BIOLOGY AND MORPHOMETRY OF *SPODOPTERA LITURA* FABRICUS, A SERIOUS DEFOLIATOR OF MANGO (*MANGIFERA INDICA*) IN JAMMU REGION (J&K)

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ABSTRACT: *Spodoptera litura* is an important polyphagous pest in India. It is serious pest of various economically important crops including mango and biology of *Spodoptera litura* was studied in detail on mango during the period of March, 2012 to February, 2013 in Jammu. *Spodoptera litura* underwent the holometabolous type of development and the studies on biology of *S. litura* indicated that on an average female moth laid 200-250 eggs in her life span. The duration of egg, larvae, and pupa lasted for an average of 5.0±0.00 days, 15.45±1.14 and 9.37±1.37 days. The Adult male and female survived for a period of 7-9 days with an average of 8.32±0.20 days. The total life cycle from egg laying to adult emergence completes in 27-31 days with an average of 28.81±1.99 days. The adult female and male are hairy. The female is pale brown while the male is darker. The female is bigger with a stout abdomen while the male is narrower and tapering towards the tip.

KEY WORDS: Mango, *Spodoptera litura,* biology and morphometry.

India is basically an agro-based country where more than 80% of Indian population depends on agriculture. Mango (*Mangifera indica* L.) is known as "king of fruits". It belongs to family Anacardiaceae (Singh, 1968; Litz, 1997). It is one of the most important trees on the earth and is now consumed worldwide. Mango is an important tropical fruit, which is being grown in more than 100 countries of the world (Sauco, 1997). But its original home is South Asia where it has been grown for the last four thousand years (Salunkhe & Desai, 1984). It is an ancient fruit of Indo-Pakistan sub-continent and is of great importance for millions (Singh, 1968; Litz, 1997). It is nutritionally rich in carbohydrates and vitamins A and C. Insects are known to cause significant damage to mango and affect agricultural productivity. One of them is *Spodoptera litura* which is an important pest of mango in India. It is also a serious pest of various other economically important crops such as cotton, groundnut, chilli, tobacco, caster, bendy and pulses etc. (Armes et al., 1997; Niranjankumar & Regupathy, 2001). It was found to cause 26 - 100 % yield loss in ground nut (Dhir et al., 1992).

MATERIAL AND METHODS

The study was conducted during the year 2012-13 in the laboratory at room temperature at Jammu University campus, (J&K), India. The insect larvae were collected from mango plantations of the area and reared in the laboratory. After emergence of adults, they were allowed to copulate separately in wire meshed cages. Each pair was observed for pre-mating, mating, pre-oviposition and oviposition behaviour and duration. Longevity of adults was also recorded. The moths have the characteristic feature of laying eggs in masses. The egg was measured and their diameter was measured by means of an ocular micrometer

after calibration. Egg was kept under laboratory conditions for incubation in Petri dishes.

Newly hatched larvae were then transferred to sterile paired petri dishes, lined with moist filter paper and provided with fresh mango leaves. The food and filter paper lining were changed after every third day during the first and second larval instars and later on food was changed daily and filter paper lining on alternate days. Larvae were observed daily and data was recorded with regards to moulting, duration and size of each larval instar, pupation and pupal period. All life stages were recorded morphometrically. Observations were recorded with regards to emergence and fecundity. Morphometric measurements were recorded using standard graphic paper method. For the study of different instars, the head capsule width was measured with the help of an occulometer. Data gathered during the experiment was analyzed statistically for calculating mean, standard deviation and standard error.

RESULTS AND DISCUSSIONS

Distribution

S. litura is distributed widespread in Asia, Oceania, North America (USA: Hawaii only) (EPPO, n.d.), Russia and UK (Aitkenhead et al., 1974).

Hosts

Spodoptera litura was first recorded from New Zealand as a pest of tobacco and it has appeared in significant numbers in home garden and on crops (Cottier & Gourlay, 1955). It is a member of the economically important polyphagous pest that a serious attack many crop plants. The host range of this species covers over 40 families of economic importance crop species (Salama et al., 1970). Among the main crop species attacked in the tropics are *Colocasia esculenta*, cotton, flax, groundnuts, jute, lucerne, maize, rice soybeans, tea, tobacco, vegetables (aubergines, *Brassica*, Capsicum, cucurbit vegetables, *Phaseolus*, potatoes, sweet potatoes, *Vigna* etc.). Other hosts include ornamentals, wild plants, weeds and shade trees (e.g. *Leucaena leucocephala*, the shade tree of cocoa plantations in Indonesia).

LIFE CYCLE OF *SPODOPTERA LITURA*

Mating behavior

Prior to mating, male actively initiates the activity. It flies several times above the female. When it stops flying, it lands close to the female. The male gradually moves by walking close to the female. Using the antennae, the male touches the female. The male quickly mounts the female and soon there is a downward movement of the insect antennae. Before a successful mating, the male courts the female for a period of 10 to 20 minutes. The male uncoiled the proboscis during mating but returns to its original form as soon as the copulation is finished. Copulation lasts for 2-3 hours.

Oviposition

The oviposition site is first located by the female. After the site was identified, the insect cleans the leaf surface area by wiping using the tip of the abdomen. The eggs are laid in mass under the shade near the petiole. A way of protecting the egg from possible predators and adverse weather factors, the mass of egg is covered by a scales which according to Paris (1968) come from the mother abdomen during the act of oviposition. The eggs are deposited in layers of 2-3. When disturbed, oviposition stops and again continues after few minutes.

Egg (Fig. 1)

The freshly laid eggs by the female are ovoid pale yellow in color slightly flattened on one side. The egg measures about 0.5 mm in diameter and 0.3 m in height. The number of eggs per mass varies considerably but is often 100 to 200 in batches and covered with hairy scales from the tip of the abdomen of the female moth. Duration of the egg stage is only two to three days. When the eggs are about to hatch the egg turns blackish which is the developing head of the larvae.

Incubation period and hatching

One day prior to hatching, the dark head of the young larva was observed inside the egg shell. Incubation period varies from 6-8 days with an average of 7.38± 1.09. Tara (1983) recorded 2 days as the incubation period, Cardona et al. (2007) recorded the incubation period as 5.0 days and Shukla and Patel (2011) reported 4.0 in the laboratory.

Larvae and number of instars

Ist instar larvae (Fig. 3)

Freshly hatched larvae are cylindrical, soft, pale yellow with many papillas on its body. Head black in colour, orthognathus, distinct, prominent. Body consists of 3 thoracic and 10 abdominal segments. Mouth parts small, biting and chewing type. The larva is hairless, sides of body with dark and light longitudinal bands; dorsal side with two dark semilunar spots laterally on each segment, except for the prothorax; spots on the first and eighth abdominal segments larger than others, interrupting the lateral lines on the first segment. Though the markings are variable, a bright-yellow stripe along the length of the dorsal surface is characteristic of *S. litura* larvae. The length of the newly hatched larvae varies between 1.82-2.35 mm with an average of 2.05± 0.26, width varies between 0.30-0.38 mm and the head capsule measured 0.24-0.27 mm with an average of 0.25± 0.00 mm (Table 1). The Ist instar takes 2-3 days with an average of 2.5±0.5 days to enter into next instar (Table 2).

2nd instar (Fig. 4)

The 2nd instars are smooth-skinned with a pattern of red, yellow and green lines, and with a dark patch on the mesothorax. They initially only eat the flesh of mango leaves, leaving the veins intact. They become brown with three thin yellow lines down the back (one in the middle and one on each side). During the 2nd instar, the body length of the larva measures 3.52-5.38 mm with an average of 4.3±0.96 mm, width varies between 0.87-1.15 mm with an average of 1.07 ±0.07 mm and the head capsule measured 0.36-0.40 mm with an average of 0.40 ±0.00 mm (Table 1). The 2nd instar takes 3-5 days with an average of 3.75±1.08 days to enter into next instar (Table 2).

3rd instar (Fig. 5)

As it grew bigger the larva became black in color with three thin yellow lines down the back, one in the middle and one on each side. A row of black dots run along its side and conspicuous row of dark triangle decorated its sides. During the third instar, the body length of the larva measures 7.00-13.10 mm with an average of 9.34±2.81 mm, width varies between 2.00 -2.76 mm with an average of 2.45±0.23 mm and the head capsule measured 0.63-0.74 mm with an average of 0.67±0.00 mm (Table 1). The 3rd instar takes 2-4 days with an average of 3±0.9 days to enter into next instar (Table 2).

4th instar (Fig. 6)

The larva became brown in color with three thin yellow lines down the back one in the middle and one on each side. A row of black dots run along its side and conspicuous row of dark triangle decorate its sides. During the fourth instars, the body length of the larva measures 22.60-25.93 mm with an average of 24.02±1.52

mm, width varies between 3.20-4.20 mm with an average of 3.70 ±0.70 mm and the head capsule measured 1.10-1.20 with an average of.1.14 ±0.00 mm (Table 1). The 4th instar takes 3-5 days with an average of 3.95±0.75 days to enter into next instar (Table 2).

5th instar (Fig. 7)

The larva gets bigger in size and secretes green colored fluid when disturbed. It is brown in color with three thin yellow lines down the back, one in the middle and one on each side. A row of black dots run along its side and conspicuous row of dark triangle decorated its sides. When disturbed, the caterpillar curls into a tight spiral with the head protected in the centre. During the fourth instar, the body length of the larva measures 26.0-33.00 mm with an average of 29.33±3.01 mm, width varies between5.20-6.43 mm with an average of 5.81± 0.86 mm and the head capsule measured 1.40-1.60 mm with an average of 18.2 ±0.84 mm (Table 1). The 5th instar takes 4-5 days with an average of 64.87±0.85 days to enter into prepupal and then pupal stage (Table 2).

Pupa (Fig. 10)

The pupa is elongated and oval in shape. The eyes and antennal case is prominent. The pupa is red in colour. The abdomen is movable. Tara (1983) has recorded the color of the prepupa as pale yellowish. The normal prepupal period lasts for one day. The freshly formed obtect pupa was yellowish and gradually reached to dark brown. The total pupal duration ranged between 8-11 days with an average of 9.37±1.37 days in the laboratory. The pupal length measures about 11.0-15.49 mm and a body width of 15.36±4.91 mm. Pupa takes 8-11 days with an average of 9.37±1.37 days to enter into adult stage (Table 2).

Adult stage (Figs. 11, 12)

The adult is hairy and brown in colour. The head, thorax, and abdomen are distinct. The antennae and legs are light brown. It has a very prominent rounded bluish black eyes occupying almost 1/3 of the facial head. Two long segmented antennae are located dorsally on the head and close to the compound eyes. It has grey to brown margins with pale veins. The lower edges of the wings are surrounded with hairs.

The female is generally bigger than the male. The abdomen of female is blunt while the abdomen of male is narrower and pointed. In terms of body color, the female is pale brown and the male was darker in color (Fig. 11, 12).

Nature of damage

The larvae feed voraciously and cause significant damage to the tree thereby affecting growth and vigour of the plant. The larva on hatching feeds on the soft parenchyma of the young leaves but acquires soon the power of biting through the smaller veins and cuts a small semicircular or rectangular flap out of the edge of the leaf which it pulls over and fastens to the upper leaf surface. The later instar larvae are voracious feeders. The whole of the green leaf tissue is destroyed by the larvae, only the largest ribs being left, with small portions of uneaten green tissue. In Jammu conditions, the larvae remain active in field from March- August with peak activity period observed during mid April- July. During this period, it causes maximum damage to the tree.

Tara (1983) has also reported the extent of damage made by *Spodoptera litua* on mulberry plantations in Jammu region. Cordona et al. (2007) has also reported that the first and second instar larvae were found to skeletonise the leaf, whereas third instar larvae consume the tender leaves entirely. The fourth and fifth instar larvae were found to feed entire leaf leaving only veins. Shukla & Patel (2011) has also found the similar damage on banana plantations.

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LITERATURE CITED

Agsaoay, M. 1998. Management of the common cutworm *Spodotera litura* (Fabr.) on peanut, Arachis hypogala L. using Bacillus thuringiensis Berliner and nuclear polyhedrosis virus. Ph. D. Thesis. UPLB.

Aitkenhead, P., Baker, C. R. B. & de Chickera, G. W. D. 1974. An outbreak of *Spodoptera litura*, a new pest under glass in Britain. Plant Patho., 23: 117-118.

Areekul, S., Wanleeluk, B., Vatanatungum, A., Skulpanich, U., Prachoubmoa, O., Teeravet, P. & Singhasenee, Y. 1963. Insect pest of corn in Thailand. Department Entomology and Plant Pathogen. Kasetsart University, Thailand. 205 p. (In Thai).

Armes Jr. N. J., Wightman, J. A., Jadhav, D. R. & Ranga Rao, G. V. 1997. Status of insecticide resistance in *Spodoptera litra* in Andhra Pradesh, India. Pestic. Sci., 50: 240-248.

Cardona, E. V, Ligat, C. S. & Subang, M. P. 2007. Life history of common cutworm, *Spodoptera litura* Fabricius (Noctuidae: Lepidoptera) in benguet. bsu research journal, 56.

Cottier, W. & Gourlay, E. S. 1955. New horticultural pest found on Nelson tobacco. N.Z. J. Agri., 91 (4): 349-51.

Dhir, B. C., Mohapatra, H. K. & Senapathi, B. 1992. Assessment of crop loss in groundnut due to tobacco caterpillar, *Spodoptera litura* (F.). Indian J. Plant Protect., 20: 215-217.

European and Mediterranean Plant Protection Organization (EPPO). n.d. 2005. The geographical distribution of *Spodoptera litura*(F.) Available Source:http://www.eppo.org/QUARANTINE/quarantine.htm.

Litz, R. E. 1997. The Mango: Botany, Production and Uses. CAB International, University Press, Cambridge, p. 587.

Navasero, M. N. & Navasero, M. M. 2002. Potential of farm-level production and utilization of *Spodoptera litura* Nuclear Polyhedrosis Virus. Philipp. Ent., 17 (2): 179-182.

Niranjankumar, B. V. & Regupathy, A. 2001. Status of insecticide resistance in tobacco caterpilar *Spodoptera litura* (Fabricius) in Tamil Nadu. Pesti. Res. J., 13: 86-89.

Paris, J. 1968. A study on the biology of *Spodoptera litura* (Fabricius). Unpublished Undergraduate Thesis. UP Los Baños, College of Agriculture.

Salama, H. S., Dimetry, N. Z. & Salem, S. A. 1970. On the host preference and biology of the cotton leaf worm *Spodopteral ittoralis*. Zei. Ang. Entomol., 67: 261-166.

Salunkhe, D. K. & Desai, B. B. 1984. Postharvest Biotechnology of Fruits, Vol. I. CRC press, Boca Raton, Florida. pp. 85.

Sangsrichan, C. 2002. Ecological of *Oligonychus mangiferus* (Rahman & Sapra) and Botani Prasad, G.R. 1997. Integrated management of *Spodoptera litura* (F.) In J.A.

Sauco, V. 1997. Mango World Production (Outside Israel, Egypt and India). Acta Hort., 455: 15-22.

Shukla Abhishek & Patel, P. R. 2011. Biology, food-utilization and seasonal-incidence of spodoptera litura fab on banana cv grand-naine Research journal of agricultural sciences, 2 (1): 49-51.

Singh, L. B. 1968. The Mango: Botany, Cultivation and Utilization. World Crop.Pp 438.

Tara, J. S. 1983. Investigations on the insect pest of mulberry (Morus spp.) in Jammu region of J&K state**.** Ph. D. Thesis, University of Jammu, Jammu.

Wightman & Ranga Rao, G. V. eds. *Spodoptera litura* in India: Proceeding of the National Scientists Forum on *Spodoptera litura* (F.). ICRISAT Asia.

Table 1. Body length of each instar immediately after ecdysis and head capsule width.

Developmental stages	Length (mm)		Width (mm)		Head capsule width (mm)	
	Range	Mean±SE	Range	Mean±SE	Range	Mean±SE
Egg	0.5-0.6	0.55±0.07	0.2-0.3	0.25±0.07		
Larvae						
Ist instar						
2nd instar	1.82-2.35	2.05± 0.26	0.30- 0.38	0.34± 0.03	0.24-0.27	0.25± 0.00
3rd instar	3.52-5.38	4.3±0.96	0.87 -1.15	1.07 ±0.07	0.36-0.40	0.40 ±0.00
4th instar	7.00-13.10	9.34±2.81	2.00 -2.76	2.45 ±0.23	0.63-0.74	0.67 ±0.00
5th instar	22.60-25.93	24.02±1.52	3.20-4.20	3.70 ±0.70	1.10-1.20	1.14 ±0.00
Pupa	26.0-33.00	29.33±3.01	5.20-6.43	5.81± 0.86	1.40-1.60	18.2 ±0.84
Adult	11.0-15.49	15.36±4.91				
Male						
Female	5-7	6.00±0.79				
	6-10	7.75±1.54				

Table 2. Duration of *spodoptera litura* development.

Developmental stages	Duration(days)	
	Range	Mean±S.E
Egg	5-6	5.5±0.5
Larval instars		
Ist instar	2-3	2.5±0.5
2nd instar	3-5	3.75±1.08
3rd instar	4-6	4.87±0.85
4th instar	2-4	3±0.91
5th instar	3-5	3.95±0.75
Total larval period	14-17	15.45±1.14
Pre pupal period	2-3	2.5±0.5
Pupa	8-11	9.37±1.37
Adult longevity	7-9	8.32±0.20
Total life cycle	36-50	28.81±1.99

Figures 1. Freshly laid egg of *spodoptera litura,* 2. Eggs ready for hatching, 3. 1st instar larva, 4. 2nd instar larva, 5. 3rd instar larva, 6. 4th instar larva.

Figures 7. 5th instar larva, 8. Prepupation (dorsal view), 9. Prepupation (ventral view), 10. Pupa, 11. Adult male, 12. Adult female.