*Takecalis affinis* Ghosh	Bamboo	Wood, Medicinal

C. *Seasonal Incidence: Fig. 1 Shows Seasonal Incidence of the Parasitoids*

There are two peaks of incidence, one in the month of May (28.9 % species and 42.9% genera) and another appears in the month of September. The number of parasitoid species gradually increases from the month of March and attains the first peak in May i.e. pre-monsoon period. During rainy season (July- June) their number decreases due to unavailability of host aphids. Only 5.3 % of total species are found in the month of November. During this time almost all the collection localities either remained covered with snow or the plants wither and dry.

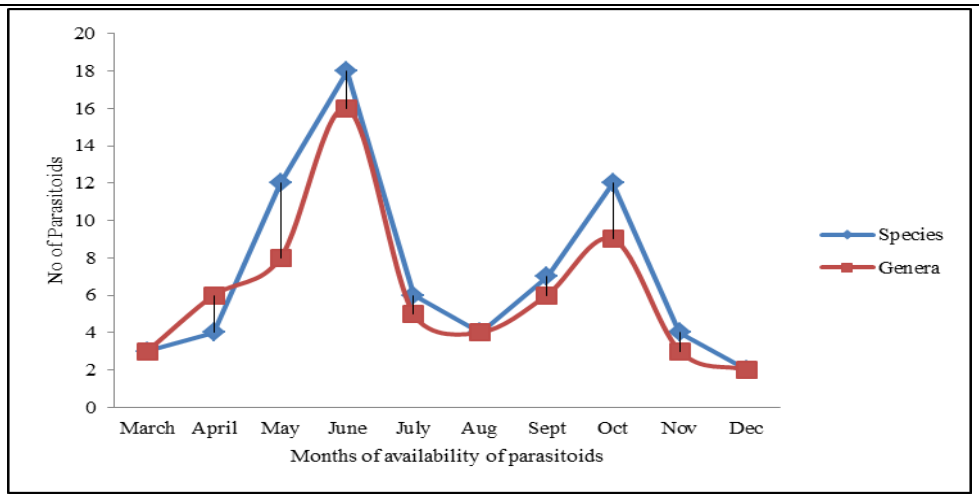

Fig. 1. Seasonal occurrence of parasitoids.

D. *Altitudinal Stratification*

Majority of the parasitoid species (76 % species and 92.9 % genera) is found between the altitude of 1500 m and 3000 m. (fig. 2). Very high and very low altitude support poor aphidiinae fauna. Only 2.6% species and 7% genera are found below an altitude of 1000m and 7.8% species and 14.2% genera above an altitude of 3000m.

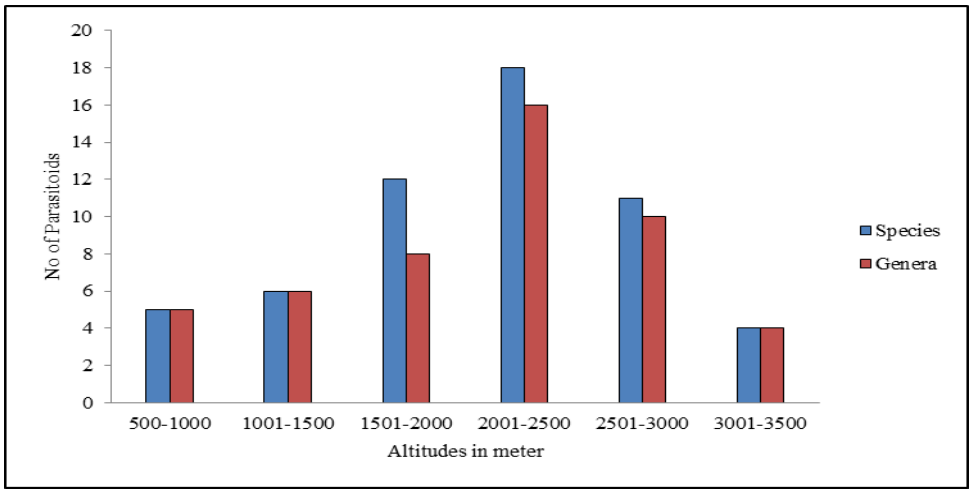

Fig. 2. Altitudinal stratification of parasitoids.

E. *Aphidiines at different Vegetation Belts*

It is seen that in tropical vegetation only one genus and one species are found. Subtropical belt includes 4 species and 3 genera. Maximum number of species and genera are found in temperate vegetation belt. 10 genera and 33 species are exclusively found in Temperate Zone.

IV. CONCLUSION

This comprehensive account of host plant, aphid and their primary parasitoid in economically important plants is significant to any future biological control program. Primary parasitoid species recorded from this study area can be potentially used as bio control agent and may be alternatives to pesticides.. But the efficiency and efficacy of these primary parsitoids and hyper-parasitods are need to be studied before applying and implementing the biological control program. This study will be helpful to protect the Himalayan medicinal

plants from their aphid pest by applying classical as well as biological control by using release and subsequent establishment in the ecosystem as well as inundative application of mass reared parasitoids should be taken into consideration.

ACKNOWLEDGEMENT

The author is thankful to Dr Samiran Chakrabarti and other co-workers of Biosystematics Research Unit, University of Kalyani for Paratype and Holotype slides and collected data on this specific line of research. I also extend my thanks to Mr. Sovon Singh Rana, my land lord of rented house for providing valuable information of the Field Station at Joshimath, Uttarakhand and author is also thankful to Dr G.G. Maiti, Plant Taxonomist, Department of Botany for identification of host plants.

REFERENCES

[1] Bisht, R.S., Rana, D.S. & Mishra P.N. 2001, Bio-Ecology of predators and parasitoids of aphids in Garhwal Hills. J. Aphidol. 15, 122-128.
[2] Chakrabarti S., Sarkar, S. & Das, B.C. 2002, Aphid parasitoids (Hymeoptera: Braconidae: Aphidiinae) from Western Himalaya. J. Aphidol. 16, 45-49.
[3] Das, B.C & Chakrabarti, S.1988, Seasonal occurrence of *Ahidius matricarae* Halliday (Aphidiidae: Hymeoptera) in Garhwal range of northwest Himalaya. Indian J. Ent. 50, 388-389.
[4] Das, B.C & Chakrabarti, S. 1989a, Aphidiid parasitoids (Hymenoptera: Aphidiidae) of graminaceous aphids in Garhwal, Western Himalaya. Orient Insects 23, 365-372.
[5] Das, B.C & Chakrabarti, S. 1989a, Two new aphid parasitoids (Hymenoptera: Aphidiidae) from Garhwal, Western Himalaya, India. Entomon 14, 345-347
[6] Das, B.C & Chakrabarti, S. 1989c, Praon himalayensis, a walnut aphid parasitoids (Hymenoptera: Aphidiidae) from Garhwal range of Western Himalayas. Entomon 14, 345-347.
[7] Das, B.C & Chakrabarti, S. 1990, New and little known aphidiid parasitoids (Hymenoptera: Aphidiidae) of gall forming aphids in western Himalaya with notes on their seasonal history. Orient. Insects 24, 399-414.
[8] Das, B.C & Chakrabarti, S. 1991a, Aphidiid (Hymenoptera: Aphidiidae) fauna of Garhwal, Western Himalaya, India. J. Bombay nat. Hist. Soc. 88, 409-413.
[9] Das, B.C & Chakrabarti, S. 1991 b, Two new Cristicaudus (Hymenoptera: Aphidiidae) as parasites of aphids in Garhwal, Western Himalaya, India. Entomon 16, 305-309.
[10] Singh, R. & Agarwala, B.K. 1992, Biology, ecology and control efficiency of the aphid parasitoids Tryosis indicus: A review and bibliography. Biol. Agric. Hort. 8, 271- 298.
[11] Stary, P. 1970, Biology of aphid parasite (Hymenoptera: Aphidiidae) with respect to integrated control. Dr. W. Junk N.V. The Hague. 1-643.
[12] Satry, P. & Ghosh, A.K.. 1983, Aphid parasitoids (Hymenoptera: Aphidiidae) from India and adjacent countries. Zoological Suvey of India,Tech. Monograph No. 7, pp. 96

AUTHOR'S PROFILE

Dr. Sanjay Sarkar, did his Ph.D. in the year 2011 from University of Kalyani. He is an Assistant Professor of the Department of Zoology (For UG & PG Studies), Serampore College (Affiliated to Calcutta University). Dr. Sanjay Sarkar has significantly contributed in the field of Entomology and Acarology. Dr. Sarkar started his research career in Taxonomy and Bio-Ecology of Parasitoids of aphids infesting cereal plants at Josimath in Uttarakhand. Following research on this line Dr Sarkar became interested in the Biosystematics of phytophagous mite. Dr. Sarkar discovered two new Genera of plant mites. He has reported altogether 51 species under 28 genera of Eriophyoid mite among which 19 species appear new to Science. Dr. Sarkar was awarded for his contribution on Eriophyoid taxonomy in International Sy--mposium on Acarlogy conducted by Acarology Development Foundation, USA. He was invited to deliver a talk on mite taxonomy in XV International Acarological Congress, Antalya, Turkey in 2018.