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Reproductive performances of lady bird beetle, *Menochilus sexmaculatus* (Coleoptera: Coccinellidae) under different food sources

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Abstract: Reproductive performances of lady bird beetle, *Menochilus sexmaculatus* were studied using different food sources viz. bean aphids, mustard aphids, citrus aphids, scale insects and mealy bugs. It was found that the pre-oviposition period was highest (5.2 ± 0.37 days) when mealy bugs were supplied as food for the beetles, whereas it was lowest (3.8 ± 0.37 days) when the beetles fed on bean aphid. The longest (21.4 ± 0.50 days) and shortest (19.20 ± 0.58 days) oviposition periods of the beetles were found when fed on bean aphid and mealy bugs, respectively. The bean aphid as a food source resulted the highest fecundity (251.2 ± 12.59), however the highest (91.52 ± 1.84%) and lowest (82.20 ± 2.73%) hatching rates were obtained in case of the citrus aphid and mealy bugs, respectively. Incubation periods varied with the variation of food sources and it ranged from 2.80 ± 0.37 to 3.80 ± 0.37 days. The sex ratio of male and female was found 0.85: 1.00 and food sources did not significantly affect the sex ratio.
Key words: Food sources, lady beetle, reproduction

Introduction

The lady bird beetles, *Menochilus sexmaculatus* (Coleoptera: Ciccinellidae) are considered to be of great economic importance in the agroecosystem. They are widely distributed in South Western Asia, Indonesia, Philippines and South Africa as a most common and efficient aphid feeding species (Rahman *et al*., 1993). They are predicious both in their larval and adult stages on various crop pests, such as aphids, coccids, thrips, jassids, scale insects, mealy bugs, Lepidopteran insects and other soft bodied insects (Mani, 1995). *M. sexmaculatus* was found in association with those insects infesting wheat, tobacco, cotton, maize, potato, lentil, mustard, bean, citrus, cucurbit, groundnut, cabbage etc and known to prey on about 39 arthropod species (Gautam, 1990; Duffield, 1995). At present emphasis is being given on the use of ecologically sound and environmentally safe pest control method. Biological pest management, particularly using predators can play a significant role in these regards. An increased knowledge of the reproduction performances of *M. sexmaculatus* would increase its utility as a biological agent. Therefore, this study was undertaken to know the effect of various food sources on the reproduction performances of lady beetle with a view to mass rearing of this predator.

Materials and Methods

Collection and rearing of nsect: Adult male and female *M. sexmaculatus* were collected from the Field Laboratory of Bangladesh Agricultural University, Mymensingh. These beetles were sexed and paired in petridishes (9.0 × 1.5 cm). Each morning fresh bean shoots and inflorescence infested with aphids were supplied in each petridish to provide food for the predators. The petridishes were examined daily to ovserve oviposition. Eggs were laid on bean pod or stem or leaves in the petridishes. After hatching, the larvae were transferred into petridishes (9.0 × 1.5 cm) and reared till adult emergence. Ten larvae were reared in each petridish. The predators were provided with aphids every day and continued until pupation. The petridishes were kept undisturbed during pupal period. The newly emerged adults were placed to other petridishes having one male and one female for mating and laying eggs. This procedure was continued for obtaining large number of adult beetles for the experiment.

Observation of reproductive performances: To observe the reproductive parameters viz. pre-oviposition, oviposition, incubation period, fecundity and survival rate, the newly emerged adult males and females were collected from the mass culture. They were confined in pairs in the petridishes for mating. A single pair of male and female was kept in each petridish (9.0 × 1.5 cm). The adults were provided with bean shoot, inflorescence or stem with bean aphid (*Aphis medicaginis*), mustard shoots, pods and leaves with mustard aphids (*Lipaphis erysimi*), citrus shoots, pods and leaves with citrus aphids (*Taxoptera citridus*) scale insects (*Aonidiella aurantii*) of known number and mealy bugs (*Pseudococcus virgatus*) of known number as their food. The foods were supplied every morning and five petridishes were maintained for each type. It was observed that mating generally took place 3 to 4 days after the adult emergence. It occurred at different times and usually started from the early morning, and the duration of copulation varied from 30 minutes to 2.5 hours. It was observed that the females did not lay eggs just after emergence. The time elaped between the date of adult emergence and the first egg deposition was considered as pre-oviposition period. After mating, the female laid eggs and the beetles were transferred to other petridishes. The eggs were observed everyday to note the hatching period. The larval and pupal periods were also recorded. The total number of eggs laid by each female during every 24 hours were counted and kept in separate petridishs. The viability of the eggs was determined by allowing them to hatch. Hatching period and hatching percentage of eggs were also counted.

Statistical Analysis: Data obtained from the experiments were analyzed in computer using one factor Completely Randomized Design (CRD) and means were ranked by Duncan's Multiple Range Test (DMRT).

Results and Discussion

Effect of food sources on pre-oviposition period: Table 1 showed that the pre-oviposition periods of lady bird beetles were dependent on food sources. The mean pre-oviposition period was found to be 3.80 ± 0.37, 4.20 ± 0.37, 4.00 ± 0.32, 4.20 ± 0.20 and 5.20 ± 0.37 days when fed on bean aphid, mustard aphid, citrus aphid, scale insects and mealy bugs, respectively. Verma *et al.* (1993)

studied the pre-ovipositio period of *M. sexmaculatus* and found 3.6 ± 1.0 days which was very close to the present findings. Singh and Singh (1993) reported that pre-oviposition period of this beetle completed in 6.6 days. The pre-oviposition period of *M. discolor* varied from 3 to 7 days when fed on bean aphid (Prodhan *et al*., 1995).

Table 1. Effect of food sources on the different reproductive period of *M. sexmaculatus*

Food sources	Reproductive period (day)		
	Preoviposition	Oviposition	Incubation
Bean aphid	3.80 ± 0.37 b	21.40 ± 0.50 ab	3.00 ± 0.32 ab
Mustard aphid	4.20 ± 0.37 ab	21.00 ± 0.45 ab	3.00 ± 0.32 ab
Citrus aphid	4.00 ± 0.32 ab	19.80 ± 0.37 a	2.80 ± 0.37 ab
Scale insect	4.20 ± 0.20 ab	21.20 ± 0.37 ab	3.80 ± 0.37 a
Mealy bug	5.20 ± 0.37 a	19.20 ± 0.58 a	2.80 ± 0.37 ab

Means within a column followed by same letter(s) are not significantly different by DMRT ($p \leq 0.05$)

Effect of food sources on oviposition period: The oviposition period was considered the duration between the period of first and last egg laid by the female. The mean oviposition period was found to be 21.40 ± 0.50, 21.00 ± 0.45, 19.80 ± 0.37, 21.20 ± 0.37 and 19.20 ± 0.58 days when fed on bean aphids, mustard aphids, citrus aphids, scale insects and mealy bugs, respectively (Table 1). Gautom (1990) recorded that the oviposition period of *M. sexmaculatus* was 36.23 and 36.51 days when fed on cotton aphid and mustard aphid. Verma *et al.* (1993) observed that the oviposition period of *M. sexmaculatus* was 43.3 ± 5.0 days. Singh and Singh (1993) found that the oviposition period of *Coccinella septempunctata* was 13.33 days. Hossain *et al.* (1995) reported that the oviposition period of *M. sexmaculatus* was 16.75 ± 1.03 days. The oviposition period for *M. discolor* lasted from 35 to 42 days when they were fed on *A. craccivora* (Prodhan *et al*., 1995). Miller and Lamana (1995) recorded that the oviposition period of *C. trifasciata* decreased from 44.2 to 11.1 days when temperature increased from 18 ^{o}C to 34 ^{o}C.

Effect of food sources on incubation period: The incubation period is the duration between the starting of egg laid and egg hatching. The observed mean incubation periods were 3.00 ± 0.32, 3.00 ± 0.32, 2.80 ± 0.37, 3.80 ± 0.37 and 2.80 ± 0.37 days on bean aphid, mustard aphid, citrus aphid, scale insect and mealy bugs, respectively (Table 1). These results revealed that the incubation period was highest in scale insects (3.80 ± 0.37) days and lowest in citrus aphids (2.80 ± 0.37 days) and mealy bugs (2.80 ± 0.37 days). Hossain *et al.* (1995) observed that the mean incubation period of *M. sexmaculatus* was 3.5 ± 0.13 days on mustard aphid which was similar to that of the present study. Debaraj and Singh (1990) recorded that the incubation period of *C. transversalis* was 8 to 10 days using *A. craccivora* as host. Prodhan *et al.* (1995) reported that the incubation period of *M. discolor* was 2 to 4 days. Miller and Lamana (1995) reported that the incubation periods of *C. septempunctata* and *C. transversalis* were 4.5 to 5.0 and 3.0 to 4.0 days, respectively.

Table 2. Effect of food sources on the different reproductive parameters of *M. sexmaculatus*

Food Sources	Reproductive parameters		
	Fecundity (Number)	Hatching rate (%)	Sex ratio (Male: Female)
Bean aphid	251.20 ± 12.59 a	89.77 ± 2.51 a	0.92: 1.00
Mustard aphid	219.60 ± 12.18 b	88.03 ± 3.93 a	0.96: 1.00
Citrus aphid	232.00 ± 11.53 ab	91.52 ± 1.84 a	0.85: 1.00
Scale insect	238.00 ± 12.83 ab	85.64 ± 1.99 a	1.04: 1.00
Mealy bug	95.20 ± 13.49 c	82.20 ± 2.73 ab	1.00: 1.00

Means within a column followed by same letter(s) are not significantly different by DMRT ($p \leq 0.05$)

Effect of food sources on fecundity: The number of eggs laid by the female beetles on different food ranged from 95.20 ± 3.49 to 251.2 ± 12.59 (Table 2). The highest number (251.20 ± 12.59) was found when fed on bean aphid and lowest number (95.20 ± 3.49) was found when fed on mealy bug.

Effect of food sources on hatching rate: The highest rate of hatching was 91.52 ± 1.84% when fed on citrus aphid and lowest rate was 82.20 ± 2.73% when fed on mealy bug (Table 2). Gautom (1990) reported that on an average 71.57% eggs were hatched in *M. sexmaculatus.* Nirmala *et al*. (1996) recorded that the mean fecundity of *C. septempunctata* was 466.00 ± 1.96 when fed on cabbage aphid.

Sex Ratio: Sex ratio was determined by counting the number of adults (males and females) developed from the laboratory reared females. The average sex ratio of this beetle *M. sexmaculatus* was 0.85: 1.0 to 1.00: 1.00 (Table 2). The sex ratio was found to be the same when the scale insects and mealy bugs were supplied as food. Sex ratios were different when the beetles were fed on bean aphid, mustard aphid and citrus aphid. Singh and Singh (1993) reported that the sex ratio (female: male) of *C. septempunctata* was 1.4:1 in natural population. The sex ratio (male: female) of *M. discolor* was found 1.00: 0.96 when they were reared on bean aphid (Prodhan *et al*. 1995).

Effect of food substances on mortality of immature stages: Mortality rates of different larval instars and pupae have presented in table 3. Results showed that the 1st instar larval mortality ranged from 6.0 to 22.0%, 2nd instar 8.51 to 23.07%, 3rd instar 6.97 to 29.03%, 4th instar 15.00 to

36.36% and pupal mortality ranged from 12.00 to 42.85%. Results showed that different food sources have significant effect on the mortality of the immature states of *M. sexmaculatus*. It may be the cause of the suitability and nutritional quality of the foods.

Table 3. Effect of food sources on the mortality rate of immature *M. sexmaculatus*

Food Sources	Mortality rate (%) of larval instars and pupae				
	1st instar	2nd instar	3rd instar	4th instar	Pupa
Bean aphid	6.00 b	8.51 c	6.97 c	15.00 b	17.64 bc
Mustard aphid	18.00 ab	12.19 b	11.11 b	21.87 b	12.00 c
Citrus aphid	18.00 ab	19.51 ab	21.21 ab	19.21 b	33.33 b
Scale insect	22.00 a	23.07 a	23.33 ab	30.43 ab	37.50 ab
Mealy bug	22.00 a	20.51 a	29.03 a	36.36 a	42.85 a

Means within a column followed by same letter(s) are not significantly different by DMRT ($p \leq 0.05$)

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