International Journal of Experimental Research and Review (IJERR)

ISSN: 2455-4855 (Online) ***Original Article***
Received: 25th May, 2018; **Accepted:** 15th July, 2018; **Published:** 30th August, 2018

DOI: https://doi.org/10.52756/ijerr.2018.v16.002

Report on winter crop plant-aphid- aphidophagous Chrysopidae (Neuroptera: Insecta) association from Murshidabad district, West Bengal, India

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Abstract

The enhancement of natural predators through habitat manipulation and increasing vegetational diversity can improve herbivore control. Aphids drew attention as they are serious phytosaccivorous pests and a threat against crop plants. Members of Family Chrysopidae (Neuroptera: Insecta) are proven biological control agents against aphids. Natural predators can bring down pesticide use against pest in a proper IPM (Integrated Pest Management) strategy. For this, identification of the existing pest, their natural predators and the pest host plant are necessary. This study deals with the field survey for aphids, aphid host plant and Chrysopidae species associated with aphids. This investigation may provide some essential basic information of occurrence aphids, their crop plant association and aphidophagous Chrysopidae. This may help to formulate an integrated pest management (IPM) strategy against aphid pest of crop plants in near future.

Keywords: Aphids, Chrysopidae, crop host plant, predator Neuroptera.

Introduction

A key role in the regulation of aphid populations is played by other insects (Van Veen et al*.,* 2008), especially those feeding exclusively on aphid species, i.e., predators. The enhancement of natural predators through habitat manipulation and increasing vegetational diversity can improve herbivore control (Landis et al*.,* 2000, Gurr et al., 2003) and is associated with enhanced environmental heterogeneity which itself serves to sustain natural enemies in the environment. The distribution, abundance, and performance of insect herbivores are affected by intraspecific variability in quality of their host plants (Rossi & Stiling, 1998; Cronin & Abrahamson, 1999; Awmack & Leather, 2002; Ruhnke et al*.,* 2009).

Crop damage by aphids

Aphids or plant lice constitute one of the most important group of phytophagous insects because of their polymorphism, host alternating, heteroecious behaviour and reproductive habits. Aphids or plant lice constitute one of the most important groups of phytophagous insects (Singh and Ghosh, 2000). Aphids (Hemiptera: Aphididae) are among the most destructive insect pests in cultivated plants worldwide (Dixon, 1977, Dong et al., 2011). Due to their asexual and sexual

reproduction, they are capable of an extremely rapid increase in numbers (Blackman and Eastop, 2000 & 2007). The damage they cause can be very significant, and cause real economic problems for producers since crops become unsuitable for consumption (Dedryver et al*.,* 2010).

Host plant selection by aphids involves responses to a variety of physical and chemical plant characteristics but is fundamentally affected by gustatory cues detected during stylet penetration of peripheral plant tissues (Powell et al*.,* 2006). The cabbage aphid (*Brevicoryne brassicae* L.) is an important pest of brassicas (Rohilla and Kumar, 1991). It can cause total crop loss on brassica leafy vegetables. Its pest status is enhanced by its high reproductive capacity

Aphid control schedule in India is mainly based on chemical poisons because of its immediate effectiveness. Moreover chemicals destroy all insects irrespective of whether they are beneficial or not and contaminate the environment, threatning the well being of the other creatures (Hamilton, 2000).

Neuroptera (Insecta) as biological control agents against aphids

Many different neuropteroid groups have been implicated as important predators in various ecosystems. However in practice members of only three families of Neuroptera viz. Chrysopidae (the green lacewings), Coniopterygidae (the dusty wings) and Hemerobiidae (the brown lacewings) have proved more broadly amenable to such assessment and employable in pest management programmes. Members of the three families are widely distributed throughout the world and are particularly found to prey upon aphids. Chrysopidae are larger, highly voracious and fecund. In field situations relatively high tolerance of Chrysopids to some commonly used insecticides can lead to their incorporation in Integrated Pest Management (IPM). Kowalska et al*.,* (1969) found that eggs of *Chrysoperla carnea*(Stephens) were more or less resistant to pesticides. For any predator to be considered as effective, preliminary study of its biosystematics, distribution, host plant preference and time of occurrence is essential (Dey, 2014).

Neuroptera (Insecta) are proven biological control agents against aphids, free living Neuropteran larvae attack and kill aphids. They suck up the aphid body fluid which serves as food for their development and maturity. Of the total natural enemies used in the world for biological control, only 5.33% of the order Neuroptera has been used as natural enemies (Chatterjee, 1997).
Two aphid species associated with *Brassica* oilseeds are: *Lipaphis erysimi* and *Brevicoryne brassicae.* Among these, the cabbage aphid (*B. brassicae*) is most predominant on cabbage, cauliflower, field mustard. The mustard aphid (*L. erysimi*) though a cosmopolitan is of major economic consequences to *Brassica* crops in the Indian sub-continent (Landin, 1982).

Some Chrysopid overwinter as larvae and may be efficient predators. They can be used to help controlling aphids in winter (Canard, 1997). McEwan (1998) stated that *Chrysoperla carnea* (Stephens) has great potential as a biological control agent as it is widely available and has a highly voracious apetite and feeds on a wide variety of insect pests.

Green lacewing, *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) is a cosmopolitan polyphagous and efficient predator commonly found in a wide range of agricultural habitat (Varma and Shenhmar, 1982). It plays an important role in natural control of sucking pests and effectiveness of *C. carnea* as a biological control agent has been demonstrated in field crops, orchards and green houses (Venkatesan et al*.,* 1997).

The green lacewing, *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae), is a generalist predator. Adults feed only on nectar, pollen, and aphid honeydew, but its larvae are

active predators. It is considered as an effective generalist predator of most species of soft bodied insect pests, especially aphids, whiteflies, thrips, coccids, and mealy bugs (McEwen et al., 2001). *C. carnea* has the adaptability to different environmental conditions and food diversity. It has a high searching capacity and a higher potential to prey on about 200 aphid species and more than 80 species of other insect pests (Tauber et al*.,* 2000). *C. carnea*has been widely used for biological control of aphids and other insect pests because of its polyphagous habits and compatibility with selected chemical insecticides, microbial agents, and amenability for mass rearing (Uddin et al*.,* 2005).

Study area:

Murshidabad is a district of West Bengal in eastern India. Situated on the left bank of the river Ganges, the district is very fertile. It borders Malda district to the north, Jharkhand's Sahebganj district and Pakur district to the north-west, Birbhum to the west, Bardhaman to the south-west and Nadia district due south. The international border with Bangladesh's Rajshahi division is on the east. Berhampore is the headquarters of the district.

Diversification of crop in Murshidabad district

In Murshidabad district rice, jute, legumes, oilseeds, wheat, barley, and mangoes are the chief crops in the east; extensive mulberry cultivation is carried out in the west. A wide spatio-temporal variation of crop diversity exists among different blocks of Murshidabad district (Pal, 2008). Diversification of crop has been seen in Murshidabad during the post Green Revolution period. The early years of post-Green Revolution period, favoured of wheat, but later gradually turned to other rabi-crops like black gram, cauliflower, cabbage, lentil, mustard (Chakraborty, 2012). Murshidabad district is regarded as a 'crop museum' and one of the food granaries of West Bengal, because almost every type of crop is grown here more or less abundantly. The district has an agrarian economy, as more than 85% of the population directly or indirectly depends upon agriculture and agri-allied sector. Several crops of economic importance are cultivated in Murshidabad district viz. mustard, cauliflower, cabbage, radish, black gram, lentil, peanut, pigeon pea, wheat, rice, jute, potato.

Material and methods

This study deals with the field survey for aphids, aphid host plan and Chrysopidae species associated with aphids. Field survey was undertaken during 2013-2014 in different parts of Murshidabad, West Bengal to study the aphid infestation among plants of economic importance. Natural enemies of those aphids belonging to Neuroptera was noted. The aphids and the Neuroptera specimens were colleceted and identified in the Zoology laboratory of Berhampore Girls' College, Murshidabad, the plant specimens were identified in the Botany laboratory of Gurudas College, Kolkata.

Results.

This investigation provides some essential basic information of occurrence aphids, their crop plant and aphidophagous predator Chrysopidae association from the crop fields of Murshidabad. The results are shown in Table I.

Discussion

From Table 1 it is seen that C*hrysopa septempunctata* Wesmael predates on the aphid *Brevicoryne brassicae* (Linnaeus) that attack field mustard (*Brassica campestris* L.) and cauliflower (*Brassica oleracea* L. *var. Botrytis)*. The predator *Chrysoperla carnea* (Stephens) is mainly associated the aphid *Macrosiphum miscanthi* Takahashi which attack crop plants black gram (*Vigna mungo* (L.) Hepper) and lentil (*Lens culinaris* Medikus) belonging to Fabaceae. *Chrysoperla carnea* (Stephens) also predates on aphids *Rhopalosiphum*

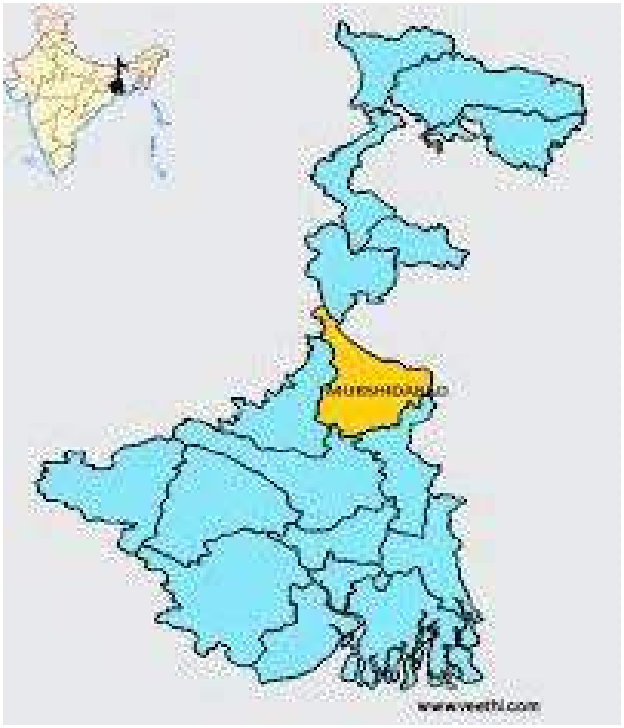

Fig. 1. Location Map of Murshidabad district in the state of West Bengal, India.

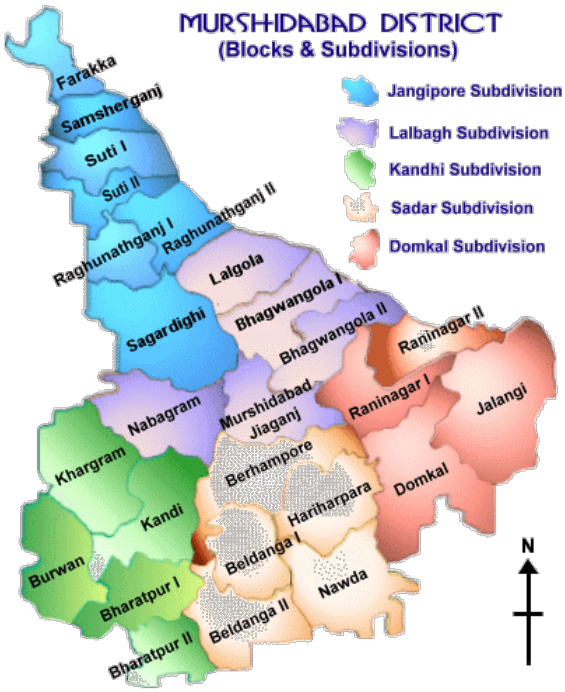

Fig. 2. Murshidabad district

Table 1. Host plant-Aphid Prey-Neuroptera Predator Association from the crop fields of Murshidabad.

rop plant-Family	Crop plant-Common name	Host Crop plant	Prey Aphid	Predator
Brassicaceae	Field Mustard	*Brassica campestris* L.	*Brevicoryne brassicae* (Linnaeus)	*Chrysopa septempunctata* Wesmael
				Cunctochrysa albolineata (Killington)
Brassicaceae	Cabbage	*Brassica oleracea* L. *var. capitata*	*Lipaphis erysimi* (Kaltenbach)	*Tumeochrysa indica* Needham
Brassicaceae	Cauliflower	*Brassica oleracea* L. *var. botrytis*	*Brevicoryne brassicae* (Linnaeus)	*Chrysopa septempunctata* Wesmael
Brassicaceae	Radish	*Raphanus sativus* L.	*Lipaphis erysimi* (Kaltenbach)	*Tumeochrysa indica* Needham
Fabaceae	Black gram	*Vigna mungo* (L.) Hepper	*Macrosiphum miscanthi* Takahashi	*Chrysoperla carnea* (Stephens)
Fabaceae	Lentil	*Lens culinaris* Medikus	*Macrosiphum miscanthi* Takahashi	*Chrysoperla carnea* (Stephens)
Fabaceae	Pigeon pea	*Cajanus cajan* (L) Millsp.	*Capitophorus formosartemisiae* (Takahashi)	*Chrysoperla carnea* (Stephens)

Fabaceae	Peanut	*Arachis hypogaea* L.	*Macrosiphoniella pseudoartemisiae* Shinji	*Chrysoperla carnea* (Stephens)
Poaceae		*Triticum aestivum* L.	*Rhopalosiphum maidis* (Fitch)	*Chrysoperla carnea* (Stephens)
				Mallada boninensis (Okamoto)
Poaceae			*Rhopalosiphum padi* (Linnaeus)	*Ankylopteryx octopunctata* (Fabricius)
				Chrysoperla carnea (Stephens)
				Cunctochrysa albolineata (Killington)

maidis (Fitch) and *Rhopalosiphum padi* (Linnaeus) that attack wheat crop (*Triticum aestivum* L.).

Conclusion

This investigation may provide some essential basic information for a thorough knowledge on aphidophagous Neuroptera species and their role as aphid predator. It is seen that C*hrysopa septempunctata* Wesmael and *Chrysoperla carnea* (Stephens) prey upon a many notorious aphids that attack and damage crops of economic importance. These two Neuropteran predators could be selected as potential candidates in an integrated pest management (IPM) strategy against aphid pest in Murshidabad district.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this work.

Acknowledgement

The authors would also like to express their thanks to the Principal, Berhampore Girls' College, Berhampore, Murshidabad and the Principal, Gurudas College, Kolkata for providing laboratory facilities to conduct this study.

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