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Biological and Morphological Parameters of Armyworm, *Spodoptera litura* in Cabbage and Maize Plants under Laboratory Conditions in Southern Punjab, Pakistan

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ABSTRACT

This study evaluates the biological and morphological parameters of Armyworm, Spodoptera litura in cabbage and maize plants under laboratory conditions in Southern Punjab, Pakistan. Armyworm, Spodoptera litura is economically an important pest of various agricultural and horticultural crops. The incubation period of eggs was 3-4 days while survival days of 1st, 2nd, 3rd, 4th and 5th larval instars were 2-3, 2-4, 3-4, 3-4 and 2-3 days, respectively on maize crop. The total life period of larvae was 10-17 days (12.9±4.02). The total developmental period from egg to adult on cabbage was 28-36 days while total life period from egg to adult was 25-38 days on maize. The female longevity period was more than male and a single female laid about 890 eggs in her whole life period. The egg width at cabbage and maize was 3.09±0.2 and 3.0±0.3mm respectively. The length and width of first instar was 3.5±0.03 and 0.28±0.14mm respectively. The length of second, third, fourth and fifth larval instars were 8.61±0.12, 13.11±0.26, 20.13±0.30 and 29.14±0.30mm, r espectively. The length of pupa and adult was 16.44±0.37 and 14.3±0.32 mm respectively. The study concluded that cabbage was most preferable host of Spodoptera litura and developmental period increased on cabbage as compared to maize.

Keywords: *Armyworm, cabbage, laboratory conditions, maize, pest, Spodoptera litura*

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INTRODUCTION

Spodoptera is big genus consist of more than 25 species all over the world such as *Spodoptera litura, Spodoptera exigua, Spodoptera lituralis, Spodoptera pectin* and many others. All are destructive pests of various cash, agricultural and horticultural crops throughout the globe (Khan, Ahmed and Nisar, 2011; Kaur, 2012; Ahmad, Ghaffar, Rafiq and Ali, 2013). Among all these destructive *Spodoptera* species, *Spodoptera litura* is proved most dangerous pest in cotton growing areas of the world including Pakistan (Ahmad M., Arif and Ahmad M, 2007).

It is mostly distributed in tropical and subtropical regions of the globe (Tenywa et al., 2018). It is high migrating pest (Fu et al., 2015) having more than 100-112 host plants (Ahmad *et al*., 2013). Maize, cabbage and cotton are the most favorable hosts of *S. litura* (Ramzan *et al.*, 2019). The larvae of *Spodoptera litura* are polyphagous (Zhang, Wan, Liu and Guo, 2006; Tuan *et al*., 2014; Yooboon *et al*., 2019) and feed on the various plants parts (leaves, fresh kernel seed and tender shoots) (Yinghua *et al*., 2017). The quality and quantity of crops can reduce by the severe attack of immature stages such larvae.

The several management strategies had been adopted by small and large scale farmers at national and international level to control this destructive pest under field and laboratory conditions (Ramzan *et al*., 2020). According to Shad, Sayyed and Saleem (2010), the commonly adopted management strategy by majority of farmers is chemicals (insecticides) against insect pests. Chemicals are extensively used against insect pests and application of the same group of insecticides caused insect resistance to insecticides (Saleem, Ahmad and Sayyed, 2008; Sang *et al.*, 2013). The excessive applications of insecticides not only cause resistance but also pollute the environment and its hazards affect human health (Kaur, Vasudev, Sohal and Manhas, 2014).

The information about biology is very important to manage the pest. According to reviewed literature, various studies had been done by many scientists and researchers related to biology and ecology of *Spodoptera litura*. Its biological parameters can vary with respect to location, environment and host plants (Xue *et al*., 2010; Kaur, 2012; Chaudhry, Sattar, Ahmad and Shehzad, 2017). There is need to study its biological and morphological parameters on different hosts in Southern Punjab, Pakistan. For this purpose, current study was carried out to evaluate the biological and morphological parameters of Armyworm, *Spodoptera litura* on two hosts (cabbage and maize plants) under laboratory conditions in Southern Punjab, Pakistan.

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MATERIAL AND METHOD

The large number of *Spodoptera litura* was collected by hand from different farmers' fields of district Multan and brought to Ecology Laboratory at Institute of Plant Protection, Muhammad Nawaz Shareef University of Agriculture, Multan, for rearing purpose. The collected larvae were shifted into glass jar with maize and cabbage leaves as food. The glass jar was covered with muslin cloth and tied with rubber band for the protection of larvae escape. The fresh new leaves were given to larvae till pupation. One pair of both adult sex (male and female) were identified, shifted into adult rearing cage for mating and egg lying purpose after emergence of adults. 10% honey solution soaked cotton was provided to adults as food. The eggs were observed on daily basis and transferred to petri dishes for hatching purpose. Ten first newly emerge larvae were randomly selected from culture and transferred into 5 cm x 1 cm petri dishes with the help of fine camel hair brush. The leaves of host plants were provided to selected larvae in the petri dishes and changed on the daily basis. Further, biological and morphological studies were determined.

Statistical analysis

In the study, standard deviation and mean of different parameters were calculated.

RESULTS AND DISCUSSION

The egg width at cabbage and maize was 3.09±0.2 and 3.0±0.3mm respectively. The length and width of first instar was 3.5±0.03 and 0.28±0.14mm respectively. The length of second, third, fourth and fifth larval instars was 8.61±0.12, 13.11±0.26, 20.13±0.30 and 29.14±0.30mm, respectively. The length of pupa and adult was 16.44±0.37 and 14.3±0.32mm respectively (Table 3).

Table 1: Biology of *Spodoptera litura* on maize under laboratory conditions

Stage of the insect	Survival days	Mean± SD
	Eggs	
Incubation period	2-3	3±0
	Larval period	
1st instar	2-3	1.4±0.62

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2nd instar	2-4	2.5±0.70
3rd instar	3-4	2.5±0.62
4th instar	3-4	2.8±0.62
5th instar	2-3	1.5±0.71
Total larval period	10-17	12.9±4.02
	Pupal period	
Pre pupal period	0.94-1	0.79±0.20
Pupal period	6-9	5.0±0.61
	Adult longevity	
Male	5-7	5.5±0.61
Female	6-9	6±1.41
Average	5.5-9	7.25±1.06
Total life cycle from eggs to adults	25.00-38.00	33.00±4.32
	Oviposition period	
Pre oviposition period	1.8-2.44	2.10±0.65
Oviposition period	2.9-5.0	3±0.67
Fecundity (no.)	770-890	790.9±13.33
Percent of hatching	80-90.0	83.00±5.39

The incubation period of eggs was 3-4 days. The survival days of 1st, 2nd, 3rd, 4th and 5th larval instars were 2-3, 2-4, 3-4, 3-4 and 2-3 days, respectively reared on maize crop. The total life period of larvae was 10-17 days (12.9±4.02). Total life period from egg to adult was 25-38 days on maize. The female longevity was more than male. A single female was laid about 890 eggs in her whole life period (Table 1).

Table 2: Biology of *Spodoptera litura* on cabbage under laboratory conditions

Stage of the insect	**Survival days**	**Mean± SD**
	Eggs	
Incubation period	3-4	3±0
	Larval period	
1st instar	2-3	2.5±0.75
2nd instar	2-3	2.5±0.76
3rd instar	3-4	3.5±0.76
4th instar	2-3	2.5±0.79
5th instar	2-3	2.5±0.79
Total larval period	11-16	14.5±3.44
	Pupal period	
Pre pupal period	0.75-1	0.97±0.16
Pupal period	7-8	7.0±0.79
	Adult longevity	
Male	6-7	6.5±0.79

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Female	7-9	8±1.44
Average	6.5-8	7.25±1.08
Total life cycle from eggs to adults	28.25-36.00	33.13±5.43
	Oviposition period	
Pre oviposition period	2.5-3.75	3.13±0.77
Oviposition period	3.5-4.5	4±0.63
Fecundity (no.)	889-900	890.5±16.13
Percent of hatching	93-95.5	90.44±6.43

The egg incubation period was 2-3 days while 1st, 2nd, 3rd, 4th and 5th larval instars was 2-3, 2-3, 3-4, 2-3 and 2-3 days respectively. The total larval life period was 11-16 days while 28-36 days was the life period from egg to adult. The pre-pupal and pupal period was completed in almost 1 and 7-8 days, respectively (Table 2).

Table 3: Morphology of *Spodoptera litura* stages on different hosts

	Cabbage		**Maize**	
	Length (mm)	Width(mm)	Length(mm)	width(mm)
Egg	2.39±0.03	3.09±0.20	2.03±0.01	3.0±0.30
1st instar	3.5±0.03	0.28±0.14	3.08±0.08	0.02±0.04
2nd instar	8.61±0.12	1.42±0.02	8.42±0.21	1.23±0.08
3rd instar	13.11±0.26	2.28±0.01	11.22±0.34	2.23±0.11
4th instar	20.13±0.30	2.44±0.10	18.12±0.43	2.42±0.08
5th instar	29.14±0.30	3.6±0.05	27.14±0.32	3.33±0.13
Pupa	16.44±0.37	5.28±0.12	14.22±0.23	4.10±0.08
Adult	14.3±0.32	7.51±0.11	12.11±0.30	7.39±0.18

The current study was conducted to check the biological and morphological parameters of *Spodoptera litura* on different hosts under laboratory conditions. Before this study, many other studies related to toxicology, temperature effect and general biology have been conducted by various researchers in the world (Ramzan *et al.*, 2019; Murtaza *et al*., 2019). In the current study, biological and morphological study was performed by using different hosts in Pakistan.

Female of *Spodoptera litura* can lay eggs in masses underside the plant leaves and covered the eggs with hairs in fields while on muslin cloth and polythene in laboratory conditions (Ramzan *et al*., 2019). The small round shape and yellowish white eggs were laid by female. The incubation period of eggs on cabbage and maize was 3-4 and 2-3 days, respectively. Our study findings are in line with many other researchers findings (Tuan *et al.*, 2015; Saljoqi, Khan and Ali, 2015; Ashwini *et al*., 2016) who had reported that eggs hatch within 3-6 days. The incubation period on tomato had been recorded 3-5 days by scientist

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(Shakya, Haseeb and Manzoor, 2015). The length and width of eggs in current study was in agreement with other researchers findings. The egg hatching period on cabbage and maize was 95 and 90% respectively. The current study results are in line with previous studies (Kumar and Bhattacharya, 2019; Murtaza *et al.*, 2020) who reported that egg incubation period was 3 days on maize crops.

There were five larval instars of *Spodoptera litura*. The cannibalism between larvae was observed during the study. Our findings related to larval instars length and width are similar to Sri and Jha's (2018) findings, which stated that length and width of larvae increase with respect to temperature. The total developmental period from egg to adult on cabbage was 28-36 days while 25-38 days on maize. Yadav, Kumar and Chauhan (2014) had reported the similar findings about developmental period of *Spodoptera litura* on cabbage crop. The pupation occurred in soil. The colour of pupae was pale yellowish while later change into dark reddish brown. Male pupae had genital aperture on 9th abdominal segment while female on 8th abdominal segment. Kandagal and Khetagoudar (2013) had reported the similar findings about identification of pupae. A study was conducted by Narvekar *et al*. (2018) to check the host preference of *Spodoptera litura* on different hosts and concluded that castor found suitable host of *Spodoptera litura* while in current study maize found suitable host.

CONCLUDING REMARKS

The study was carried out to evaluate the biological and morphological parameters of Armyworm, *Spodoptera litura* on two hosts (cabbage and maize plants) under laboratory conditions in Southern Punjab, Pakistan. A large number of *Spodoptera litura* was collected from different farmers' fields of district Multan. They were brought to Ecology Laboratory at Institute of Plant Protection, Muhammad Nawaz Shareef University of Agriculture, Multan, for experimentation. There were five larval instars of *Spodoptera litura*. The cannibalism between larvae was observed during the study. *Spodoptera litura* is the insect pest of various host plants throughout the globe including Pakistan. The study concluded that among the tested host plants, cabbage was the most preferable host of *Spodoptera litura* than maize crop.

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