

Feeding Efficacy, Circadian Rhythms and Oviposition of the Lady Bird Beetle (*Coccinellidae: Coleoptera*) under Controlled Conditions

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ABSTRACT

An experiment to estimate the feeding efficacy, circadian rhythms and oviposition of the lady bird beetle (*Coccinellidae: Coleoptera*) was accomplished from November, 1999 through April, 2000 in the farmlands and laboratory conditions. In all, 2880 aphids were provided to 576 beetles with the aphids consumed per jar being 2044 and the percentage of aphids consumed per jar was 71.00. On the four pieces of the musclin cloth and filter papers for the different times intervals, the means for the musclin cloth and that of the filter Paper were 395.2 ± 31.00 , 335 ± 9.05 , 341 ± 14.70 , 358 ± 14.70 , 358 ± 19.70 , 258 ± 15.80 , 339.50 ± 19.80 , 315 ± 13.50 and 351.6 ± 27.40 , respectively. Finally, a comparison was made between both the musclin cloth and the filter papers to evaluate the periodicities of the time intervals per week for the beetle oviposition. Of both the mediums, the maximum oviposition (2021) was recorded on the green musclin cloth and (1758) for the filter paper, respectively. It was concluded that the coccinellids are the potential agents for controlling the aphids in the farmlands of cotton and wheat and, therefore, their numbers in the fields should be augmented for better production.

Key Words: Feeding efficacy; Circadian rhythms; Oviposition; Lady bird beetle

INTRODUCTION

The lady bird beetle (*Coccinellidae: Coleoptera*) is being exploited as a potent animal for the effective control of the aphids besides other animal pests that cause colossal economic losses throughout Pakistan (Fayyaz, 1998). Many species of aphids attack different croplands and thus, cause economic losses. They also serve as the potential vectors for many diseases in the standing crops. Attacks of aphids on the wheat fields has resulted in a depletion of seeds on the cumulative basis and this situation is becoming alarming in the developing countries (Furtick, 1975; Liu *et al.*, 1986).

Of the various predatory animals, which attack the aphids include the “coccinellids” in the croplands, and when the beetles, due to their predaceous nature, are allowed to wander in the selected vegetations, there is an overall reduction in the number of aphids per food crop (Korschefsky, 1988; Mosaad *et al.*, 1992). Coccinellids exhibit a close synchrony with their prey species i.e., usually the coccinellids reproduce when the prey species (aphids) are increasing in numbers, and become quiescent when the prey species are also declining. They increase their population size in a fairly short time under suitable weather conditions (Kenneth & Hagen, 1970).

The circadian rhythms are the biological clock time rhythms being generated in every animal during different hours of the day. It is due to these biological rhythms that animals manifest their daily periodicities at different sessions and different seasons throughout the year (Hendricks *et al.*, 1996; Matleson, 1998). In Pakistan, over the past many decades a great deal of funding has been spent on the pesticides in an effort to control the various pests in the croplands, but unfortunately, their unwise and

injudicious use has frequently erupted the stable agroecosystems (Anonymous, 1997). The detrimental impact of the hazardous toxicants has always resulted in more costs and less benefits and only a few attempts have been made to exploit the biological control measures, especially with reference to Pakistan (Economic Survey of Pakistan, 1997). The present study was, therefore, aimed at knowing about the feeding efficacy against the aphids in the selected food crops at the Campus of University of Agriculture, Faisalabad and the circadian rhythms with respect to the oviposition of the lady bird beetle on the preferred surface of the beetles (musclin cloth and the filter paper) to oviposit for various light and dark periods to ascertain some beneficial information for exploiting general biology of this beetle species.

MATERIALS AND METHODS

Studies on the feeding efficacy, circadian rhythms and oviposition of the lady bird beetle (*Coccinella septempunctata*) were extended from November, 1999 through April, 2000 in the farmlands and under laboratory conditions of University of Agriculture, Faisalabad. Specimens of the lady bird beetle were obtained from the visitations to the cotton and wheat fields during the winter and spring seasons. Pairs of the adult beetles were separated from the mass of the collected samples with the help of a camel brush and later placed in the glass jars (5.0 x 2.5”) at a temperature range ($25 \pm 5^\circ\text{C}$) in the laboratory. Adult pairs were fed with the aphids each day to note their feeding efficacy. Number of aphids supplied were counted and the number of aphids consumed by the beetles were also recorded after 24 hours time interval. When the collected

aphids were totally consumed by the beetles, they were replaced with the fresh aphid samples. In all, 2880 aphids were fed to 576 beetles during the entire period of study. To investigate the circadian rhythms of the beetles with respect to the oviposition, the preferred surface for the oviposition of the beetles were recorded. A muslin cloth, dyed into four colours viz., white, blue, green and red, respectively was laid to note the oviposition of the beetles. Adult beetle pairs were placed separately on the four coloured clothes for a period of five time intervals per week as follows:

10:14	12:12	14:10	0:24	24:0
L:D	L:D	L:D	L:D	L:D

The recordings were also among the four coloured filter papers with the similar time periods as for the muslin cloth. Finally, a comparison was made between the treatments (muslin cloth and filter papers), along with a comparison among treatments and the filter papers to record the emergence of the larvae from the adult beetles.

RESULTS AND DISCUSSION

It is evident from Table I that for all the six months of the study period, the number of beetles was kept constant along with the aphids supplied for consumption. The number of aphids consumed per jar by the beetles varied considerably with a maximum 454 aphids consumed in December, regarding the percentage consumption per jar, it was 94.58 also recorded during the same month (Table I).

Table I. Combined effect of the predatory efficacy of *Coccinella septempunctata* on the aphids (November, 1999 to April, 2000)

Months	No. of beetles	No. of aphids	Aphids consumed/ jar	%age of aphids consumed/jar
November	96	480	295	61.45
December	96	480	454	94.58
January	96	480	366	76.25
February	96	480	243	51.00
March	96	480	329	68.54
April	96	480	357	74.40
Total	576	2880	2044	426.22
± SE			29.20	71.00

It is evident from Table II that for the six months of this study, for the muslin cloth, the maximum mean oviposition was recorded on the white coloured muslin cloth, 395.20 ± 31.00 , and the least on the red, being 335.80 ± 9.05 (Table II). Similarly, for the filter paper, the incidence of beetle oviposition was fairly low than the muslin cloth, with the maximum 351.60 ± 27.80 , and the minimum 258.20 ± 15.80 (Table II). Data of the present studies indicate the predatory efficacy of the lady bird beetle (*Coccinella septempunctata*) on the aphids supplied from November 1999 through April, 2000. Results depict variations both for the aphids consumption per jar and their percentage. It is also evident from the data that the “Coccinellids” are important biological controlling agents against the aphids in the cotton and wheat farmlands and their occurrence in both the croplands with a view to obtain high crop yields is essential (Liu *et al.*, 1986; Xu, 1985; Vyas & Patil, 1984; Fayyaz, 1988). The peak number of aphids consumed was in December and least in February (Table II). It suggests that the rate of aphid consumption was more in spring due to their ready availability in the field crops (Ferran & Sarroque, 1984; Hameed & Hussain, 1984; Burton *et al.*, 1985; Zuniga *et al.*, 1986).

Data on the circadian rhythms with respect to the oviposition shows that on the two distinct media (muslin cloth and filter paper) under constant light dark time intervals show that for the overall maximum number of oviposition (2021), on the muslin cloth, it occurred on the “green” colour; whereas, the minimum (1723) was recorded on the “blue” colour (Table II). As regards the filter paper, it is evident that the maximum oviposition (1758) was found on “red” colour the least (1289) on the “white” colour filter paper. Accordingly, the incidence of oviposition was recorded to be more on the muslin clothes under the constant light : dark reactions than the filter papers. It exhibits an inference of the generations of the circadian rhythms among the beetles (Greenberg *et al.*, 1996; Leppla *et al.*, 1990; Pilfer, 1995 Wilkins *et al.*, 1997). It was concluded that the lady bird beetle was an important beneficial insect and its population should be enhanced in our cash crops as of cotton and wheat to get an effective control over the aphids for better crop yields.

Table II. Combined impact of the oviposition recorded for the lady bird beetle under different time intervals

Obs. time	Muslin cloth				Filter paper			
	white 0700-1300	green 1300-1900	blue 1900-0100	red 0100-0700	white 0700-1300	green 1300-1900	blue 1900-0100	red 0100-0700
10:14	344	375	322	307	217	316	290	312
12:12	313	414	315	380	256	349	279	340
14:10	389	396	380	399	230	406	320	379
00:24	468	429	348	392	298	330	348	442
24:00	462	407	358	315	288	304	340	285
Total	1976	2021	1723	1793	1289	1705	1577	1758
Mean	395.20	335.80	341.20	358.60	258.20	339.50	315.40	351.60
± SE	31.00	9.05	14.70	19.70	15.80	19.80	13.50	27.40

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(Received 20 May 2001; Accepted 18 July 2001)