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Biological control potential of *Coccinella septempunctata* Linnaeus (Coleoptera: Coccinellidae) on major homopteran pests of rapeseed

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ABSTRACT: The role of the predator, *Coccinella septempunctata* in regulating the field density of the *Brassica* aphids, *Lipaphis erysimi* (Kaltenbach), *Myzus persicae* (Sulzer) and *Brevicoryne brassicae* (Linnaeus) was studied for two cropping seasons (2003-2005) on rapeseed, *Brassica juncea* cv. M27. The numerical density of the predator was observed to increase in response to increase in density of aphid prey in the field. The correlation analysis showed significant positive correlationship between the predator and two aphid species viz., *L. erysimi* and *M. persicae*, but non-significant positive relationship was observed with *B. brassicae*. In the laboratory, prey preference of *C. septempunctata* was in the order *L. erysimi* > *M. persicae* > *B. brassicae*.

KEY WORDS: Aphid, *Brevicoryne brassicae*, *Coccinella septempunctata*, *Lipaphis erysimi*, *Myzus persicae*, predator

INTRODUCTION

Rapeseed, *Brassica juncea*, is one of the major oilseed crops predominantly grown in India. The annual production of rapeseed and mustard in India is approximately 4.8 million tonnes (Anonymous, 1993). The *Brassica* aphids *viz*., *Lipaphis erysimi* (Kaltenbach), *Myzus persicae* (Sulzer) and *Brevicoryne brassicae* (Linnaeus) damage the leaves, inflorescences, apical buds and pods in almost all the mustard growing regions of India (Mathur *et al.*, 1987), causing damage up to 96 percent in seed yield (Bakhetia, 1984; Verma and Singh, 1987; Suri *et al.*, 1988). The main predators of these aphids in India are coccinellid beetles, which have been reported to manage the pest population in the field to a certain extent (Agarwala *et al.*, 1987; Ghosh *et al.*, 1991; Omkar and Bind, 1993; Afroze, 2001). Consequently, in the plains and highland of north-east India, the adults and larvae of the coccinellid, *Coccinella septempunctata* L., are quite common during the cropping periods (Agarwala *et al.*, 1987; Singh and Singh, 2004). *C. septempunctata* is one of the commonest ladybird predators of aphids in agricultural and horticultural habitats (Hodek and Honek, 1996). Although highly polyphagous, *C. septempunctata* shows preference to aphids infesting plants in low vegetative stands such as *Brassica* crops. Effectiveness of ladybeetles as predators of aphid pests in any agro-ecosystem depends upon the understanding of the factors that influence its growth, prey preferences as well as predatory potential. The present paper aims to study the above aspects with reference to *C. septempunctata* predating on rapeseed aphids.

MATERIALS AND METHODS

The seasonal abundance of the coccinellid predator, *Coccinella septempunctata* (L.), and its prey aphids was assessed on rapeseed var. M27 in the experimental field of Life Sciences Department, Manipur University for two subsequent crop seasons (2003--2005). There were 5 plots of 4 X 2m^2 size each. The experimental plots were kept free from insecticides and recommended agronomical practices from the State Agricultural Department were followed. The spacing was

10 cm between the rows. Observations on the seasonal activity of *C. septempunctata* and its prey were made at 7 days interval. Density of both larvae and adults of the coccinellid were recorded from 20 randomly selected plants from five plots. The aphid densities were assessed from 10 cm apical shoot of each randomly selected plant (Bakhetia and Sekhon, 1991). The meteorological parameters for the period of study 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 insect pest.

The stock culture of *C. septempunctata* was maintained at 26 ± 3°C and relative humidity 65 ± 5 per cent on 15 cm long host plant twigs in the Aphid Research Laboratory, Department of Life Sciences, Manipur University. To evaluate their biotic potential and prey preference, the larvae and adult beetles from the stock culture were transferred individually to separate Petri dishes (9.5 cm diam.). One hundred numbers of each species were provided as prey, *viz.*, *L. erysimi*, *M. persicae* and *B. brassicae*. After 24 hours, the unconsumed aphids were counted in each set to record the number of aphids consumed. The experiment was performed to evaluate the prey preference of II, III and IV instars, and adults of *C. septempunctata*. The experiment was replicated 10 times for each set and prey species. The raw data was subjected to one factor ANOVA for interaction between the predators and effect of different prey consumption.

RESULTS AND DISCUSSION

The infestation of aphids on rapeseed *Brassica juncea* cv. M27 began from December and continued till harvesting in February. Three species of aphids, *viz.*, *Lipaphis erysimi*, *Myzus persicae* and *Brevicoryne brassicae* appeared in succession on the crop. The immigrant alates initiated the formation of colonies on the host plant, subsequently, apterous morphs occurred in large numbers on the crop.

In both cropping seasons, *viz.*, 2003–04 and 2004–05, *L. erysimi* was the first to colonize the crops, followed one week later by *M. persicae* and *B. brassicae*, respectively (Fig. 1 & 2). The population build up of *L. erysimi* began in November and attained its maximum in January in both years (562.3 aphids / sample during 2003–04 and 183.5 aphids / sample during 2004–05) after which the population declined gradually. The population build up of *M. persicae* exceeded its critical level of 20 aphids/100 leaves during January. The peak activity of the aphid was observed during 1st week of February during 2003-04 (160.37 aphids/sample) and during last week of January (46.44 aphids/sample) in 2004-05. Infestation of *B. brassicae* started later in both years with a maximum of 70.21 aphids per sample in February. Chandra and Kushwaha (1986), Sharma *et al.* (1997) and Devi *et al.* (2001) observed more or less same period of high aphid activity on cruciferous crops in different parts of the country. On the basis of density of their occurrence, *L. erysimi* could be graded as the dominant species and *B. brassicae* and *M. persicae* as secondary and tertiary species, respectively. An average temperature of 12.95–20.71°C coupled with an average relative humidity 59–83.93 per cent, 2.86 – 8.87 hours sunshine and 0.33–10.4 kilometers per hour wind speed was observed to be congenial for development of aphid population. In both years, fairly widespread rainfall (0.8 - 69.3 mm) was ascribed during the period of aphid incidence (Fig. 1& 2).

Prior to flowering period of rapeseed crop, the population density of the *Brassica* aphids, was more on adaxial surface of leaves, mainly stem and branches in the order of niche preference. Upon flowering and development of inflorescence, they congregated towards the base of inflorescences, which revealed marked preferential feeding sites (Tripathi *et al.*, 1986; Rana *et al.*, 2001). Although the aphids were observed to be associated with an array of predators, in the present study, emphasis has been given on the more abundant and voracious *C. septempunctata*. The larvae as well as adult stages of the predator were observed in the colonies from December with an initial density of 0.11 predator / sample. Their density gradually increased with increase in aphid density and peaked (3.25 individual / sample in 2003-04 and 2.3 individual / sample in 2004 – 05) when prey density was considerably high in the field. It was interesting to note that among the three aphid species the maximum density of *C. septempunctata* coincided with that of *L. erysimi*.

The correlation analysis between the aphids and predator showed significant positive correlation between the predator and two aphid species, *viz.*, *L. erysimi* and *M. persicae* and a weak relation with *B. brassicae* (Table 1). Thus, the larvae and adults of *C. septempunctata* were observed in higher numbers when *L. erysimi* and *M. persicae* were abundant in the field. The results also revealed that temperature, relative humidity, rainfall and wind speed correlated negatively with aphid density

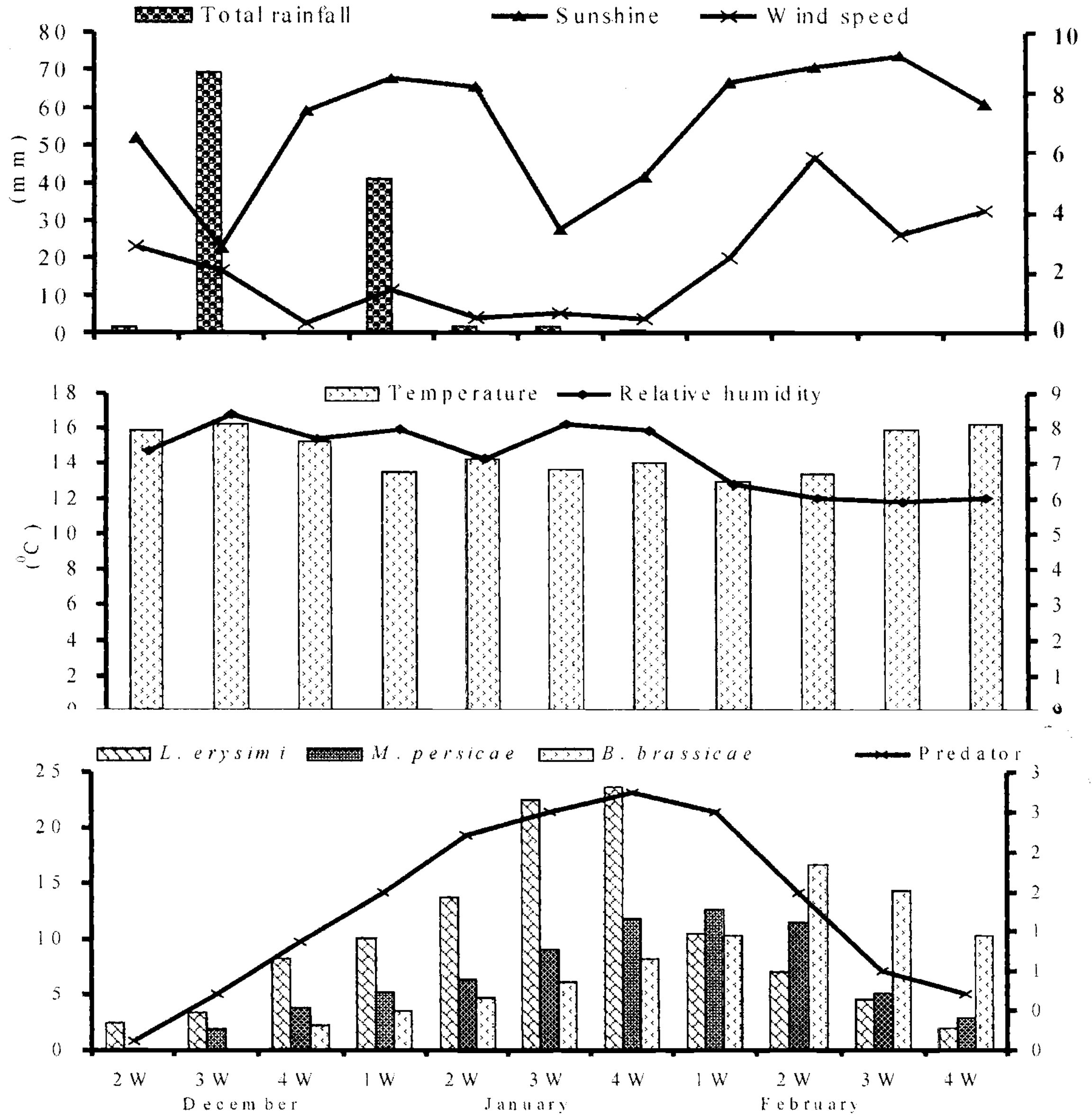

Fig. 1. Seasonal incidence of Brassica aphids in relation to *C. septempunctata* and abiotic factors on rapeseed M27 during 2003-2004

during the cropping seasons. Similar observations were also reported by Butani and Kapadia (1997), Manzar *et al.* (1998) and Bijaya *et al.* (2001). During the present study, *B. brassicae* too exhibited a positive and conducive relation with the said factors. As a result, their densities were observed to increase steeply during the fruiting stage of the crop with increase in temperature and long sunshine hours.

The coccinellid was found to prey upon all the life stages of prey available within its reach. Table 2 shows the average number of prey consumed by *C. septempunctata* on three homopteran pests of rapeseed. The II instar consumed 15.17 ± 0.25, 13.29 ± 0.10, 7.35 ± 0.12 aphids of *L. erysimi*, *M. persicae* and *B. brassicae*, respectively. Among the larval stages, highest voracity was observed in IV instar larvae (Table 2). The adult female consumed more number of prey than any other stage (Table 2).

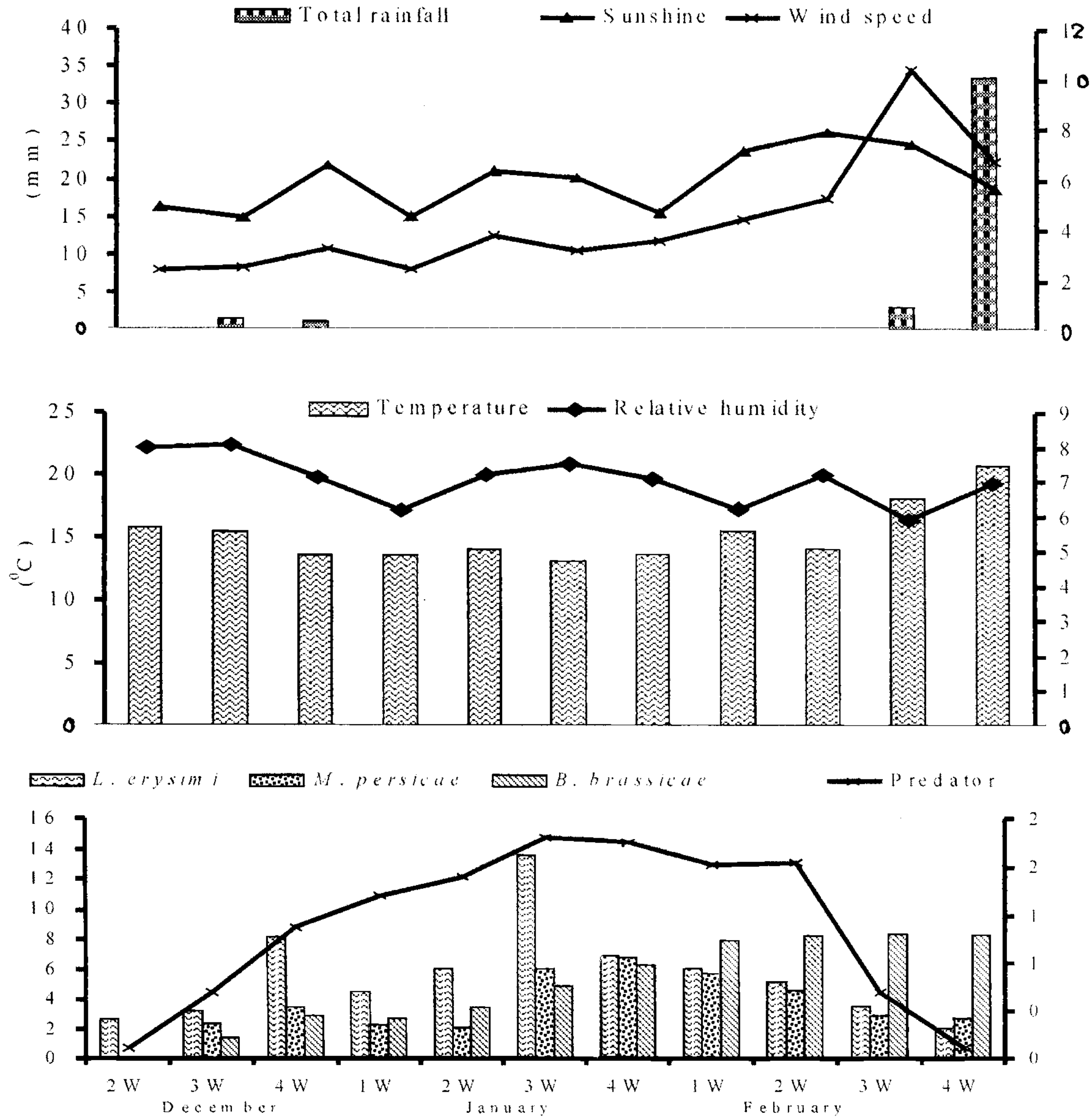

Fig. 2. Seasonal incidence of *Brassica* aphids in relation to *C. septempunctata* and abiotic factors on rapeseed M27 during 2004-2005

Table 1. Correlation co-efficient of different *Brassica* aphids with abiotic factors and *C. septempunctata*

Pests species	Temperature	Relative humidity	Total	Sunshine	Windspeed	Predator
L. erysimi	-0.162	0.386*	-0.138	-0.242	-0.484*	0.700**
M. persicae	-0.186	-0.098	-0.212	0.198	-0.183	0.725 **
B. brassicae	0.045	-0.645 **	-0.207	0.564**	0.372*	0.127

* Significant at 5 % level ; * * Significant at 1 % level

Table 2. Feeding potential of *C. septempunctata* on three homopteran pests of rapeseed

Pest species	Number of pests consumed during 24 hours				
	Nymphal instars			Adults	
	II	III	IV	Male	Female
L. erysimi	15.17±0.25c	30.70±0.16c	40.50±0.26 c	30.20±0.49 b	45.50±0.35 c
M. persicae	13.29±0.10b	26.90±0.45 b	35.27±0.56 b	28.42±0.24 b	40.50±0.22 b
B. brassicae	7.35±0.12a	18.65±0.25 a	20.59±0.17 a	19.24±0.40 a	25.29±0.34 a

Mean values followed by common letters (column wise) are not significantly different at $P < 0.05$

The different life stages of this coccinellid showed a high degree of variation in feeding potential and maximum variation was with *L. erysimi* and minimum with *B. brassicae*. The prey preference in the present study was in the order *L. erysimi* > *M. persicae* > *B. brassicae*. The present findings are in conformity with those of Srivastava *et al.* (1978). Omkar and Srivastava (2003) performed similar experiments on the same beetle and reported maximum consumption of *L. erysimi*. From the preceding observations it can be summarized that the biotic potential of *C. septempunctata* can be further assessed in relation to *L. erysimi*.

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