Morphometric Studies of Tobacco Caterpillar, [*Spodoptera litura* (Fabricius)] on Different Host plants

Abstract

Tobacco caterpillar, *Spodoptera litura* (Fabricius) is an economically important polyphagous pestinflicting significant economic damage to numerous field and horticultural crops. Research was conducted at the Department of Entomology, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, in laboratory settings to validate the presence of this pest. The investigation involved detailed measurements of the various larval stages, pupa, adult male, and female, of tobacco caterpillar including the wingspan. The first to sixth instars of *S. litura* exhibited significantly greater length and width as well as width of head capsule, when reared on the tomato as a host. The pupae of *S. litura* reached at their maximum length and width when raised on marigold (16.75 mm and 4.36 mm), while the minimum pupal measurements (14.10 mm and 4.42 mm) was observed in case of maize. In regards to the adult moths, both male and female specimens displayed the longest length and wing span when associated with tomato (16.71 mm and 18.22 mm for length, 38.47 mm and 38.73 mm for wingspan, respectively), whereas the smallest measurements were recorded for those associated with maize (14.35 mm and 16.95 mm for length, 35.10 mm and 35.12 mm wingspan respectively).The present study confirmed the presence of *S. litura*that require immense attention to prepare the management strategy against it.

Keywords: *Tobacco Caterpillar, Larva, Morphometry, Tomato, Marigold*

1. INTRODUCTION

Spodoptera litura (Fabricius) is a highly polyphagous insect that significant threat to agriculture and many other countries [1]. This insect has a wide range of host plants and has been reported to damage over 112 plant species from 44 different families [2]. In India alone, it has been observed affecting about 40 plant species Chari and Patel [3]. Various crops are known to serve as host plants for *Spodoptera litura*, and researchers [4-6] have documented its presence and damage in several agricultural crops. Some of the crops known to be affected by *Spodoptera lituraviz.,* maize, castor, cauliflower, tobacco and several grasses etc. *Spodoptera litura's* ability to infest such a wide range of crops and plant species makes it an important agricultural pest that requires efficient management strategies to mitigate its impact on crop yields. Other hosts include ornamental plants, native vegetation, unwanted plants, and shade trees, such as *Leucaena leucocephala*, which serves as a shade tree in Indonesian cocoa plantations [7].

The damage inflicted by *S. litura* on tomatoes is significantly more pronounced. This pest has been documented to initiate leaf skeletonization in the early stages and extensive defoliation in later stages, thereby diminishing the plants' photosynthetic capability [8]. Entomopathogenic nematodes (EPNs) are beneficial organisms that parasitize insect pests and are increasingly employed as a biopesticide against a wide array of such pests [9]. Their remarkable qualities have sparked considerable commercial interest in utilizing nematodes as biological insecticides, presenting a promising alternative to chemical approaches in integrated pest management (IPM) strategies. EPNs possess numerous attributes that render them effective biocontrol agents. They exhibit behavior akin to insecticides or conventional plant protection chemicals, and they can be seamlessly integrated into IPM programs. Cultivating and applying EPNs is straightforward, utilizing established methods and equipment. Moreover, they demonstrate compatibility with various chemical pesticides, making them a valuable addition to IPM initiatives [10].

2. MATERIAL AND METHODS

Mass rearing of Tobacco Caterpillar was initiated under laboratory conditions. Early instars were collected from the field and brought to the laboratory and maintained in plastic container having holes in the lids for their proper growth and development and larvae were fed with fresh chopped cabbage. The

paired adult was allowed to mate in separate mating cages. After eggs laying, these were separated and kept under BOD incubator in Petri plates for further development, and to maintain larval population of *Spodoptera litura*.

To initiate the morphometrics study of *S. litura*under laboratory condition, the samples of each instar as well as other stages were preserved in 70 % alcohol. The length and width of larvae, pupae, adults (5 of each stage) and width of head capsule were measured by using stereo zoom binocular microscope having magvision image analysis software and reference scale. Moulting was confirmed by presence of exuviae.

Data on morphometrics of different stages *viz.* larva, pupa and adult of *S. litura* on different hosts were measured by using stereo zoom binocular microscope having magvision image analysis software and reference scale. To record the length and width, head capsule of larvae, 5 samples (larvae) from each host (maize, marigold, pigeon pea and tomato) were killed and preserved in 70 % alcohol. For further observation, the specimens were transferred to blotting paper for removing moisture then mount on glass slide to study under on stereo zoom binocular and reference scale. Several characters were linearly measured using stereo zoom binocular and on reference scale *viz.* Head capsule, larval body length, pupal length and width, wing span as well as body length of male and female adults were measured.

3. RESULTS AND DISCUSSION

3.1 First instar larvae:

The data in Table 2 and 3 indicates that the maximum length and width of first instar larvae and usual width of head capsule were observed in tomato, measuring 2.74 mm and 0.45 mm, 0.34 mm respectively. In contrast, when considering maize and marigold, their respective values for first instar larval length were 1.58 mm and 1.38 mm, while their widths were 0.34 mm and 0.26 mm, and their size of head capsule 0.32 mm and 0.31 mm respectively. However, the minimum length and width were recorded in pigeon pea, measuring 1.15 mm in length and 0.30 mm in width along with their head capsule width 0.27 mm

3.2 Second instar larvae:

Table 2 and 3 clearly demonstrates that the second instar larva exhibited its maximum length and width as well as head capsule measuring 8.65 mm and 1.35 mm, 0.53 respectively, on tomato plants. These measurements were similar to those observed on maize, which had lengths of 8.24 mm and widths of 1.13 mm. The average width of head capsule on maize is 0.50. When it comes to marigold, their respective measurements for II instar larval length were 4.14 mm and 0.54 mm, with head capsule width 0.46 mm. Conversely, Pigeon pea displayed notably smaller larval measurements, with a minimum length of 3.55 mm and a minimum width of 0.44 mm with widths of head capsule 0.42 mm.

3.3 Third instar larvae:

The lowest larval length and width measurements as well as head capsule width were observed in case of pigeon pea, measuring 7.75 mm and 0.74 mm, 0.64 mm respectively. On the other hand, marigold and maize displayed varying lengths and widths. Specifically, marigold had larval lengths of 10.58 mm and widths of 1.47 mm, maize had lengths of 11.42 mm and widths of 2.07 mm. Marigold and maize had average width of head capsule 0.71 mm and 0.74 mm respectively. The maximum length and width measurements were obtained from tomato, measuring 16.75 mm and 2.21 mm, respectively with head capsule width 0.87 mm. (Table 2 and 3)

3.4 Fourth instar larvae:

In Table 2 and 3, it is evident that fully grown larvae displayed their maximum body length and width on tomato plants, measuring 26.84 mm and 2.94 mm, respectively. The head capsule width of 1.24 mm was measured on tomato. These measurements were distinct from those observed in other treatments.

3.5 Fifth instar larvae:

The minimum larval length and width were observed on marigold 23.15 and 3.57 mm respectively. The width of head capsule 1.60 mm was measured on marigold. On maize the respective

values were 24.23 mm, 3.68 mm with head capsule 1.65 mm. The maximum larval length and width were recorded from tomato 32.65 and 3.68 mm respectively. The width of head capsule 2.44 mm was measured on tomato. (Table 2 and 3)

3.6 Sixth instar larvae:

The fully grown larvae exhibited their maximum length and width on tomato plants, measuring 37.52 mm and 4.52 mm, respectively. Notably, width of head capsule measured on tomato was 3.35 mm. Conversely, when considering maize and marigold, their respective measurements for fully grown larval length were 29.10 mm and 28.00 mm, with widths of 4.25 mm and 4.19 mm. whereas, measurement of width of head capsule of maize and marigold 1.98 mm and 1.89 mm respectively. These measurements were statistically at par to each other as indicated in Table 2 and 3.

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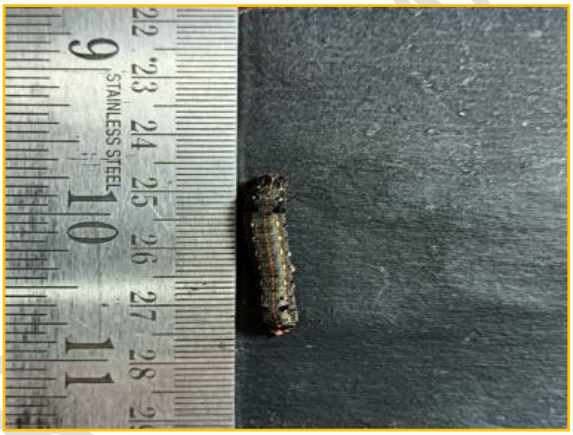
<tr><td>  </td><td>  </td></tr>
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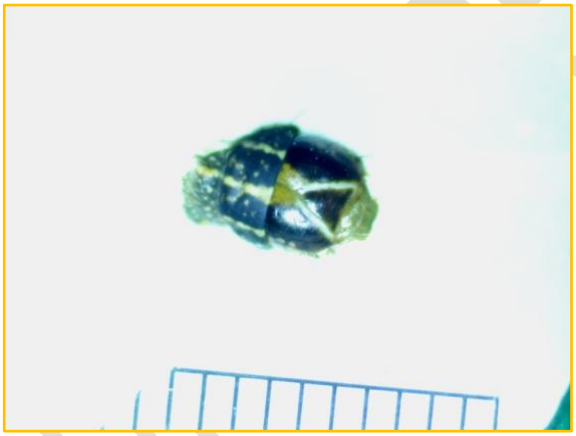
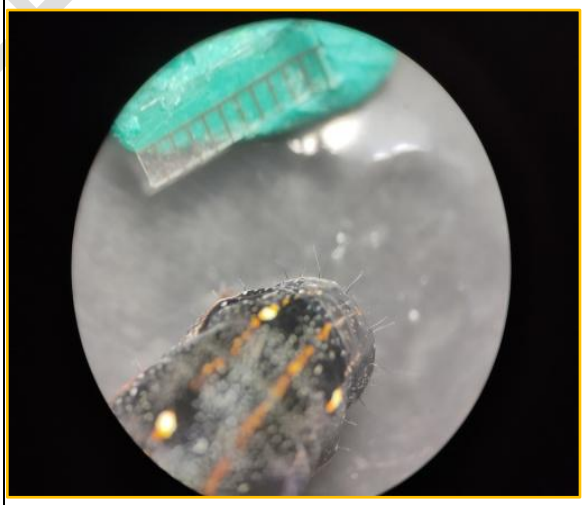
<tr><td>  </td><td>  </td></tr>
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Figure 1: Morphometric study of different instars and pupae of *Spodoptera litura*.
A- Morphometric of early instars larvae. **B-** Head capsule measurement of early instars **C-**Morphometric of late instar larvae. **D-**Head capsule measurement of late instars larvae. **E-** Morphometric of pupae

Table 1: Morphometric variation of Tobacco caterpillar, *S. litura*larvae and pupae on different hosts

S.No.	Host plants ⟶ / Instars ↓	Tomato		Maize		Marigold		Pigeon pea	
		Length (mm)	Width (mm)	Length (mm)	Width (mm)	Length (mm)	Width (mm)	Length (mm)	Width (mm)
1	I	2.74±0.49	0.45±0.06	1.58±0.12	0.34±0.02	1.38± 0.04	0.26±0.04	1.15±0.09	0.30±0.15
2	II	8.65±0.56	1.35±0.08	8.24±0.12	1.13±0.06	4.14±0.10	0.54±0.13	3.55±0.12	0.44±0.33
3	III	16.75±0.85	2.21±0.08	11.42±0.26	2.07±0.05	10.58±0.23	1.47±0.16	7.75±0.19	0.74±0.04
4	IV	26.84±0.87	2.94±0.24	19.25±0.33	2.36±0.16	18.78±0.28	2.28±0.04	-	-
5	V	32.65±0.69	3.70±0.35	24.23±0.45	3.68±0.02	23.15±0.39	3.57±0.02	-	-
6	VI	37.52±0.61	4.52±0.20	29.10±0.34	4.25±0.29	28.00±0.33	4.19±0.04	-	-
7	Pupae	16.72±0.49	4.83±0.21	14.10±0.07	4.42±0.34	16.75±0.85	4.36±0.01	-	-

Table 2: Width of head capsule and growth rate of *Spodoptera litura* during larval development

S. No.	Host plants ⟶ / Instar s ↓	Tomato		Maize		Marigold		Pigeon Pea	
		Mean ±SE	Growth Ratio	Mean± SE	Growth ratio	Mean± SE	Growth ratio	Mean± SE	Growth ratio
1	I	0.34±0.03	-	0.32±0.02	-	0.31±0.01	-	0.27±0.01	-
2	II	0.53±0.03	1.55	0.50±0.01	1.56	0.46±0.02	1.48	0.42±0.02	1.55
3	III	0.87±0.02	1.64	0.74±0.02	1.48	0.71±0.01	1.42	0.64±0.01	1.52
4	IV	1.24±0.02	1.24	1.05±0.03	1.41	1.03±0.02	1.45	-	-
5	V	2.44±0.04	1.96	1.65±0.02	1.57	1.60±0.03	1.55	-	-
6	VI	3.35±0.02	1.37	1.98±0.02	1.20	1.89±0.01	1.18	-	-

Pupae:

Table 1 clearly illustrates that the maximum length and width of fully grown pupae were observed in marigold, measuring 16.75 mm and 4.36 mm, respectively. These measurements were statistically similar to those recorded for tomato, which had a length of16.72 mm and 4.83 mm width. However, the lowest recorded length (14.10 mm) and width (4.42 mm) were found in maize.

Adult:

Female moth:

The data presented in the table (Table 3) on the maximum body length of female moths and their wing spans. The results indicated that the longest body length was observed in female moths from tomato, measuring 18.22 mm, followed by marigold 17.67 mmand maize 16.04 mm in maize. The maximum wing span of female moths was on tomato (38.47 mm). followed by was 37.74 mm in marigold. These measurements were similar to each other and slightly smaller wing span of female moths were recorded from maize, which measured 35.10 mm.

Male moth:

Table 3 clearly indicated that maximum body length and wing span of male moth were observed on tomato (16.71 and 38.73 mm), followed by marigold (16.34 and 38.13 mm), and maize (14.35 and 35.12 mm).

Table 3: Morphometric variation in adult moths of Tobacco caterpillar, *Spodoptera litura* on different hosts.

(A) Female:

S. No.	Host Plants	Length (mm)			Wing span (mm)		
		Min.	Max.	Mean± SE	Min.	Max.	Mean± SD
1	Tomato	16.40	19.45	18.22±0.34	34.90	41.11	38.73±0.57
2	Maize	14.57	16.95	16.04±0.20	31.20	37.32	35.12±0.40
3	Marigold	16.27	19.05	17.67±0.44	34.39	40.62	38.13±0.58
4	Pigeon pea	-	-	-	-	-	-

(B) Male:

S.No.	Host Plants	Length(mm)			Wing span (mm)		
		Min.	Max.	Mean± SE	Min.	Max.	Mean± SD
1	Tomato	15.10	17.97	16.71±0.42	36.10	40.95	38.47±0.80
2	Maize	12.11	15.87	14.35±0.45	32.65	36.87	35.10±0.43
3	Marigold	14.80	17.78	16.34±0.41	35.92	39.77	37.74±0.70
4	Pigeon pea	-	-	-	-	-	-

The comparative impact of four different host plants viz., maize, tomato, marigold, and pigeon pea were studied on the morphological characteristics of *S. litura*. Notably, the larvae of *S. litura* exhibited the most significant increase in both length and width when reared on tomato plants, followed by maize, marigold and pigeon pea. This observation aligns with the findings of Kumar and Bhattacharya [11], who also noted similar trends in larval development when fed on tomato leaves.

Average width of head capsule of*S. litura*were measured on four different host, maximum width was observed on tomato 3.35 mm, followed, by maize 1.98 and least development 1.89 mm was recorded on marigold.In terms of pupal development, marigold plants yielded the most substantial pupae, with a recorded length of 16.75 mm and a width of 4.36 mm, followed by tomato, maize. This result is consistent with the research of Ramzan et al. [12], who reported pupal measurements of 14.22 mm in length and 4.10 mm in width on maize. On the contrary, Ramya and Jha [13] observed different pupal dimensions of 16.72 mm in length and 4.83 mm in width when reared on tomato leaves under controlled laboratory conditions.

Regarding the adult stage, tomato proved to be the most favourable host, yielding females with a maximum body length of 18.22 mm and a wing span of 38.73 mm, and males with a body length of 16.71 mm and a wing span of 38.47 mm. Marigold also supported relatively larger adults, while maize was the least suitable host. These findings are in line with those reported by Kumari et al. [14], who found similar measurements for males (15.84 mm in length and 32.12 mm in wing span) and females (14.08 mm in length and 31.64 mm in wing span) when reared *S.litura* on maize in laboratory conditions. Based on the morphological characteristics observed at different developmental stages, it can be concluded that tomato is the most conducive host for the growth of *S. litura*, followed by marigold and maize [15].

4. Conclusion

The first to sixth instars of *S. litura*exhibited significantly greater length and width as well as width of head capsule, when reared on the tomato as a host. The pupae of *S. litura* reached at their maximum length and width when raised on marigold (16.75 mm and 4.36 mm), while the minimum pupal measurements (14.10 mm and 4.42 mm was observed in case of maize). In regards to the adult moths, both male and female specimens displayed the longest length and wing span when associated with tomato (16.71 mm and 18.22 mm for length, 38.47 mm and 38.73 mm for wingspan, respectively), whereas the smallest measurements were recorded for those associated with maize (14.35 mm and 16.95 mm for length, 35.10 mm and 35.12 mm wingspan respectively).

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