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Life history traits and food consumption of hog plum leaf beetle *Podontia 14-punctata* (Chrysomelidae: Coleoptera)

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Abstract

The objective of this article is to find out the life history traits and food consumption of Hog Plum Leaf Beetle *Podontia 14-punctata* or *Podontia quatuodecimpunctata* (Chrysomelidae: Coleoptera). However, the result of life history traits *Podontia 14-punctata* reveals that the pre-oviposition, oviposition and incubation period of the hog plum leaf beetle were average 19.8 ± 0.55 , 8.0 ± 0.21 and 5.7 ± 0.15 days, respectively. The average number of eggs laid in a cluster by the female was 41.5 and hatching rate was 96.27%. The eggs were, more or less, oval round and at the end freshly laid eggs become yellow in colour, naked and are arranged in multiple layers usually two, before hatching it became dull yellowish-white. Dark black head and legs of grub were visible through egg membrane just before hatching. The mean duration of the 1st, 2nd, 3rd, 4th instars larvae and were 3.3 ± 0.15 , 3.4 ± 0.16 , 3.3 ± 0.15 and 3.7 ± 0.15 days. But the mean duration of the pupa varied from 14-17 days. The total developmental periods from egg to adult were 37.1 days. In addition, a larva consumed leaf of hog plum 32.127 cm^2 or 3.8234 g during its total developmental period. But the final instars larvae consumed the highest amount of leaf.

Keywords: Life history, food consumption, *podontia 14-punctata*, chrysomelidae

Introduction

The hog plum (*Spondias mangifera* L.) is a popular subtropical fruit, locally known as "Amra". It grows in Bangladesh but good quality "Amra" is cultivated commercially in Barishal district and the fruit is consumed mostly in green stage and is also used as pickle, chatti, murbba etc. (Ahmed 1969). It is grown throughout the tropics (Maniruzzaman 1988; Verheij and Coronel 199; Ahmed 1969). The fourteen spotted leaf beetle, *Podontia 14-punctata* or *Podontia quatuodecimpunctata* (Chrysomelidae: Coleoptera) is distributed through South East Asia (Husain and Ahmed 1977; Howlader 1993) [8]. It is the most destructive pest of hog plum not only Bangladesh but also in India (Lefroy 1971) [10]. It is grown throughout the tropics (Maniruzzaman 1988; Verheij and Coronel 1991). It is reported to be used as fodder in different parts of India like Asham, Madhya Pradesh, Punjab and Uttar Pradesh (Singh 1982) [15]. It is a voracious leaf eating insect of feeds on the hog plum (*Spondias mangifera* L.) both the young and aged plant. The young plant is completely defoliated and at severe infestation the plant is die out. The fourteen spotted leaf beetle, *Podontia quatuodecimpunctata* belongs to the family Chrysomelidae under the order of Coleoptera is distributed throughout South East Asia and feeds on *S. mangifera* Wild of the hog plum tree. The hog plum leaf beetle is a serious pest of the hog plum. Both adults and larvae are voracious leaf feeder. As a result, of their attack, the tree becomes completely defoliated. It is reported that in Bangladesh, the beetles appear in April, abundant during July to September and disappear in October. The peak period of defoliation is August and September (Beeson 1941; Baksha 1997) [5, 3]. The damage due to the pest is severe during the period when the tree is in full foliage (Mondol 1975) [11]. The insect causes damage about 96% of the levees of hog plum. Average infestation of the leaves is 50%, the beetles completely defoliate the tree and cause stunting of the growth of the three eventually reduces fruit size and yield. During off season the insect pupate in the soil in hibernating condition. All four larval stages retain a fecal coat, possibly mimicking bird dropping (Barlow 1900; Stebbing 1914; Baksha 1997) [4, 16, 3]. The study of biology or life history traits provides the information about the integrated management of insect, amount of insecticide,

types of insecticide and spray method a pest (Rono *et al.* 2008) [2]. There are many works on the life history traits and food consumption on many insect pest such as biology or life history traits and food consumption of lemon butterfly *Papilio demoleus* L. (Papilionidae: Lepidoptera) (Karim *et al.* 2008) [9], life history traits and food consumption of mango defoliator, *Cricula trifenestrata* Helfer (Amin *et al.* 2008) [2, 9], biology of lady beetle *Micraspis discolor* (Fab.) (Coccinellidae: Coleoptera). (Chowdhury *et al.* 2008) [16] etc. But from the review of literatures, it was found that there very limited information about biology and food consumption of hog plum leaf beetle, *P. quatodecimpunctata*. For this reason, the objective of this article is to find out the life history traits and food consumption of hog plum leaf beetle *Podontia 14-punctata* (Chrysomelidae: Coleoptera), which is very much necessary for the management of this pest.

Materials and Methods

The study on life history traits and leaf consumption morphology of hog plum leaf beetle, *Podontia quatodecimpunctata* were done in the laboratory of Entomology of Hajee Mohammad Danesh Science & Technology University, Dinajpur, Bangladesh from May, 2017 to August, 2017. The mean monthly temperature was 30 ± 2 °C and relative humidity 80 ± 5 %.

Collection and Rearing of adult beetle

Adult hog plum leaf beetles were collected from the hog-plum orchard and placed in pair (one male and one female) in several petridishes (150 cm × 90 cm). Fresh hog-plum leaves were supplied daily in each petri dish to ensure availability of food. After egg laying the beetles were transferred to another Petridis. The date of egg laying and hatching period were recorded.

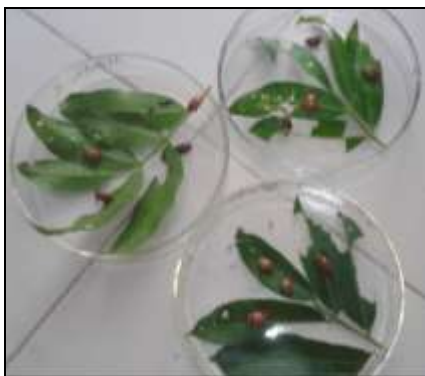


Fig 1: Rearing of Adult beetle



Fig 2: Egg mass

Rearing of larvae

The young larvae immediately were isolated carefully after hatching and placed in separate petridishes with the help of soft brush. One larva was placed in one petri dish and ten replications were used for the same. Fresh food was provided twice daily when needed. Data were taken carefully to record the time of moulting, number of instar and duration of each larval instar. Observation was made daily four times at 6:00 hour's intervals. At the end of final instar, when feeding was stopped the larvae were kept undisturbed and some soil were provided in the glass jar to help for the making their pupal chamber until the emergence of adults.



Fig 3: First instar larva



Fig 4: Second instar larva



Fig 5: Third instar larva



Fig 6: Fourth instar larva

The pre-pupal and pupal periods

The pre-pupal and pupal periods of the male and female were also recorded. For observation of pre-ovipositional, ovipositional period, fecundity and longevity of the adults, the newly emerged adults were confined in a pair of each sex in a petridish for allowing them to mate and lay eggs with adequate supply of fresh hog-plum leaves daily.



Fig 7: Pupa with earthen cell



Fig 8: Pupa of hog plum leaf beetle

Leaf consumption by the larvae and adult beetle

After hatching the 1st instar larva was placed in a petridish and adequate fresh foods were supplied after molting the 2nd, 3rd and 4th instar larvae were reared in same manner. Fresh foods were also supplied to new adults. The foliage consumed by larva and adult were recorded daily in terms of area and weight basis by subtracting leaf area and weight before and after consumption by placing leaves in an electronic automatic area meter (Model L-13,000, LI-COR, Nebraska, USA) and Mettlers Digital Balance (Model-MR 220. No. 971373).

The medium mature leaves were supplied by making small pieces with the help of a sharp scissor. The initial weight of supplied leaf pieces in each petridish was taken separately with the help of electric balance. To find out the weight of consumed leaves (g) in 24 hours (A), the weight of unused leaves (C) and the weight of moisture loss from the control petridish (D) were subtracted from the initial weight of supplied leaves (B).

Calculation can be as follows:

$$A = B - (C+D),$$

Where,

A = Weight of consumed leaves (g)

B= Initial weight of supplied leaves (g)

C = Weight of unused leaves (g)

D = Weight of moisture loss from the control petridish (g)

The process was repeated in case of all larval instars. Leaf consumption by each larval instar in different days was recorded.

Results and Discussions

The Results, discussions about the life history traits or biology and leaf consumption of hog plum leaf beetle *Podontia 14-punctata* are harmonically presented in different figures and tables and are presented below:

Mating of hog plum leaf beetle

Mating of *P. quatuodecimpunctata* took place 17 to 23 days after adult emergence. Copulation generally commenced from early morning and continued for 6-7 hours. The insect mated more than once in its life.

Hossain *et al.* (2004)^[7] reported that mating of this insect took place 10-17 days after adult emergence and mating duration was 5.89 ± 1.4 hours. According to Sardar and Mondal (1983)^[13] mating took place 2-3 weeks after emergence.

Pre-oviposition, oviposition and incubation period of hog plum leaf beetle

The pre-oviposition period varied from 17 to 23 days with an average of 19.8 ± 0.55 days (Figure 1). Mondal (1975)^[11] reported that pre-oviposition period was 20.2 days with a maximum of 23 days of the beetle in April to August. Branson and Johnson (1973) stated that the pre-oviposition period varied from 14 days under laboratory condition of these insects, which were very close to the present findings.

The oviposition period ranged from 7 to 9 days. The mean oviposition period was 8.0 ± 0.21 days (Figure 1). Hossain *et al.* (2004)^[7] found that the mean ovipositional period of this beetle was 8.8 ± 0.4 days and parallel of the present study.

The incubation period varied from 5 to 6 days with an average of 5.7 ± 0.15 days (Fig. 1). Singh and Misra (1989)^[14] found that the incubation period of same insect was 7-8 days. Baksha (1997)^[3] also reported that the incubation period of this beetle was 7-8 days. Sardar and Mondal (1983)^[13] observed that the eggs of this beetle hatched in 5-6 days.

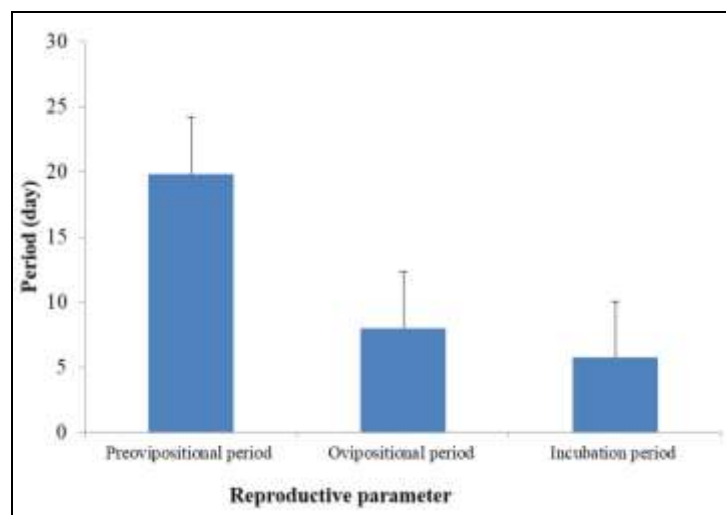


Fig 1: Pre-oviposition, oviposition and incubation periods (mean \pm SE) of *P. quatuodecimpunctata*

Eggs of hog plum leaf beetle

The female laid eggs on the leafstalk and under the lower surface of leaves and occasionally at the bottom and side wall of the petridishes. The egg was laid in clusters of 33 to 50. The egg remains attached vertically to the leaf surface or on the wall of the rearing petridishes with sticky secretions. The eggs were, more or less, oval round and at the end freshly laid eggs become yellow in colour, naked and are arranged in multiple layers usually two, before hatching it became dull yellowish-white. Dark black head and legs of grub were visible through egg membrane just before hatching.

Larval duration of hog plum leaf beetle

The larva was soft bodied, elongated, somewhat flattened and consisted for 4 larval instars. The total larval period varied from 12.0 to 16.0 days an average of 13.7 ± 0.11 days (Figure 2).

First instars of hog plum leaf beetle: The duration of the 1st instars larvae varied from 3 to 4 days within an average of 3.3 ± 0.15 day (Figure 2). Hossain *et al.* (2004)^[7] found that the mean duration of first instars larva of *P. quatodecimpunctata* was 3.75 ± 0.13 days.

Second instars of hog plum leaf beetle

The result of the duration of the 2nd instars revealed that the duration varied from 3 to 4 days and the mean duration was 3.4 ± 0.16 days (Figure 2). Hossain *et al.* (2004)^[7] found that the mean duration of 2nd instars larvae of *P. quatodecimpunctata* was 3.6 days.

Third instars of hog plum leaf beetle

The duration of 3rd instars larva varied from 3 to 4 days with an average of 3.3 ± 0.15 days (Fig. 2). Hossain *et al.* (2004)^[7] also reported that the duration of 3rd instars larva of *P. quatodecimpunctata* was 3.3 days which is similar to the present study.

4th instars of hog plum leaf beetle

Observation made on the duration of the 4th instars larva with an average of 3.7 ± 0.15 days (Fig. 2). with minimum of 3 days and maximum 4 days. Hossain *et al.* (2004)^[7] also reported that the duration of 3rd instars larva of *P. quatodecimpunctata* was 4.0 days which is similar to the present study.

Sardar and Mondal (1983)^[13] reported he average total larval period from first to final instar was 16.6 days and the mean duration of each instar was the same (4 days), which support the duration of the of 1st 2th 3th, 4th instars larval period and total larval period.

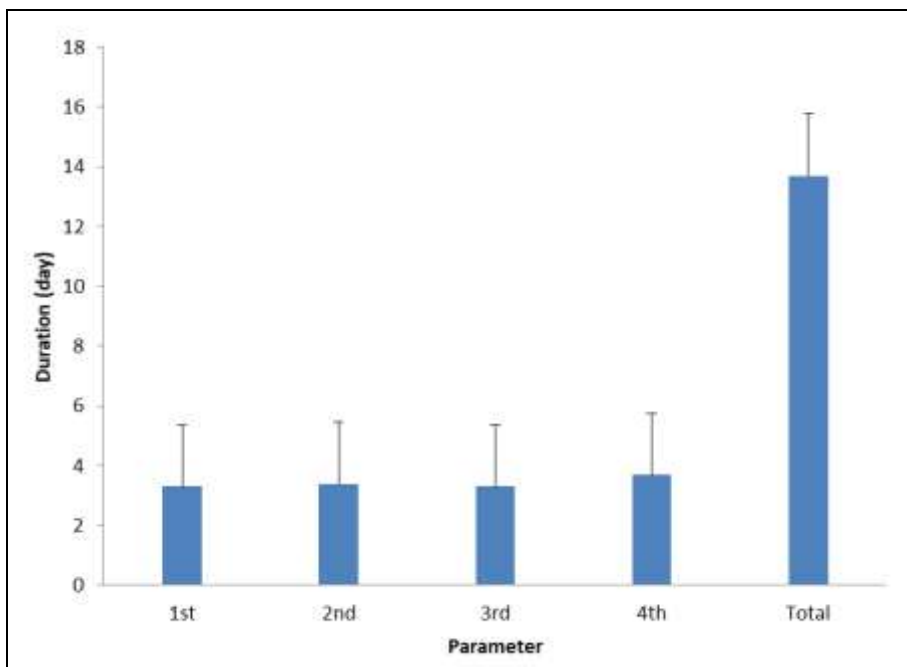


Fig 2: Duration of different larval instars (mean±SE) of *P. quatodecimpunctata*

Pre-pupal and pupal duration of hog plum leaf beetle

Before pupation, the full grown larvae entered a short prepupal stage, lasting 2-3 days (Figure 3). At the beginning of this stage of the larvae stopped feeding, entered into the soil and selected a site for pupation. It made an oval earthen chamber within which it pupated. Sardar and Mondal (1983)^[13] reported that the duration of prepupal stage of this beetle varied from 2-3 days which is similar to present observation.

The pupal cell was found in the soil at a depth of 1 to 2 cm. The mean duration of the pupa varied from 14-17 days (Figure 3). Sardar and Mondal (1983)^[13] observed that the pupal period of hog plum beetle for female was about 30 days. Singh and Misra (1989)^[14] also observed that the duration of this beetle was 14-29 days. Baksha (1997)^[3] reported that the pupal stage of this beetle lasted for 15-30 days. From the above discussion it may be concluded that there is considerable variation of pupal periods in this present work and it might be due to temperature variation.

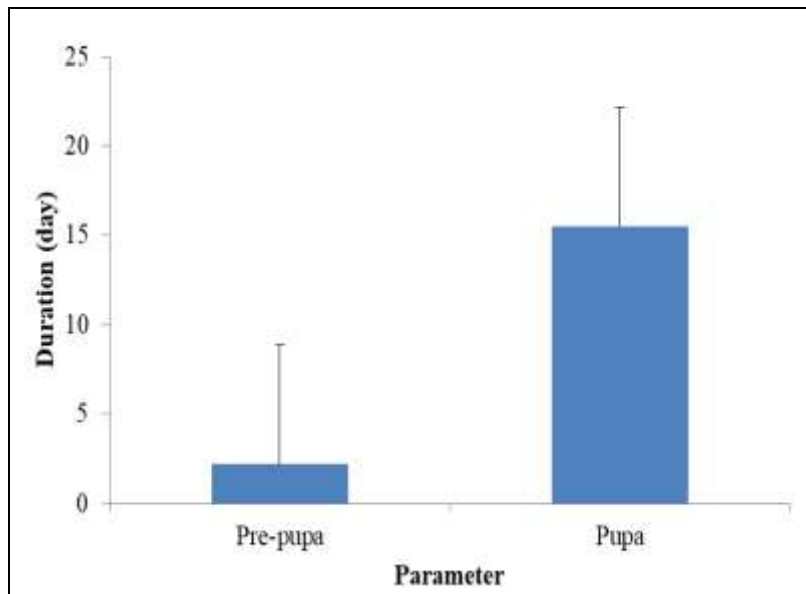


Fig 3: Pre-pupal and pupal periods (mean±SE) of *P. quatodecimpunctata*

Adult longevity

The longevity of adult beetles was counted from the emergence of the adult to its death. In general the longevity of the male beetle was shorter than the female. The longevity of male beetles varied from 18 to 23 days with an average of 20.6 ± 0.52 days (Figure 4). But the longevity of

the female beetles varied from 35 to 43 days with an average of 39.9 ± 2.23 days (Figure 4). Sardar and Mondal (1983)^[13] described the longevity of this adult beetle as 44-52 days which is slightly differed with the present study. It may be the effect of food and environmental conditions.

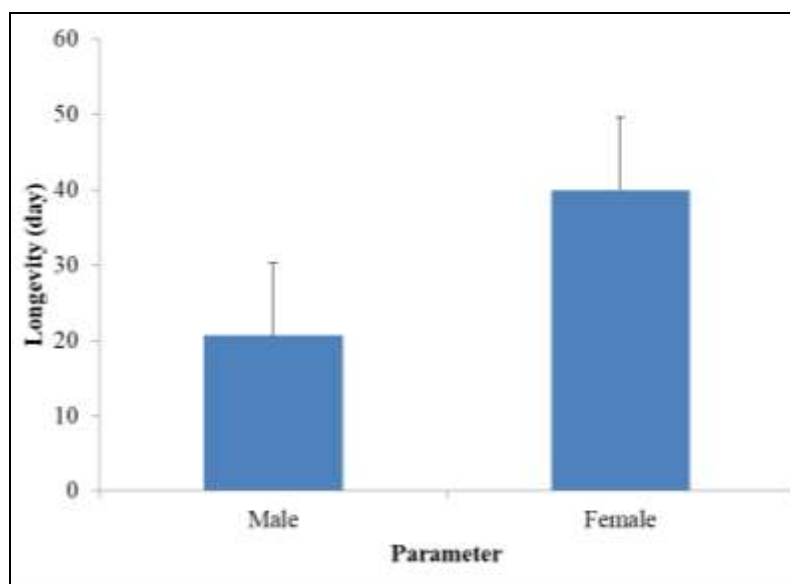


Fig 4: Longevity (mean±SE) of adult *P. quatodecimpunctata*

Leaf consumption of hog plum leaf beetle

Weight basis

The mean leaf consumption in terms of weight by a larva was 3.82 g during the entire larval period of 13.8 days. The 1st, 2nd, 3rd and 4th instars larvae consumed 0.074, 0.65, 0.96 and 2.13 g leaflet (Figure 5), respectively. It was observed that the final instars larva consumed highest

quantity of food among the instars. The mean leaflet consumption by an adult was 8.96 g. However, the insect consumed 12.78 g of leaflet during its life span. Hossain *et al.* (2004)^[7] reported that the mean leaf consumption of *P. quatodecimpunctata* was 11.79 g. and those slightly differ but nearly close proximity to the present findings.

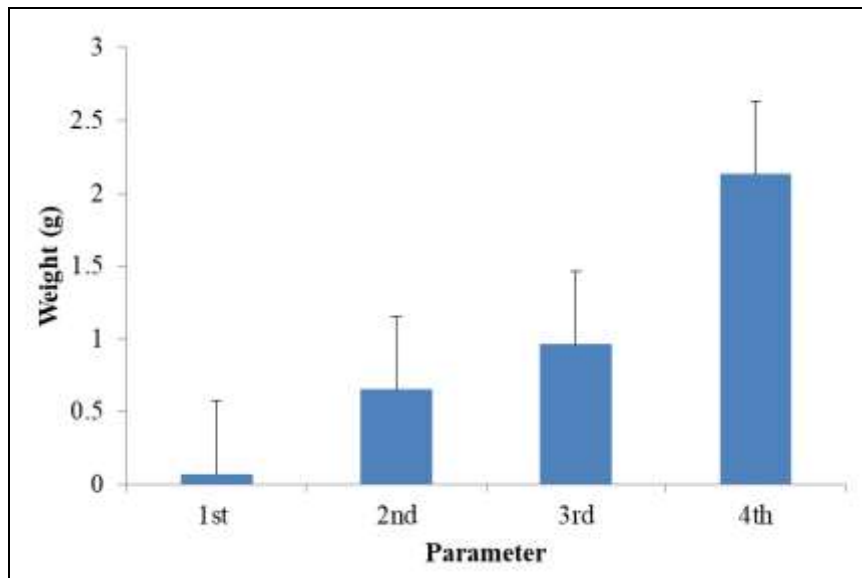


Fig 5: Leaf consumption pattern (weight basis) at different larval instars (mean±SE) of *P. quatuordecimpunctata*

Area basis

The larvae consumed in an average of 0.66, 5.93, 7.6, and 17.94 cm² of leaves (Figure 6) during its life span. Hossian

et al. (2004)^[7] stated that the mean leaf consumption of *P. quatuordecimpunctata* was 95.41 cm² which is slightly different to the present findings.

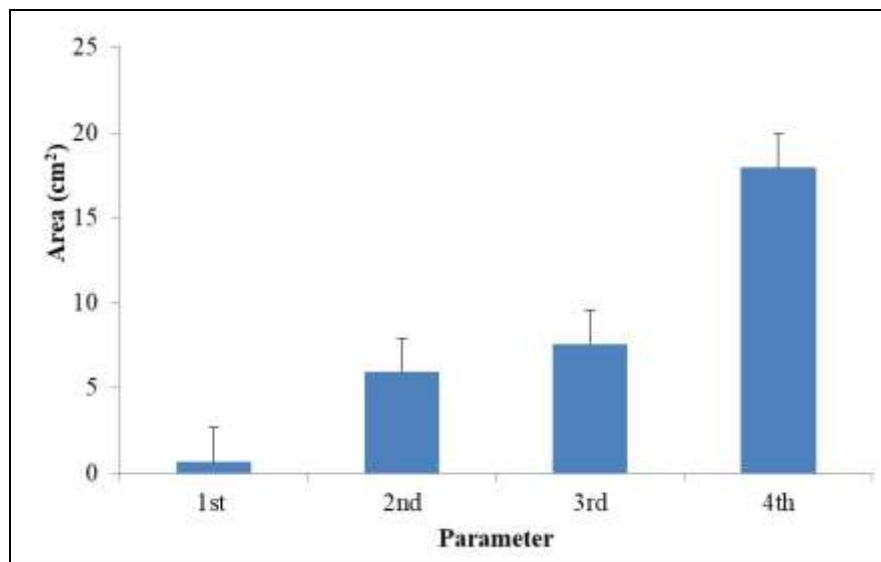


Fig 6: Leaf consumption (area basis) at different larval instars (mean±SE) of *P. quatuordecimpunctata*

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