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Life table evaluation of *Spodoptera litura* (Fabricius) on tomato at room temperature

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ABSTRACT

The life table of Spodoptera litura (Fabricius) was studied on tomato at room temperature under laboratory conditions at Vegetable Entomology Lab., Department of Entomology, YSPUHF, Nauni, Solan. The pre-oviposition period ranged from 29th to 31st day of pivotal age. The oviposition started from 32nd day of pivotal age and continued till 39th day. The adults lived upto 43rd day of pivotal age and thus post-oviposition period ranged from 40th to 43rd day of pivotal age. Females contributed highest number of progeny (mx = 149.809) in the life cycle on the 33rd day of pivotal age. The net reproductive potential (Ro) was 560.63 females with the mean length of generation period (T) 34.68 days. The innate capacity for increase (rm) and finite rate of increase (λ) were found to be 0.1846 and 1.6895 females/female/day, respectively with a weekly multiplication rate of 3.64times.The hypothetical F2 females were found to be 314305.9969.

Keywords: *Spodoptera litura,* tomato, life table, temperature

INTRODUCTION

The tobacco caterpillar, *Spodoptera litura* Fab. (Lepidoptera: Noctuidae) is a polyphagous devastating pest of numerous wild and cultivated plants throughout the world. Earlier, it was known as *Prodenia litura*. It is considered as one of the most destructive insect pests in Asia-Pacific region because of its high reproductive rate and heavy losses to crops. The behavior of moving like army from one field to another gave its local name as armyworm in Indo-Pak region (Ahmad *et al* 2007). The reproductive capacity and migration ability over long distances have made it economically important pest of many agricultural crops, with a wider geographical range throughout Asia, from North Africa to Japan, Australia and New Zealand (Feakin 1973). Out breaks of the pest occurs due to its resistance to insecticides, favourable weather conditions, cyclonic weather and heavy rainfall after a long dry spell (Thanki *et al* 2003). Sushilkumar and Ray (2018) studied forty five plant species of crops and weeds belonging to 21 families for host preference study. Among crop plants, maximum preference was observed on *Lycopersicon esculentum* Mill., *Spinacea oleracea* L., *Brassica oleracea* L. var. *capitata* and *Trifolium alexandrium* L. Among the weed plants, high feeding preference was observed on *Alternanthra philoxeroides* Mart., *Euphorbia hirta* L., *Eichhornia crassipes* Mart., *Trianthema portulacastrum* L., *Parthenium hysterophorus* L., *Cichorium intybus* L., *Rumex obtusifolius* L., *Chenopodium album* L. and *Ipomea fistulosa* Mart. Ahmad *et al* (2013) during their survey in the cotton belt in Pakistan revealed 27 plant species as host plants of *S. litura* belonging to 25 genera of 14 families including cultivated crops, vegetables, weeds, fruits and ornamental plants. It is a noxious pest that damages crop extensively by skeletonizing the leaves and thus reducing the photosynthetic activity of the plant (Selvaraj *et al* 2010). In early stages, the caterpillars are gregarious and scrape the chlorophyll content of leaf lamina giving it a papery white appearance. Later they become voracious feeders making irregular holes on the leaves and later skeletonization leaving only veins and petioles.

For developing different methods of protection, it is imperative to know the complete record of the life history parameters such as development, longevity, survivorship and fecundity and a complete life table of the insect on particular host or variety. The developmental biology and life table of species are important components in understanding the population dynamics of a species. Hence, this study was carried out using tomato crop.

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MATERIALS AND METHODS

Insect Culture

The neonates from eggs laid by collected adults and field collected larvae were reared on fresh castor leaves under laboratory conditions at Vegetable Entomology Laboratory, YSPUHF. For the study, newly emerged adults from the laboratory culture were kept in jars for egg laying. The inner wall of the jar was lined with filter paper. A small cotton wick soaked in 10% sucrose solution was placed in the oviposition containers to provide a source of carbohydrate for adult feeding. Egg masses laid on filter paper were used for this study. For constructing life tables, 100 freshly laid eggs were collected carefully from the egg masses in the oviposition jar with the help of wet camel hair brush and placed in ten other similar jars in batches of ten each. Fresh leaves of tomato were provided daily in the morning.

Life Table Studies

Observations on hatching, larval development, formation of pupae and successful emergence of adults and fecundity were recorded daily. For determinination of the age specific fecundity, total number of adults emerged on the same day were caged in oviposition jars for oviposition. The number of eggs obtained / female were divided by female sex ratio to get the number of female birth (mx). The fertility tables were prepared by using the formulae of Birch (1948), elaborated by Howe (1953) and Watson (1964) viz., x = Pivotal age in days, lx = Survival of female at age 'X'; mx = Age schedule for female births at age 'X'.

Net reproductive rate (R0)

The values of 'x', 'lx' and 'mx' were calculated from the data given in life tables. The sum total of the products 'lxmx' is the net reproductive rate (R0) (Lokta, 1925). The 'R_0' is the rate of multiplication of population in generation measured in terms of females produced per generation. The number of times a population would multiply per generation was calculated by the following formula: $R_0 = \sum lxmx$.

Mean duration of generation (Tc)

The appropriate value of generation time (Tc) i.e. the mean age of the mothers in a cohort at the birth of female offspring was calculated by using the following formula: $Tc = \sum lxmx / R_0$.

Innate capacity for increase (rm)

Total number of individuals survived and mean number of female offspring births were recorded at each age interval. From these data, the arbitrarily value of 'rm (rc)' was derived by the following formula:

$rm = \log_e R0/Tc$

Where, e = 2.71828

Tc = Mean generation time

The intrinsic rate of increase (rm) was subsequently calculated from the arbitrarily 'rm' by taking two trial values selected on either side of it differing in the second decimal place and substituting in the equation $\sum e^{7-rmx}$. lxmx (Atwal and Bains, 1974). Thus, the two values of the equation were found which lay immediately above or below 1097.

The values of $\sum e^{7-rmx}$. lxmx obtained from the two trials were plotted against their respective arbitrarily 'rm' which give a straight line. The straight line was intersected by a vertical line drawn from the described value at 1097. The two point of intersection gave the accurate 'rm' value. The precise generation time (T) was calculated by using the following formula:

T = logeRo/rm.

The finite rate of natural increase (λ)

The number of females per female per day i.e. finite rate of increase was determined as:

$\lambda = \text{antilog}_e\, r_m$.

From this data, the weekly multiplication of the population was calculated. The hypothetical F2 females were also be worked out with the formula $(R_o)^2$.

RESULTS AND DISCUSSION

Life fecundity tables were prepared to determine the survival of female (lx) and age specific fecundity (mx). The life fecundity data (Tables 1 and 2) indicated that preoviposition

Table 1: Life table (for female) and age specific fecundity of *Spodoptera litura* on tomato

Pivotal age in days (x)	Survival of female at different age interval (lx)	Age schedule for female births (mx)	(lxmx)	(x.lxmx)
0-31	Immature stages, Pre-oviposition stage			
32	0.7	146.667	102.667	3285.333
33	0.7	149.809	104.867	3460.6
34	0.7	128.019	89.613	3046.853
35	0.7	99.314	69.52	2433.2
36	0.7	101.619	71.133	2560.8
37	0.7	68.095	47.667	1763.667
38	0.7	60.238	42.167	1602.333
39	0.7	47.143	33	1287
40	0.7	0	0	0
41	0.65	0	0	0
42	0.5	0	0	0
43	0.2	0	0	0
44	0	0	102.667	3285.333
			$R_0=\sum lxmx = 560.63$	$\sum xlxmx=19439.79$

period ranged from 29th to 31st days of pivotal age. Females deposited first batch of eggs on 32nd day and stopped it after 39th day with lx values being 0.7 and 0.7, respectively. The lx decreased gradually after 40th day of pivotal age due to adult mortality. The females contributed highest number of progeny (mx = 149.81) in the life cycle on the 33rdt day of pivotal age. Similar results were obtained by Patil *et al* (2014) on tobacco cv. Anand-119. The pre-oviposition period ranged from 39th to 40th days of pivotal age. Females contributed highest number of progeny (mx = 580.13) in the life cycle on the 44th day of pivotal age. Results obtained by Patil *et al* (2015) on bidi tobacco were in contrast with the results of present study. The pre-oviposition period was ranged from 36 to 37 days of pivotal age. Females contributed highest number of progeny (mx = 508.92) in the life cycle on the 41st day of pivotal age.

Table 2: Mean length of generation, innate capacity for increase in numbers and finite rate of increase in number of *Spodoptera litura* on tomato

S.No.	Population growth indices	Formula	Calculated Values
1	Net reproductive rate	$R_O = \sum lx\ mx$	560.63
2	Mean length of generation	$T_C = (\sum x.lxmx)/R_O$	34.675 days
3	Innate capacity for increase in numbers	$r_m = \log_e R_O/T_C$	0.1745 females/female/day
4	Corrected ‘rm’	$\sum e^{7\text{-}rcx.}lxmx$	0.1846 Females/female/day
5	Corrected generation time	$T = \log_e Ro/rm$	14.89 days
6	Finite rate of increase in numbers	$\lambda = \text{antilog}_e\ rm$	1.6895 Females/female/day
7	Weekly multiplication of population	$WM = e^{7.rm}$	3.641
8	Hypothetical F2 females	$(R_0)^2$	314305.9969

The net reproductive potential (Ro) was worked as 560.63females/ female with the mean generation time (T) was 34.68 days. The intrinsic rate of increase (r_m) and finite rate of natural increase in numbers (λ) as 0.1846 and 1.6895 females/female/ day, respectively. Weekly multiplication of population was calculated 3.64 times per week. The hypothetical females population in F2 generation was 314305.9969. Similar results were obtained by Gedia *et al* (2008) on groundnut. The net reproductive rate was 510.79 females, with the generation period of 35.67 days. The innate capacity for increase and finite rate of increase were 0.1748 and 1.1910 females per day, respectively, with a weekly multiplication rate of 3.3994 times. Patil *et al* (2014) obtained contrasting results on tobacco cv. Anand-119. The net reproductive potential (R_o) obtained was 786.84 females with the mean length of generation period (T) 43.49

days. The innate capacity for increase (r_m) and finite rate of increase (λ) were found to be 0.1542 and 1.1667 females / female / day, respectively with a weekly multiplication rate $(\lambda)^7$ of 2.94 times. The hypothetical F2 females were found to be 619121.30. Contrasting results were obtained by Patil *et al* (2015). The net reproductive potential (Ro) was 1243.08 females with the mean length of generation period (T) 40.83 days. The innate capacity for increase (rm) and finite rate of increase (l) were found to be 0.1755 and 1.1918 females/female/day, respectively with a weekly multiplication rate (λ) 7 of 3.41 times. The hypothetical F2 females were found to be 1545253.36.

Tomato is a host of tobacco caterpillar, *Spodoptera litura*. It supports its growth and development. Consumption of tomato favours egg laying and growth and development of the insect.

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