Bionomics of predatory butterfly, apefly (Spalgis epius) (Lepidoptera: Lycaenidae) on mealybug, Paracoccus marginatus (Hemiptera: Pseudococcidae) in Mulberry

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Abstract

Apefly, Spalgis epius (Westwood) (Lepidoptera: Lycaenidae) is a small phytophagous butterfly. The larvae feed on the bugs of Pseudococcidae, Hemiptera. In the present study, the development of immature stages and life cycle of this predatory butterfly was observed on Paracoccus marginatus (Williams and Granara de Willink) (Hemiptera: Pseudococcidae) in mulberry under laboratory conditions. The collected eggs have been stored in the laboratory at 40-80% Relative Humidity and 25-30 °C. The eggs had been disk-shaped and greenish-blue in colour, sculptured and each top and bottom compacted with micropylar disperse withinside the top and hatched in 3.2 ± 0.15 days. It beneath is going 4 larval instars and the entire larval duration lasts 12.99 ± 0.01 days. The top surface of the larval body turned completely evolved with a wax coating. The mold on the hard dorsal side of the pupa resembled the face of a monkey structure. The prepupal larva reduced in size and the surface of the body turned dull black colour. The duration of the pupal period was recorded as 10.07 ± 0.03 days. The overall duration from egg to adult emergence was observed as 30.64 ± 0.31 days. In adults, the patch is larger in females than that in males. The information of the development and life cycle of S. epius on natural/ factitious hosts on numerous crops is advantageous to develop and standardize the mass culturing techniques for exploration of this capability species for predation of mealybugs.

Keywords: Lycaenidae, mass culturing, monkey, predator

Introduction

Butterflies are a taxonomically well-studied group, which have received a reasonable amount of attention throughout the world and around 18,000 species of butterflies are estimated to be there in the world and India alone has recorded 1,501 species (Kehimkar, 2008) [11]. The larva of the Apefly, Spalgis epius (Westwood) (Lepidoptera: Lycaenidae, Miletinae) a hemipterophagous butterfly were found feeding on eggs, nymphs and adults of papaya mealybug, S. epius is a member of the entirely entomophagous lycaenid subfamily Miletinae, most species of which feed on Hemiptera (Perice et al., 2002) [15]. Several species of mealybugs are serious pests of economically important crops worldwide (Browning 1992 and Franco et al., 2001) [6, 9]. In the Indian region, the larva of S. epius has been reported as a possible predator of Macconellicoccus hirsutus in mulberry gardens (Gowda et al., 1996; Mani, 1995 and Rahman and Vijayalakshmi, 1998) [12, 8, 16]. Near the mealybug colony, Spalgis epius lays its eggs, after hatching the caterpillar of Spalgis epius proceed into the colony to cater on the mealybugs. The caterpillar camouflage itself by covering its back with the skins of mealybug after cater on them. The pupa of Spalgis epius has a remarkable similarity to the monkey face structure. The prepupal larva reduced in size and the surface of the body turned black color. The duration of the pupal period was recorded as 10.07 ± 0.03 days. The overall duration from egg to adult emergence was observed as 30.64 ± 0.31 days. In adults, the patch is larger in females than that in males. The information of the development and life cycle of S. epius on natural/ factitious hosts on numerous crops is advantageous to develop and standardize the mass culturing techniques for exploration of this capability species for predation of mealybugs.

Materials and Methods

The present study was carried out in the Department of Sericulture, Assam Agricultural University from December 2018 to November 2019.
The mealybug, *Paracoccus marginatus* infected mulberry plants growing in the field of Department of Sericulture, Assam Agricultural University, Regional Sericulture Research Station, Central Silk Board, Jamuguri and Govt. Sericulture Farm, Titabar of Jorhat district were thoroughly surveyed and the *Spalgis epius* was collected by using a camel hairbrush to produce a laboratory culture and allowed to lay eggs on mealybug raised on cocoa fruit. The *Paracoccus marginatus* was identified by its elongate oval body, slightly flattened dorsalventrally covered with mealy wax, not thick enough to hide the yellow body, light yellow legs, no bare areas on the dorsum, and ovisacs on the ventral surface with 15 to 17 lateral wax filaments, the posterior pair of filaments being noticeably longer (Miller and Miller, 2002) [10].

*S. epius* eggs were collected from the host insect and stored individually in 4.5 cm diameter petri dishes with stages of mealybugs in the current investigation. Every day, the petri dishes were checked for larval eclosion. The caterpillar developed in the petri dishes was daily cleaned and the faecal matter and remains of dead mealybug stages were removed. *S. epius* larvae were fed fresh mealybug stages on a daily basis. The molting stage of *S. epius* larvae was observed to arrive at the larval stadia, and the growth of the larvae was monitored. The number of larval instars, prepupa, pupal stage, and adult development phase, as well as the number of instars in a life cycle, were all carefully observed. Micrometric techniques were used to measure the egg and each stage of the larva, including the 1st instar, 2nd instar, 3rd instar, 4th instar, prepupa, and pupa. Under laboratory settings, three pairs of mature *S. epius* butterflies were reared in each cage. Three males and three females who emerged in the lab were released into wooden cages measuring 30 x 30 x 30 cm to test their longevity. Three different types of mealybug infested mulberry were hung inside the cage for the butterflies to lay eggs or feed on the mealybugs' honeydew. The mortality of butterflies in the cages was monitored on a daily basis. To feed the butterflies, one-centimetre cotton balls soaked in a 1:1 honey: water solution was strung within the cage. The mealybug culture was kept at 25-30°C and 40-80% relative humidity in the lab. The results of the laboratory tests were statistically analysed using the Standard Error Method (Gomez and Gomez, 1984) [7].

Results and Discussion
The results of the development and life cycle of *S. epius* on Mealybug in mulberry in laboratory condition are furnished below.

Egg
Before hatching as neonate larvae, the egg colour was greenish-blue and then turned whitish. It was disc-shaped, sculpted, and compacted on both the top and bottom, with micropylar disparity on the top. The eggs hatched in 3.2±0.15 days under laboratory conditions (Table 1). The findings are consistent with those of Hall et al., (2007) [9], who observed that *S. epius* eggs were disc-shaped, greenish-blue in colour, and sculptured. Minno et al., (2005) [14] discovered that the egg of *Fonseca tarquinius*, a predatory Lycaenidae, was also greenish-white and spherical with faint sculpturing.

First instar Larva
The larval body was creamy white at this stage, with a dark brown head bordered with fine white setae. The larvae in the first stage lived for 2.80 ± 0.15 days (Table 1). The initial instar stage lasted 2.77±0.01 days. According to Venkatesha et al., (2004) [19], the surface of the larval body of *S. epius* was covered in a white wax covering that was hidden by a mound of mealy bugs. Furthermore, Dinesh and Venkatesha (2012) [5] found a substantial negative association between the population of *S. epius* and temperature, indicating that the population of *S. epius* drops as the temperature rises.

Second instar larva
The larval head turns a dark brown colour, and the body appears grey with white and a white wax covering the mid-dorsal area. The average duration of the 2nd instar larva was 3.47±0.01 days.

Third instar larva
The dorsal line was covered with a thick wax coating. The average duration of the 3rd instar larva was 3.37±0.01 days.

Fourth instar larva
This stage's larva was shorter and had more setae than the third instar. The average duration of the 4th instar larva was 3.38± 0.01days. The size of *S. epius* four larval instars is similar to that of other Lycaenidae species such as *Paralucia pyrodiscus* (Braby, 1990) [2] and *Lycaedes melissa* Samuelis (Hermes et al., 1996) [10]. The duration of this stage was found to be 3.80±0.07 days on average.

Pupa
The pupal stage seems to be naked, with a smooth surface. It had the appearance of a monkey's face. Light brown and whitish-grey were found on the dorsal and lateral surfaces. The mould on the pupa's hard dorsal side view resembled a monkey's face. The pupa's dorsal side was found to be clear, with dots of eyes, nose, and cheeks gradually darkening as it developed. According to Hall et al., (2007) [9] the unique monkey-faced pupa of *S. epius* was comparable to that of *Fonseca tarquinius*. Balduf (1939) [1] thought the monkey-faced look of some lycaenid pupa was a form of defence, but he didn't explain why. The findings are consistent with those of Dinesh et al., (2010) [8], who found that the *S. epius* cycle took 23.80±1.50 days to complete, with a mean maximum temperature of 29.00±1.80°C, a mean minimum temperature of 26.50±1.40 °C, and a mean relative humidity of 44.40±6.70 per cent. Thangamalar et al., (2010) [18] estimated the combined duration of the *S. epius* larval and pupal phases to be 14.83±0.44 days, while Dinesh et al., (2010) [4] estimated it to be 19.8±1.39 days.

Total period of development
From egg to adult emergence, the average total development period was 33.85±0.33 days (Table 1). The findings are consistent with those of Vinod Kumar et al., (2006) [120], who found that the *S. epius* mean total developmental period from egg to adult was 29.86±0.59 days was also studied in the laboratory condition using the mealybug, *Planococcus citri* reared on pumpkins.

Adult
The adult *S. epius* lacked a tail on its hind wings. A delicate tiny butterfly with a grey underside and several thin vertical wavy patterns. Both sexes have a brown upper forewing with a diffuse or well-defined discal patch near the terminal cell. Male forewings have a sharp apex and straight termen, but female forewings have a round apex and termen. The male
forewing has a prominent little quadrate mark near the cell’s end, whereas the female forewing has a bigger quadrate spot. The discal patch on the male marking was tiny in size and had crisp characteristics. The discal patch on the female was a dull white colour and was larger. When the butterfly wings were held against a bright light source, the white patch on the females’ wings was more visible.

Table 1: Developmental period of different stages of Spalgis epius

| Stages       | Mean  | SEM(±)(Days) |
|--------------|-------|--------------|
| Egg          | 3.2   | ±0.15        |
| 1st instar   | 2.77  | ± 0.01       |
| 2nd instar   | 3.47  | ± 0.01       |
| 3rd instar   | 3.37  | ± 0.01       |
| 4th instar   | 3.38  | ± 0.01       |
| Total larval period | 12.99 | ± 0.01 |
| Pupa         | 10.07 | ± 0.03       |
| Total period of development | 33.85 | ±0.33 |

5 observations with 3 numbers of larvae per plate

Conclusion
The average total developmental period of S. epius on P. marginatus in mulberry from egg to adult was 33.85 days, according to the findings. The egg was greenish and sculpted into a disc form. The larva’s body was covered in a thick layer of white wax, and the pupa’s face resembled that of a monkey. The ability to understand the life cycle of S. epius on factitious/natural hosts on various crops would aid in the development and standardisation of mass culturing procedures for the study of this prospective species in biocontrol programmes and Integrated Pest Management.

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