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**THE BIOLOGY OF PUMPKIN BEETLES, *Aulacophora foveicollis* (Lucas)
AND *Aulacophora nigripennis* (Motschulsky)
(Coleoptera: Chrysomelidae) FROM TAMIL NADU, INDIA**

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Abstract

The present study was conducted to study the biology of pumpkin beetles, *Aulacophora foveicollis* (Lucas) and *Aulacophora nigripennis* (Motschulsky) under laboratory condition. *A. foveicollis* female were laid an egg with a range of 67 to 98 eggs with an average of 82.50 ± 5.20 and *A. nigripennis* 40 - 70 eggs laid per female. The oviposition period varied from 9 - 13 and 8 -12 days with an average of 10.67 ± 1.2 and 10.00 ± 0.76 days. In *A. foveicollis* the average length of egg, 1st, 2nd, 3rd and final instar larva and pupa length were 0.75 ± 0.08 mm, 2.00 ± 0.012 mm, 4.67 ± 0.44 mm, 7.77 ± 0.18 mm, 11.67 ± 0.88 mm and 5.37 ± 0.29 mm and the breadth were measured 0.60 ± 0.03 mm, 0.41 ± 0.06 mm, 0.65 ± 0.08 mm, 0.83 ± 0.09 mm and 2.07 ± 0.18 mm 3.13 ± 0.18 mm respectively. In *A. nigripennis*, the average length of egg, 1st, 2nd, 3rd and final instar larva and pupa were 0.67 ± 0.06 mm, 1.80 ± 0.16 mm, 3.75 ± 0.88 mm, 6.70 ± 0.08 mm, 9.20 ± 0.20 mm and 4.50 ± 0.38 mm and the breadth were measured 0.55 ± 0.05 mm, 0.35 ± 0.03 mm, 0.57 ± 0.05 mm, 0.83 ± 0.07 mm, 1.80 ± 0.15 mm and 2.75 ± 0.24 mm. The average of longevity of adult male and female *A. foveicollis* was 42.51 ± 3.24 mm and 48.01 ± 3.66 mm. In *A. nigripennis* 40.67 ± 0.66 and 47.33 ± 1.77 days respectively. The adult male and female *A. foveicollis* length and breadth was measured about 6.42 ± 0.46 mm, 2.78 ± 0.17 mm and 8.00 ± 0.66 mm, 3.06 ± 0.24 mm. In *A. nigripennis* adult male and female, length and breadth was measured about 6.00 ± 0.68 mm, 2.50 ± 0.23 mm and 7.70 ± 0.66 mm, 2.85 ± 0.23 mm. The present study clearly demonstrated that the length, breadth in different instars and adult *A. foveicollis* are somewhat bigger in size compare to *A. nigripennis*. The egg laying, oviposition period, incubation, hatching percentage and longevity of adult male and female was varied in both species.

Key words: *Aulacophora foveicollis*, *Aulacophora nigripennis*, Egg laying, Oviposition period, Incubation, Hatching percentage and Longevity.

1. Introduction

Among the major pests of cucurbit vegetables and pumpkin beetles are the most important pest. The red pumpkin beetle is widely distributed throughout India, Bangladesh, Pakistan, Afghanistan, Ceylon, Burma, Indo-China, Iraq, Iran, Greece, Turkey, Israel, South

Europe, Algeria, Egypt, Cyprus and Andaman Island. *A. foveicollis* is active, brilliant orange - red coloured and *A. nigripennis* black with orange coloured, but grubs are small yellowish white with a brownish head and when full-grown measures about 12 mm in length (Singh, 1970).

In India the pumpkin beetles, *A. foveicollis* and *A. nigripennis* are the serious pest of cucurbitaceous vegetables particularly cucumber,

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white gourd, sweet gourd, bottle gourd, muskmelon and watermelon. Adult feed on the leaves, flowers and in some causes on fruits while the groups 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 resown for 3 to 4 times (Alam, 1969).

Life cycle of red pumpkin beetles from egg to adult emergence varies from 27 to 56 days and there are 6 - 8 overlapping generations a year (Roy and Pandae, 1991). Maximum population of the insect is observed during April and May and then it shows a downward trend, the population again exhibits and upward trends in July and August. However, in the present study on the biology of pumpkin beetles *A. foveicollis* and *A. nigripennis* are scarce in India. Here, an attempt has been made to fill up this lacuna.

2. Materials and Methods

The experiments were conducted on the biology of pumpkin beetles, *A. foveicollis* and *A. nigripennis* in the laboratory of the Department of Zoology, Annamalai University, Tamil Nadu, India. The prevailing room temperature was 30 ± 2 °C with relative humidity 80 ± 5 %.

Collection site

Insects were collected from the vicinity of Annamalai University, by hand picking during the early morning before 11.00 A.M. from the cucurbitaceous plants during their feeding time. These insects are moderate flier and easy to pickup.

Plant materials

Bottle gourd (*Lagenaria vulgaris*), Sweet gourd (*Cucurbita moschata*, Duck) and cucumber leaves were used as food for pumpkin beetles *A. foveicollis* and *A. nigripennis*. All the fresh leaves were collected daily from the vicinity of Annamalai University, Tamil Nadu, India.

Rearing technique

Plastic rearing tray of 12" × 8" × 6" have been used for this study. The tray was smeared with soil taken from the field and made a bed of 2" thick soils were moistened at every 24 hrs interval in the laboratory. Adult beetles were sexed and confined in pairs in the plastic tray for matting and oviposition. Freshly and healthy leaves of plants materials were supplied every day for each pair of insect. After oviposition, adult beetles were transferred in different plastic trays and the eggs were kept undisturbed for hatching. Immediately after hatching, the larvae were transferred in different plastic trays. Ten larvae per tray were reared up to adult emergence. The length and breadth of larvae at each instar and pupae were measured.

Statistical analysis

Data obtained from the experiments were analyzed using Mean $\pm$ SE was used in this study.

3. Result and Discussion

Egg

The egg was oval in shape. The length of the *A. foveicollis* eggs varied from 0.60 mm to 0.85 mm with an average of 0.75 ± 0.08 mm and the breadth was measured about 0.60 ± 0.03 mm with a maximum of 0.65 mm and minimum of 0.55 mm. *A. nigripennis* eggs varied from 0.60 mm to 0.75 mm with an average of and 0.67 ± 0.06 mm. The breadth at the widest region averages at 0.55 ± 0.05 with a maximum of 0.60 mm and minimum of 0.50 mm (Table - 2 and 3). Under ordinary conditions the eggs appeared irregular in shape which may be due to the membranous chorion. Freshly laid egg was yellow colour with slight greenish tint. In dry environment before hatching no appreciable colour change has been marked. A black spot like micropyle was visible at pole of the egg.

Eggs were laid singly or in batches on leaves that were closely associated with the moist soil and leaves (Fig. 1 and 7). Both *A. foveicollis*



and *A. nigripennis* females laid eggs from 67 -98 and 40 - 70 (Table - 1). The average number of eggs laid per female of *A. foveicollis* was 82.50 ± 5.20 . Oviposition period varied from 9 to 13 days with an average of 10.67 ± 1.2 days (Table - 1). Almost same type of results was observed in a laboratory study by Azizul Bari (2007) and Das and Ishaque (1998). They reported that the oviposition period of 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) and Azizul Bari (2007) 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. In *A. nigripennis* the average number of eggs laid per female was 55.01 ± 4.19 and the oviposition period was 10.00 ± 0.76 . In the present study, *A. nigripennis* biology first time we recorded.

Hatching of eggs

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 colour of the grub was whitish yellow. Afterwards, the colour gradually became creamy. The per cent of *A. foveicollis* eggs hatched ranged among 42.86 to 88.23 with an average of 73.37 ± 1.76 days. The average incubation period of was 11.53 ± 0.1 days with maximum 13 days and minimum 11 days (Table - 1). These were in accordance with that found by Azizul Bari (2007); Das and Ishaque (1998) and Alam (1969). In a laboratory study, Roy and Pandae (1991) found that the most favorable temperature for development and survival of the pumpkin beetle was 27.5°C days. The egg, larval and pupal stages lasted 8.3 - 15.8, 12.6 - 18.1 and 10.0 - 15.2 days respectively. In *A. nigripennis*, the hatching percentage was maximum 78.23 and minimum of 40.56 days and the incubation period was maximum 10 days and minimum 5 days (Table - 1).

Larva

Pumpkin beetles, *A. foveicollis* and *A. nigripennis* 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 colour (Fig. 2 - 4) and (Fig. 8 - 10). Just after hatching the grub *A. foveicollis* was measured maximum 2.2 mm and minimum 1.8 mm with an average of 2.00 ± 0.012 mm (Table - 2). In *A. nigripennis* maximum 2.1 mm and minimum 1.5 mm in length with an average of 1.80 ± 0.16 mm (Table - 3). The average breadth of 1st larval grub of *A. foveicollis* and *A. nigripennis* was 0.41 ± 0.06 mm and 0.35 ± 0.03 mm respectively. The average duration of 1st instars larvae was 4.00 ± 0.00 and 2.00 ± 0.15 days (Table - 5 and 6). In *A. nigripennis* average body length of the 2nd instars larvae was 4.67 ± 0.44 mm with maximum 5.5 mm and minimum 4.0 mm (Table - 2). In *A. nigripennis* the average body length of 2nd instar was 3.75 ± 0.88 with maximum 4.5 mm and minimum 3.0 mm (Table - 3). The breadth at the widest region of the body averages 0.65 ± 0.08 mm *A. foveicollis* and 0.57 ± 0.05 mm *A. nigripennis* with maximum 0.80 mm and minimum 0.55 mm and 0.65 mm and 0.50 mm. It was easily distinguishable from the first instar. The duration of 2nd instar in *A. foveicollis* 4 - 5 days and *A. nigripennis* 3 days, with an average of 4.33 ± 0.33 and 3.00 ± 0.0 days (Table - 4 and 5). The third instar larva of *A. foveicollis* measured maximum 8.0 mm, 7.4 mm and in length with an average of 7.77 ± 0.18 mm. The breadth was maximum 1.0 mm and minimum 0.70 mm with an average of 0.83 ± 0.09 mm (Table - 2). In *A. nigripennis*, 3rd instar larva length measured maximum 7.0 mm and minimum 6.4 mm with an average of 6.70 ± 0.88 . The breadth was measured maximum 0.98 mm and minimum 0.68 mm with an average of 0.83 ± 0.07 (Table - 3). Feeding of the both larvae was increased at this instar and their movement was crawling in nature. The duration of the 3rd instar larvae *A. foveicollis* ranged from 3 to 4 days with an average of 3.67 ± 0.33 days (Table - 4). In *A. nigripennis* the average duration of the third instar was 3 days with an average of 3.00 ± 0.23 (Table - 5).



The fourth instar or full-fed larvae represent the typical grub of the species. It was cruciform with 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 colour and sclerotized (Fig. 4 and 10). The body was creamy in colour with smooth and soft unsclerotized integument. After third moulting body appeared wrinkled and a bit flattened dorsoventrally. Later on after feeding the full-fed grub assumed the robust and cylindrical shape unlike the first instar. The length of the final instar larvae ranged from maximum 13.00 mm and minimum 10.00 mm with an average of 11.67 ± 0.88 mm. The breadth ranged from maximum 2.40 mm and minimum 1.80 mm with an average of 2.07 ± 0.18 mm (Table - 2). During last instar of *A. foveicollis*, 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 (Table - 4). The present result were also complying with the findings of Azizul Bari (2007); Das and Ishaque (1998) and Alam (1969) also state 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 grub were from 9.50 to 13.00 mm and 1.00 to 1.75 mm respectively. In *A. nigripennis*, 4th instar larva length measured maximum 11.0 mm and minimum 8.0 mm with an average of 9.20 ± 0.20 . The breadth was measured maximum 2.0 mm and minimum 1.60 mm with an average of 1.80 ± 0.15 (Table - 3). The average duration of the fourth instar larva of *A. nigripennis* 5 - 6 days with an average of 5.50 ± 0.42 (Table - 5). In the present findings of *A. nigripennis* biology was first time we recorded in India.

Pupa

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

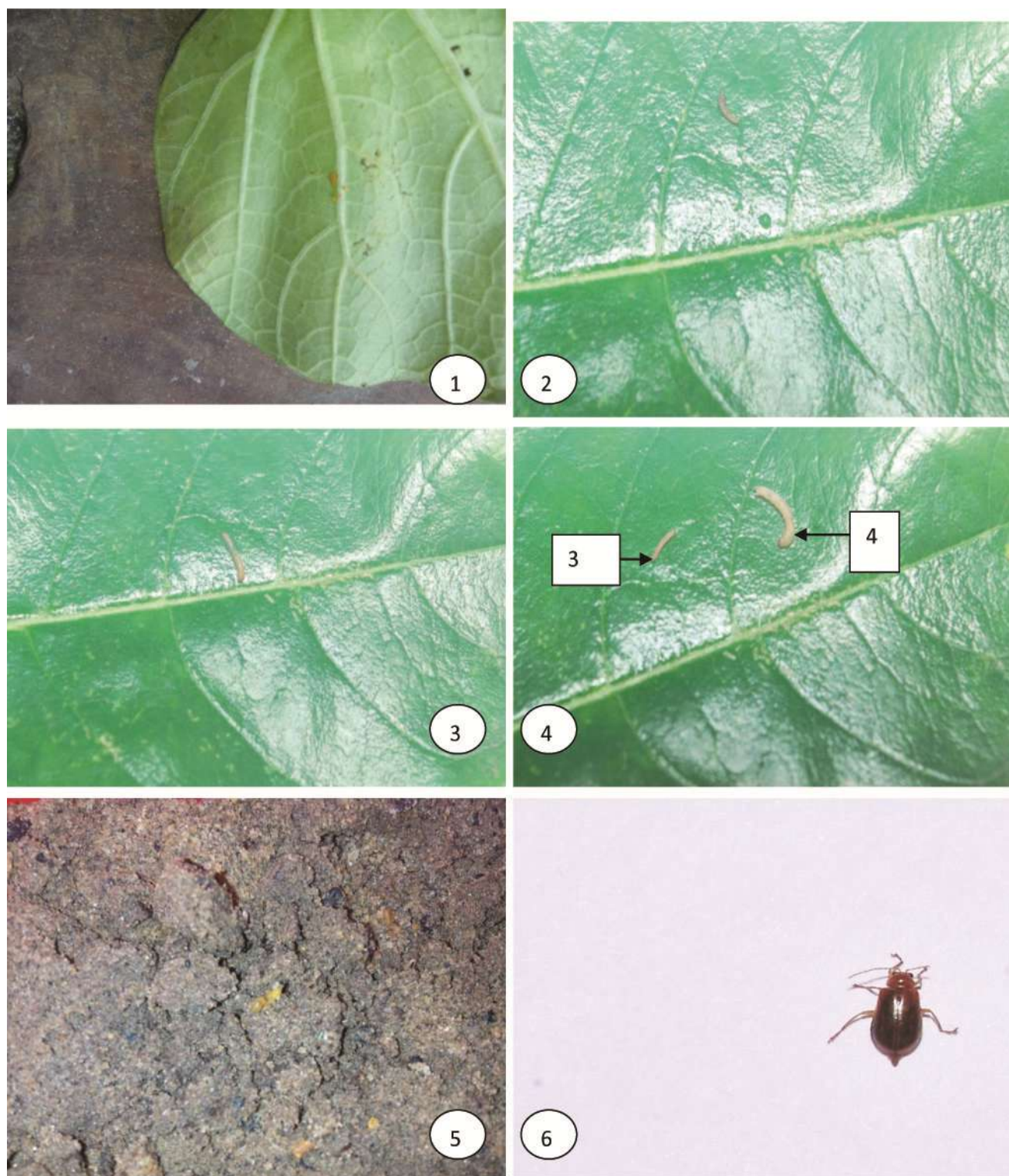
colour with hypognathus head, wider at the thoracic region and narrower towards the caudal region (Fig. 5 and 11). The pupa *A. foveicollis* was excrete type and the length of the pupa ranged from maximum 5.80 mm and minimum 4.80 mm with an average of 5.37 ± 0.29 mm. The breadth ranged from maximum 3.40 mm and minimum 2.80 mm with an average of 3.07 ± 0.18 mm (Table - 2). The average duration of the pupal period was 12.33 ± 0.33 days with maximum 13 days and minimum 12 days (Table - 4). The present study was attest to that of Azizul Bari (2007). Reeta and Johri (2003) observed that incubation, larval and pupal periods of pumpkin beetle *A. foveicollis* on various species of cucurbit plants were lowest during pre-monsoon (7.00, 11.00 and 7.94 days) in the month of July and February when relative humidity ranged at 70.55 and 60.60 %.

In *A. nigripennis* pupa length measured maximum 5.0 mm and minimum 4.0 mm with an average of 4.50 ± 0.38 . The breadth was measured maximum 3.10 mm and minimum 2.40 mm with an average of 2.75 ± 0.24 (Table - 3). The average duration of the pupal period was 12 - 16 days with an average of 14.00 ± 1.07 (Table - 5). In the present findings of *A. nigripennis* biology was slightly different to *A. foveicollis*.

Adult

Just after emergence they were not active, move slowly. The adults looked light brownish in colour with a very soft body. After emergence, the elytra covered the entire abdomen in the both sexes, but during latter period considerable portion of the last abdominal segments remains uncovered with the elytra. In case of the male uncovered portion was a bit smaller. In *A. nigripennis* the elytra appeared black, gradually the colour deepens and body gets hardened to its usual colour and texture. It required about a week to assume its natural state. In *A. foveicollis* 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 hypognathus and strongly sclerotized.

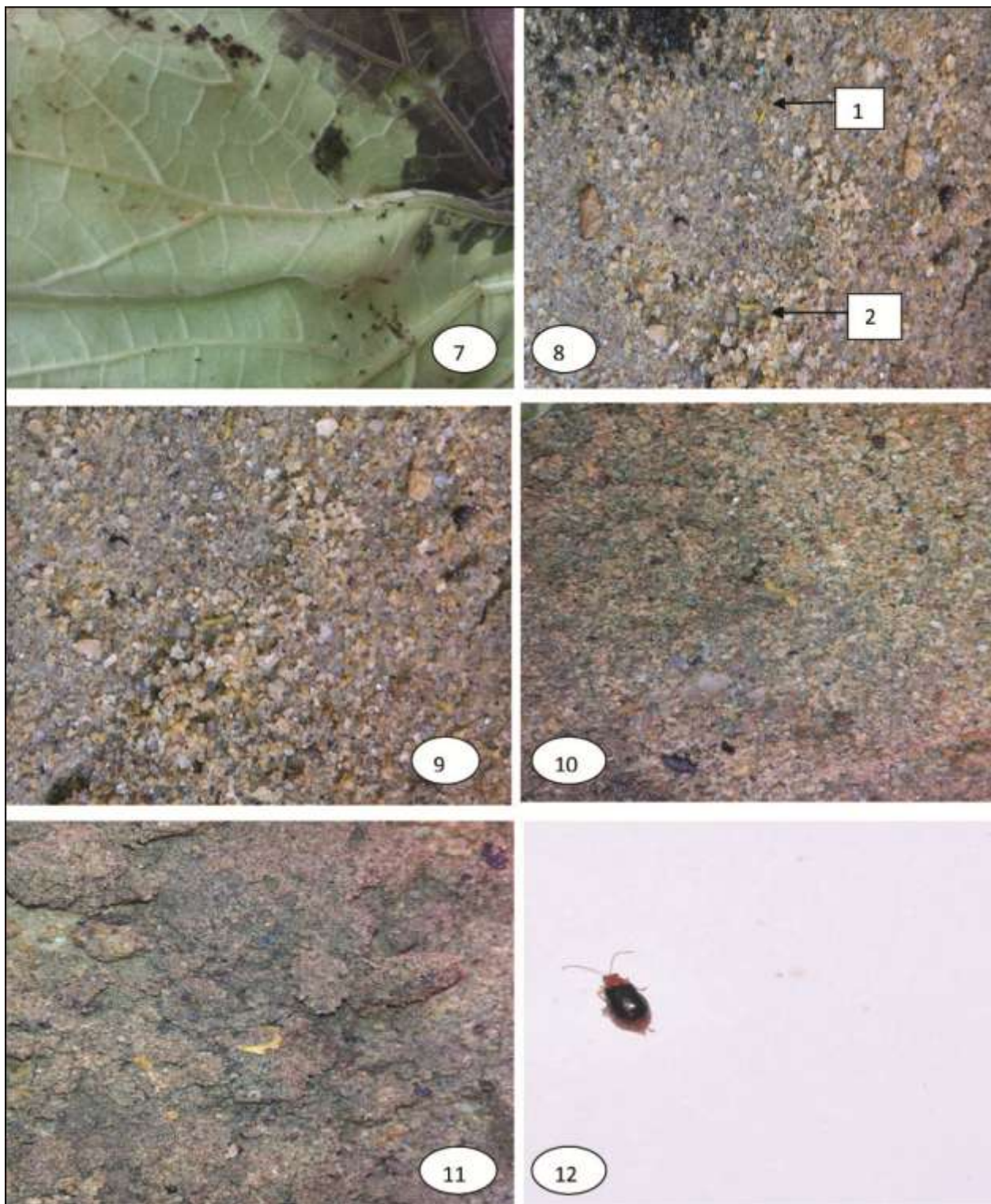




Figures – 1 to 6: Life cycle of *A. foveicollis*

1. *A. foveicollis* Egg.
2. First instar
3. Second instar
4. (3) Third and (4) fourth instar
5. Pupa
6. Adult.





Figures - 7 to 11: Life cycle of *A. nigripennis*

- 7. *A. nigripennis* Egg.
- 8. (1) First instar and (2) second instar
- 9. Third instar
- 10. Fourth instar
- 11. Pupa
- 12. Adults



Table – 1: Developmental stages of pumpkin beetle, *Aulacophora foveicollis* (Lucas) under laboratory condition

Developmental stages	<i>A. foveicollis</i>		Mean ($\pm$ SE)	<i>A. nigripennis</i>		Mean ($\pm$ SE)
	Minimum (days)	Maximum (days)		Minimum (days)	Maximum (days)	
Oviposition period	9	13	10.67 $\pm$ 1.2	8	12	10.00 $\pm$ 0.76
Number of eggs laid per female	67	98	82.50 $\pm$ 5.20	40	70	55.01 $\pm$ 4.19
Incubation period	11	13	11.53 $\pm$ 0.1	5	10	7.50 $\pm$ 0.57
Hatching percentage	42.86	88.23	73.37 $\pm$ 1.76	40.56	78.23	59.40 $\pm$ 4.52

Table – 2: Morphometric measurements of different developmental stages of pumpkin beetle *A. foveicollis*

Different stages of life cycle	Length (mm)			Breadth (mm)		
	Minimum	Maximum	Mean $\pm$ SE	Minimum	Maximum	Mean $\pm$ SE
Egg	0.60	0.85	0.75 $\pm$ 0.08	0.55	0.65	0.60 $\pm$ 0.03
1 st instar	1.8	2.2	2.00 $\pm$ 0.012	0.35	0.50	0.41 $\pm$ 0.06
2 nd instar	4.0	5.5	4.67 $\pm$ 0.44	0.55	0.80	0.65 $\pm$ 0.08
3 rd instar	7.4	8.0	7.77 $\pm$ 0.18	0.70	1.00	0.83 $\pm$ 0.09
4 th instar	10.0	13.0	11.67 $\pm$ 0.88	1.80	2.40	3.07 $\pm$ 0.18
Pupa	4.80	5.80	5.37 $\pm$ 0.29	2.80	3.40	3.13 $\pm$ 0.18
Adult Male	5.50	7.00	6.42 $\pm$ 0.46	2.50	3.10	2.78 $\pm$ 0.17
Adult Female	6.75	9.00	8.00 $\pm$ 0.66	2.75	3.50	3.06 $\pm$ 0.24

Data represents values are Mean $\pm$ SE (n=6)

Table – 3: Morphometric measurements of different developmental stages of pumpkin beetle *A. nigripennis*

Different stages of life cycle	Length (mm)			Breadth (mm)		
	Minimum	Maximum	Mean $\pm$ SE	Minimum	Maximum	Mean $\pm$ SE
Egg	0.60	0.75	0.67 $\pm$ 0.06	0.50	0.60	0.55 $\pm$ 0.05
1 st instar	1.5	2.1	1.80 $\pm$ 0.16	0.30	0.40	0.35 $\pm$ 0.03



2 nd instar	3.0	4.5	3.75±0.88	0.50	0.65	0.57±0.05
3 rd instar	6.4	7.0	6.70±0.08	0.68	0.98	0.83±0.07
4 th instar	8.0	11.0	9.20±0.20	1.60	2.0	1.80±0.15
Pupa	4.0	5.0	4.50±0.38	2.40	3.10	2.75±0.24
Adult Male	5.5	6.50	6.00±0.68	2.00	3.00	2.50±0.23
Adult Female	6.70	8.70	7.70±0.66	2.70	3.00	2.85±0.23

Data represents values are mean±SE (n=6)

Table – 4: Duration of different developmental stages of pumpkin beetles, *A. foveicollis* reared on the leaf of cucumber plant under laboratory condition

Different stages of life cycle	Duration (Days)		
	Minimum	Maximum	Mean±SE
1 st instar larva	4	4	4.00±0.00
2 nd instar larva	4	5	4.33±0.33
3 rd instar larva	3	4	3.67±0.33
4 th instar larva	4	5	4.67±0.33
Total larval period	15	18	16.67±0.33
Pupal period	12	13	12.33±0.33
Total period from egg to adult	45	47	46.00±0.58
Longevity of adult male	40	45	42.51±3.24
Longevity of adult female	46	50	48.01±3.66

Data represents values are mean±SE (n=6)

Table – 5: Duration of different developmental stages of pumpkin beetle, *A. nigripennis* reared on the leaf of cucumber plant under laboratory condition.

Different stages of life cycle	Duration (Days)		
	Minimum	Maximum	Mean±SE
1 st instar	2	2	2.00±0.15
2 nd instar	3	3	3.00±0.23
3 rd instar	3	3	3.00±0.23
4 th instar	5	6	5.50±0.42
Total larval period	13	14	13.61±0.12
Pupal period	12	16	14.00±1.07
Total period from egg to adult	42	44	43.01±3.27
Longevity of adult male	40	42	40.67±0.66
Longevity of adult female	44	50	47.33±1.77

Data represents values are mean±SE (n=6)



Fully developed beetle was red orange in colour with metallic tint (Fig - 6). In *A. nigripennis* usually black elytra with very soft body (Fig - 12). The adult male *A. foveicollis* measured maximum 7.00 mm and minimum 5.50 mm with an average of 6.42 ± 0.46 mm. The breadth measured maximum 3.10 mm and minimum 2.50 mm with an average of 2.78 ± 0.17 mm (Table - 2). In *A. nigripennis* adult male measured maximum 6.50 mm and minimum 5.5 mm with an average of 6.00 ± 0.68 . The breadth was measured maximum 3.00 mm and minimum 2.00 mm with an average of 2.50 ± 0.23 (Table - 3). The *A. foveicollis* adult female was slightly larger than the male and measured maximum 9.00 mm and minimum 6.75 mm in length with an average of 8.00 ± 0.66 mm (Table - 2). The breadth of the adult female ranged from maximum 3.50 mm and minimum 2.75 mm with averages of 3.06 ± 0.24 mm. In *A. nigripennis* adult female measured maximum 8.70 mm and minimum 6.70 mm with an average of 7.70 ± 0.66 . The breadth was measured maximum 3.00 mm and minimum 2.70 mm with an average of 2.85 ± 0.23 (Table - 3). The longevity of *A. foveicollis* adult males ranged from 40 to 45 days with an average of 42.51 ± 3.24 days while the longevity of adult females ranged from 46 to 50 days with an average of 48.01 ± 3.66 days (Table - 4). In *A. nigripennis*, the longevity of male ranged from 40 - 42 days with an average of 40.67 ± 0.66 and the longevity of female ranged from 44 - 50 days with an average of 47.33 ± 11.77 (Table - 5). The present study was in agreement with the results of Azizul Bari (2007). 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.

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Conflict of Interest

The authors are declared that no conflict of interest.

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