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BIOLOGY AND MORPHOMETRY OF *SPODOPTERA LITURA* (FAB.) ON CABBAGE

S. B. Ashwini[1], J. Ashoka[1], M. Bheemanna[1] and S. G. Hanchinal[1]

[1]Department of Agricultural Entomology, University of Agricultural Sciences, College of Agriculture, Raichur -584 104, India.
[2]Department of Genetics and Plant Breeding, University of Agricultural Sciences, College of Agriculture, Raichur -584 104, India.
e-mail: ashwinisb07@gmail.com

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ABSTRACT : The studies on the biology of *Spodoptera litura* (Fab.) on cabbage revealed that the incubation period of egg, total larval and pre-pupal period were 2.33 ± 0.19, 21.10 ± 1.08 and 2.22 ± 0.38 days, respectively. The pre-oviposition, oviposition and post-oviposition periods were 2.94 ± 0.33, 3.11 ± 0.43 and 4.45 ± 0.72 days, respectively. The total life cycle from egg to emergence of adult was 35.44 ± 1.44 (male) and 36.04 ± 1.61 (female) days, respectively.

Key words : Biology, morphometry, life cycle, *Spodoptera litura*, cabbage.

INTRODUCTION

Cabbage, *Brassica oleracera* var. *capitata* is an important vegetable crop of world-wide. It is attacked by number of insect pests at various stages of crop growth. *Plutella xylostella* (L.), *Spodoptera litura* (F.), *Pieris brassicae* (L.), *Thysanoplusia* sp. and *Helulla undalis* (F.) cause appreciable damage. *S. litura* was known to be a sporadic pest earlier, has emerged as destructive pest in the recent past on cabbage. It is distributed throughout southern and eastern world *viz.*, tropical and temperate Asia, Australia and pacific Islands (Feakin, 1973) and infests more than hundred crop species belonging to 44 families of which 40 species are known from India. The major host plants include tobacco, cotton, groundnut, castor, chilli, potato, soybean, cauliflower, cabbage, tomato, beans and sunflower. The *S. litura* larvae initially scraped the leaf tissue gregariously in clusters and skeletonized the leaves. *S. litura* is next only to fruit borer, *H. armigera* (Hub.) in economic importance both at national and global level. The information on the life cycle and morphometry of this pest on cabbage is lacking in Hyderabad-Karnataka region of Karnataka and hence study has been undertaken.

MATERIALS AND METHODS

The biology and morphometrics of *Spodoptera litura* (Fab.) on cabbage was studied at Department of Entomology, College of Agriculture and Main Agricultural Research Station, UAS Campus, Raichur during 2013-14 under laboratory conditions at 25 ± 1.5 ÚC temperature with relative humidity of 65 ± 5 per cent. The initial culture was obtained by collecting larvae and egg masses from the infested cabbage field and confined in plastic container in laboratory and covered with muslin cloth. The larvae were reared in plastic container by providing fresh cabbage leaves. The pupae were kept on moist soil for adult emergence. The adults were provided with cotton swab soaked in 10 per cent honey solution was kept suspended in the oviposition cages as adult food. Ten such sets were kept for egg laying as well as for recording observations on pre-oviposition, oviposition and post-oviposition periods. The egg duration was studied on the basis of 10 eggs in a petri plate which were provided with wet blotting paper at their surface. Immediately after egg hatching, individual larvae were transferred on to petri plates containing fresh cabbage leaves and 20 such petri plates were kept and larvae were observed daily and the duration of different larval instars was recorded. Each larva was provided with a small leaf disc for feeding. The food was changed daily. The body length of the larvae and breadth of the head capsule were measured and recorded. The pre-pupal period characterised by the contracted body and sluggishness of the larvae was studied on the basis of 20 larvae which entered the pre-pupal stage on the same day. The pre-pupal and pupal periods and their measurements were also recorded. The weight of the full grown larva and one day old pupa was recorded. The duration from adult emergence to death of adult was recorded to work out the longevity. The sex ratio of *S. litura* was determined by counting the male and female adults emerged from 100 pupae reared on cabbage leaves.

RESULTS AND DISCUSSION

The biological parameters on developmental periods of egg, larvae, pupae and adult were presented in Table 1.

Table 1 : Biological parameters of *S. litura*.

Insect stages		Duration (Days)	
		Range	Mean±SD
***Egg**	Incubation period	2.00 - 2.70	2.33 ± 0.19
****Larval instars**	I instar	1.85 - 3.50	2.03 ± 0.35
	II instar	4.62 - 5.95	5.08 ± 0.26
	III instar	2.95 - 3.95	3.51 ± 0.38
	IV instar	2.62 - 4.04	3.52 ± 0.42
	V instar	2.33 - 4.04	3.46 ± 0.51
	VI instar	2.87 - 4.42	3.49 ± 0.46
Total larval period		18.93 - 23.23	21.10 ± 1.08
Pre-pupa		1.92 - 3.08	2.22 ± 0.38
****Pupa**	Male	6.95 - 11.20	9.80 ± 1.29
	Female	7.62 - 11.92	10.40 ± 1.12
***Adult longevity**	Male (with food)	7.23 - 8.74	7.99 ± 0.45
	Female (with food)	8.24 - 10.95	9.67 ± 0.83
	Male (without food)	5.00 - 7.40	6.13 ± 0.84
	Female (without food)	6.00 - 8.40	7.23 ± 0.81
Life cycle (Egg to emergence)	Male	32.47 - 37.18	35.44 ± 1.44
Female		33.19 - 39.46	36.04 ± 1.61

*Mean of ten observations. **Mean of twenty observations.

Table 2 : Morphometry of various stages of *S. litura*.

Life stages	*Length (mm)		*Breadth (mm)	
	Range	Mean ± SD	Range	Mean ± SD
Egg	0.45 - 0.49	0.47 ± 0.01	0.31- 0.48	0.44 ± 0.05
Larval instars				
I instar	1.22 - 1.94	1.41 ± 0.21	0.28 - 0.30	0.29 ± 0.01
II instar	2.42 - 2.84	2.65 ± 0.13	0.42 - 0.45	0.44 ± 0.01
III instar	6.46 - 7.50	6.85 ± 0.73	0.53 - 0.62	0.59 ± 0.03
IV instar	16.75 - 18.60	17.48 ± 0.71	1.30 - 1.53	1.42 ± 0.08
V instar	22.00 - 27.50	24.29 ± 1.72	1.91 - 2.17	2.02 ± 0.10
VI instar	33.00 - 42.5	38.27 ± 3.35	2.30 - 2.57	2.45 ± 0.09
Pre-pupa	24.25 - 30.75	27.38 ± 2.21	4.50 - 5.20	4.77 ± 0.25
Pupa				
Male	13.75 - 19.00	17.38 ± 1.56	4.50 - 5.50	5.10 ± 0.29
Female	16.00 - 22.50	19.13 ± 1.88	4.00 - 7.00	5.68 ± 0.94
Adult (at wing expansion)				
Male	11.00 - 19.50	16.25 ± 2.81	32.50 - 37.00	34.70 ± 1.62
Female	13.50 - 20.00	17.25 ± 2.00	32.00 - 41.00	37.55 ± 3.30

*Mean of ten observations.

Egg: Eggs were round, pearl-white coloured with sculptured chorion. Eggs were laid in mass. The length and breadth of the egg was 0.47 ± 0.01 and 0.44 ± 0.05 mm, respectively. The eggs hatched in 2.33 ± 0.19 days. Cardona *et al* (2007) reported that the egg measured 0.6 mm in diameter on castor. According to Sreenivasa *et al* (1997), the egg duration to be 2.00 to 2.50 days on groundnut genotypes (Tables 1 and 2).

Larvae : The freshly hatched larva was tiny, cylindrical pale green with dark brown head. Head was wider than the body and prothoracic shield was present. The larvae possessed small setae on their body. As the larva advanced to second and subsequent instars body turns wider than the head. The third instar larva was pale green coloured with brownish head. Larvae has three yellow longitudinal lines, one on top and one each on sides; a row of black dots run on each side in two parallel rows. On meso and metathoracic segments, white spots were seen on the lateral sides along the black stripes. The fourth instar larva was greenish to black with a dark brownish head and three white spots were observed on cervical region. The colour of fifth instar larva varied from light green to dark brownish shades with a dark brown head. The sixth instar larva was stout, smooth and cylindrical. It was dull greyish to blackish green coloured with bright yellow semicircular stripes on lateral sides.

Larvae passed through six instars with a mean larval period lasting 21.10 ± 1.08 days. The duration of the first to sixth instar larva were 2.03 ± 0.35, 5.08 ± 0.26, 3.51 ± 0.38, 3.52 ± 0.42, 3.46 ± 0.51 and 3.49 ± 0.46 days, respectively (Table 1). The head capsule width of the above instars measured about 0.29 ± 0.01, 0.44 ± 0.01, 0.59 ± 0.03, 1.42 ± 0.08, 2.02 ± 0.10 and 2.45 ± 0.09 mm, respectively (Table 2) and body length of larvae measured 1.41 ± 0.21, 2.65 ± 0.13 and 6.85 ± 0.73, 17.48 ± 0.71, 24.29 ± 1.72 and 38.27 ± 3.35 mm, respectively (Table 2). The weight of full grown sixth instar larva was 12.26 ± 2.82 g (Table 3). The results of the present study indicated six larval instars in *S. litura* is in line with earlier reports of Xue *et al* (2010) observed six distinct larval instars on different hosts. The total larval period of *S. litura* noticed in the present study can be compared with the findings of Sreenivasa *et al* (1997) (18.10 to 23.00 days on groundnut), Cardona *et al* (2007) (23.90 ± 0.71 days on castor). The first instar larval duration was 2.5 days on cabbage Xue *et al* (2010), which is in corroborate the present findings. The duration of the third and fourth instar larvae was 3.00 to 3.50 and 3.00 to 4.00 days on groundnut genotypes Sreenivasa *et al* (1997) and 3.3 to 7.3 and 3.3 to 5.3 days on cotton Tithi *et al* (2010b), which is more or less in accordance with the present findings of Cardona *et al* (2007) and

Table 3 : Reproductive biological parameters of *S. litura*.

Particulars	Range (Days)	Mean ± SD
Pre-oviposition period (days)	2.62 - 3.75	2.94 ± 0.33
Oviposition (days)	2.50 - 4.00	3.11 ± 0.43
Post-oviposition (days)	3.00 - 5.30	4.45 ± 0.72
Fecundity (Eggs per female)	108-703	304.40±183.93
Weight of sixth instar larvae (g)	8.10 - 16.89	12.26 ± 2.82
Weight of one day old pupa (g)		
Male	0.95 - 3.05	2.22 ± 0.50
Female	1.52 - 3.53	2.53 ± 0.46
Egg hatching (%)	75.00-93.00	84.60 ± 5.89
Sex ratio (Male: Female)	1:1.45	

*Mean of ten observations.

Xue *et al* (2010). Further, the sixth instar larval weight of 9.40 to 10.30 g Sreenivasa *et al* (1997), which is more or less tally with the present findings.

Pre-pupa and pupa : Pre-pupal stage was characterized by shortened body of the larvae was lasted 2.22 ± 0.38 days (Table 1). It measure 27.38 ± 2.21 mm in length and 4.77 ± 0.25 mm in breadth (Table 2). Pupae were reddish dark brown with two small spines at the tip of abdomen. The pupa is about 17.38 ± 1.56 and 19.13 ± 1.88 mm in length of male and female, while the corresponding breadths were 5.10 ± 0.29 and 5.68 ± 0.94 mm (Table 2). The pupal period of male and female lasted for 9.80 ± 1.29 and 10.40 ± 1.12 days, respectively (Table 1). The weight of male and female pupa was 2.22 ± 0.50 and 2.53 ± 0.46 g, respectively. The present findings on pupal measurements were comparable with the reports of Cardona *et al* (2007) and Tithi *et al* (2010a). The duration of pupa was 10.9 days on cabbage, 10.1 days both on cowpea and sweet potato Xue *et al* (2010) which corroborates with the present findings.

Adult : Freshly emerged adult moths were greyish-brown in colour. The forewings had grey to reddish-brown coloured with a strong wavy markings and pale lines along the veins in females whereas in males, bluish areas occur on the wing base and tip. The hind wings were greyish-white with grey margins with dark veins.

The male and female measured 34.70 ± 1.62 and 37.55 ± 3.30 mm across the spread of wings and breadth was 16.25 ± 2.81 and 17.25 ± 2.00 mm (Table 2). Female live longer (9.67 ± 0.83) than males (7.99 ± 0.45 days) (Table 1). The results corroborate the finding of Sreenivasa *et al* (1997) who also reported that female (9.50 to 10.50 days) live longer than males (8.30 and 10.40 days). The pre-oviposition, oviposition and post-oviposition periods were 2.94 ± 0.33, 3.11 ± 0.43 and 4.45 ± 0.72 days, respectively. Oviposition period (3.40 days) was in close agreement with findings of Sharma (1994). The male to female ratio of *S. litura* reared on cabbage leaves was 1:1.45. The fecundity varied from 108 to 703 eggs (average of 304.40 ± 183.93 eggs) per female at 25 ± 1.5 ºC temperature of the present study contradicted the earlier findings of Xue *et al* (2010), but the sex ratio corroborate our findings. The total life cycle from egg to adult emergence was 35.44 ± 1.44 (male) and 36.04 ± 1.61 (female) days, respectively. The per cent hatchability was 84.60 ± 5.89 when the larvae reared on cabbage leaves (Table 3) (Sreenivasa *et al*, 1997). The total life cycle from egg to adult emergence was 35.44 ± 1.44 (male) and 36.04 ± 1.61 (female) days of the present study contradicts the reports of Sreenivasa *et al* (1997), according to them the total developmental period of *S. litura* was 32.25 days on groundnut genotype and this difference might be due to difference in the hosts used and prevailing environmental conditions during the study.

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