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Biological control potential of an aphidophagous syrphid, *Episyrphus balteatus,* De-Geer (Diptera : Syrphidae) on mustard aphid, *Lipaphis erysimi* (Kalt.) (Homoptera : Aphididae) on cabbage ecosystem in Manipur.

Y. Romabai devi[1], J. Kalita[2] and T.K. Singh[1]*

[1*]Aphid Research Laboratory, Department of Life Sciences, Manipur University, Canchipur, Imphal – 795003, Manipur, India.
[2]Department of Zoology, Gauhati University, Guwahati, Assam.

Abstract
The role of the predator syrphid, *Episyrphus balteatus* in regulating the field population of the mustard aphid, *Lipaphis erysimi* (Kalt.) was studied for two subsequent crop-seasons during 2008 – 2010 on cabbage, *Brassica oleracea* var. *capitata.* The numerical density of the predator was recorded to increase in response to density of the aphid prey in the field. The correlation analysis showed significant positive correlationship between the predator and prey species i.e. *L. erysimi*, whereas temperature, relative humidity, rainfall and wind speed correlated negatively with the aphid density in the ecosystem.

Keywords: *Episyrphus balteatus*, biological control, population density *Lipaphis erysimi,* predator.

INTRODUCTION

Aphids (Homoptera : Aphididae) are some of the most destructive pests of crop plants. Among the crop pests *Lipaphis erysimi* (Kalt.) is one of the polyphagous species which attacks the shoots, leaves, inflorescence and pods of *Brassica* plants (Mathur *et al.,* 1987). In particular cases, *Lipaphis erysimi,* could cause 96% damage on rape seed and mustard (Bakhetia, 1984). While monitoring, the populations of *Brassica* aphids on cabbage in the field, occurrence of syrphid larvae were recorded along with aphids and preying upon *L. erysimi.* Larvae of syrphids rank as the major natural enemies and play an important role in the suppression of aphid populations (Ghorpade, 1981).Thus, syrphids have been noted as one of the efficient biocontrol agents of aphids (Kotwal *et al.,* 1984, Singh & Misra, 1988; Radhakrishnan & Muraleedharan, 1993). Moreover, some considerable work has also been carried out with reference to syrphids in India by Chitra Devi *et al,* (1996), Verma *et al.,* (2005) and Murali Baskaran *et al.,* (2009). Economically, the predaceous larvae of *E. balteatus* are notable in being important enemies of aphids, mainly *Aphis gossypii* Glover, *A. craccivora* Koch, *Lipaphis erysimi* (Kalt.), *Myzus persicae* (Sulzer) and M*acrosiphoniella sanborni* (Gillete) serving as common accepted food of the predator (Samuel *et al.,* 2005).

In the present study an attempt has been made to assess the predatory potential and biotic interactions with special reference to the syrphid *Episyrphus balteatus* (De Geer) in terms of prey feeding capacity, frequency of occurrence and seasonal incidence of predators in relation to the density of the prey *L. erysimi.*

So the present paper aims to study the above aspects with reference to *Episyrphus balteatus* predating on cabbage aphids.

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*Corresponding Author

T.K. Singh
Aphid Research Laboratory, Department of Life Sciences, Manipur University, Canchipur, Imphal – 795003, Manipur, India

Tel: +91-9436891553
Email:tksingh06@yahoo.co.in

MATERIALS AND METHODS

The seasonal occurrence of the syrphid predator, *Episyrphus balteatus* (De Geer) and its prey aphid *Lipaphis erysimi* (Kalt.) were assessed on cabbage *Brassica oleracea* var. *capitata* in the Experimental Field of Life Sciences Department, Manipur University, for two successive crop seasons i.e. during 2008-09 & 2009 – 2010 respectively. There were 5 plots of 4 x 2m^2. The experimental plots were kept free from insecticides and recommended agronomical practices from the state Agricultural Department were followed. The spacing was 45cm between the plants and rows. Observations on the seasonal activity of the predator syrphid, *E. balteatus* and its prey aphid *L. erysimi* were recorded at 10 days interval. Density of both the predator and prey were assessed from 20 randomly selected plants from five plots following Church & Strickland (1954) Method.

During the study period, the meteorological parameters were recorded from the nearby meteorological observatory and the data thus collected were subjected to statistical methods of correlation analysis (Panse and Sukhatme, 1985) in order to find out the relationships of environmental factors with population densities of the insects.

The stock culture of *Episyrphus balteatus* was maintained at $26 \pm 2^0 C$ and relative humidity 65 ± 5 % with 16:8 hrs. L.D. photoperiod, by releasing ten pairs of adult flies in an oviposition cage (90 x 60 x 60) cms approx. kept in the Aphid Research Laboratory, Departments of Life Sciences, Manipur University. Four or five aphid infested potted plants of flowering mustard were kept for attraction of the adult flies to yellow flowers (Schneider, 1969 & Karelin, 1972). The adult flies were provided with a diet of 50% honey and drinking water in a swab of cotton (Frazer 1972). To evaluate the biotic potential and prey preference, the eggs and larvae were collected by cutting the twigs from the plants on the pots of stock culture. Thus the collected eggs from the leaves of the twigs were kept in 9.6 cm wide petridishes individually. After hatching the individual larvae were provided with one hundred numbers of aphids

as prey, sufficient enough for the next 24 hrs (Verma *et al.,* 2005). On the next day, live aphids in each petridishes were counted and aphids eaten by each larva were recorded. The petridishs were cleaned daily and soaked in 70 percent alcohol so as to provide hygienic condition for the developing larva. The number of aphids consumed by the larvae in each instars and also the total number consumed during the larval period were calculated. The predatory potential studies were conducted with ten larvae and each was considered as one replication.

RESULTS AND DISCUSSION

The infestation of aphids on cabbage *Brassica oleracea* var. *capitata* started from the last week of November and continue till harvesting the crop in the first week of March. In the first cropping season i.e. 2008-2009, the prey aphid first appeared in the second week of November. At the beginning the population of the aphid was very low, i.e. 1.55 prey / sample but attained its maximum density (101.45 aphids / sample) at the first week of February. The population of the predator commence at the first week of December and attained its maximum activity (1.05 predator/ sample) at the first week of February which is coincided with the maximum population of aphids. The peak period witnessed an average temperature of 17.5^0 C, relative humidity 71.4% and wind speed 2.58 Km/hr. with no rainfall. The aphid and predator show a declining trend after February due to gradual increase in temperature.

In the second cropping season, i.e. 2009-2010 the prey aphid, *L. erysimi* started its occurrence in the third week of November and attained its maximum incidence in the second week of February (110.45 aphids / sample) which coincided with the peak activity of the predator (1.25 predator / plant) during which the mean temperature, relative humidity, rainfall and wind speed were 16.82^0 C, 75.7%, 6.43 mm and 0.03 Km/hr. with 7.48 hrs sunshine. After that the density of both the prey and predator become declined. In both the consecutive years, the maximum incidence of prey and peak activity of the predators fall within the month of February with slight variation.

The correlation analysis between the prey aphids and predator *E. balteatus* show significant positive correlation, the values being 0.564 and 0.867(p=0.005) for the year 2008-2009 and 2009-2010 respectively (Table-I). This indicated the positive role of predator in suppressing the population of aphid, *L. erysimi* in the field.

Table 1. Correlation co-efficient value 'r' between *E. balteatus* with *L. erysimi* and abiotic factors.

Parameters	Year	
	2008 – 2009	2009 - 2010
Prey *(L.erysimi)*	0.564*	0.867**
Temperature	-0.399	-0.402
Relative Humidity	-0.091	-0.76**
Total rainfall	-0.453	0.475
Windspeed		-0.448
Sunshine		0.185

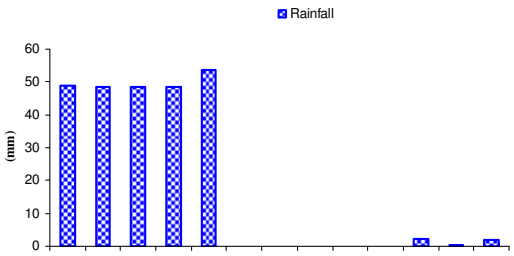
Table 2.Correlation co-efficient value 'r' between L. erysimi and abiotic factors.

Parameters	Year	
	2008 – 2009	2009 - 2010
Temperature	0.35	-0.112
Relative Humidity	-0.54	-0.669*
Total rainfall	-0.711**	0.663*
Windspeed		-0.232
Sunshine		0.149

* Significant at P = 0.05 ** Significant at P = 0.001

Table 3. Feeding potential of *Episynphus balteatus* on *L. erysimi.*

Predatory stage	I	II	III	Life time consumption of prey during larval period
Per day consumption	18.75±2.24	54.35±7.13	98.12±0.69	
Total Consumption	92.62±14.21	122.87±32.57	196.25±1.38	411.74±48.16



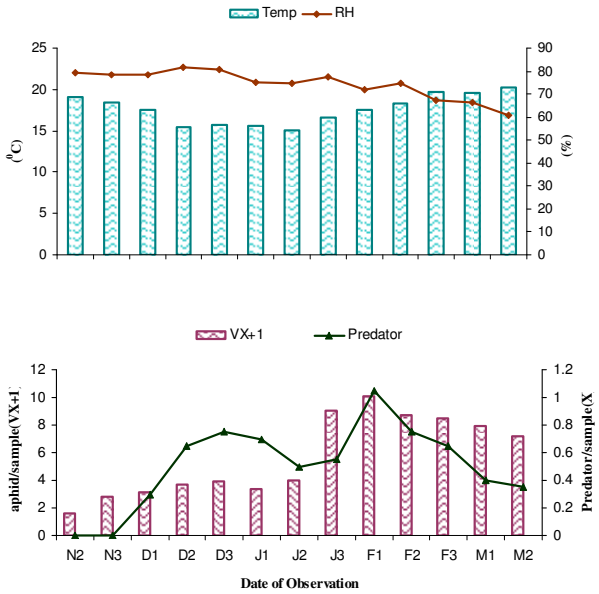


Fig 1. Population incidence of *Episyrphus balteatus* and *Lipaphis erysimi* with abiotic factors on *B. oleracea* var. *capitata* during 2008-2009

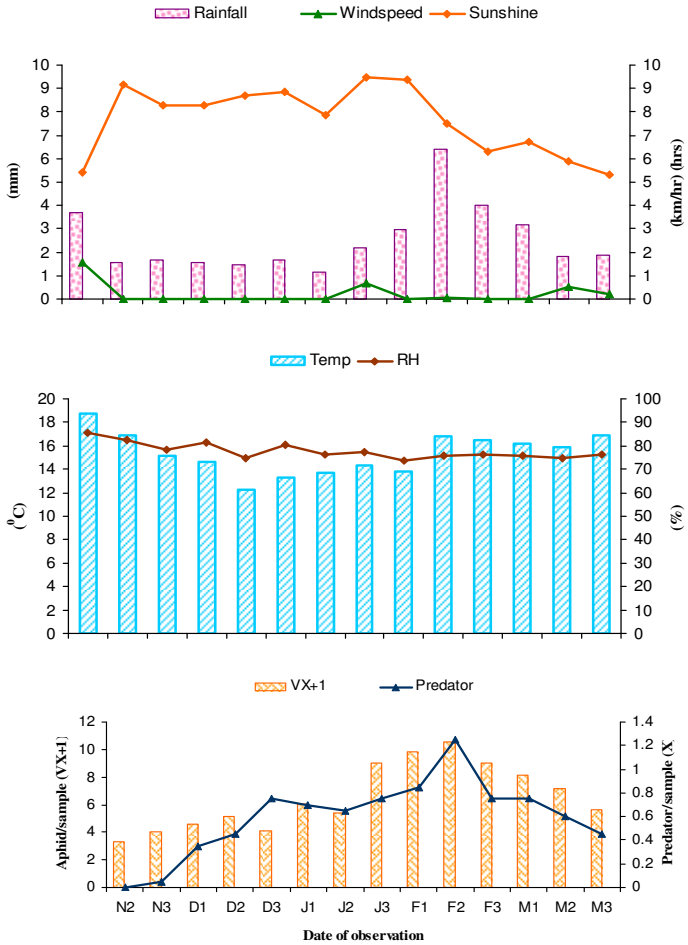


Fig 2. Population incidence of *Episyrphus balteatus* and *Lipaphis erysimi* with abiotic factors on *B. oleracea* var. *capitata* during 2009-2010

Singh (1993); Singh *et al.,* (1995) had also reported density – dependent relationship between the population of aphids and their natural enemies. Thus, the larvae and adults of *E. balteatus* were observed in higher numbers when prey aphid, *L. erysimi* were abundant in the field. The findings are in conformity with that of Bilashini *et al.,* (2007) who had reported positive correlation between

the prey *L. erysimi* and predators of their experimental insects. However, the study revealed that the temperature, relative humidity, rainfall and windspeed show negative correlation with the predators population along with prey aphids. Similar observations were also reported by Butani and Kapadia (1997), Manzar *et al.,* (1998) and Bijiya *et. al.,* (2001). Paul and Konar (2005) also reported that the predators had negative correlation with temperature and rainfall, while Jalali *et al.,* (2004) had reported positive correlation between the temperature and predator. As such, when the temperature become high, the density of aphids attained maximum which in turn was conducive for population build up of the predator.

Predatory Potentiality of *E. balteatus* (De Geer) on mustard aphid, *L. erysimi,* Kalt.

The consumption of prey *L. erysimi* by different larval instars of *E. balteatus* are presented in (table 3). The rate of feeding was found to vary greatly among different larval instars. The prey consumption gradually increase with the age of the developing instars. Thus it was found that first, second and third instars larvae of *E. balteatus* consumed 18.75±2.24, 54.35±7.13 and 98.12±0.69 of aphids per day/larva respectively. Moreover, it was recorded that the 3rd instars larvae was the most voracious feeder. The total duration during the larval period was found to be 9.62 days and total number of aphids consumed during the larval period was 411.74 ± 48.16.

The present findings are supported by the work of Baskaran *et.al.* (2009) who had reported the highest rate of prey consumption by the 3rd instars larvae of four species of syrphids on *Aphis gossypii*. From the above results it can be concluded that *E. balteatus* played an important role in the suppression of *Lipaphis erysimi* under field condition. This is also supported by the result obtained from the study of the predatory potential of larval stages of *E. balteatus* in the laboratory. Thus the involvement of *E. balteatus* in the field regulation of *L. erysimi* can't be underestimated.

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