

Ontogeny of *Spilosoma obliqua* (Walker) on castor (*Ricinus communis*) leaves under laboratory conditions

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Abstract

The Castor plant (*Ricinus communis*) is an important oilseed crop, is highly vulnerable to *Spilosoma obliqua* (Walker), a lepidopteran insect pest also known as Bihar hairy caterpillar or Jute hairy caterpillar. It is a polyphagous pest infecting a wide range of as many as 126 species belonging to 24 plant families that are economically important including pulses, oilseeds, cereals, and gram. The *Spilosoma obliqua* caterpillar feeds gregariously on Castor leaves and causes significant loss to the crops. In this study, the life cycle of *Spilosoma obliqua* was observed in laboratory conditions by feeding fresh Castor leaves. The study reveals that the entire lifespan of *Spilosoma obliqua* ranged between 39 and 46 days. The eggs laid were slightly greenish, and the number of eggs per batch was 130 to 250. The period of egg incubation ranged from 6 to 8 days. The larval development had 6 instars before pupation. The duration of the pupal stage ranged from 8 to 12 days. Adult moth appeared slight light brown with many black spots on wings and red abdomen. The longevity of adult male moths and female moths was 3-5 days and 5-8 days respectively. Male and female moth could be identified by tapered and blunt abdomen respectively. During life cycle observation on Castor leaves, *Spilosoma obliqua* was parasitized by *Proapanteles oblique* (Hymenoptera: Braconidae).

Keywords: *Spilosoma obliqua*, life cycle, *Proapanteles oblique*, ontogeny, pest, castor

Introduction

The Castor plant (*Ricinus communis*) is an important oilseed crop known for its rapid growth and perennial nature. This plant can be found on disturbed areas such as rocky slopes, road borders, and abandoned fields in tropical and subtropical regions. It holds significant importance in Indian agriculture due to its adaptability, economic value, and diverse applications. The castor plant is attacked by a wide range of pests that contribute significantly to yield losses in the oilseed industry. Among them, *Spilosoma obliqua* Walker (Lepidoptera: Erebidae), commonly known as the Bihar hairy caterpillar, is a highly polyphagous insect of the class Insecta. Equipped with biting and chewing type mouthparts, this pest infests numerous plant species, including several economically important crops such as pulses, cereals, oilseeds, and gram. Apart from India, many other countries have reported this insect like Myanmar, Pakistan, Nepal, and China (Kabir and Khan, 1968; Singh and Sehgal, 1992) [7, 14]. *Spilosoma obliqua* is a common pest across India, especially in northern and northeastern states. It remains most active from April to November and affects a wide range of important crops. (Deshmukh *et al.*, 1976) [4] studied the host range of this caterpillar and reported that it fed on nearly 76 plant species. However, it is now increasingly evident that this pest is highly polyphagous, feeding on as many as 126 species across 24 plant families. The caterpillar stage of these moths is gregarious and causes critical damage to the crops by feeding soft green tissue and leaves. This causes defoliation, and only stems are left behind. In India it is very serious pest in Assam, Bengal, Bihar, Delhi, Maharashtra, NE Region, and UP. In Manipur (North East India), it has been reported as a common pest of many agricultural and horticultural crops. It remains active from March to November, and causes severe crop loss to various crops at different stages of plant growth (Ram & Pathak, 1980) [12].

Phytophagous insects are generally oligophagous, and the tendency to become polyphagous insects is very much significant in the context of plant protection (Ananthakrishnan, 1992) [2]. This is because they not only increase their host range for feeding, shelter, and survival but also present significant challenges to the entomologists. Adult female of *Spilosoma obliqua* deposits their eggs underside surface of leaves in crowded conditions. The early-stage caterpillars are gregarious. They feed mostly on the soft green tissues of the leaves at the back of the veins, thus leaves become skeletonized. *Spilosoma obliqua* caterpillars go through 6 instars (Adsule and Kadam, 1979) [1]. According to Warad & Kalleshwaraswamy, (2017) [16] 5th instar caterpillar of *Spilosoma obliqua* is the most damaging stage. Previously, the biology and life cycle of *Spilosoma obliqua* (Walker) were studied in Bangladesh on jute crops (Kabir and Khan, 1969) [8]. A study was conducted on biology of *Spilosoma obliqua* on Mulberry in Karnataka (Kotikal, 1982) [9]. The present study is focused on the life cycle of *Spilosoma obliqua* (Walker) on Castor leaves in laboratory conditions.

Material and Methods

Collection of Insects: The collection of *Spilosoma obliqua* (Walker) was done from different field areas of Katihar, Chhapra, Hajipur, and Patna, Bihar, India.

Identification of Insect: For identification the collected insects were sent to the Zoological Survey of India, Patna, Bihar, India. The identification report confirmed the collected insect species were *Spilosoma obliqua* (Walker).

Rearing of *Spilosoma obliqua*: Rearing of *Spilosoma obliqua* (Walker) was done under laboratory condition (28±2°C and 75 to 80% RH) in the insect rearing cage,

plastic box covered with muslin cloth by feeding fresh castor leaves during the month of August to November in the central Research Laboratory of Patna Women's College,

Patna University Patna, Bihar, India. Total developmental stages of *Spilosoma obliqua* from egg to adult were recorded.



Fig 1: Insect rearing box and plastic jar



Fig 2: *S. obliqua* feeding on Castor leaves

Results and Discussion

The present investigation revealed that total life cycle of *Spilosoma obliqua* included 4 stages viz., Egg, Larva, Pupa and Adult. The larval phase included 5 moults and six instars. Deposition of eggs started after 24 hours after mating in clusters.

Eggs: The fresh egg laid by *Spilosoma obliqua* Walker on Castor leaves was green coloured. Before hatching of eggs, it turns blackish. The incubation period of eggs was about 6-8 days with an average of 6.95 ± 0.18 days. The base of eggs was flattened and round on upper side. The number of eggs per batches was 130 to 250 and 500 to 900 eggs per female moth was recorded. Previously Similar egg laying pattern of *Spilosoma obliqua* was observed by different research workers (Singh and Singh 1990; Ganiger and Sannaveerappanavar 2007) [5, 15].

1st Instar: The freshly hatched larva integument was slight creamy with black coloured head capsule. The body had small hairs. Brown spots was observed on the body. After few hours of hatching larvae turned pale yellow. They fed on castor leaves gregariously. The larval period of 1st instar was recorded as 2-3 days with an average of 2.5 ± 0.11 days. The larval body length ranged from 2-5 mm with an average of 3.15 ± 0.25 mm (Table 1).

2nd Instar: The 2nd instar larva was yellow coloured with more and long hairs and slight increase in their body size. The duration of 2nd instar larva ranged from 2-4 days with an average of 2.9 ± 0.17 days and the body length ranged from 5-9 mm with an average of 6.75 ± 0.31 mm (Table 1).

3rd Instar: The 3rd instar larva was more active than previous one. The larva was slightly different from 2nd instar having dark segments anterior and posterior regions with yellowish mid region. The larval duration ranged from 3-5 days with an average 3.9 ± 0.19 days and body length was 10-15 mm with an average of 12.6 ± 0.40 mm (Table 1).

4th Instar: The larva was morphologically like the 3rd instar but body length was bigger. The feeding habit changed from

gregarious to solitary. The larval duration was ranged from 3-4 days with an average of 3.5 ± 0.11 days. The body length measured was 16-25 mm with an average of 20.25 ± 0.73 mm. (Table 1). The caterpillars were vigorous eater feeding vigorously on Castor leaves.

5th Instar: 5th instar caterpillar was like 3rd and 4th instar caterpillar except body length and dense white hairs on the body. The duration ranged from 3-4 days with an average of 3.5 ± 0.11 days and the caterpillar's length were ranged from 25-34 mm with an average of 29.7 ± 0.58 mm (Table 1). Caterpillars were very active and vigorous feeders.

6th Instar: The caterpillar had dense hairs on the body. The anterior and posterior segments were darker. The larval duration ranged from 3-4 days with an average of 4.95 ± 0.18 days. Fully grown caterpillar was 35-45 mm with an average of 39.5 ± 0.67 mm in length (Table 1). After 4 days larva stopped feeding and started to prepare silk cocoon above their body and became inactive before pupation.

Pupa: Pupation occurred inside the hairy cocoon at the bottom of the rearing box beneath the leaves. Their cocoons were made up of larval hairs and silk (Nair *et al.*, 1986) [10]. At the beginning pupae were soft and yellowish which gradually became dark brown before the emergence of adults. The duration of Pupal period ranged from 8-12 days with an average of 9.8 ± 0.32 days and length of Pupa was measured 11-16 mm with an average of 13.5 ± 0.40 mm (Table 1).

Adult: The adults that emerged from pupae were slightly pinkish brown coloured moth with numerous dark spots. The abdomen was reddish. Female moth was bigger than male. Male moth had pointed abdomen while female have blunt abdomen. After emergence from pupa most of them started mating. Male moth had shorter life than female which ranged from 3-5 days in male with an average of 3.9 ± 0.19 days and in female 5-8 days with an average of

6.35±0.25 days. The length of male moth ranged from 15-20 mm with an average of 17.75±0.38 mm and female moth

length was ranged from 18-24 mm with an average of 20.65±0.44 mm (Table 2).

Table 1: Duration and Size (length) of different developmental stages of *Spilosoma obliqua* in laboratory conditions

Stage	Duration (Days)	Mean ± SE	Size (Length)mm	Mean ± SE
Egg	6–8 days	6.95±0.18	0.4–0.6	0.5±0.02
1st Instar	2–3 days	2.5±0.11	2–5	3.15±0.25
2nd Instar	2–4 days	2.9±0.17	5–9	6.75±0.31
3rd Instar	3–5 days	3.9±0.19	10–15	12.6±0.40
4th Instar	3–4 days	3.5±0.11	16–25	20.25±0.73
5th Instar	3–4 days	3.5±0.11	26–34	29.7±0.58
6th Instar	4–6 days	4.95±0.18	35–45	39.5±0.67
Pupa	8–12 days	9.8±0.32	11–16	13.55±0.40
Adult	Male: 3–5 days	3.9±0.19	15–20	17.75±0.38
	Female: 5–8 days	6.35±0.25	18–24	20.65±0.44

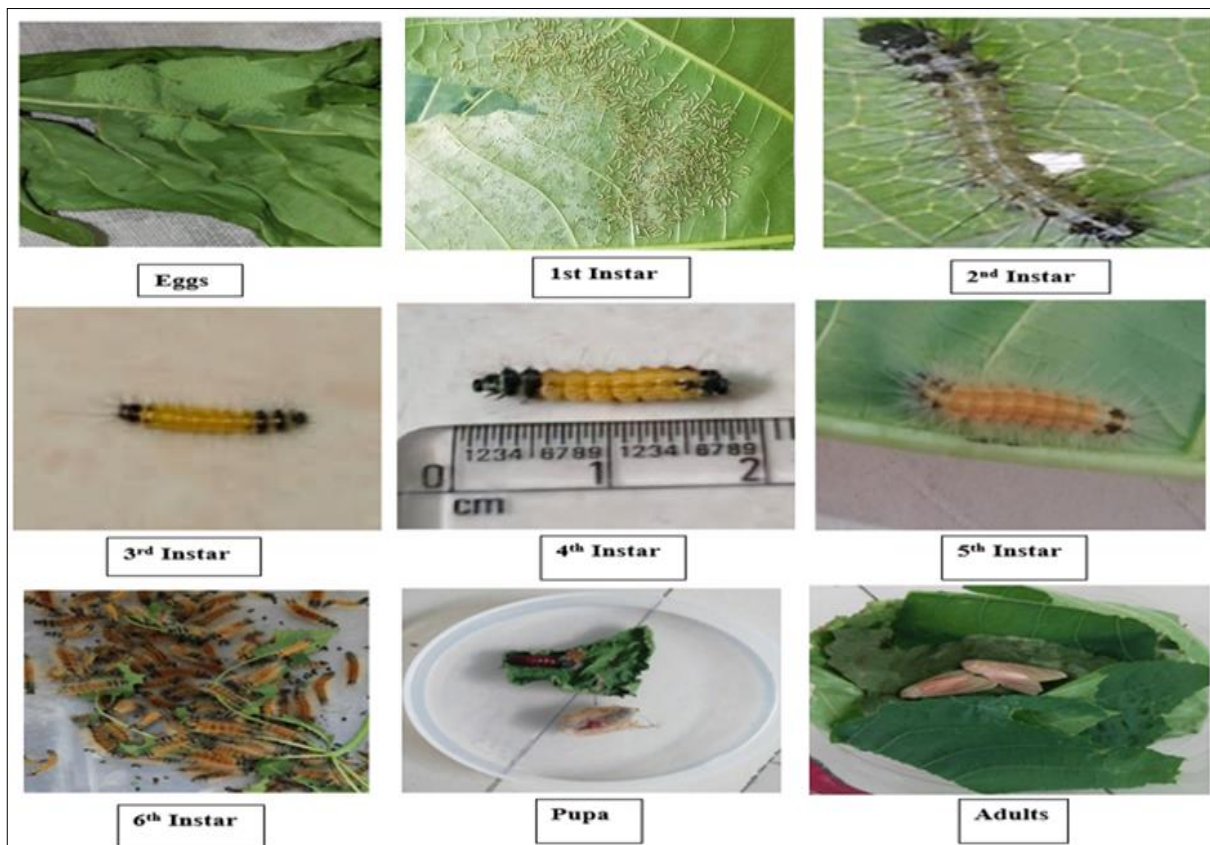


Fig 3: Different developmental stages of *Spilosoma obliqua* (Walker)

Pre-oviposition and Oviposition periods: After 24 hours of mating, oviposition started in 3 to 5 batches. *Spilosoma obliqua* (Walker) pre-oviposition period ranged between 1–2 days with an average of 1.45±0.11 days (Table 2). The oviposition period ranged from 3–5 days with an average of 3.75±0.17 days (Table 2). Nath and Singh (1996) [11] and Singh and Singh (1990) [15]. Females chose a suitable place to lay eggs in cluster of 130–250 eggs per female.

Total lifespan: Total lifespan of *Spilosoma obliqua* ranged

from 39–46 days with an average of 42.5±0.55 days (Table 2). The present study found close conformity with the report of Nath and Singh (1996) [11] and Singh and Singh (1990) [15] Debaraj and Singh (2010) [3], (Islam *et al.*, 2022) [6].

Longevity: The longevity of male *Spilosoma obliqua* ranged from 39 to 44 days with an average of 41.2±0.40 days where as the longevity of female *Spilosoma obliqua* ranged from 42 to 46 days with an average of 43.85±0.34 days (Table 2).

Table 2: Pre-oviposition, Oviposition, and longevity of *Spilosoma obliqua* (Walker) on Castor leaves

Parameter	Days	Mean ± SE
Pre-oviposition	1-2	1.45±0.11
Oviposition	3-5	3.75±0.17
Total life cycle	39-46	42.5±0.55
Male longevity (Egg-Adult)	39-44	41.2±0.40
Female longevity (Egg-Adult)	42-46	43.85±0.34

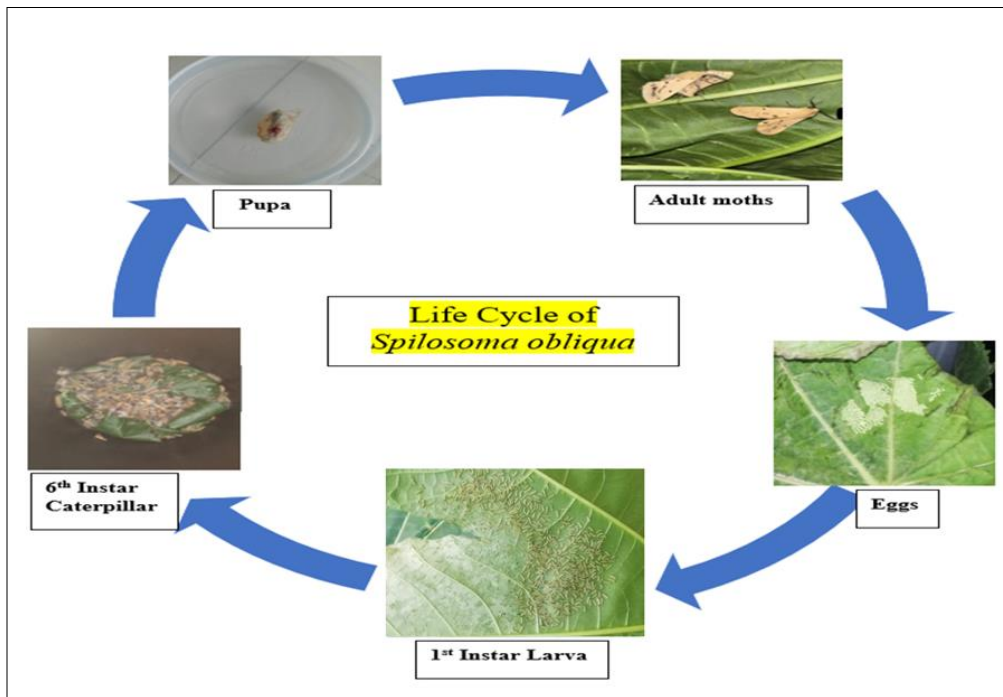


Fig 4: Life cycle of *Spilosoma obliqua* (Walker)

Parasitism on *Spilosoma obliqua* (Walker)-

During the life cycle observation of *Spilosoma obliqua* (Walker) feeding on Castor leaves was found to be parasitized by the *Proapanteles oblique* (Wilkinson) (Hymenoptera: Braconidae). It is a gregarious, endoparasitoid specific to *Spilosoma obliqua* (Walker) (Selvaraj *et al.*, 2015) [13] *Proapanteles oblique* is a natural

endo-parasitoid that was infecting mainly second, third, and fourth instar caterpillars of *Spilosoma obliqua* during life cycle observation. Approximately 30–40% of the early stages of *Spilosoma obliqua* were destroyed by the *Proapanteles oblique* parasitoid. This parasitoid can be used as a biocontrol agent against *Spilosoma obliqua* at the early instar level.



Fig 5: Infected *Spilosoma obliqua* by *Proapanteles oblique* parasitoid

Conclusion

The present investigation revealed that whole life cycle of *Spilosoma obliqua* (Walker) had 9 different stages of development starting from egg, 1st instar, 2nd instar, 3rd instar, 4th instar, 5th instar, 6th instar, pupa and adult. Total life span of the *Spilosoma obliqua* completed in between 39 to 46 days on Castor leaves in laboratory conditions. Also, a natural parasitoid *Propenteles oblique* was infecting the *Spilosoma obliqua* particularly on 2nd, 3rd, and 4th instar level of caterpillar. Which can be used as a biological control of *Spilosoma obliqua* on different host plants.

Conflict of Interest

The authors have no conflict of interest.

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