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Research Article

Comparative Biology of *Spodoptera litura* (Lepidoptera: Noctuidae) on Different Hosts under Laboratory Conditions in Pakistan

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ABSTRACT

One of the most economically significant insect pests in world agriculture is the armyworm, Spodoptera litura Fabricius (Lepidoptera; Noctuidae). In 2019, S. litura was reared in a lab environment to study its biological parameters on different hosts. The sixth larval instar was recorded in this study. The period of 1st, 2nd, 3rd, 4th, 5th and 6th larval instar on cotton was 3.55±0.10, 3.59±0.09, 3.99±0.10, 4.56±0.09, 6.65±0.15, and 5.59±0.17 days, respectively. Maximum adult emergence was recorded on cabbage followed by cotton and maize. The larval length and weight were found higher on cabbage followed by cotton and maize. The pupal development was less concerning days on maize than other tested hosts. The highest mean fecundity was 2954.16 eggs per female on cabbage leaves while minimum with 987.19 eggs per female on maize leaves. The sex ratio of female to male was recorded as 1:0.7, 1:0.6, and 1:0.5, on cabbage, cotton and maize, respectively. Female was long lived than male as recorded on all tested hosts. Among all tested hosts, cabbage was recorded as the most preferable and suitable host for pest. The current study findings will provide suitable information about hosts of S. litura but suggest further studies.

Keywords: *Armyworm; Spodoptera litura; Cabbage; Maize; Cotton; Preferable hosts.*

INTRODUCTION

Agriculture, which is the practice of cultivating crops and rearing livestock, is vitally important to the economy of emerging and impoverished nations. When Pakistan gained its independence, agriculture accounted for around 53% of the nation's GDP, and more than 65% of the labour force was occupied in this industry.

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In this industry, our lifestyles and entrepreneurial spirit intersect (Azam & Shafique, 2017; & Jatoi, 2020). Pakistan is among the top producers of important crops, including wheat, maize, cotton, rice, sugarcane, etc., which account for about 35% of all agricultural production. The production of horticultural and agricultural crops or vegetables is reducing due to insect pests, and pathogens. Among reported insect pests, *Spodoptera litura* is a dangerous pest.

S. litura is the most significant polyphagous pest of different crops, vegetables, pulses and oilseeds such as cotton, maize, sugarcane, onion, tomato, potato, okra, and many others (Ramzan et al., 2021; & Murtaza et al., 2020). The establishment, development, survival, and fertility of herbivorous insects are significantly influenced by the host plant (Tuan et al., 2016; & Narvekar et al., 2018).

This moth is primarily active at night, and because of their high mobility and ability to lay their eggs on a variety of host plants, they help or even guarantees the survival of *S. litura* individuals under a variety of environmental conditions (Anjali et al., 2014; & Naik et al., 2017). It results in economic losses by harming the embryonic portions of plants and creating small galleries (Naz et al., 2003; Yinghua et al., 2017; Tuan et al., 2014; & Zhang et al., 2006) inside the hosts.

S. litura migrates to other plants to finish their growth and development in the absence of suitable hosts, which becomes the cause of its spreading to other areas and becomes difficult to control it. Many workers have tested different management strategies around the globe to control this moth on different host plants. Before adopting any best strategy against this pest, the proper guidelines and information related to the host plant are necessary using different hosts. The present research work was done in the laboratory to fulfil this research gap.

MATERIALS AND METHODS

Spodoptera litura collection and rearing

S. litura larvae were collected from different maize fields of the farmers. Collected larvae were brought to the laboratory for rearing purposes and performing further experiments. The fresh leaves of maize were collected from maize plants planted nearby the laboratory. The collected leaves were washed with flowing water and then with distilled water to remove the pathogens or dust particles. The second generation newly emerged first instar larvae were shifted into different hosts such as cotton, okra, and maize leaves to check the pest biological parameters and compare the pest growth and development. The culture was maintained under laboratory conditions *i.e.* 27 ± 5°C and relative humidity (RH) (70 ± 5%). On every second day, food was changed and new leaves were given to larvae for feeding. The similar procedure was continued until larvae reached to pupal stage. The pupae were collected and placed into separate container for adult emergence. Two pair of emerged adults from each host plant were placed into separate rearing cages for further investigation. The eggs were collected on tissue paper hanged inside each cage.

Biological parameters

The pest parameters such as incubation period, larval period, pupal period, and adult longevity on each tested host were noted and written on data recording pages.

RESULTS AND DISCUSSION

Host plant play key role in the growth, survival, and development of insect pests such as *Spodoptera litura* (Jeyasankar et al., 2013; & Abdullah et al., 2019). The immature stages of pest, such as larvae attack different parts of plants such as leaves, twigs, fruits and flowers, which ultimately reduce the production (Lakshman et al., 2017). In this study, different hosts (cotton, maize and cabbage) were tested to check the pest preference and biological parameters as given in table 1. The neonatal larvae were light green in colour with a dark black head. They also had a little black patch on the first abdominal segment. The first larval instar's mean development period was 2.8 days.

The larvae of the second instar had an amber-colored head and a light, white to the yellowish body with a hint of brown on the

dorsum. The second larval instar's median development period was 3.59±0.09, 2.56±0.13 and 3.48±0.11 days on cotton, maize and cabbage, respectively. Our current study conclusion is almost similar to the previous studies conducted by early researchers in the world, including Pakistan (Xue et al., 2010; Ramzan et al., 2019; Huang et al., 2019; & Purohit, 2020).

Table1. List of treatments (host plants) tested in the current study

Serial Number	Treatment	Common name	Scientific name	Family
1	T_1	Cotton	*Gossypium hirsutum*	Malvaceae
2	T_2	Maize	*Zea mays*	Poaceae
3	T_3	Okra	*Abelmoschus esculentus*	Malvaceae

Table2. Biological parameters of *S. litura* on different hosts

Parameters	Cotton	Maize	Cabbage
Eggs			
Incubation period	3.48 ± 0.71a	3.00±0.00a	3.02±0.01a
Larvae			
First instar	3.55±0.10a	1.24±0.53b	3.44±0.09 b
Second instar	3.59±0.09a	2.56±0.13ab	3.48±0.11 b
Third instar	3.99±0.10a	4.16±0.17 b	4.48±0.11 a
Fourth instar	4.56±0.09a	4.24±0.09 b	4.44±0.09 a
Fifth instar	6.65±0.15a	6.23±0.21c	7.42±0.11 b
Sixth instar	5.59±0.17a	6.10±0.05bc	7.33±0.10b
Total larval period	29.34±0.30a	23.70±0.40c	30.54±0.40b
Pupal period	7.75±0.41a	7.86±0.24b	7.21±0.30c
Adult			
Male adult	7.32±0.09a	6.29±0.10a	7.23±0.11a
female adult	8.41±0.08a	6.76±0.11bc	7.33±0.26ab

The 1st, 2nd, 3rd, 4th, 5th and 6th larval instar period on cotton was 3.55±0.10, 3.59±0.09, 3.99±0.10, 4.56±0.09, 6.65±0.15, and 5.59±0.17 days, respectively as given in table 2. Maximum (30.54±0.40) larval period was recorded on cabbage while lowest (23.70±0.40) on maize crops. The larval period of *S. litura* on cotton, maize and soybean was 15.50, 14.91 and 13.10 days, respectively (Farahani et al., 2011). The current study results are in line with Farahani et al. (2011) and Yadav et al. (2014).

Length of larva on cotton, maize and cabbage was 3.64±0.15, 3.45±0.32, and 3.98±0.10 cm, respectively, while 0.63±0.05, 0.50±0.02, and 0.72±0.3g, respectively (Table 3). Length and weight of pupa on cotton were 1.54±0.04cm and 0.067±0.04g, respectively, while 1.13±0.09 cm and 0.029±0.03g on maize (Table 4). Kumar et al. (2019) and Kamiya et al. (2004) had reported similar findings.

Table3. Parameters/period of larva on different hosts

Treatments	Length (cm)	Weight (g)	Period (No. of days)
Cotton	3.64±0.15a	0.63±0.05a	7.76±0.43a
Maize	3.45±0.32b	0.50±0.02cd	6.04±0.41b
Cabbage	3.98±0.10ab	0.72±0.3bc	8.87±0.36ab

Note: Length is taken in cm while weight is taken in g.

Table4. Parameters/period of pupa on different hosts

Treatments	Length (cm)	Weight (g)	Period (No. of days)
Cotton	1.54±0.04a	0.067±0.04a	10.03±0.37d
Maize	1.13±0.09c	0.029±0.03c	11.66±0.41b
Cabbage	1.99±0.06bc	0.0927±0.01b	13.55±0.43c

Note: Length is taken in cm while weight is taken in g.

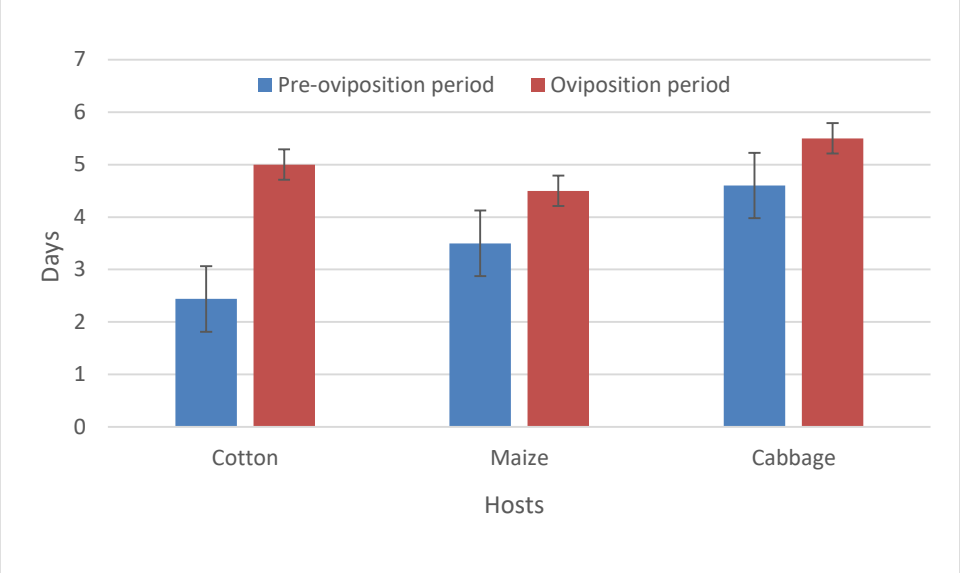

Figure1. Pre-oviposition and pre-oviposition period of *S. litura* on different hosts

CONCLUSION

The comparative biology of *Spodoptera litura* is crucial for determining the optimal hosts that may be utilized for *S. litura* mass rearing and that support its development. Similar to this, knowledge of *S. litura*'s life history characteristics in relation to various host plant species can aid in the development of effective control measures for this destructive economic pest. The comparative biology of *S. litura* on various hosts revealed that the cabbage host had the shortest larval growth period while the maize host had the longest. The host plant had an impact on all of the biological characteristics of S. litura that were measured for the study.

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Each author has equal contribution in this research work.

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