BEAN APHID PREDATION EFFICIENCY OF LADY BIRD BEETLE Micraspis discolor F. (COLEOPTERA: COCCINELLIDAE)

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ABSTRACT

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The experiment was conducted at the Department of Entomology, Hajee Mohammad Danesh Science and Technology University, Dinajpur, during January to April 2007 at 21.02° C ± 4.5 °C (Room temperature) to determine the predation efficiency of *M. discolor*. Predation efficiency of 1st, 2nd, 3rd and 4th instar larvae of *Micraspis discolor* were 1.9±0.20, 3.6±0.19, 4.43±0.24 and 6.08±0.24 aphids, respectively, while the predation efficiency of male and female adults were 1003.27±104.35 and 1216.40± 22.89 aphids, respectively. The data of the aphid predation of the beetles reveal that the larvae of the 4th instar showed significantly the highest predation performances and the 1st instar showed the lowest one. The female beetles were more effective in aphid predation in compared to the male beetles.

Keywords: Lady beetle, *Micraspis discolor*, predation efficiency

INTRODUCTION

The lady bird beetles have been associated with good fortune in many myths and legends. They have been honoured through the centuries as they vernacular indicates that the term 'Lady' is in reference to biblical Mother Mary (Roache, 1960). The coccinellids, commonly known as lady bird beetles and have been known worldwide as a predator of a number of insects. They are distributed in many countries of Asia, including Bangladesh (Islam and Nasiruddin, 1978). Lady beetles, often called ladybug or coccinellids. They are the most commonly known of all beneficial insects. In Europe these beetles are called ladybirds (William, 2002). They are of great economic important as predaceous both in their larval and adult stages on various important crop pests such as aphids, coccids and other soft bodied insects including aphids (Hippa *et al*, 1978; Kring *et al*, 1985), while the species *M. discolor* feed on many inscet pests such as aphids, brown plant hopper, corn borer, Lepidopteron insects, mealybug, white flies (Rao *et al*, 1989; Mani, 1995). Predaceous coccinellids is also found in association with those insects infesting bean, wheat, chilli, sorghum, tobacco, cotton, maize, potato, lathyrus, soyabean, sweet potato, lentil, mustard, brinjal, groundnut, sunflower and cabbage. (Gautam *et al*, 1995; Duffieded, 1995).

Aphid is one of the most destructive pests and its distribution is world wide (Begum *et al*, 1991). Bean aphid, *Aphis craccivora* Koch. attacks the bean plant and other leguminous crops attacked by the nymphs and the adults of aphid cause damage by sucking the sap from the flowers, buds, pods, tender shoots and reduce the market value (Srivastava and Singh, 1986). At the time of infestation plant fails to give flowering and pods setting resulting in 20-40% yield loss (Islam, 2007).

Insecticidal control is not only expensive but also its residues left over the sprayed surface of the crops or in the soil and have become a matter of concern of environmental pollution. The indiscriminate use of pesticides causes phytotoxicity and destruction of beneficial organisms such as predators, parasitoids, microorganisms and pollinators (Luckman and Metcalf, 1978). Global warning has cautioned us and the adverse consequences of pesticide use are always alarming and also inducing pest out break because of pest resistance. These entomological backlashes have compelled the scientists to be concerned with entomologically compatible pest management programs (Hodek, 1970).

Now a day, Integrated Pest Management (IPM) is well known to entomologists, where all suitable pest control techniques are being used to find ecologically sound and environmentally safe ways of pest control. Biological control should be regarded as the backbone of any IPM program and about 90% of all potential pests are already under biological control (Debach and Rosen, 1991). The biological control is one of the most effective means of achieving insect control (Pedigo, 2004). The vegetable growers use less insecticide or avoid insecticides in developed countries. In recent years, pest control particularly for aphids has been revolutionized by the application of predators and parasitoids in those countries (Bari and Sardar, 1998). The coccinellid beetles are considered to be a great economic importance in agro-ecosystem through their successful employed in the biological control of many injurious insect (Agarwala *et al*, 1988).

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In our country most of the farmers are not well acquainted with grubs and pupae of the lady birds. They are accustomed to use insecticide indiscriminately without monitoring the pest population above the Economic Threshold Level (ETL) as well as consulting experts of this line. Its adverse side effects have already caused threat to a great extent to human being, beneficial predators. Our poor farmers are becoming poorer and crops vulnerable due to attack of pest and disease. In this aspect exploration of predators like *M. discolor* in Bangladesh may play a vital role as part of IPM Programm. The study of the predation efficiency of *M. discolor* would increase its ability of biological control agent and be a prime requirement for biological control. But reviews of predation efficiency of *M. discolor* is limited and environmental conditions of Dinajpur are different from other areas of the country. So, the present study was undertaken to determine the predation efficiency of *M. discolor M. discolor*

MATERIALS AND METHODS

The experiment was conducted at the laboratory of the Department of Entomology, Hajee Mohammad Danesh Science and Techonolgy University (HSTU), Dinajpur, during the period of January to April 2007. All the experiment were completed at 21.02° C $\pm 4.5^{\circ}$ C (Room temperature) and 66.05 ± 0.95 % RH.

Collection and mass culture

A culture of large number of larvae and adult predator of *Micrapis discolor* were established in the laboratory in order to supply necessary insects for the experiment. For this reason, some males and females of the *Micrapis discolor* were collected by sweep net from the unsprayed horticulture field and were confined in petridishes. Bean aphids were also collected daily with infested bean leaves, stems, twigs and inflorescences from the same unsprayed field and supplied as food. These beetles were sexed and paired in petridishes (6.0 x1.0 cm). The bottom of the petridishes was covered with blotting paper (Whitman filter paper no 1). After hatching of eggs, the grubs were transferred to several medium sized petridishes (11cm diameter) and reared on bean aphids. The emerged adults were sexed and confined in pairs in the petridishes and fed on bean aphids. Egg masses were collected and reared as above and continued for several times for obtaining large number of larvae and adult predators.

Use of predator and procedure of counting predation efficiency

After hatching, the young larvae were transferred individually in a petridishes (6.0×1.0 cm). The bottoms of the petridishes were covered with blotting paper. Aphids were supplied every morning at the rate of 90, 80, 70 and 60 in number for 1st, 2nd, 3rd and 4th instar, respectively. The preys were supplied on bean leaf and the base of the bean leaf was covered by water soaked cotton for protecting from the wilting. The food was changed within 24 hours. The number of aphids consumed within 24 hours and duration of each instar were recorded.

For determining the predation efficiency of adult beetle, the newly emerged adults were transferred individually in petridishes $(6.0 \times 1.0 \text{ cm})$. Aphids were supplied everyday at the rate of 100 for an adult on bean leaf. The base of the bean leaf was covered as described earlier. The number of aphids consumed by an adult beetle were recorded every 24 hours and continued until the death.

Statistical analysis

Date of the predation efficiency of larval instars and adult beetles were analyzed using SPSS, version 12.01 (SPSS, Chicago, IL, USA).

RESULTS AND DISCUSSIONS

Predation efficiency

Predation efficiency depends on the searching behavior of the beetle, its size and also the surrounding environment of the predator. Both larvae and adults of *M. discolor* fed on *A. craccivora* voraciously but their rate of feeding were varied. They feed both day and night, but mainly at day time.

Different stages	Predatio	Mean \pm SE		
Different stages	Minimum	Maximum		
1. Larva:	<u>.</u>			
1 st instar	1	3	1.90 ± 0.20	
2 nd instar	2	5	3.60 ± 0.19	
3 rd instar	3	8	4.43 ± 0.24	
4 th instar	4	10	6.08 ± 0.24	
2. Adult:				
Male	885	1269	1003.27 ± 104.35	
Female	1149	1393	$1216\ 40\pm22\ 89$	

Table 1. Predation efficiency of larvae and adult of *M. discolor* as observed in the study





Larval instars

Figure 1. Numbers of bean aphid consumed per day by larva of *M. discolor*.

Bars with no common letter are significantly different (p \leq 0.05, DMRT)

The predation efficiency of larvae was determined by the counting of total number of aphids consumed by each larval instar within 24 hours. The results were presented in the (Figure 1 and Table1). The feeding rate was increased gradually from the 1st instar to 4th instar. Aphids consumed by the 1st and 4th instar larvae have shown significantly different but 2nd and 3rd instar have shown significantly similar (Figure 1). The consumption of preys by the 1st instar larva varied from 1 to 3 aphids with an average 1.9 ± 0.20 aphids. In the 2nd instar, the minimum and maximum consumption were 2 to 5 aphids with an average of 3.60 ± 0.19 aphids. In 3rd instar larva showed some better high predatory activities and their behaviour were more than fast. The consumption rate varied in this instar upto 3 to 8 aphids and average predation was 4.43 ± 0.24 aphids. At the 4th and final instar, they were very much active upto pre-pupal stage. They require larger amount of food than the previous instars due to bigger size, longer durations and also might be food deposition for total pupal period. In this stage they consumed the highest 10 and the lowest 4 aphids with an average of 6.08 ± 0.24 aphids (Table 1). The total number of bean aphid consumed by the each larva during its total larval development period form 38 to 58 aphids with an average of 48.60 ± 2.04 aphinds during their entire larval period (Table 2).

Parto and Sontakke (1994) stated about the consumption rate of *M. discolor*. They stated that the 1st, 2nd, 3rd and 4th instars larvae were 11.4 \pm 1.6, 20 \pm 2.2, 9.2 \pm 1.4, 41.2 \pm 1.8 respectively and the larvae consumed on average 22.1 \pm 14.4 aphids during their development period. On the other hand, Ngammuang (1987) found that the feeding capacity of four larval period were 21.80 \pm 3.29, 41. 90 \pm 7.78, 66.25 \pm 20.13, 122.15 \pm 25.20 aphids which was very much high with present findings. But the findings of Parto and Sontakke (1994) near similar to the present result. These variations were observed which might be due to the variation of quality of food and depending on larval period as well as rared season. The present findings observed that the aphid consumption by the larva of *M. discolor* was higher in subsequent larval instars that is the later instars took more aphid than the previous instars.

No. of observation	Days									Total		
	1st Instar		2nd Instar		3rd Instar		4th Instar					
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	
1	2	2	3	4	3	4	6	5	6	8	7	50
2	1	2	3	3	4	4	5	5	7	8	6	48
3	2	2	4	3	4	5	4	4	5	7	5	45
4	3	2	5	5	4	5	3	4	6	5	4	46
5	1	1	3	2	3	4	3	5	4	7	5	38
6	2	2	4	5	6	4	7	8	6	9	5	58
7	3	3	4	4	3	5	8	6	5	10	7	58
8	2	1	4	3	3	5	7	8	6	9	6	54
9	2	2	2	3	3	4	6	6	7	8	6	49
10	1	2	4	4	4	3	4	5	4	4	5	40
	1.9	1.9	3.6	3.6	3.7	4.8	5.3	5.6	5.6	7.5	5.6	48.6
Mean \pm SE	<u>+</u>	<u>+</u>	<u>+</u>	±	±	±	<u>+</u>	±	\pm	\pm	<u>+</u>	<u>+</u>
	.22	.17	.25	.29	.28	.55	.53	.43	.32	.55	.29	2.04
	19 ± 020 36 ± 019		0.19	443 ± 0.24		6.08 ± 0.24						

Table 2. Maximum and Minimum Number of bean aphid consumed per day by M. discolor larva



Figure 2. Cumulative predation of aphid by different larval instar of M. discolor

In the (Figure 2) it has been showed the cumulative predation of aphid by different larval instars. The 1st instar larva preys 1 to 3 aphids with an average of 1.90 ± 0.20 aphids. At the 2nd instars minimum and maximum aphids consumed 2 to 5 aphids with an average 3.60 ± 0.19 aphids. In 3rd instars it was 3 to 8 aphids with an average of 4.43 ± 0.24 aphids but the 4th and final instar lowest and highest prey was 4 to 10 aphid with and average of 6.08 ± 0.24 aphids (Table 1). This graph indicated that the aphid consumption at different instars increased gradually. It was higher consumption at final instar. This increasing trend confirmed the gradual growing of larva.

Adult predation efficiency



Figure 3. Number of aphid consumed per day by adult of *M. discolor*



Figure 4. Cumulative predation of aphid by adult beetle of *M. discolor*

The predation efficiency of both male and female beetles was also studied. It was found that the female beetle consumed more preys than the male one. The range of aphid predation by the female beetle was 1149 to 1393 with an average of 1216.40 ± 22.89 aphids whereas, the male beetle fed 885 to 1269 aphid with an average of 1003.27 ± 104.35 aphids (Figure 4 & Table 2). The aphid predation of the female was much higher than the male one. From the above discussions it was clear that the aphid consumption between male and female beetle differed significantly. Ngammuang (1987) observed that the average number of aphids consumed by the adult of *M. discolor* was 1547.80 \pm 552.55 aphids. Natapol and Pensook (1988) found that the average predation capacity of *M. sexmaculatus* in its adult stage of male and female were 1012.7 and 1109.9 aphids respectively. The first one result of Ngammuang (1987) varied but the last one result of Natapol and Pensook (1988) was near similar to the present study. It can be said that this variation may be due to variation of the quality of food, physiological activities of beetle and seasonal variation.

It was seen from the experiment that the cumulative predation of aphid by adult female beetles consumed more aphid than male (Fig. 3 & 4). In case of male the minimum and maximum aphids prey was 885 and 1269 aphids; whereas, lowest and highest consumption by the female beetle was 1149 and 1393 aphids. The graph indicates that the aphid predation by the both male and female beetle was increasing gradually. So, there was close relation between the age of beetle and consumption rate of aphid. Beetle was growing day by day and predation rate also increasing at certain period and at last of all beetle died. William (2002) stated that an adult will eat about 300 medium-size aphids before it lays eggs. More than 5,000 aphids may be eaten by a single about in its lifetime. From the experiment it would indicated that aphid predation depend on food supply, temperature, humidity, seasonal variation and also age of the beetle.

The findings of present study indicated that the predator beetle was the most important to protect the aphid. From the above discussion it was seen from the experiment the adult *M. discolor* was a promising biological agent as well as the final instar larva consumed large number of aphid as other instars. So, this instar larva and adult may be use for the biological control of aphid specially bean aphid.

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