

Study on Biology of Red Pumpkin Beetle in Sweet Gourd Plants

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ABSTRACT

An experiment was conducted to study the biology of red pumpkin beetle, *Aulacophora foveicollis* (Lucas.) under laboratory condition. Sweet gourd plants were used as host plant for studying biology the test insect. It was found that female red pumpkin beetle laid a range of 128 to 194 eggs with an average of 152.3 ± 20.9 . Oviposition period varied from 9 to 13 days with an average of 10.7 ± 1.2 days. The average length and breadth of egg at 1st, 2nd, 3rd and final instar larva and also pupa were 0.75 ± 0.08 mm and 0.60 ± 0.03 mm, 2.00 ± 0.12 mm and 0.41 ± 0.06 mm, 4.67 ± 0.44 mm and 0.65 ± 0.08 mm, 7.77 ± 0.18 mm and 0.83 ± 0.09 mm, 11.67 ± 0.88 mm and 2.07 ± 0.18 mm, 5.37 ± 0.29 mm and 113 ± 0.18 mm, respectively. Incubation period, larval period and pupal period were 11.53 ± 0.1 days, $16.674.33$ days and 12.38 ± 0.31 days, respectively. The average longevity of adult male and female was 40.67 ± 0.66 days and 47.33 ± 3.06 days, respectively.

Introduction

Among the major insect pests of cucurbit vegetables, red pumpkin beetle, *Aulacophora foveicollis* (Lucas.), (Coleoptera: Chrysomelidae) is one of the most important pest. The red pumpkin beetle is widely distributed throughout Bangladesh, India, Pakistan, Afghanistan, Ceylon, Myanmar, Indo-China, Iraq, Iran, Greece, Turkey, Israel, South Europe, Algeria, Egypt, Cyprus and the Andaman Island.

The beetle is an active, brilliant orange-red colored, about 7 mm long and about 2.6 mm broad insect. The grub is small yellowish white with a brownish head and when full-grown measures about 12 mm in length (Singh, 1970). In Bangladesh, the red pumpkin beetle is a serious pest of cucurbitaceous vegetables specially cucumber, white gourd, sweet gourd, bottle gourd, watermelon and muskmelon. The cucurbitaceous vegetables grown all the year round and it supplies a major portion of the vegetable foods. Both the adults and the grubs of red pumpkin beetle cause considerable damage to cucurbits during all stages of plant growth. Adults feed on the leaves, flowers and in some cases on fruits, while the grubs attack the roots, underground stem and leaves closely in touch with soil, thereby lowering the yield substantially. At the advent of spring the beetles defoliate the cucurbit seedlings to such an extent that, sometimes the crop has to be replant for 3 to 4 times (Alam, 1969). The adults feed on both surface of leaves, while the grub feed on the middle of the leaf and produce a characteristic, circular ring like injury. Adults feeding on flowers then they feed mainly on petals, but they also attack anthers, pollens, stigma and ovary rendering the flowers incapable of fruiting. The beetles also injure fruit, producing characteristic

circular bands of injury which help in rotting and subsequent attack of diseases of the fruits. No statistical records are available on the actual loss of the crops due to the attack of the pest. The pest, however, occurs throughout the year and causes severe damage to the crops especially at seedling stage. The life cycle of red pumpkin beetle from egg to adult emergence varies from 27 to 56 days and there are 6-8 overlapping generations a year (Roy & Pande, 1991). Maximum population of the insect is observed during April and May and then it shows a downward trend, the population again exhibits an upward trend in July and August. Thereafter there is a gradual decline in population. The adult population persists up to the middle of November. For the selection and execution of any plant protection program on the management of the pest, it is the basic requirement to study the biology of the pest. It is essential to have a fair knowledge on its behavior, fecundity longevity, mortality, growth pattern, which will help to ascertain the appropriate control measures for the management of the pest by reducing its population and damage to plants. However, research works on the biology, feeding behavior and food preference of red pumpkin beetle are scanty in Bangladesh. Therefore, the present study was undertaken to investigate the biology of red pumpkin beetle on sweet gourd plants under laboratory condition.

Materials and Methods

The experiments were conducted on the biology of red pumpkin beetle, *Aulacophora foveicollis* (Lucas.) in the laboratory of the Department of Entomology, Bangladesh Agricultural University, Mymensingh, Bangladesh during the period from January to April, 2007. The prevailing room temperature was 30 ± 2 °C with relative humidity $80 \pm 5\%$.

Food Sources

Sweet gourd (*Cucurbita moschata*) leaves were used as food for red pumpkin beetle. All the leaves were collected from Char Nilokhia, Mymensingh Sadar Thana, Mymensingh, Bangladesh. Das and Ishaque (1998b) recorded the food plants of *A. foveicollis* and the food plants were bottle gourd (*L. siceraria*), cucumber (*C. sativus*), watermelon (*Citrullus lanatus*), ridge gourd (*L. acutangula*), pointed gourd (*T. dioica*) and ash gourd (*B. hispida*).

Mass Culture of the Test Insect

In order to meet the demand of test insect, a stock culture of large number of grubs and adult beetles were maintained in the laboratory. For this purpose, the adults of *A. foveicollis* (Lucas.) were collected from the host plants of the farmer's field of Char Nilokhia. Breeding and rearing of the field collected insects were done in 9 cm × 1.5 cm diameter Petri-dishes in the laboratory. Adult beetles were sexed and confined in pairs in the petri-dishes for mating and oviposition. Fresh and healthy leaves of host plants were supplied every day for each pair of insect. The cut end of the leaf petiole was provided with water soaked cotton pad to prevent leaf from withering. After oviposition, adults beetle were transferred in different petri-dishes and the eggs were kept undisturbed for hatching. Immediately after hatching, the larvae were transferred in different petri-dishes; ten larvae per petri-dish were reared up to adult emergence. The newly emerged adults were again sexed and confined in pairs in petri-dishes for mating and laying eggs. This culture was maintained in order to avoid the effect of previous food plants on the biology of the test insect.

Biology

From laboratory stock, immediately after hatching larvae of red pumpkin beetle were carefully transferred to previously marked petri-dishes (dia 9.0 cm) with the help of a soft camel hair brush. Moistened soils were placed to cover the bottom of each petri-dish, Soils are moistened at every 24 hours interval. One grub was reared in each petri-dish. Fresh leaves of sweet gourd plants were given to the larvae at 24 hours interval in morning and uneaten leaves along with feces were removed. The cut end of the leaf petiole was provided with water soaked cotton pad to prevent leaf from withering. The larvae were observed daily until pupation to record the number of larval instars and their duration. Three replicates were used for the host plant. The petri-dishes were placed randomly on the table in the laboratory. Special care was taken to prevent even slight injury to the skin of the larvae and good hygienic condition was maintained in the rearing dishes. The pupae were kept in the respective Petri-dishes without causing any disturbance until the adult emergence to record pupal period. The length and breadth of larvae at each instars and pupae were measured and recorded.

Results and Discussion

Egg of red pumpkin beetle

The egg was oval in shape (Fig. 1). The length of the eggs varied from 0.60 mm to 0.85 mm with an average of 0.75 ± 0.08 mm. The breadth at the widest region averages at 0.60 ± 0.03 mm with a maximum of 0.65 mm and minimum of 0.55 mm. Under ordinary conditions the eggs appeared irregular in shape which may be due to the membranous chorion. Freshly laid egg was yellow color with a slight greenish tint. In dry environment, it becomes whitish while normal color was retained in moist environment. Before hatching no appreciable color change has been marked. A black spot like micropyle was visible at one pole of the egg. Eggs were laid singly or in batches on leaves that are closely associated with the moist soil. A female laid eggs from 128 to 194 on an average the number of eggs laid per female was 152.33 ± 20.93 (Table 1). Oviposition period varied from 9 to 13 days with an average of 10.67 ± 1.2 days. Almost same types of results were observed in a laboratory study by Das and Ishaque (1998a). They reported that the oviposition period of red pumpkin beetle varied from 10 to 15 days. Eggs were laid singly in batches of 34 to 75. Number of eggs laid per female ranged from 90 to 200 eggs. Alam (1969) also stated that the long axis of the egg varied from 0.69 to 0.89 mm with an average of 0.76 mm. The breadth was from 0.47 to 0.75 mm. These findings were also almost similar to the present study.

Hatching of eggs red pumpkin beetle

Moisture and shade were considered to be essential for hatching of eggs. The young grub ruptured the viteline membrane making vertical slit at the micropylar region. The young grub then gradually came out of the egg. Just at hatching the body color of the grub was whitish yellow. Afterwards, the color gradually became creamy. The percent of egg hatched ranged between 42.86 and 88.23 with an average of 73.37 ± 1.76 . Average incubation period of eggs was 11.53 ± 10.1 days with maximum 13 days and minimum 11 days. These results were in accordance with that found by Das and Ishaque (1998a) and Alam (1969).

Larva of red pumpkin beetle

Red pumpkin beetle moulted three times and had four larval instars. Just after hatching the grub was cruciform type, with yellowish head and the anal portion was brown in color. Just after hatching the grubs were measured maximum 2.2 mm and minimum 1.8 mm in length with an average of 2.00 ± 0.12 mm (Table 2). The average breadth of the grub was 0.41 ± 0.06 mm. The average duration of 1st instar larvae was 4.00 ± 0.00 days (Table 3). The average body length of the 2nd instar larvae was 4.67 ± 0.44 mm with maximum 5.5 mm and minimum 4.0 mm (Table 2). The breadth at the widest region of the body averages 0.65 ± 0.08 mm with maximum 0.80 mm and minimum 0.55 mm.

Table 1. Oviposition period, number of eggs laid, incubation period and hatching percentage of eggs of red pumpkin beetle, *A. foveicollis* reared under laboratory condition.

Developmental stages	Minimum	Maximum	Mean ± SE
Oviposition period (Days)	9	13	10.67 ± 1.2
Number of eggs laid per female	128	194	152.33 ± 20.93
Incubation period (Days)	11	13	11.53 ± 0.1
Hatching percentage	42.86	88.23	73.37 ± 1.76

Table 2. Morphometric measurement of different developmental stages of red pumpkin beetle, *A. foveicollis*.

Different stages of life cycle	Length (mm)			Breadth (mm)		
	Minimum	Maximum	Mean ± SE	Minimum	Maximum	Mean ± SE
Egg	0.60	0.85	0.75 ± 0.08	0.55	0.65	0.60 ± 0.03
1st Instar larva	1.8	2.2	2.00 ± 0.12	0.35	0.50	0.41 ± 0.06
2nd Instar larva	1.4	5.5	4.67 ± 0.44	0.55	0.80	0.65 ± 0.08
3rd Instar larva	7.4	8.0	7.77 ± 0.18	0.70	1.00	0.83 ± 0.09
4th Instar larva	10.0	13.0	11.67 ± 0.88	1.80	2.40	3.07 ± 0.18
Pupa	4.80	5.80	5.37 ± 0.29	2.80	3.40	3.13 ± 0.18
Adult male	5.50	7.00	6.42 ± 0.46	2.50	3.10	2.78 ± 0.17
Adult female	6.75	9.00	8.00 ± 0.66	2.75	3.50	3.06 ± 0.24

Table 3. Duration of different developmental stages of red pumpkin beetle, *A. foveicollis* reared on leaf of sweet gourd plant under laboratory condition.

Different stages of life cycle	Duration (Days)		
	Minimum	Maximum	Mean ±SE
1st Instar larva	4	4	4.00 ± 0.00
2nd Instar larva	4	5	4.33 ± 0.33
3rd Instar larva	4	3	3.67 ± 0.33
4th Instar larva	4	5	4.67 ± 0.33
Total larval period	16	17	16.67 ± 0.33
Pupal period	12	13	12.33 ± 0.33
Total developmental period from egg to adult	45	47	46.00 ± 0.58
Adult longevity of male	40	42	40.67 ± 0.66
Adult longevity of female	44	50	47.33 ± 1.77

It was easily distinguishable from the first instar larvae by size. Feeding habit, reaction to light and movement were same as in first instar. The duration of 2nd instar was 4 to 5 days with an average 4.33 ± 0.33 days (Table 3). The third instar larvae measured maximum 8.0 mm and minimum 7.4 mm in length with an average of 7.77 ± 0.18 mm. The breadth was maximum 1.0 mm and minimum 0.7 mm with an average of 0.83 ± 0.09 mm. Feeding of the larvae was increased at this instar and their movement was crawling in nature. The duration of the 3rd instar larvae ranged from 3 to 4 days with an average of 3.67 ± 0.33 days (Table 3). The fourth instar or full-fed larvae represent the typical grub of the species. It was cruciform without ventral prolegs. The body was elongate, cylindrical and slightly broader towards posterior region. Head was small as compared to the body and deep brown in color and sclerotized. The body was creamy in color with smooth and soft non-sclerotized integument. After third moulting body appeared wrinkled and a bit flattened dorso-ventrally.

Later on after feeding the full-fed grub assumed the robust and cylindrical shape unlike the first instar. The length of the final instars larvae ranged from 10.00 mm to 13.00 mm with an average of 11.67 ± 0.88 mm. The breadth ranged from 2.80 mm to 3.40 mm with an average of 3.13 ± 0.18 mm (Table 2). During the last instar, the grubs take maximum food and feed voraciously. They feed on cucurbit leaf. Duration of 4th or full-fed larvae ranged from 4 to 5 days with an average of 4.67 ± 0.33 days. The total larval period ranged from 16 to 17 days with an

average of 16.671 ± 0.33 days (Table 3). The present findings were also comply with the findings of Das and Ishaque (1998a). They reported larval period of 18.90 to 20.60 days while Alam (1969) also stated that duration of each larval instar varied from 3 to 6 days. Just after hatching the grub measured 1.91 mm in length and 0.39 mm in breadth on an average. Length and breadth of the full-fed grubs were from 9.50 to 13.00 mm and 1.00 to 1.75 mm, respectively.



Fig. 1. Eggs of Red Pumpkin Beetle, *Aulacophora foveicollis* on Sweet Gourd leaf.

Pupa of red pumpkin beetle

Fully developed larvae stopped feeding and movement and then moved to the soil for pupation. It constructed an oval and almost water proof whitish earthen cell. It then rests inside the cocoon and remains motionless with the body slightly curved. The pupa was greenish yellow in color with hypognathous head, wider at the thoracic region and narrower towards the caudal region. The pupa was exarate type and the length of the pupa ranged from 4.80 mm to 5.80 mm with an average of 5.37 ± 0.29 mm. The breadth ranged from 2.80 mm to 3.402 mm with an average of 3.13 ± 0.18 mm. The average duration of the pupal period was 12.33 ± 0.33 days with maximum 13 days and minimum 12 days. Reeta and Johri (2003c) observed that incubation, larval and pupal periods of red pumpkin beetle *A. foveicollis* on various species of cucurbit plants were lowest during pre-monsoon (7.00, 11.00 and 7.94 days) followed by monsoon (10.00, 13.00 and 9.26 days) and post-monsoon (15.00, 14.74 and 15.02 days) periods.

Adult of red pumpkin beetle

Just after emergence they were not active, move slowly. The adults looked light brownish in color with a very soft body. After emergence the elytra covered the entire abdomen in both the sexes, but during later period considerable portion of the last abdominal segments remains uncovered with the elytra. In case of the male the uncovered portion was a bit smaller. The elytra appeared black, gradually the color deepens and body gets hardened to its usual color and texture. It required about a week to assume its natural state. The head, antennae and legs were yellow, the thorax was brownish yellow, elytra reddish orange, ventral side of the abdomen was black with shining small hairs. The head was hypognathous and strongly sclerotized. Fully developed beetle was red orange in color with metallic tint. The adult male measured 5.50 mm to 7.00 mm in length with an average of 6.42 ± 0.46 mm and the breadth measured 2.50 mm to 3.10 mm with an average of 2.78 ± 0.17 mm. The adult female was slightly larger than the male and measured 6.75 mm to 9.00 mm in length with an average of 8.00 ± 0.66 mm. The breadth of the adult female ranged from 2.75 mm to 3.50 mm with averages of 3.03 ± 0.24 mm (Table 2). The longevity of adult male ranged from 40 to 42 days with an average of 40.67 ± 0.66 days while the

longevity of adult female ranged from 44 to 50 days with an average of 47.33 ± 1.77 days (Table 3). The present findings were in agreement with the results of Alam (1969). He reported that the adult male of red pumpkin beetle measured 5.5 mm to 6.75 mm in length with an average of 6.25 mm. The breadth averages 2.45 mm. The adult female was slightly larger than the male and was 6.25 to 8.25 mm in length with an average of 6.75 mm. The breadth averages 3.01 mm.

Conclusion

Knowledge of the biology and ecology of insect and mite pests and their natural enemies is a prerequisite for pest management methods compatible with Integrated Pest Management. A successful management plan requires information about a species biology including its diet and lifecycle. So the present study was conducted to study the biology of red pumpkin beetle. A female laid eggs with an average of 152.33 ± 20.93 and incubation period was 11.53 ± 0.1 days. The larvae moulted three times and had four instar. The grubs were cruciform. The pupae were greenish in color. Fully developed beetle was red orange in color with metallic tint. Both the adults and larvae cause damage to the host plants.

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