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FIELD LIFE TABLE STUDIES OF *SPODOPTERA LITURA* (F.) INFESTING SUNFLOWER IN BENGALURU CONDITIONS, KARNATAKA, INDIA

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Abstract

Field life table studies of *Spodoptera litura* (F.) infesting sunflower were undertaken during 2012-13 at Zonal Agricultural Research Station, UAS, Bengaluru. The age specific life table for *S. litura* (F.) on sunflower revealed that the late stage (fourth and fifth instar) larvae were more vulnerable to natural mortality factors and totally 88.01 per cent mortality recorded in this study. Totaly14 mortality factors were identified in *S. litura* on sunflower during the study period number of larvae dead due to NPV was maximum and it is contributing higher 'k' value. The highest 'k' value was observed in late larval stage.

Key words: Field Life table, *Spodoptera litura*, Sunflower

Introduction

Sunflower constitutes one of the world's important oil seed crop. In India, during 2011-12, the area under sunflower cultivation was 7.219 lakh ha, with a total annual production of 4.999 lakh tonnes and productivity of 692 kg per ha. The cultivated sunflower is largely confined to south Indian peninsular states *viz.*, Karnataka, Andhra Pradesh, Maharashtra and Tamil Nadu, among which Karnataka occupies first position, accounting for an area of 3.840 lakh ha. with a production of 1.930 lakh tonnes and productivity of 503 kg per ha (Anon., 2012). The tobacco caterpillar, *S. litura* (Fab.) is a serious polyphagus insect species attacking wide range of food plants belonging to diverse botanical origin. It is known to cause losses ranging between 25.8 -100 per cent in crops such as, groundnut (Dhir *et al*., 1992); potato in India (Trivedi, 1988) and soybean in Japan (Higuchi *et al*., 1994). This pest is usually gregarious during the early instars causing skeletonization symptoms on the foliage of its host plants, late age larvae feed singly on the leaves and bite large holes on them. Life tables are the most important tools in the pest management, reveal the most opportune periods and vulnerable stages of the insect species. Series of life tables of the pest increases the understanding about the pest dynamics and mortality factors such as predators, parasitoids and pathogen infection on the pest and we can use major key mortality factor in management of the pest.

Material and Methods

The present investigations on field life table of *Spodoptera litura* (Fab.) infesting sunflower were carried out during 2012-13 at All India Coordinated Research Project (Sunflower), Zonal Agricultural Research Station (ZARS), University of Agricultural Sciences, GKVK, Bengaluru.

Sampling in egg stage

The investigation was carried out to know the key mortality factors of *S. litura* in sunflower ecosystem during 2012-13. The egg masses of the pest were collected from sunflower field and 100 eggs were separated from each of the field collected egg mass and incubated separately at room temperature in the laboratory to record the egg mortality due to infertility and parasitisation. Totally, such 10 sets were maintained as replications. The absolute population of egg and larval stages of *S. litura* per 35 quadrates (each quadrates measuring 4x4.2m) was recorded in field. Samples were drawn from the field populations throughout the cropping season *i.e*., from August to December 2012.

Sampling in larval stage

Similarly, samples of different larval stages were collected from sunflower field at an interval of 5 to 6 days, then 5 to 6 such samplings were done during the cropping season from each plot (*i.e*., August to December 2012), brought to laboratory and incubated at room temperature in plastic boxes (size: 24x19x10cm) to record the mortality in each instar either due to parasitisation, disease or due to unknown causes. Based on the level of mortality at each developmental stage of the pest, a definite number of larvae of each instar were collected from the sunflower field for accurate determination of the survival rate. When larvae entered last instar they were provided with soil mixed with sand in plastic boxes for pupation and to observe the parasitoid emergence. The number of malformed pupae, disease infected pupae and incompletely pupated ones were counted and the percentage of the same was calculated, besides per cent adult emergence was also computed**.**

Sampling in pupal stage

To study the mortality factors in the pupal stage, direct sampling was done by digging one square meter area and collecting the pupae. Ten such random spots (of 1 square meter area each) were dug in one acre of sunflower cropped

area to calculate at the pupal population per 4000m^2 area. The reasons for the pupal mortality either due to parasitisation or infection or due to unknown causes were separated out.

Results and Discussion

The data regarding the age specific life table was presented in Table 1. The egg mortality in *S. litura* was mainly due to infertility (6.55%) and unknown causes (11.62%). Larval mortality in the early instars was largely due to unknown causes that could not be clearly discerned (32.99%), followed by braconid parasitoid (6%), NPV (0.82%) and tachinid parasitoid (0.61%). The causal agents of larval mortality in the late instar (52.02%) were NPV and unknown causes (15.79%). In the pre-pupal stage unknown causes was the largest mortality factor (11.81%). In the pupal stage, unknown causes (17.71%) followed by malformed (14.20 %) and non emergence (5.48%) were the important mortality factors. In adult stage 7.59 per cent of moths were malformed and mortality due to unknown causes was 5.80 per cent. The malformed moths were incapable of reproduction.

In the pre-pupal stage unknown causes was the single largest mortality factor (11.81%). In the pupal stage unknown causes (17.71%), followed by malformation (14.2 %) and lack of emergence of adult (5.48%) were the major mortality factors.

In the adult stage, 7.59 per cent of moths were malformed and mortality due to unknown causes was 5.80 per cent. The malformed moths were incapable of reproduction.

The total mortality of *S. litura* was 88.01 per cent. The highest mortality was observed in the larval stage (75.44%) followed by pupal stage (33.03%), egg stage (17.40%) and adult stage (13.33 %), in that decreasing order.

Survivorship curves

It was observed that the curve obtained in the present study was almost similar to type III curves (Fig.1) indicating that the mortality rate was constant in all the stages. Hence, the mortality at later stage of development like pupa or adult would have greater impact on population reduction.

Mortality factor (k-factor)

A total of 14 mortality factors were identified in *S. litura* on sunflower during the study period (From k_1 to k_{14}). Egg infertility, larval parasitoids, virus, malformed pupa, adult malformation and unknown causes. These factors varied greatly in their k values (Fig. 2).

Relationship between mortality of *S. litura* and k-value

The k- values are expected to increase exponentially with increasing level of mortality. This aspect was verified by plotting the k–values irrespective of individuals or the total k- value against per cent mortality values recorded for the corresponding k-values. Although, the results were not verified for the nature of association, the plot clearly suggested an exponential relationship between the two (Fig. 3). Thus the data reflects a clear anticipated pattern of association between the two.

For disscussion there are no earlier reports was found on field life table study of *S. litura*

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Table 1. Life-table for *S. litura* under laboratory conditions from field collected population

Age interval x	No. alive at the beginning of x (lx)	Factor responsible for dx dxF	No. of deaths a	Mortality per cent 100qx	Mortality d = a/lx	Survival S = 1-d	'K' value (-ln (s))
Egg (N1)	626	Infertility	41	6.55	0.0655	0.935	0.0672
	585	Unknown	68	11.62	0.1162	0.884	0.1233
		Sub total	**109**	**17.41**			
Early instar	517	Braconids	31	6.00	0.0600	0.940	0.0619
	486	Tachnid	3	0.61	0.0062	0.994	0.0060
	483	NPV	4	0.82	0.0083	0.992	0.0080
	479	Unknown	158	32.99	0.3299	0.670	0.4005
		Sub total	**196**	**37.91**			
Late instar	321	NPV	167	52.02	0.5202	0.480	0.7340
	171	Unknown	27	15.79	0.1579	0.842	0.1720
		Sub total	**194**	**67.81**			
Pre pupa	127	Unknown	15	11.81	0.1181	0.882	0.1256
		Sub total	**15**	**11.81**			
Pupa	112	Malformed pupae	16	14.29	0.1429	0.857	0.1543
	96	Not emerged pupae	4	5.48	0.0548	0.945	0.0566
	92	Unknown	17	17.71	0.1771	0.823	0.1948
		Sub total	**33**	**29.46**			
Adult moth	75	Malformed adult	6	7.59	0.0759	0.924	0.0790
	69	unknown	4	5.80	0.0580	0.942	0.0598
		Sub total	**10**	**35.44**			
Normal females x 2 (N2)	65						
Reproducing femalesx2	32.5						
Generation survival (N2/N1)	0.103						

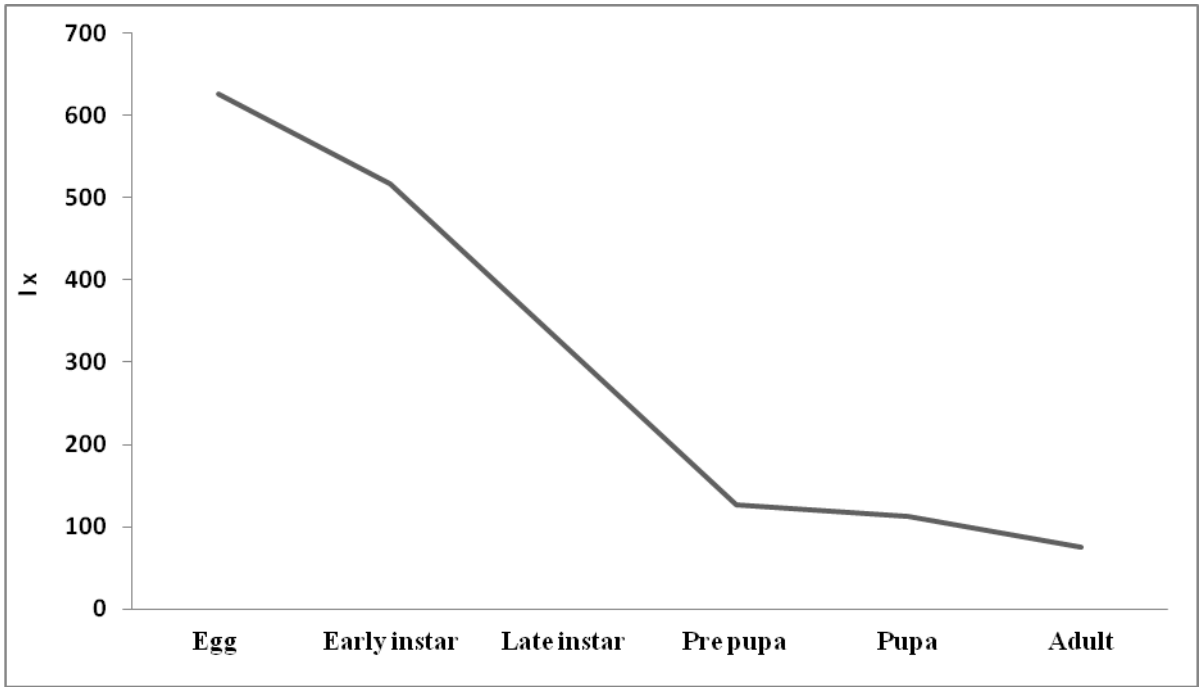

Fig. 1. Survivorship curve for *S. litura* at different age intervals

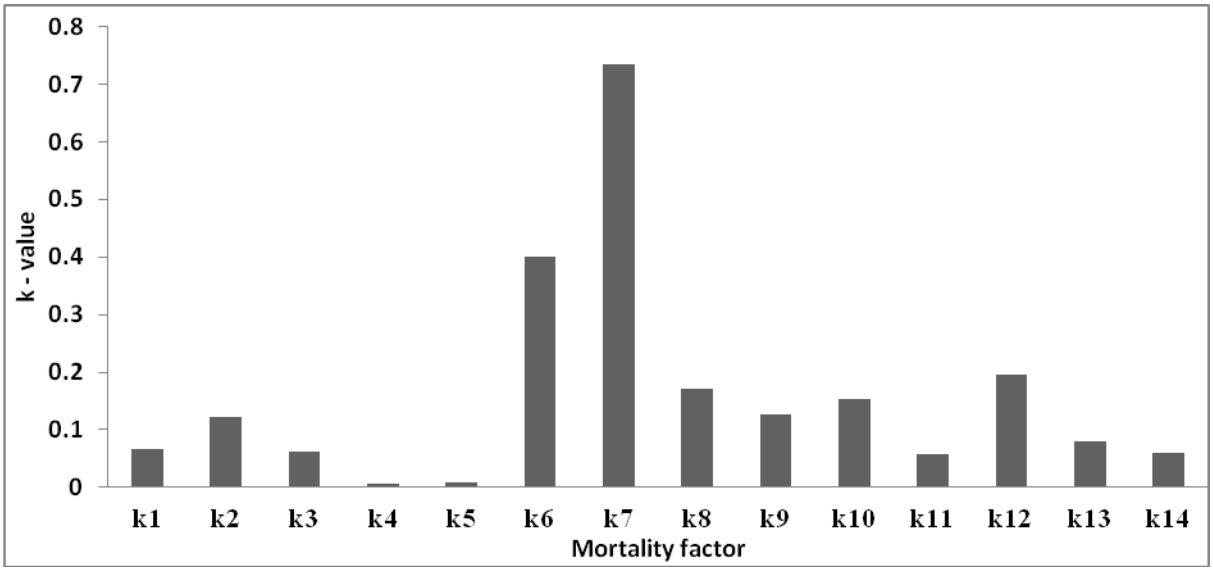

Fig. 2 Key mortality factors for *S. litura* on sunflower in life-table studies on field collected population

Egg stage	Infertility	K_1		Unknown causes	K_8
	Unknown causes	K_2	Pre pupa	Unknown causes	K_9
Early instars	Braconids	K_3	Pupa	Malformed pupae	K_{10}
	Tachnid	K_4		Not emerged pupae	K_{11}
	NPV	K_5		Unknown causes	K_{12}
	Unknown causes	K_6	Adults	Malformed adult	K_{13}
Late instars	NPV	K_7		unknown	K_{14}

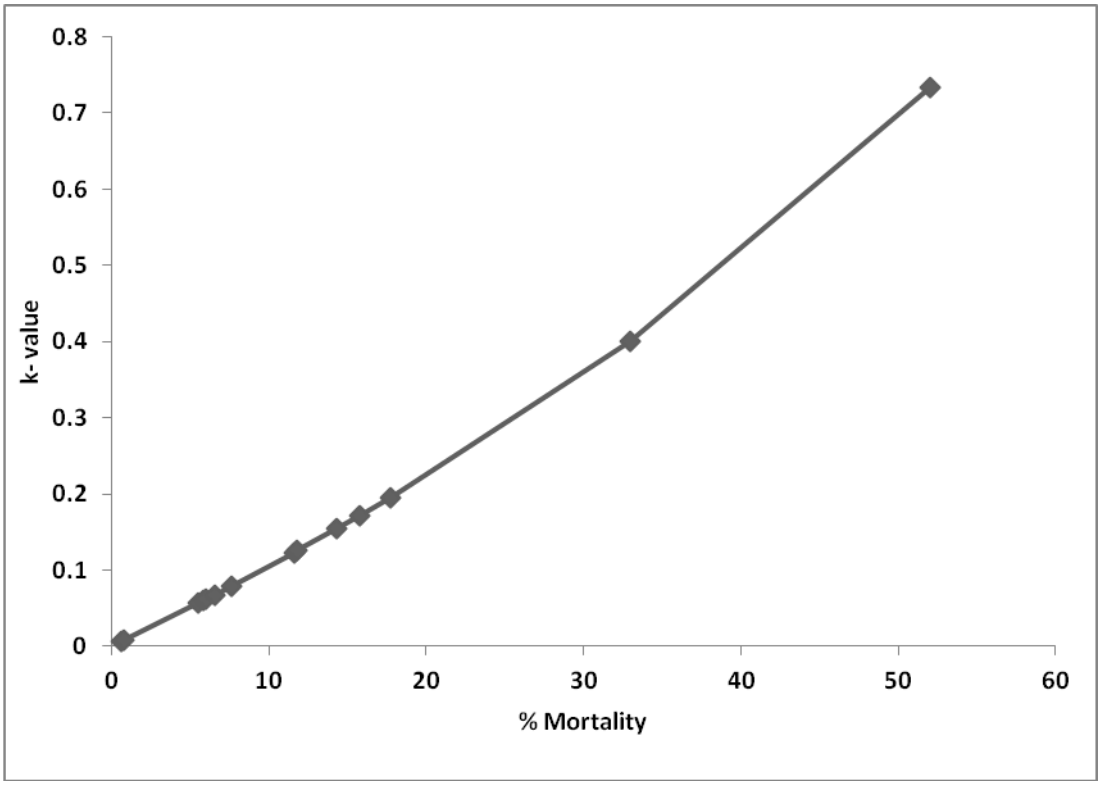

Fig. 3. Relationship between mortality of *S. litura* and k-value