Biology of Tobacco Caterpillar (*Spodoptera litura* Fabricius) on Castor Plant

Abstract

The present study highlights the biology of Tobacco Caterpillar (*Spodoptera litura* Fabricius) on Castor Plant. The host plant quality is a key determinant of the fecundity of herbivorous insects; it also affects insect reproductive strategies, egg size and quality, the allocation of resources to eggs, and the choice of oviposition sites. The present study was conducted in 2024 in the Department of Agricultural Entomology, College of Agriculture, Madhav University, Pindwara, Sirohi (Rajasthan). To study the biology of *Spodoptera litura*, it was taken up under laboratory conditions. The host preference was investigated based on observations recorded on different developmental stages of *S. litura*. The effects of host plant viz., castor. The development of this insect was studied to determine the most preferred host. It was assessed based on the incubation period, larval period, pre-pupal period, pupal period, adult emergence, adult longevity, fecundity, incubation period, and total life span from the larvae reared on castor leaves. By considering all the criteria for comparing the relative effect of castor plants on the biology of *S. litura*, it can be concluded that castor was the most preferred host plant against *S. litura*.

Keywords: Tobacco Caterpillar, herbivorous insects, fecundity, pupal period

INTRODUCTION

"The tobacco caterpillar, *Spodoptera litura* (Fabricius) (Lepidoptera: Noctuidae), is one of the economically important and regular polyphagous pests on field and horticultural crops" [1]. It is widely distributed in Asia, including India, Pakistan, China, Korea, and Japan [2]; Africa, Australasia, and Pacific islands [3]. "*S. litura* has a wide host range, feeding on approximately 389 species of plants belonging to 109 families worldwide" [4], out of which 60 species of plants are known from India (Garad et al., 1984), causing economic losses to different crop species ranging from 26-100% yield loss under field conditions [5]. "Among the main host plant species attacked by *S. litura* in the tropics are *Colocasia esculenta*, cotton, flax, groundnuts, jute, lucerne, maize, rice, soybeans, tea, tobacco, and vegetables such as aubergines, Brassica, Capsicum, cucurbit vegetables, Phaseolus, potatoes, sweet potatoes, and species of Vigna. Other hosts include ornamentals, wild plants, weeds, and shade trees (for example, *Leucaena leucocephala* and the shade tree of cocoa plantations in Indonesia)" [6]. "Although it had been a sporadic pest of many crops, gradually it has become a very important insect pest in recent years" [7]. "The outbreak of this pest generally occurs with good rainfall after a long dry spell" [8]. "Although it had been a sporadic pest in India, an outbreak of this pest has been reported on soybeans in Kota (Rajasthan) and Marathwada and Vidharba (Maharashtra) regions of India have been reported to cause monetary losses to the tune of USD 4.5 and 22.5 crores, respectively, with the regions of India causing greater yield loss" [9]. "It has become a major pest and endemic to southern states of India,

causing yield losses of up to 71%" [10]. Recent outbreaks of *S. litura* caused 90% defoliation of sunflower-cultivated germplasm growing in Central and Southern parts of India during 2005 [11]. Also, "the elevated CO_2 level, under present climatic changes, is supposed to increase the feeding by this pest on cotton by 30%" [12]. "The host plant quality is a key determinant of the fecundity of herbivorous insects; it also affects insect reproductive strategies, egg size and quality, the allocation of resources to eggs, and the choice of oviposition sites" (Caroline et al., 2002). "The newly hatched larvae feed gregariously from the lower surface of the leaves and cause heavy damage to the leaves, shoots, stems, and capsules. The larval stages are key elements in damaging the crops; grown-up larvae consume almost whole plant leaves, leaving behind midribs and hard veins only. The study of the influence of different host plants on the growth, development, and fecundity of insects is very Understanding the host suitability of pests and reducing larval survival and development can be beneficial. On poor-quality hosts due to nutritional composite and secondary plant metabolites, different host plants can also play an important role in the population increase and outbreak of polyphagous insect pests" [13]. "The knowledge of the life parameters of *S. litura* and understanding the components of its fundamental life history on different host plant species may help to make progress in efficient strategies to control this economic pest" [14, 15].

MATERIALS AND METHODS

Insects Rearing:

The present study was conducted in November, 2024 in the Department of Agricultural Entomology, College of Agriculture, Madhav University, Pindwara, Sirohi (Rajasthan). To study the biology of *Spodoptera litura,* it was taken up under laboratory conditions. To study the biology of *Spodoptera litura* on castor, initial larvae were collected from castor fields of the research farm, College of Agriculture, Madhav University, Pindwara, Sirohi (Rajasthan), India, and transferred to a clean container by providing healthy castor leaves with long petioles. "The leaf was kept in a plastic container containing moist filter paper to keep it fresh. This served as an immediate source of food for the first instar larvae. Leaf along with the egg mass was transferred to pre-sterilized transparent plastic containers and covered with muslin cloth. The leaf was changed when the larvae entered the third instar. Thereafter, containers were cleaned with 2 per cent formaldehyde, shade dried and fresh castor leaves were given every day till the larvae entered into the last instar larval stage. These late larval instars were collected from containers and pupae thus obtained were collected and kept in small plastic jars covered with muslin cloth. During the process, male and female pupae were separated based on external genitalia. These pupae were kept in separate small plastic jars for adult emergence, which were covered with muslin cloth. The pupa will be transferred to egg-laying receptacles for adult emergence and egg-laying after three days of pupation" [12].

Mating Period and Fecundity*:*

Immediately after adult moth emergence, one pair of male and female moths were released into a separate egg-laying glass jar. The inner surface of the egg-laying glass jar was lined with white paper to provide space for egg-laying. A piece of cotton soaked in 10% honey solution in a perti dish (dia. = 3 cm), was kept inside the jar as a food source for the emerging adults, which were

covered with the muslin cloth. For this purpose, ten small glass jars were maintained for observing oviposition period, fecundity, and viability of eggs, adult male and female longevity.

Developmental Stages:

For describing different developmental stages of *S. litura i.e.,* egg, larva, pupa, adult and changes in their body size and colour, each stage was observed and data recorded regularly. Observations were recorded on the biology of *S. litura* on castor. The experiments were started with newly laid egg masses of *S. litura* females. On castor, four replications (10 larvae in each) were maintained.

Egg: Count the number of eggs laid by a female in each treatment. The incubation period was recorded from the day of egg laying to the emergence of first instar larvae (in days) on different hosts.

Larva: Immediately after hatching, first instar larvae were allowed to feed on fresh soft leaves of castor in rearing glass jars up to the third instar because of their gregarious nature. However, during their successive development, the larvae of *S. litura* were reduced to 20 - 40 in each rearing glass jar. Rearing jars were cleaned with 2% formaldehyde (excreta and filter paper were changed) and fresh food was supplied daily to maintain good hygienic conditions for growing larvae. During the fourth and fifth instar stages, 15 – 25 larvae were kept in glass jars and provided with sufficient food and space. Rearing jars were covered with sterilized muslin cloth and secured with a rubber band.

Pre-pupal Period: Pre-pupal stage was characterized by the larva becoming sluggish, decreasing in size and further feeding ceased, soon the body contracted longitudinally and the insect became motionless. The observation of the pre-pupal stage will be recorded based on the above symptoms of the larvae. The period taken from the formation of pre-pupa to pupa will be considered as the pre-pupal period.

Pupae: The pupal period was recorded from the day of pupation to the day of adult emergence by taking a sample of 10 pupae in each replication.

Adult:

1. Percentage of adult emergence: The number of adults that emerged from the pupae was converted in per cent to obtain the data on the percentage of adult emergence.

2. Adult longevity: Adult longevity was recorded by keeping the female and male moths in separate glass jars numbering 10 pupae in each jar. A piece of cotton soaked in 10% honey solution in a perti dish (dia. = 3 cm), was kept inside the jar as a food source for the emerging adults. The number of days for which an adult survived was recorded as the adult longevity period. The interval (in days) between the emergence of the adults and their death was recorded as the adult longevity period.

Site of Oviposition: The site of oviposition was observed under laboratory and field conditions. Under field conditions, the egg mass was observed on the underside of different host leaves, covered with yellowish-brown hairs. However, in the laboratory, egg laying was observed on muslin cloth and filter paper, and most of the egg masses were not covered with yellowish-brown hairs.

Statistical Analysis: The life history parameters of *S. litura were* analyzed to calculate the mean and standard deviation.

RESULTS AND DISCUSSION

The findings of the experiment have been presented below under the respective heads as detailed in materials and methods.

Biology of Tobacco Caterpillar, *Spodoptera litura* (Fabricius), on Castor:

The host preference was investigated based on observations recorded on different developmental stages of *S. litura*. The effects of castor plant. The development of this insect was studied to determine the most preferred host. It was assessed based on the incubation period, larval period, pre-pupal period, pupal period, adult emergence, adult longevity, fecundity, incubation period, and total life span from the larvae reared on different hosts.

Incubation Period: It is evident from Table 1 that the incubation period was reported on castor 2.0-3.0 days. The observations on the incubation period are confirmed by the findings of Ramaiah and Maheswari [16], who reported that the incubation period on castor is 3.00 days, Gupta et al. (2015). 5.5 days on mango, Azidah and Azirum [17] 3.00 days on different hosts, Shakya et al. [18] 4.2 days on tomato, Rajasekar and Sridevi [19] 3.87 days on castor, and Soni et al. (2001) reported an incubation period on castor.

Larval Period

First Instar Larvae: The newly hatched first Instar larvae were pale green with dark blackheads, having distinctly visible black hairs on the body and small, tiny blackish spots visible on the first abdominal segment, which later became yellowish green in colour. It is presented in Table 1, first instar larval period 2.0-3.0 days.

Second Instar Larvae: The second Instar larvae were smooth-skinned, hairless, and pale greenish. It is evident in Table 1 that, the first instar larval period is 2.0-3.0 days.

Third Instar Larvae: The third Instar larvae grew bigger and changed their body colour to dark green with two dorsal black spots on the first abdominal segment and dark crescent-shaped black spots on the sides of the subsequent abdominal segment. The third instar larval period lasted for about 3.0 - 4.0 days (Table 1).

Fourth Instar Larvae: The fourth Instar larvae changed their colour from green to brown, with three thin lines of dorsal bands changing the colour, with the central band becoming shiny orange and the two lateral bands becoming yellowish. It is presented in Table 1 that the fourth instar larval period is 3.0-4.0 days.

Fifth Instar Larvae: After the fourth moult, the larvae get bigger and secrete green-coloured fluid when disturbed. The fifth instar larvae were brown with three thin yellowish lines or bands as mentioned above. A row of black intermittent dots runs along its side. The maximum fifth instar larval period was recorded at 2.0-3.0 days (Table 1). Similarly, Ramaiah and Maheswari [16] reported a larval period of 13.50 days on castor. Gupta et al. (2015) observed a larval period of 15.45 days on mango, and Shakya et al. [18] 25.00 days on tomato. Rajasekar and Sridevi [19] 12.67 days on castor. Dwivedi et al. [20] also reported castor as the most suitable host for the larval development of *S. litura*; from the present findings, it was revealed that cotton and soybean were

the least preferred hosts as they had a retarding effect on larval development; these findings corroborate with the findings of Rani et al. [21], who reported cotton as the least preferred host and had a retarding effect on larval development. The present findings are in agreement with Mishra and Srivastava [22], Mandal et al. [23], Ramaiah and Maheswari [16], Soni et al. (2001), and Azidah and Azirum [17], who reported the shorter larval durations on the most preferred host.

Pupal Period: Pupal period was recorded on the pupae formed from the larvae reared 7.0-8.0 days, (Table 1). Similarly, Ramaiah and Maheswari [16] reported a pupal period of 7.50 days on the castor. Shabout et al. [24] a pupal period of 7.54 days on castor, followed by cotton (8.00 days) and soybean (8.43 days). Rajasekar and Sridevi [19] observed the pupal period on the castor as 7.66 days.

Adult: The adult moth was hairy and brown with a complex pattern of creamy-coloured crisscrossing markings on the forewings, and the wings were silvery-whitish in colour. The male is generally shorter than the female, and males have a prominent white band on their forewings, unlike females. The male adult is darker, and the female is pale brown. Thus, the entire life cycle of *S. litura* was completed in a range between 26.85 and 35 days under laboratory conditions (Table 1).

Adult Emergence: The data presented in Table 1 showed percent adult emergence from reared larvae 75-87%. Soni et al. (2001) recorded that the maximum adult emergence from the larvae reared on cauliflower *was* 90.63 per cent and 92.50 per cent, respectively.

Adult Longevity

Male: The longevity of male moths obtained from the larvae reared on recorded after keeping them on a 10% honey solution (Table 1). Adult male moths emerged and survived for 4.0-5.0 days.

Female: It is evident from Table 1 that the longevity of female moths of *S. litura* was recorded at 6.0-7.0 days. The present findings, with slight differences, were in agreement with the finding of Ramaiah and Maheswari [16], who recorded the longevity of male (6.50 days) and female (8.00 days) moths of *S. litura* on castor. Rajasekar and Sridevi [19] reported the longevity of male (3.16 days) and female (5.50 days) moths of *S. litura* on castor. Shabout et al. (2011) reported a female longevity of 6.33 days on castor, followed by (6.07 days) and cotton (6.22 days).

Fecundity: The female adult moths obtained from the larvae reared on a 10% honey solution for egg laying. As evident from Table 1, the female moth obtained from castor 750-840 number of eggs. Similarly, Ramaiah and Maheswari [16] recorded the fecundity of females on the castor (890.50). Soni et al. (2001), recorded the highest fecundity of females on cabbage (557.06) than on cauliflower (397.63), and Rajasekar and Sridevi [19] reported 262.5 on castor.

CONCLUSION

By considering all the criteria for comparing the relative effect of castor plants on the biology of *S. litura*, it can be concluded that castor was the most preferred host plant against *S. litura*. The knowledge of the life parameters of S. litura and understanding the components of its fundamental life history on different host plant species may help to make progress in efficient strategies to control this economic pest.

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Table 1. Biology of tobacco caterpillar, *Spodoptera litura* on Castor.

Sr. No.	Stage of the insect		Minimum (Days)	Maximum (Days)	Mean ± SD
1.	Incubation Period (days)		2.0	3.0	0.71
2.	Larval Period	First instar	2.0	3.0	0.71
		Second instar	2.0	3.0	0.71
		Third instar	3.0	4.0	0.71
		Fourth instar	3.0	4.0	0.71
		Fifth instar	2.0	3.0	0.71
3.	Pre- Pupal Period		0.85	1.0	0.11
4.	Pupal Period		7.0	8.0	0.71
5.	Percentage of adult emergence (%)		75..0	87.0	8.49
6.	Adult longevity (days)	Male	4.0	5.0	0.71
		Female	6.0	7.0	0.71
7.	Fecundity (No.)		750	840	63.64
8.	Total life cycle (days)		26.85	35	5.76

Eggs

Larva 1st Instar 2nd Instar 3rd Instar 4th Instar 5th Instar

Pre-Pupa Pupa

Female Moth Male Moth

Plate 1. Developmental stages of tobacco caterpillar, *S. litura* Fabricius