Research article
Bangladesh Journal of Entomology
ISSN (Print): 1021-1004, ISSN (Online): 3007-3332, Website: www.bangladeshes.org
Bangladesh J. Entomol. (2025) 33(2): 1-14

LIFE HISTORY AND MORPHOLOGICAL DESCRIPTION OF *CYCLOSIA PAPILIONARIS* (DRURY) (LEPIDOPTERA: ZYGAENIDAE) MOTH: A SERIOUS PEST OF LOTKON IN BANGLADESH

Md. Shahinur Islam[1*], A. T. M. F. Islam[1], Md. Mosharraf Hosain[1] and Akira Yamanaka[2]

[1]Radiation Entomology and Acarology Division, Institute of Food and Radiation Biology, Atomic Energy Research Establishment, GPO Box-3787, Dhaka-1000, Bangladesh

[2]Department of Applied Molecular Bioscience, Graduate School of Medicine, Yamaguchi University, Yoshida, Yamaguchi, Japan

Received: 1 July 2025; Accepted: 16 August 2025

ABSTRACT

Cyclosia papilionaris (Durry 1773) is commonly known as the Drury Jewel moth. The larvae of this moth defoliate the delicate leaves of young trees and nursery plants of lotkon fruit (Burmese grape). There is a lack of sufficient biological information regarding the management of this pest. The aim of this study is to observe and record the developmental stages information (egg to adult) with descriptive images, including feeding behaviour and nature of damage. The biology of the moth was studied in laboratory conditions on their host plants. The study was carried out at a temperature of 27.61°C ± 3.85 and 69% ± 4.58 relative humidity. The female deposited eggs in clusters, and each cluster contains a maximum of 68 eggs and a minimum of 18 eggs with the mean of 36. The total larval period (1st instar to 4th instar) was 20.09± 1.61 days, and the pupal period was 28.09± 6.56 days. The pupal cocoon was constructed using a plastic substrate combined with leaves, thus offering substantial support for the laboratory rearing method. The female moth lived longer, 17.82± 2.48 days, than the male moth, 5.73± 0.65 days. The results of this study are expected to provide valuable support for managing this pest in an agroecosystem.

Keywords: Morphology, Drury Jewel moth, Lepidoptera, Zygaenidae, Lotkon

INTRODUCTION

Cyclosia papilionaris is commonly known as the Drury Jewel moth, which was described by Dru Drury in 1773. This moth belongs to the family Zygaenidae, and

*Corresponding author: *islam.shahin89@gmail.com*

order Lepidoptera. *Cyclosia papilionaris* has eight subspecies, which are distributed throughout South-east Asia and also reported from the Andaman and Nicobar Islands, India (Leong 2012). The habitat is made up of humid deciduous forests and rainforests, and the moth is typically active during the day and can coexist with other diurnal insects, particularly with butterflies (Gardner *et al*. 2009, Endo and Kishida 1999). Adult moths consume pollen and nectar, and larvae feed on the young leaves of the host plant. The primary host plant is *Baccaurea ramiflora* (Robinson *et al*. 2011), but they also feed on the leaves of *Baccaurea sapida* and *Aporusa dioica* (Baksha 2008). However, it is a major and serious defoliator of the young *Baccaurea ramiflora* plants in Bangladesh (Islam *et al*. 2012, Baksha 2008). *Baccaurea ramiflora*, commonly known as the Burmese grape, belongs to the Phyllanthaceae family. The Burmese grape is known locally as lotkon in Bangladesh, and growing in Bangladesh, Thailand, Peninsular Malaysia, and several parts of South-east Asia (Rahman *et al*. 2014). It is estimated that approximately 1,890 hectares of land are used to cultivate this fruit in Bangladesh (Hossain *et al*. 2017, Rahman *et al*. 2014). Following satisfying the domestic demand, local growers generate foreign currency through the export of this fruit (Islam *et al*. 2012). Burmese grapes are naturally rich with many bioactive compounds and have nutritional benefits (Paul *et al*. 2020, Pradhan *et al*. 2015, Francesca *et al*. 2012, Kermasha *et al*. 1987b). The nursery plants and young trees are severely attacked by the larvae of the *Cyclosia papilionaris* moth. As a result, there is poor growth of the trees and low yield of fruit production (Islam *et al*. 2012). The biological information is very scarce regarding the management of this pest. The studied literature and website-based information demanded the detailed biological information about the *Cyclosia papilionaris* moth in the recent emergence and invasion of lotkon trees. The majority of the literature and website-based information are sporadic, lacks description of developmental stages, and does not identify distinct growth stages, i.e., egg, specific larval instar, prepupae, and pupa characteristics. Although Islam *et al*. (2012) studied the biology and management of this pest in Bangladesh, they could not provide precise identification of embryonic stages with detailed descriptions. However, biological data is crucial for tracking and managing the pest in the agroecosystem, including life cycle, behaviour, ecology, pest aggregation, and number of generations. This research aims to study different aspects of biology in detail with descriptive images, including feeding behaviour and the nature of damage, which would provide good support for controlling this pest in agriculture sectors.

MATERIALS AND METHODS

Experimental site: The study was conducted in the Laboratory of Radiation Entomology and Acarology Division, Institute of Food and Radiation Biology (IFRB), Atomic Energy Research Establishment (AERE), Savar, which is located at 23°51′30″N and 90°16′00″E with an altitude of 15 m above sea level. This research was carried out from May 2019 to November 2019, October 2020 to December 2020, and September 2022 to November 2022, subsequently.

Larvae collection and rearing: To investigate the biology under laboratory conditions, larvae of *Cyclosia papilionaris* were collected from the host plant and kept in a rearing cage (44 cm × 38 cm × 38 cm) covered with net. The larvae were fed with host plant (*Baccaurea ramiflora*) leaves that are kept fresh by placing the moist piece of cotton around the cut tip and wrapped with aluminium foil. The leaves were changed at an interval of 12 hours during the rearing period. Larvae were grown up to adult emergence and sexual maturity under the laboratory conditions. Adults were given access to a 10% sugar solution on small cotton balls. Larvae were reared in a cooled incubator (VS-3250BipC-L, KTR Europe GmbH, Vision Scientific Co., Ltd., made in Korea).

Oviposition: For oviposition, males and females (1:2 ratios of male and female) were placed inside the cylindrical tubes (radius 4.5 cm and height 10 cm) that were made from hard paper and a paper sheet was placed at the bottom of the tube where young tender leaves of host plant were given for oviposition (Fig. 1a). Female moths laid eggs around the tube and on a paper sheet. Eggs were collected from tubes and paper sheets, and maintained in a plastic container (26 cm × 17 cm × 7 cm) for hatching.

Morphometric measurements: Morphometric measurement analysis of different life stages and different body parts was carried out by taking 4-10 replications of each stage, viz., egg stage, larval stages (first to fourth instar), pupal stage, and adult stage linearly. The larval instar, pupal stage duration, and life span of the adult moths were observed daily and recorded. The length and width were measured using a Vernier calliper (Mitutoyo, Model 500-196-20, Japan), while the weight was measured using an electronic balance (HT224RCEN, Shinko Co., Ltd., made in Japan). In addition to the above parameters, colour, shape, size, moulting, and feeding behaviour, and nature of damage were also recorded.

Temperature and humidity maintenance: The entire experiment was maintained at an average temperature of 27.61 °C ±3.85 with an average 69% ±4.58 relative humidity (RH) and a light: dark ratio (L:D) of 14:10. The RH and temperature were maintained by using a digital Max-Min Thermo Hygro and Clock (Zeal).

RESULTS AND DISCUSSION

Eggs: Eggs are laid by egg laying apparatus (Fig. 1a). Eggs are oval and light yellow (Fig. 1b & 1c), and the size was 1.16± 0.09 mm in length, and 0.19± 0.01 mm in breadth (Table 1), and they were laid in clusters (Fig. 1b) that contain a maximum of 68 eggs and a minimum 18 with a mean of 36. Islam *et al.* (2012) found light brown colour eggs, and 6–8 eggs in each cluster, which differs from present finding. Moreover, in captive breeding females showed more interest in depositing their eggs in a white paper sheet and tube wall than host plant leaves. In our present observation, eggs did not hatch under laboratory conditions. Though rearing was maintained for three years, eggs did not hatch despite adopting many strategies for hatching. However, this moth species deposited eggs four times in her lifespan, and the ovipositional pattern is shown in Fig. 2. Larvae: The *Cyclosia papilionaris* moth has four larval instars. The first instar larvae appearance is totally different from the others three instar larvae. The newly hatched larvae are covered with a hairy spine structure and is grey-black in colour. After 1-2 days later, a yellow-coloured circle band appear on the middle of the body and the before the abdominal end (Fig. 3a). The newly hatched larvae keep it up for 3.68± 0.33 days (Table 2). First-instar larvae had a body length of 4.6±1.17 mm, a breadth of 2.03± 0.09 mm, and a

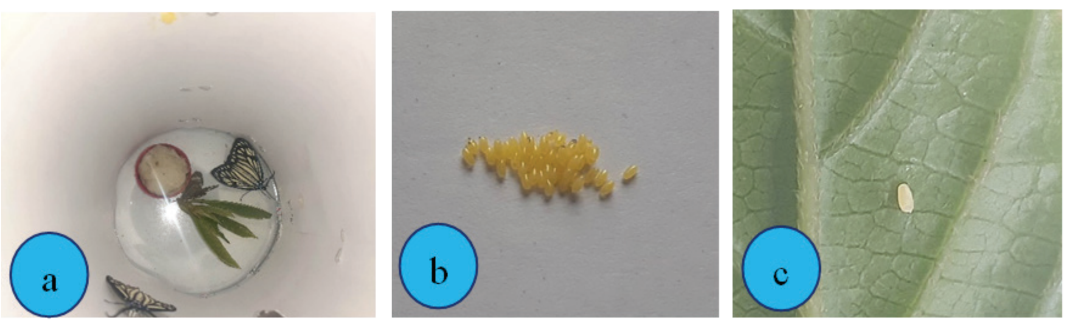

Fig. 1. Oviposited eggs of *Cyclosia papilionaris*; a. egg laying apparatus, b. oviposited eggs in cluster and c. single egg.

weight of 15.15± 1.71mg (Table 1). The size of the larvae in the second, third, and fourth instars appeared to be too similar, with the exception of the body length, body parts, and protrusion (spine and stalk) size. In the beginning, the body colour is pale blue, but as they mature, they turned in to blackish hue before pupa formation. The larvae have a black head with black mandible and hairy structure present in front of the head and around the body. The nipple-like stalks (tubercles) present on the dorsal and lateral surfaces of the body, which are brilliant yellow and red in colour. Each thoracic (T1 to T3) and abdominal (A1 to A9) segment bears six stalks, where segments T1 and T2 had yellow stalks, but T3 bears a pair red stalk. The abdominal segments A1 and A2 exhibited a pair of red stalks, while other segments (A3 to A9) had yellow stalks. And all stalks were encircled by a yellow ring at its base (Figs. 3b, 3c & 3d). Similar works were done on another nearest species *Cyclosia sordidus* by Leong (2012). The second and third instar larvae extended 4.04± 0.47 days and 5.10±0.58 days. The fourth instar larvae hang around for 7.27± 1.01 days. The total period of larvae (first-fourth instar) was 20.09± 1.61 days (Table 2). The body length of second-instar instar larvae was 11.3± 2.22 mm, breadth was 4.00± 0.82 mm, and weight was 54.95± 22.63 mg. The third instar was measured 15.85 ± 1.35 mm in length, 5.70 ± 0.54 mm in breadth, and 198.43 ± 63.82 mg in weight. The fourth instar larvae were 23.0± 2.58 mm in length, 6.78± 0.816 mm in breadth, and 619.44± 171.13 mg in weight (Table 1).

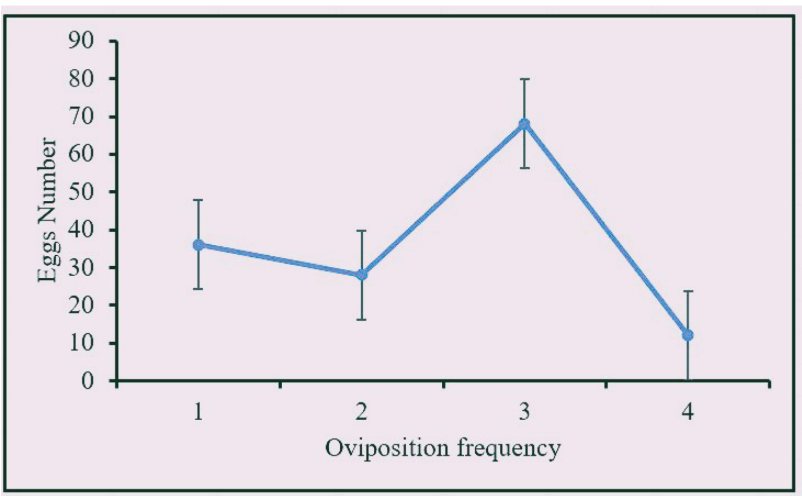

Fig. 2. Ovipositional pattern of *Cyclosia papilionaris*.

Table 1. Morphometric data of egg and larvae stages of *Cyclosia papilionaris* moth

Developmental stages (n=10)	Size		
	Length (mm)	Width (mm)	Weight (mg)
Egg	1.16± (0.09)	0.19± (0.01)	-
I- instar	4.6± (1.17)	2.03± (0.09)	15.15± (1.71)
II-instar	11.3± (2.22)	4.00± (0.82)	54.95± (22.63)
III- instar	15.85± (1.35)	5.70± (0.54)	198.43± (63.82)
IV-instar	23.0± (2.58)	6.00± (0.816)	619.44± (171.13)

Table 2. Developmental period of *Cyclosia papilionaris* moth

Developmental stages (n=10) Minimum		Duration (Days)		
		Maximum	Mean±Sd	
Larval period	I- instar	3.0	4.0	3.68± (0.33)
	II-instar	3.0	4.5	4.04± (0.47)
	III- instar	4.0	6.0	5.10± (0.58)
	IV-instar	6.0	9.0	7.27± (1.01)
Total larval period		16.0	23.0	20.09± (1.61)
Pupa period		20.0	42.0	28.09± (6.56)
Male Longevity		5.0	7.0	5.73± (0.65)
Female Longevity		14.0	22.0	17.82± (2.48)

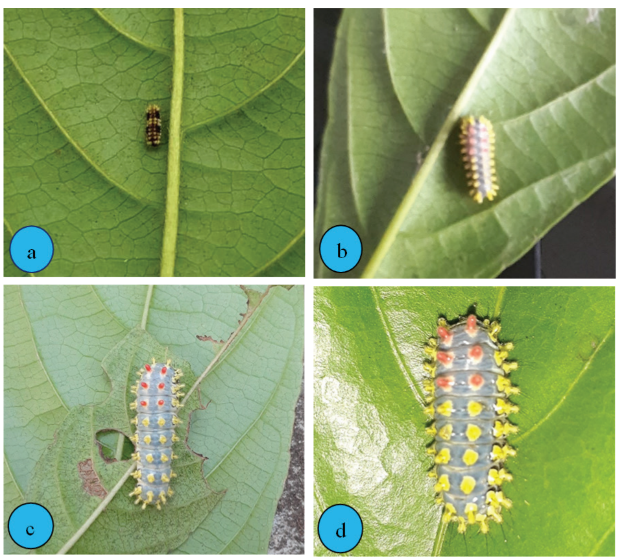

Fig. 3. Larval instar of *Cyclosia papilionaris*; a. 1st instar, b. 2nd instar, c. 3rd instar and d. 4th instar.

Pupa formation: At the end of the final instar, larvae turn blackish in colour, stop feeding, and become sluggish before pupae formation (Fig. 4a). Pupa form within a cocoon. Many moths, caterpillars, and other holometabolous insect larvae spin silk to form cocoons, which serve as protective coverings for the pupa (Darby 1958). They made cocoon on the ventral surface of the leaves that wrapped in silk covering (Fig. 4b). Butterflies and moths can make cocoons on the underside of leaves, in cracks, close to the base of tree trunks, hanging from twigs, or hidden in leaf litter (Scoble 1992). Islam *et al*. (2012), and Leong (2012) reported similar observations for pupa formation in *Cyclosia papilionaris* species. In this study, it was found that they were able to build cocoons by using plastic substrate, which will provide good support for laboratory rearing (Fig. 4d). Cocoon could make individually or in combination in host plant leaves (Figs. 4b & 4c). Pupal cocoon length was 24.36 ± 4.61 mm (Table 3). Prepupae is the first stage of the pupal life cycle, they are

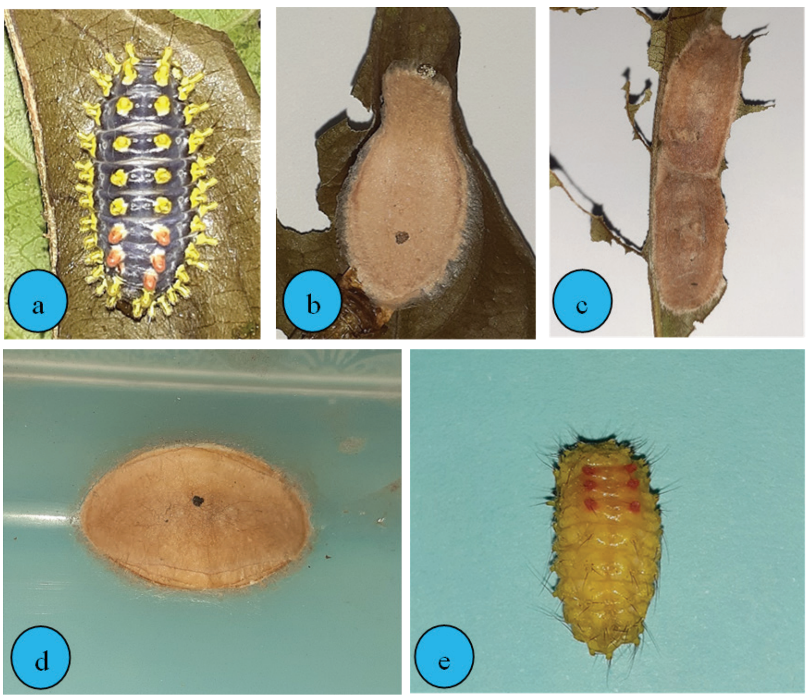

Fig. 4. Pupa formation process of *Cyclosia papilionaris*; a. Non feeding stage of larvae before pupa formation, b. single cocoon, c. combined cocoon, d. cocoon on plastic substrate and e. prepupae.

orange, and all the larva characteristics disappeared in this stage (Fig. 4e), and the length was 11.60± 0.49 mm an average (Table 3).

Pupa characteristics: Pupa is a stage of life that occurs between the larval and adult phases and develops all kinds of organs in this stage through the complete metamorphosis (Borror *et al*. 2004). Male pupae are black-brown in colour and slender in shape (Figs. 5a & 5b). Female pupae are apparent to be chubby and light brown in colour (Fig. 5c & 5d). Female pupa is larger than the male pupa. Male pupae in several species are often smaller than female pupae (Carvalho *et al*. 2014). Male pupae are black and have rounded knob (Fig. 5a), whereas females pupa opening knob are brown in colour (Fig. 5c). According to Walt *et al*. (2008), female pupae have a noticeable longitudinal suture on the ventral side of the eighth and ninth abdominal segments, while male pupae have a brief slit on the ventral side of the ninth abdominal segment, frequently encircled by tiny, rounded knobs. Carvalho *et al*. (2014) illustrated that genital lobe shape could be reliable identification of male and female pupae in *Aedes aegypti* mosquitos. Pupal duration was 28.09± 6.56 days (Table 2). The length of female pupa was 16.10± 0.70 mm and male pupa was 12.12± 0.85 mm (Table 3).

Adults moth characteristics: Sexual dimorphism is prevalent and easy to identify based on the adult coloration and ornamentation. Males and females both have pectinate antennae. Male is pale brown with white spots on fore and hind wings (Fig. 6a). Female is also pale brown in colour with white spots on fore and hind wings (Fig.6b). Males have less wing spots than females. In comparison to male, female is longer than male in fore and hind wing, antennae, and body length (Fig. 7). The characteristics of the adult moth are similar to those observed by Islam *et al*.

Table 3. Length of prepupa, pupa and pupal cocoon of *Cyclosia papilionaris* moth

Developmental stages	Length (mm)		
	Minimum	Maximum	Mean± Sd
Pre pupa (n=5)	11.0	12.0	11.60±0.49
Female pupa (n=4)	15.0	17.0	16.10±0.70
Male pupa (n=4)	11.0	13.0	12.12±0.85
Pupal cocoon (n=11)	16.0	35.0	24.36±4.61

Fig. 5. Pupa of *Cyclosia papilionaris*; a-b. ventral and dorsal view of male Pupa, c-d. ventral and dorsal view of female pupa.

Fig. 6. Adult of *Cyclosia papilionaris*; a. male, b. female.

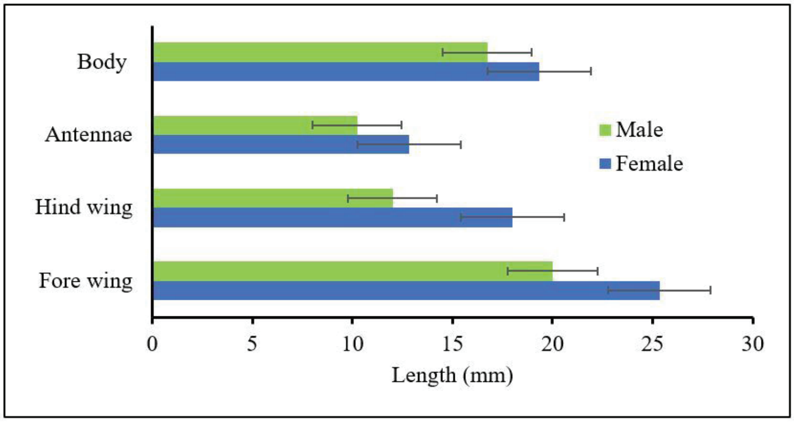

Fig. 7. Comparison of body parts length of male and female of *Cyclosia papilionaris*.

(2012), Rahman and Hossain (1985), and Beeson (1941). The male lived for 5.73± 0.65 days, while the female lived for 17.82± 2.48 days, respectively (Table 2).

Feeding behaviour: The larvae of *Cyclosia papilionaris* preferred the host plant of *Baccaurea ramiflora*. There have been previous reports of at least four different species of *Cyclosia* sp. using the genus *Baccaurea* (Phyllanthaceae) as a preferred larval host plant. These include: (i) *Cyclosia macularia* on *Baccaurea motleyana* and *Baccaurea racemosa*, (ii) *Cyclosia nivipetens* on *Baccaurea motleyana*, (iii) *Cyclosia panthona* on *Baccaurea ramiflora*, and (iv) *Cyclosia papilionaris* on *Baccaurea ramiflora* (Robinson *et al*. 2011). Larvae of the first instar made longitudinal and circular holes, and consumed the soft portion of delicate leaves without consuming veins (Fig. 8a). Second instar larvae feed the young leaves of the host plants by creating a circle or ring and also feed edge of the tender leaves (Fig. 8b). First and second instar larvae did not eat the midribs and veins in the early stages of their development. The first and second instar caterpillars spent more time searching their plant leaves and also spent more time resting. Third and fourth instar larvae prefer to consume the mature leaves of the host plant (Fig. 8c). At the end of the third instar, larvae turn into voracious feeders. The centre and edge of the leaf feeding were begun. Larvae were more voracious in their fourth or final instar (Fig. 8d). The third and fourth instar caterpillars spent less time searching for selecting plant leaves and also spent more time resting. Johnson and Zalucki (2007) discovered that different instar larvae of *Helicoverpa armigera* have distinct eating behaviours, including

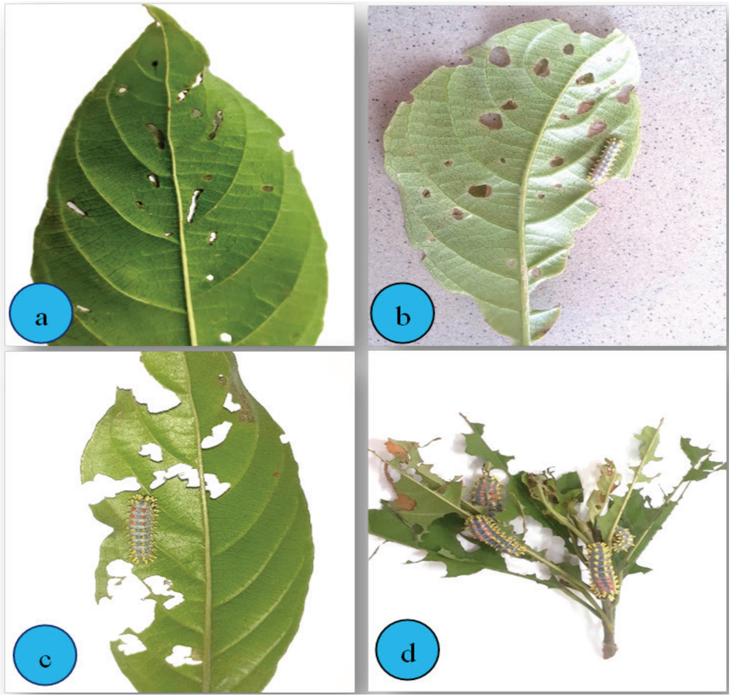

Fig. 8. Feeding behaviour of *Cyclosia papilionaris* caterpillar; a. First instar feeding, b. Second instar feeding, c. Third instar feeding and d. Fourth instar feeding.

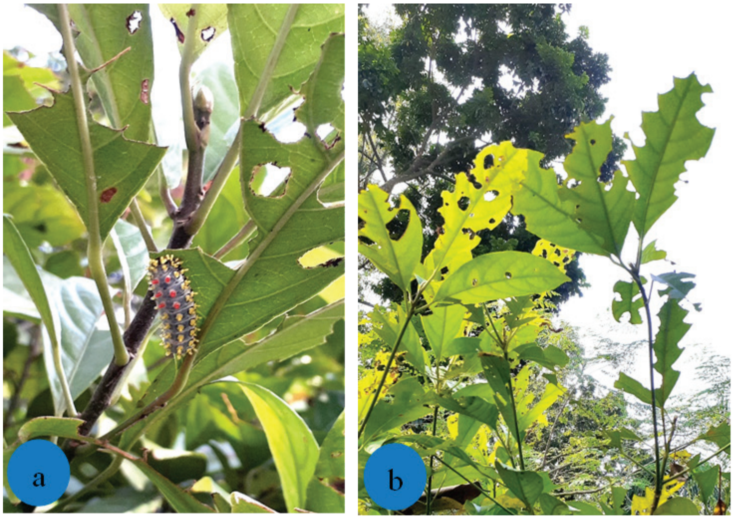

Fig. 9. Damage caused by *Cyclosia papilionaris* caterpillar; a. Fourth instar caterpillar feed the leaf margin and proceeds inward, b. Caterpillars feed the leaves and eventually turned into yellow.

searching, feeding, and resting. According to them, third-instar larvae prefer to feed on exposed plant leaf sections and spend less time resting and foraging, and the first instar larvae are choosy to select plant leaves and spend more time for searching and resting. Islam *et al*. (2018, 2019) found that caterpillars of the butterfly *Papilio polytes* and *Papilio demoleus* showed comparable feeding habits.

Nature of damage: It is observed that larvae of the *Cyclosia papilionaris* moth in the beginning of May. The peak infestation was found in July and August. It is observed 2-3 generations per year. The last generation was completed from September to October. Young trees with severe infestations lose all of their leaves except the midribs, which results in the defoliation of the trees (Fig. 9a). Leaves that are severely impacted wither and drop to the ground. Although the trees are not destroyed, there are unquantifiable effects on their growth and fruit production (Fig. 9b). Similar plant damage caused by the *Cyclosia papailionaris* caterpillar was observed by Islam *et al*. (2012). Islam *et al*. (2012) also observed adults appearing in May, abundance of larvae in June, peak infestation in July and August, and three generations per year, which is more or less similar to the present study.

CONCLUSION

The lotkon fruit cultivation is expanding day by day in Bangladesh. Regarding the pest and disease management of this fruit, the details of the life history and their ecology of *the Cyclosia papilionaris* moth are very essential for lotkon growers to take timely action. Biological data is crucial for tracking and managing pest species in the agroecosystem. The present findings on the biology of *Cyclosia papilionaris* would be important to develop proper management strategies to control this pest.

ACKNOWLEDGEMENTS

This work was conducted under Institute of Food and Radiation Biology, Atomic Energy Research Establishment, BAEC and Faculty of Science, Yamaguchi University, Japan agreement for research cooperation (2020-2025), Dr. A.T.M Fayezul Islam and Dr. Akira Yamanaka were the respective counterparts.

REFERENCES

BAKSHA, M. W. 2008. Insect pests of forest of Bangladesh. Bulletin 8, Forest Entomology Series, Bangladesh Forest Research Institute, Chittagong, Bangladesh, 131Pp.

BEESON, C. F. C. 1941. The Ecology and control of Forest insects of India and the Neighboring Countries. Govt of India press, Delhi, India, 767Pp.

BORROR, D. DELONG, J. & DWIGHT, M. 2004. Introduction to the Study of Insects., New York, 203Pp.

CARVALHO, D. O., NIMMO, D. & NAISH, N. 2014. Mass Production of Genetically Modified *Aedes aegypti* for Field Releases in Brazil. *J. Vis. Expo*. **(83)**: e3579. doi: 10.3791/3579.

DARBY, G. 1958. What is a Butterfly. Chicago, Benefic Press, 41Pp.

ENDO, T. Y. & KISHIDA. 1999. Day-flying Moths: Chalcosiinae & Epicopeia. Endless Science Information, Tokyo, 119 Pp.

FRANCESCA, G., TULIPANI S. & ALVAREZ-SUAREZ, J. M. 2012. Minor fruits: Composition, nutritional quality, and impact on human health. *Nutr*. **28**: 9-19.

GARDNER, T. A., BARLOW, J. & CHAZDON R. 2009. Prospects for tropical forest biodiversity in a human-modified world. *Eco. Lett*. **12(6)**: 561-82.

HOSSAIN, M. F., ISLAM, M. A. & AKHTER, S. 2017. Nutritional value and medicinal uses of minor fruits: Burmese grape (*Baccaurea ramiflora* Lour). *Int. J. Food Sci. Nutr*. **6**: 211-214.

ISLAM, M. S., ISLAM, F. A. T. M. & YAMANAKA, A. 2017. Biology and Morphometrics of the common Mormon butterfly, *Papilio polytes* Linnaeus (Lepidoptera: Papilionidae) rearing under laboratory condition. *Univ. J. Zool. Rajshahi Univ*. **36**: 49-56.

ISLAM, M. S., YASMIN, M. & ISLAM, F. A. T. M F. 2019. Studies on the biology and population abundance of lemon butterfly, *Papilio demoleus* L. (Papilionidae: Lepidoptera). *Bangladesh J. Entomol*. **29**(1): 77-90.

ISLAM, M. R., BAKSHA, M. W. & RAHMAN, M. Z. 2012. Biology, Ecology, and control Of Lotkon (*Baccaurea ramiflora* Lour) Defoliator, *Cyclosia papilionaris*, Drury (Lepidoptera: Zygaenidae) in Bangladesh. *B.J.F.S.* **32**(1): 40-44.

JOHNSON, M. L. & ZALUCKI, M. P. 2007. Feeding and foraging behavior of a generalist caterpillar: are third instars just bigger versions of firsts? *Bull. Entomol. Res*. **97**(1): 81-88.

KERMASHA, S., BARTHAKUR, N. N. & MOHAN, N. K. 1987. Chemical composition and proposed use of two semi- wild tropical fruits. *Food. Chem*. **26**: 253–259.

LEONG, T. M. 2012. Final instar caterpillars and metamorphosis of *Cyclosia Sordidus* (Walker) in Singapore (Lepidoptera: Zygaenidae: Chalcosiinae). *Nat. Singap*. **5**: 151–158.

PAUL, T. R., ISLAM, M. D. & WAHED, M. I. I. 2020. Phytochemical and comparative biological studies of *Baccaurea ramiflora* (Lour) extract. *Int. J. Biosci*. **16**(5): 197-211.

PRADHAN, S., BHOWMICK, N. & DEB, P. 2015. Fruit growth and development of Burmese grape (*Baccaurea sapida*). *Indian J. Plant Physiol*. **20**: 86–91.

RAHMAN, R & HOSSAIN, M. 1985. Antapaksmal Keetpataiiga Parichiti. Bangla Academy, Dhaka, Bangladesh, 362Pp.

RAHMAN, S. M. L., BHUYAN, M. H. M. B. & MUSTAKIM, A. M. 2014. Fruit characteristics, yield contributing characters and yield of some lotkon genotypes under northeastern region of Bangladesh. *Int. J. Sustain. Crop Prod*. **9**(1): 8-10.

ROBINSON, G. S., ACKERY, P. R. & KITCHING, I. J. 2011. HOSTS—A Database of the World's Lepidopteran Hostplants. Natural History Museum, London, 45Pp.

SCOBLE, M. J. 1992. The Lepidoptera: Form, Function and Diversity. Oxford, Oxford University Press. 98Pp.

WALT, V. D., BERG, J. V. D & DU PLESSIS, H. 2008. Using morphological characteristics to distinguish between male and female larvae and pupae of the groundnut leaf miner, *Aproaerema modicella* (Deventer) (Lepidoptera: Gelechiidae). *S. Afr. J. Plant Soil*. **25**(3): 182-184.