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Studies on biology of red pumpkin beetle, *Aulacophora foveicollis* Lucas under Vaishali, Bihar, India.

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Abstract- An experiment was conducted under laboratory conditions for the investigation of the different aspects of biology of *Aulacophora foveicollis* Lucas, the red pumpkin beetle, is a species of beetle belongs to the family Chrysomelidae under the order Coleoptera and class insecta or hexapoda. The most favorite sweet gourd and bottle gourd plants were selected /used as a host plants for feeding to conduct this research. The sexually matured female red pumpkin beetle laid eggs loosely in a bunch of 110 to 180 eggs on the underside of the leaf of cucurbit plants with an average of 140.5 ± 29.8 . The eggs were oval in shape and yellow in color and incubated for 11.7 ± 0.2 days and hatchability percentage was 85.14 ± 1.24 . The newly-hatched larvae were pale yellow in color with dull brown heads. The larval period was 12.05 ± 0.14 days. The pupation occurred in earthen cell. The pupa was an exarate type with naked appendages. The fully-developed pupa was yellowish in color with red eyes. The pupal periods varied in different monsoon periods. Wings of the newly-emerged adults were dull-brownish in color; later, with the advancement of adult age, the wings turned bright orange-red. Sexual dimorphism was observed in adults. The longevity of male and females was 62.70 ± 2.70 and 63.05 ± 1.68 days, respectively. A pair was able to mate 15 times. In case of multiple mating, a male was found to mate 7 virgin females, whereas, a female was mated by 6 virgin males. The first mating was found on 9.21 ± 0.24 days after emergence. The mating period was continued up to 12.15 ± 0.47 days from the day of first mating. The mean pre-oviposition period was 6.70 ± 0.28 days. The egg laying activity was continued by the female up to 8.6 ± 0.54 days, which was the oviposition period. The near post-oviposition period (last egg laying to death of females) was 25.0/11.02. The adult longevity of females was slightly higher than the male (63.05 ± 1.68 days for female and 62.70 ± 2.4 days for male).

Key words: *Aulacophora foveicollis*, Sexual dimorphism, hexapoda

INTRODUCTION

In Vaishali, India, the red pumpkin beetle, *Aulacophora foveicollis* Lucas is widely spread severe pest of cucurbitaceous vegetables such as cucumber, sweet gourd, bottle gourd, bitter gourd, watermelon, muskmelon etc. The beetle is an active, brilliant orange-red colored, about 7 mm long and about 2.6 mm broad insect. The larva

is small yellowish-white with brownish head whereas adult is a approximately 12 mm in length.¹ The cucurbitaceous vegetables are grown all the year- round, and it supplies a significant portion of the vegetable foods. Both the adults and the larva of the red pumpkin beetle cause considerable damage to cucurbits in almost all stages of plant development. Adults mostly attack the above ground parts, while the larva attacks the part touching the soil, thereby lowering the yield substantially. During spring, the beetles feed on the cucurbit seedlings to such a limit that re sowing

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may be required 3-4 times.^{2,3} The adults feed on both surfaces of leaves, while the larva feeds on the middle of the leaf and produces a quality, circular ring-like injury. Adults feeding on flowers and make them sterile. The beetles also cause injury to the fruit. The pest has a regular occurrence and cause serious damage at seedling stage. The life cycle of this pest is completed in 27 to 56 days, which includes 6-8 overlapping generations in a year.^{4,5} The insect population reaches its peak during April and May as well as in July and August. The adult population persists up to the middle of November. It is essential to have a fair concept of its behaviour, fecundity, longevity, mortality, and growth pattern to establish the appropriate control measures for managing the pest by reducing its population and injury to plants. However, research works on the biology, feeding habits, and food choice of red pumpkin beetle are insufficient in India & hence the present study was carried out to know the biology of the red pumpkin beetle under laboratory conditions.

MATERIALS & METHOD:

Mass Culture of the Test Insect.

In order to fulfill the required stock of pest insects for investigation, culture of larvae and adult beetles were done in the laboratory. To meet the requirement, the adults of red pumpkin beetle were collected from the host plants. The collected insects were carried out in Petri-dishes under laboratory conditions. Adults of both the sexes were allowed to mate and left in the petri-dishes for oviposition. The leaves of host plants were provided as food source of the beetles. Once oviposition was completed, the adult beetles were shifted to different Petri-dishes and the eggs were kept for hatching & after hatching, the larvae were transferred in different Petri-dishes; ten larvae per petridish were allowed for emergence. Newly emerged adults were again allowed to mate and left in Petri dishes for mating and laying eggs.

Biology

During the lab culture, after hatching, the larvae of red pumpkin beetle were shifted to marked petri-dishes with the help of a soft camel hair brush. The bottom of each petri-dish was covered with wet soil. Only one larva/grub was left per petri-dish for rearing. For proper development, the larvae were provided with fresh leaves of host plants at 24 hours intervals & the uneaten leaves were cleaned along with the faecal matter. To keep the

leaves fresh, it is surrounded with cotton buds. The larvae were observed on a routine basis until they turned into pupa, and the numbers of larval instars were recorded along with the duration. The pupae were kept in the respective Petri-dishes without causing any disturbance until the adult emergence to record the pupal period. The length and width of larvae at each instars and pupae were measured and recorded & were statistically analyzed.

RESULTS & DISCUSSION

Egg of red pumpkin beetle

The egg was oval in shape; the extent of the eggs varied from 0.56 mm to 0.80 mm, with an average of 0.64 ± 0.08 mm. The breadth at the broadest region averages 0.70 ± 0.14 mm with a highest of 0.60 mm and a lowest of 0.55 mm. Before hatching, no appreciable color change has been marked. A black spot like a micropyle was visible at one pole of the egg. Eggs were laid singly or in batches on leaves that are intimately linked with the damp soil. A female laid eggs from 128 to 194 on average. The number of eggs laid per female was 152.33 ± 20.93 . Oviposition periods varied from 5 days with an average of 5.00 ± 0.00 days. Eggs were laid singly or in batches of 34 to 75. The number of eggs laid per female ranged from 90 to 200 eggs.

Larva of red pumpkin beetle

Red pumpkin beetle molted three times, and there were four larval instars. Immediately after hatching the larva/grub was a cruciform type, with a yellowish head & brown anal portion. Just after hatching the larvae were measured highest 2.6 mm and a lowest 1.8 mm in length with an average of 3.00 ± 0.32 mm (Table 1). The average width of the larva was 0.51 ± 0.08 mm. The average duration of 1st instar larva was 5.00 ± 0.00 days (Table 2). The average body length of the 2nd instar larva was 5.65 ± 0.55 mm, with a maximum of 5.4 mm and a minimum of 1.5 mm. The breadth at the widest region of the body averages 0.76 ± 0.08 mm with a maximum of 0.75 mm and a minimum of 0.52 mm. It was simply distinguishable from the first instar larva by size. All other tested parameters like Feeding habit, reaction to light, and movement were the same as in the first instar. The duration of 2nd instar was 3 to 5 days with an average 4.34 ± 0.35 days (Table 2). The third instar larva measured a highest of 7.8 mm and a lowest 7.3 mm in length with an average of 9.76 ± 0.27 mm. The breadth was a maximum 1.08 mm and a minimum

0.71mm with an average of 0.93 ± 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 larva ranged from 5 to 6 days with an average of 5.66 ± 0.34 days (Table 2). The fourth instar or full-fed larvae represent the typical grub of the species. It was cruciform without ventral pro legs. The body was elongated, cylindrical, and slightly broader towards the posterior region. The head was small as compared to the body and deep brown in colour and sclerotized. The body was creamy in color with a smooth and soft non-sclerotized integument. After the third moulting, body appeared wrinkled and a bit flattened dorso-ventrally. Later on, after feeding, the full-fed grub assumed a robust and cylindrical shape, unlike the first instar. The length of the final instar larvae ranged from 9.70 mm to 12.50 mm with an average of 21.66 ± 0.87 mm. The breadth ranged from 1.70 mm to 2.55 mm with an average of 4.07 ± 0.30 mm (Table 1). During the last instar, the grubs take maximum food and feed voraciously. They feed on cucurbit leaves. Duration of 4th or full-fledged larvae ranged from

6 to 7 days with an average of 6.66 ± 0.35 days. The present findings also complied with the results of Das and Ishaque (1998a)⁶. They reported a larval period of 18.90 to 20.60 days, while Alam (1969)² and Tripathy *et al.* (2020)⁷ also stated that the 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 average. The size and breadth of the full-fed grubs were from 9.50 to 13.00 mm and 1.00 to 1.75 mm, respectively.

Pupa of red pumpkin beetle

The fully developed larvae stopped feeding and moved to the soil for pupation. It constructed an oval earthen cell. It then rests inside the cocoon and remains motionless, with the body slightly curved. The pupa was greenish-yellow in color with a hypognathous head, wider at the thoracic region and narrower towards the caudal region. The length of the pupa ranged from 4.35 mm to 5.40 mm with an average of 6.36 ± 0.38 mm. The breadth ranged from 2.58 mm to 2.75 mm with an average of 4.14 ± 0.27 mm. The average duration of the pupal period was

Table 1- Morphometric Measurement of different developmental stages of red pumpkin beetle *Aulacophora foveicollis*.

Different stages of Life Cycle	Length			Width		
	Minimum	Maximum	Mean \pm SE	Minimum	Maximum	Mean \pm SE
Eggs	0.56	0.80	0.64 ± 0.08	0.55	0.60	0.70 ± 0.14
1 st Instar larva	1.8	2.6	3.00 ± 0.36	0.32	0.55	0.51 ± 0.08
2 nd Instar larva	1.5	5.3	5.65 ± 0.55	0.52	0.75	0.76 ± 0.08
3 rd Instar larva	7.3	7.8	9.76 ± 0.27	0.71	1.08	0.92 ± 0.09
4 th Instar larva	9.7	12.5	21.66 ± 0.87	1.70	2.55	4.07 ± 0.30
Pupa	4.5	5.4	6.36 ± 0.38	2.58	2.75	4.14 ± 0.27
Adult male	5.4	7.4	7.41 ± 0.55	2.76	2.80	3.78 ± 0.28
Adult female	6.8	10.5	7.00 ± 0.45	2.68	3.59	4.06 ± 0.36

Table 2- Duration of different developmental stages of red pumpkin beetle *Aulacophora foveicollis* reared under laboratory condition.

Different stages of Life Cycle	Duration		
	Minimum	Maximum	Mean \pm SE
Eggs	5	5	05.00 ± 0.00
1 st Instar larva	5	5	05.00 ± 0.00
2 nd Instar larva	3	5	04.34 ± 0.35
3 rd Instar larva	5	6	05.66 ± 0.34
4 th Instar larva	6	7	06.66 ± 0.35
Pupa	13	14	12.33 ± 0.33
Adult male	43	46	45.67 ± 0.66
Adult female	42	47	44.66 ± 0.65

12.33 ± 0.33 days with a maximum of 14 days and a minimum of 13 days. Reeta and Johri (2003)⁸ observed that incubation, larval and pupal periods of red pumpkin beetle is 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, 14.72 and 15.05 days) periods.

Adult of red pumpkin beetle

After the emergence the adult was not so active & moving slowly. The adults looked light brownish with a very soft body. After emergence, the elytra covered the entire abdomen in both sexes, but during a later period, a considerable portion of the last abdominal segments remains uncovered with the elytra. In the case of the male, the exposed portion was a bit smaller. The elytra appeared black, gradually the color deepens, and the body gets hardened to its usual colour 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, and the ventral side of the abdomen was black with shining tiny hairs. The head was hypognathous and strongly sclerotized. The fully developed beetle was red-orange with a metallic tint. The adult male measured 5.40 mm to 7.40 mm in length with an average of 7.41 ± 0.55 mm, and the breadth measured 2.76mm to 2.80 mm with an average of 3.78 ± 0.28 mm. The adult female was slightly larger than the male and measured 6.80 mm to 10.50 mm in length with an average of 7.00 ± 0.45 mm. The breadth of the adult female ranged from 2.68 mm to 3.59 mm with standards of 4.06 ± 0.36 mm (Table 1). The longevity of adult males ranged from 43 to 46 days with an average of 45.67 ± 0.66 days, while the longevity of adult females ranged from 42 to 47 days with an average of 44.66 ± 0.65 days (Table. 2).

CONCLUSION

The full concept of the biology of a pest is essential for successful pest management strategies. A successful management plan requires information about the biology, such as the nature of food and feeding behaviour, fecundity, fertility and lifecycle for effective pest management. A female laid eggs with an average of 152.33 ± 20.93, and the incubation period was 11.53 ± 0.1 days. The larvae

moulted three times and had four instars. The larvae/grubs were cruciform. The pupae were greenish in color. The fully developed beetle was red-orange in color with a metallic tint. Both the adults and larvae cause damage to the host plants.

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