



## Study Life Cycle stages of *Spodoptera litura* (Fabricius) on Biological Feed on *Glycine max*

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### Abstract:

The present study investigates the biology and developmental performance of *Spodoptera litura* (Fabricius) reared on a natural host plant (soybean) under optimised laboratory conditions. The results were recorded on morphometric characteristics of immature stages, pupal and adult morphometry, consolidated developmental duration, reproductive chronology, and environmental regulation of life cycle stages of *Spodoptera litura*. The insect completed its life cycle within 35–44 days, with females exhibiting longer longevity than males. Larval development comprised with six instars, showing a gradual increase in body length ranging between  $1.49 \pm 0.01$  mm in first instar and  $35.52 \pm 1.44$  mm in sixth instar. Morphologically, the female pupae and adults were comparatively larger than males, indicates the sexual dimorphism. The present investigations concluded that the complete embryonic development period range approximately 3–5 days, while the complete larval phase lasted 17–21 days and the pupal stage 8–9 days. The egg hatchability exceeds up to 90% with laboratory conditions maintained 25 °C temperature and 58 % relative humidity. The relative findings confirm, the soybean plant is a nutritionally suitable natural diet for *Spodoptera litura* and provide reliable baseline data for ecological studies, mass rearing, and integrated pest management.

**Keywords:** *Spodoptera litura*, Natural diet, Morphometry, Bioassay, *Glycine max*

### INTRODUCTION

*Spodoptera litura* is an important critical pest adopted with tobacco plant. It is one of the most economically important polyphagous insect pests in India and other parts of Asia. The pest attacks a wide range of cultivated crops, including soybean, groundnut, cotton, tobacco, pulses, oilseeds, and several vegetable crops, causing substantial yield losses every year. The larval stages are particularly destructive, as they feed voraciously on foliage and are capable of defoliating crops within a short period under favorable conditions., Seth & Sharma, (2002); Tuan et al., (2015). The pest status of *S. litura* is primarily attributed to its high reproductive potential, short life cycle, multivoltine nature, and adaptability to diverse host plants and climatic conditions. In addition, frequent and indiscriminate use of chemical insecticides has led to the development of resistance in *S. litura* populations, making its management increasingly difficult., Gupta et al., (2005); Abbas et al., (2025). These challenges have emphasized the need for detailed biological and ecological studies to support the development of sustainable pest management strategies. The biology and development of insect pests under laboratory-controlled conditions is a fundamental study related to insect physiology, toxicology, biological control, and population dynamics. Laboratory-reared insects are widely used in bioassays and resistance monitoring programmes; however, the quality of biological data largely depends on the diet and environmental conditions provided during rearing., Di et al., (2021). Host plant diet plays a crucial role in influencing larval growth, developmental duration, survival, morphometry, and reproductive fitness of lepidopteran insects Ganguly & Srivastava, (2020). Natural diets allow insects to express their inherent biological potential by providing

balanced nutrients and host-specific phytochemicals, which are often absent or inadequately represented in artificial diets., Seth & Sharma, (2002).

Soybean (*Glycine max* L.) is one of the preferred host plants of *S. litura* and supports rapid larval development and high reproductive output. The nutritional richness of soybean leaves, particularly their protein content, has been shown to positively influence larval growth and pupal weight, ultimately enhancing adult fecundity., Narvekar & Mehendale, (2018); Maharjan et al., (2023). Despite the agronomic importance of soybean, comprehensive data on the morphometric characteristics, developmental duration, and reproductive biology of *S. litura* reared exclusively on soybean under optimized laboratory conditions remain limited.

In this context, the present investigation was assumed that the biological study and developmental performance of *Spodoptera litura* reared on soybean as a natural diet under optimized laboratory conditions. The study focuses on detailed morphometric measurements of immature stages, pupal and adult morphology, developmental duration. The findings are expected to provide reliable baseline information useful for laboratory rearing, pest biological study and integrated pest management.

## MATERIALS AND METHODOLOGY

*Spodoptera litura* larva were collected from infested crop site of soybean. The collected material was carefully transported to the laboratory and examined to eliminate parasitized or diseased individuals. Healthy larvae were used to establish a laboratory culture. Initial rearing was carried out on fresh soybean leaves to acclimatize the insects to the experimental diet. Subsequent generations were maintained exclusively on soybean to ensure uniformity in biological observations, following standard rearing practices for noctuid pests., Ganguly & Srivastava, (2020); Hashmi et al., (2023). Detailed morphometric observations were recorded for all developmental stages using standard measurement techniques. The length and breadth of randomly selected eggs and larval instars were measured using a calibrated ocular micrometer under a stereoscopic microscope. Larval instars were differentiated based on molting events and head capsule exuviae, with the duration of each instar recorded to establish the complete larval period., Tuan et al., (2015); Ganguly & Srivastava, (2020). Upon pupation, the pupae were sexed based on abdominal characteristics, and their duration, length, and breadth were recorded separately for males and females., Rabari et al., (2018). Following emergence, adult morphometric parameters, including body length and wingspan, were measured for both sexes using a millimeter scale., Di et al., (2021). All biological observations were systematically recorded and analyzed using descriptive statistical methods. The data were expressed as range and mean  $\pm$  standard deviation to summarize morphometric measurements, developmental durations, and reproductive parameters, providing a reliable baseline for the study., Gupta et al., (2005); Hashmi et al., (2023).

## RESULTS AND DISCUSSION

The present investigation elucidates the biological life cycle stages and morphometric characteristics of *Spodoptera litura* (Fabricius) reared on a natural diet of Soybean (*Glycine max*). The study was conducted under optimized laboratory conditions ( $25 \pm 1.58$  °C,  $58 \pm 4.47\%$  RH). The results indicate that soybean provides a nutritionally superior substrate, supporting healthy growth for their life cycle stages. Morphometric parameters have been studied as per distinct life cycle states *Spodoptera litura* insect pest.

**(I) Morphometry of Egg:** The eggs of *S. litura* were observed to be spherical, pearly white, and laid in masses covered with golden-brown hair scales. The morphometric analysis revealed a mean egg length of  $0.62 \pm 0.02$  mm and a breadth of  $0.53 \pm 0.02$  mm (Table 1). These dimensions are consistent with the findings of Rabari et al. (2018), who reported an egg size of 0.60 mm on cabbage. The narrow range of variation (0.60–0.63 mm) observed in the present study suggests that embryonic size is a stable genetic trait, largely unaffected by the immediate larval diet of the parent, as noted by Seth and Sharma, (2002). The incubation period lasted for  $3.60 \pm 0.89$  days (Table 2), confirming that the laboratory microclimate (25 °C) was optimal for embryonic development., Maharjan et al., (2023).

**(II) Morphometry of Larva:** The larval phase comprised six distinct instars, with the total larval period lasting  $18.60 \pm 1.82$  days (Table 2). This duration is notably shorter than the 25.60 days reported on tomato by Seth and Sharma, (2002), indicating that soybean foliage facilitates faster metabolic conversion and development. Morphometrically, the larvae exhibited significant growth spurts:

**Early Instar:** The first instar measured  $1.49 \pm 0.01$  mm. A critical growth threshold was observed between the second (3.80 mm) and third instar (10.37 mm), where the body length nearly tripled (Table 1). This transition marks the shift from gregarious scraping to voracious defoliation.

**Late Instar:** The final sixth instar reached a maximum mean length of  $35.52 \pm 1.44$  mm and a breadth of  $4.26 \pm 0.32$  mm (Table 1). This somatic growth is superior to that reported by Ashwini et al., (2016) on cabbage. The substantial biomass accumulation in the final instar supports the hypothesis of Narvekar and Mehendale (2018) that protein-rich legumes like soybean enhance larval size more effectively than cruciferous hosts

### (III) Morphometry Pupa:

Following the larval phase, the insect entered the pupal stage, which lasted for  $8.40 \pm 0.55$  days (Table 2). Sexual dimorphism was clearly evident in the pupal morphometry. Female pupae were larger, with a mean length of  $20.28 \pm 0.39$  mm, compared to male pupae at  $19.72 \pm 0.81$  mm (Table 1). The larger size of the female pupa is biologically significant as it correlates with the reserves required for future egg production.

### (IV) Morphometry of Adult:

Adult stage showing sexual dimorphism as per morphological characters. The adult females exhibited a larger wingspan ( $38.53 \pm 0.31$  mm) compared to males ( $38.28 \pm 0.40$  mm) (Table 3). According to Tuan et al. (2015), a larger wingspan in females is an adaptive trait to support the aerodynamic requirements of carrying a heavy egg load during flight.

**Table 1: Morphometric Parameters of the life cycle Stages of *Spodoptera litura***

life cycle Stages	Developmental Stage	Morphometric Measurement	Range (mm)	Mean $\pm$ SD (mm)
Egg	Egg Shell	Length	0.60 – 0.63	$0.62 \pm 0.02$
		Breadth	0.51 – 0.54	$0.53 \pm 0.02$
Larva	Instar I	Length	1.48 – 1.50	$1.49 \pm 0.01$
		Breadth	0.34 – 0.37	$0.35 \pm 0.02$
	Instar II	Length	3.78 – 3.82	$3.80 \pm 0.02$
		Breadth	0.70 – 0.77	$0.73 \pm 0.04$
	Instar III	Length	10.00 – 10.70	$10.37 \pm 0.35$
		Breadth	1.20 – 1.45	$1.34 \pm 0.13$
	Instar IV	Length	18.49 – 19.00	$18.73 \pm 0.26$
		Breadth	2.10 – 2.27	$2.20 \pm 0.09$
	Instar V	Length	25.29 – 27.04	$26.11 \pm 0.88$
		Breadth	2.80 – 3.01	$2.90 \pm 0.11$
	Instar VI	Length	34.00 – 36.87	$35.52 \pm 1.44$
		Breadth	3.90 – 4.50	$4.26 \pm 0.32$
Pupa	Male	Length	19.00 – 20.60	$19.72 \pm 0.81$
		Breadth	6.11 – 6.44	$6.29 \pm 0.17$
	Female	Length	19.94 – 20.70	$20.28 \pm 0.39$
		Breadth	6.22 – 6.45	$6.33 \pm 0.12$
Adult	Male	Body Length	18.66 – 19.99	$19.40 \pm 0.68$
		Wingspan	37.88 – 38.68	$38.28 \pm 0.40$
	Female	Body Length	19.22 – 20.00	$19.72 \pm 0.43$
		Wingspan	38.19 – 38.79	$38.53 \pm 0.31$

Table 2: Total developmental (life span) profile of *Spodoptera litura*

Stage Parameters	Developmental Stage	Observed Span (days)	Mean $\pm$ SD
<b>Embryonic Transition</b>	Egg	3 - 5	3.60 $\pm$ 0.89
<b>Larval Growth</b>	Instar I	2 - 4	3.00 $\pm$ 0.71
	Instar II	2 - 3	2.80 $\pm$ 0.45
	Instar III	3 - 4	3.40 $\pm$ 0.55
	Instar IV	2 - 4	3.00 $\pm$ 0.71
	Instar V	3 - 4	3.40 $\pm$ 0.55
	Instar VI	2 - 3	2.80 $\pm$ 0.45
	Larval Phase	17 - 21	18.60 $\pm$ 1.82
<b>Metamorphic Transition</b>	Pupa	8 - 9	8.40 $\pm$ 0.55
<b>Adult Survival</b>	Male	7 - 9	7.80 $\pm$ 0.84
	Female	10 - 12	10.80 $\pm$ 0.84
<b>Total Life Span</b>	Male	35 - 41	37.60 $\pm$ 2.41
	Female	38 - 44	40.60 $\pm$ 2.41

Figure 1: Life cycle Stages of *Spodoptera litura*

Photo Plate 1 : Egg



Photo Plate 2 : Larva



Photo Plate 3 : Pupa



Photo Plate 4 : Adult

## CONCLUSION

In the present investigation, the laboratory reared *S. litura* Life cycle stages have been concluded that the complete life span of *S. litura* in 35–44 days with females exhibiting longer longevity than males. The incubation period lasted for  $3.60 \pm 0.89$  days. The larval development comprised with six instar stage, shown a gradual increase in body length ranging between  $1.49 \pm 0.01$  mm in first instar and  $35.52 \pm 1.44$  mm in sixth instar. The pupal stage of their life cycle lasted for  $8.40 \pm 0.55$  days and the adult females exhibited a larger wingspan ( $38.53 \pm 0.31$  mm) compared to males ( $38.28 \pm 0.40$  mm). The comparative analysis of morphometric and biological parameters confirms that *Glycine max* is a highly suitable natural feed for the bioassay study of *S. litura*.

## ACKNOWLEDGMENT

The authors are grateful to the Department of Zoology, K.R.T. Arts, B.H. Commerce and A.M. Science (KTHM) College, Nashik, Savitribai Phule Pune University, Pune and Council of Scientific and Industrial Research (CSIR), New Delhi for funding and corporate for present investigation.

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