SEASONAL ABUNDANCE OF *DIARETIELLA RAPAE* (M´INTOSH) (BRACONIDAE: APHIDIINAE) PARASITIZING *LIPAPHIS ERYSIMI* (KALTENBACH) (HEMIPTERA: APHIDIDAE) IN *BRASSICA JUNCEA* VARIETY PUSA BOLD

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[**Akhtar, M. S., Dey, D., Usmani, M. K. & Choudhury, R. A.** 2010. Seasonal abundance of *Diaretiella rapae* (M´Intosh) (Braconidae: Aphidiinae) parasitizing *Lipaphis erysimi* (Kaltenbach) (Hemiptera: Aphididae) in *Brassica juncea* variety Pusa bold. Munis Entomology & Zoology, 5 (2): 692-696]

ABSTRACT: The occurrence of *Diaretiella rapae* parasitizing *Lipaphis erysimi* in Mustard variety Pusa bold (*Brassica juncea*) was evaluated. Successful parasitism was 75.46% and 68.96% during 2006-07, 2007-08 respectively. Correlation coefficient of average per cent relative humidity with both aphid (r=-0.52) and parasitoid (r=-0.59) were negatively significant whereas day (r=0.65) and the night temperature (r=0.61) had significant positive correlations with the parasitoid population only. The best fitted polynomial regression equation indicated that 30-60% variability of the aphid population could be explained by the different weather parameters, while 11-50% variability of the parasitoid population could be explained by weather parameters.

KEY WORDS: *Brassica juncea, Diaretiella rapae,* Parasitism, *Lipaphis erysimi,* Seasonal abundance.

Mustard is the primary and most important oilseed crop in India. It is the major source of edible oil for human consumption. The mustard aphid *Lipaphis erysimi* (Kaltenbach) causes serious losses of yield in Mustard crops and reduces its marketable value. Increase in population beyond 9.45 aphids per plant, reduce the seed yield by 59.3 per cent with an economic injury level of 2.04 aphids/ plants with an index of 0.98 and infestation 37.4 per cent (Singh & Malik, 1998). Aphid parasitoids are very important control agents for aphid pest in a variety of agricultural and horticultural crops (Hagvar & Hofsvang, 1991). *D. rapae* is described as one of the most important factor for natural control of mustard aphid (Dhiman, 2007; Dogra et al., 2003; Pike et al., 1999). On the other hand, *D. rapae* females are more attracted by crucifer plants than by other types of plants (Sheehan & Shelton, 1989; Vaughn et al., 1996). Furthermore, parasites and prey prefer the same host plant possibly because aphids and *D. rapae* positively respond to the volatile compounds produced by the plants (Bundemberg, 1990) and honeydew emitted by aphids and used by its natural enemies as kairomones (Brown et al., 1970; Dicke & Sabelis, 1988).

The aims of this study were (i) to examine the seasonal occurrence of *Lipaphis erysimi* and the relationship between aphids and the parasitoids *Diaeretiella rapae* (M'Intosh) during the crop period (ii) to assess the effect of *Diaeretiella rapae* on population density of aphid and (iii) their relationship with different meteorological parameters.

MATERIALS AND METHODS

The present investigations were carried out at the research farm of Indian Agricultural Research Institute, New Delhi (28°4'N, 77°09'E and 228.16m above mean sea level) during two consecutive *rabi* seasons *viz*., 2006-07 and 2007-08. *Brassica juncea* variety Pusa bold was sown in 4 plots, sized 10×12 m. Sowing was done on 16th November 2006 and 20th November 2007. Standard agronomic practices were adopted for raising a good crop.

Sampling was done at weekly intervals from the time of appearance of the aphid on the crop till the harvest of the crop. The terminal 10 cm of the main shoot infested with aphids from 10 randomly selected plants from each plot were cut and placed in small plastic jars. These jars were covered with muslin cloth tied with rubber band, and kept under laboratory conditions of 26±5°C and 65±5% RH. Data on total number of aphids in each jar was recorded on the day of collection by direct count. Subsequent observations on number of parasitoids emerged were noted daily for two weeks. The emerged parasitoids were counted, segregated and processed for further studies.

Data for six meteorological parameters *viz.,* maximum and minimum temperature; maximum and minimum relative humidity; rainfall and sunshine hours were collected from meteorological station, IARI Observatory. The daily recording of these parameters were averaged over standard week and estimated according to the procedure adopted by Das et al. (2006):

I. Day temperature (DT) = $T_{max} - 0.4\ (T_{max} - T_{min})$

II. Night temperature (DT) = $T_{min} + 0.4\ (T_{max} - T_{min})$

These data were utilized for computations of correlation and regression. Step wise multiple regression analysis were done using population parameters as dependent variables and meteorological data as independent variables.

RESULTS AND DISCUSSION

During the crop season of 2006-07 the aphid started appearing from the 9th week of crop age and mummified aphids due to the activity of parasitoid could be observed from the 11th week of crop age. The number of aphids per plant kept on increasing and the population peaked (156 aphids/plant) during the 11th week of crop age i.e. 5th standard week. The number of mummified aphids due to activity of *D. rapae* was observed from 11th week of crop age (i.e. 5th standard week) and increased gradually till 16th week of crop age. The population of parasites was calculated from the numbers which emerged in the laboratory. The population of aphids and parasitoids peaked during the 13th week of crop age when maximum temperature, minimum temperature, morning % relative humidity, afternoon % relative humidity and bright sun shine hrs were 24.61°C, 10.44°C, 89.86%, 57.29% and 7.11 hours respectively. The per cent parasitism was as high as 75.81 during 2006-07 (Table 1).

The aphids started appearing from the 9th week of crop age during the second crop season of 2007-08 but the mummified aphids were observed a week ahead of the last crop season i.e. from the 10th week of crop age (i.e. 5th standard week). The number of mummified aphids increased gradually and could be seen in the field up to 18th week of crop age. During the crop season of 2007-08 the population of aphids peaked during the 15th week and continued to remain at that level during 16th week of crop age (342 aphid/plant) i.e. peak population of aphids was observed during both 10th and 11th standard weeks when maximum temperature, minimum temperature, morning % relative humidity, afternoon % relative humidity and bright sun shine hrs were 28.40 °C, 10.40 °C, 77.00%, 22.00% and 4.50 hours respectively (Table 1). On an average 1.8 to 66.50 aphid parasitoids emerged per week till 18th week of crop age. The maximum number of parasitoid emergence (165) was during the 16th week of crop age when maximum temperature, minimum temperature, morning % relative humidity, afternoon % relative humidity and bright sun shine hrs were 30.66°C, 14.80°C, 89.00%, 31.50% and 4.70 hours respectively (Table 1). This was slightly different from what was observed in the previous year with slightly lower per cent parasitism (68.92) compared to the previous year (Table 1).

Successful parasitism of the mustard aphid by *D. rapae* was very high during both the both years (Figure 1). These results agree well with the reports of Alam & Hafiz (1960), Bijaya et al.(2001), Bisht et al.(2001) and Devi et al.(2001) in which they reported the dominant role played by parasitoids in the regulation of the population of *Brassica* aphids.

Analysis of the linear association between direct and derived weather variables revealed that % relative humidity had a significant negative correlation with both aphid (r=-0.52) and parasitoid (r=-0.59) populations whereas day temperature (r=0.65) and night temperature (r=0.61) had a significant positive correlation with the parasitoid population only. However bright sun shine did not have any influence on both populations (Table 2).

In order to estimate the relation between direct and derived weather variables with populations of both aphid and parasitoid quantitatively, regression equations were constructed. The best fitted polynomial regression equation indicated 30-60% of variability of aphid population could be explained by weather parameters, *viz.,* day temperature (60%), night temperature (30%), average % relative humidity (30%) and bright sun shine (44%) while 11-50% variability of parasitoid population could be explained by weather parameters, *viz.,* day temperature (50%), night temperature (43%), average % relative humidity (46%) and bright sun shine (11%) (Table 2). The current findings are similar to those of Devi et al. (2001) and Bijaya et al. (2001).

ACKNOWLEDGEMENTS

We would like to thank Dr. V.V. Ramamurthy, Principal Investigator, Network Project on Insect Biosystematics (NPIB 21-17), Division of Entomology, Indian Agricultural Research Institute, New Delhi for providing necessary facility and Indian Council of Agricultural Research (ICAR), New Delhi for providing financial assistance to NPIB 21-17.

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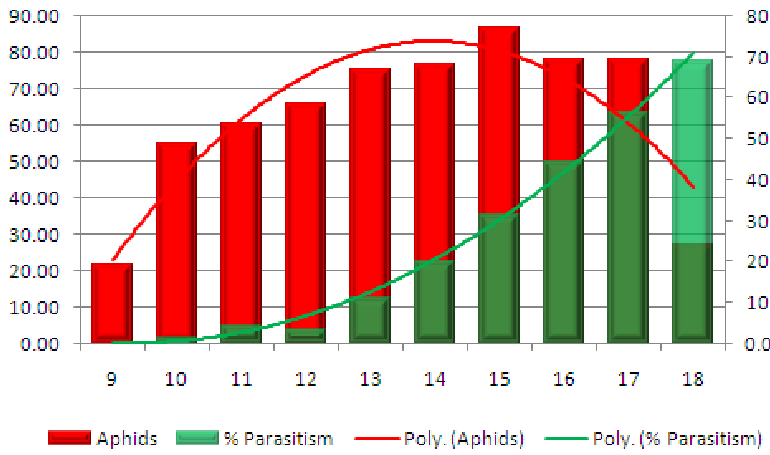

Figure 1. Percent parasitism with respect to aphid's population

Table 1. Parasitization of *L. erysimi* by *D. rapae* on *B. juncea* variety Pusa bold.

Crop season	Crop age (weeks)	*Average number aphid per sampling unit	Average number of parasitoids emerged	% Parasitism
2006-07	9	11.73	0.00	0.00
	10	31.08	0.00	0.00
	11	48.10	2.43	5.06
	12	26.98	1.65	6.12
	13	30.25	6.52	21.55
	14	16.70	6.17	36.95
	15	4.48	2.75	61.38
	16	3.43	2.60	75.80
2007-08	9	31.55	0.00	0.00
	10	78.28	1.80	2.30
	11	72.43	2.95	4.07
	12	104.23	2.70	2.59
	13	120.25	10.30	8.57
	14	136.48	24.70	18.10
	15	169.25	52.00	30.72
	16	153.00	66.50	43.46
	17	78.25	44.13	56.40
	18	27.25	18.78	68.92

*=Average based on 40 sampling unit

Table 2. Quantitative analysis of aphid and parasitoid populations corresponding to different weather parameters

Weather Parameters	Aphid			Parasitoids		
	(r)	Regression equation	R^2	(r)	Regression equation	R^2
Day temperature ^{O}C	0.07	$y = 0.001x^2 - 0.173x + 20.68$	0.60	0.65*	$y = 0.124x + 16.17$	0.50
Night temperature ^{O}C	0.02	$y = -0.001x^2 + 0.042x + 71.07$	0.30	0.61*	$y = 0.109x + 13.52$	0.43
Average % Relative Humidity	-0.52*	$y = -0.001x^2 + 0.042x + 71.07$	0.30	-0.59**	$y = -0.574x + 73.22$	0.46
Bright Sun Shine (Hrs)	-0.39	$y = 0.000x^2 - 0.049x + 7.220$	0.44	-0.13	$y = -0.001x^2 + 0.071x + 5.512$	0.11

r= Correlation coefficient; *= Correlation is significant at the 0.05 level (2 tailed); **= Correlation is significant at the 0.01 level (2 tailed)