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# LIFE TABLE STUDIES OF GREEN SEMILOOPER ON SOYBEAN

**Madhuri S. Laute*, Nikita V. Patil and U. P. Barkhade**

Department of Agricultural Entomology, Post Graduate Institute, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Krishinagar, Akola - 444 104 (Maharashtra), India.

## Abstract

The present investigation entitled "Life table studies of green semilooper on soybean" was conducted in laboratory at Department of Agricultural Entomology, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *kharif* 2011-2012 to study the life table of green semilooper on soybean. Life table studies of green semilooper on soybean revealed that younger larvae ($I^{st}$ to $III^{rd}$ instar) stage of green semilooper suffered highest during August and September due to fungal infection. There were 34 and 35.71 per cent mortality among younger larvae ($I^{st}$ to $III^{rd}$ instar) during August and September, respectively. There were 33.33 and 29.62 per cent mortality among older larvae ($IV^{th}$ to $V^{th}$) instars during August and September due to fungal infection as well as unknown reason. There were 18.18 and 15.78 per cent mortality in pupal stage during August and September due to unknown reason. The Generation Survival of green semilooper was higher during September (0.33) than August (0.26) with trend index (0.70) during August. After $36^{th}$ MW the population of pest was not observed in soybean field population therefore trend index during second month could not be worked out. The age specific key mortality was highest in younger larvae ($I^{st}$ to $III^{rd}$ instar) during both months as 'k' value was highest *i.e.* 0.1804 and 0.1919 followed by older larvae ($IV^{th}$ to $V^{th}$) *i.e.* 0.1761 and 0.1526 and for pupae 0.0872 and 0.0746, adult 0.301 ,respectively in both months. The natural mortality in green semilooper was more as generation survival observed during both months studies was 26 to 33 per cent. Hence, it is necessary to observe early larval stages to adopt plant protection measures for the management of green semilooper.

***Key words :*** Green semilooper, life table, key mortality factors. fungal infection.

## Introduction

Soybean (*Glycine max*. L) is one of the most important leguminous oilseed crop of great economic value occupying an important position in world trade.About 73.44 million hectare of land in world is under soybean cultivation. The area under soybean in India during 2011 was 103.338 lakh hectare and total production was 119.395 lakh tonns and productivity of 1155 kg/ha. In Maharashtra during *kharif* 2011 area sown under soybean was 30.613 lakh hectare with total production of 38.458 lakh tonns with average yield 1256 kg/ha (Anonymous, 2011). Among various insect pests, green semilooper is one of the most serious polyphagous pest of soybean crop in India (Bhattacharya *et al*., 1977). It feeds on leaves of soybean plants from vegetative to maturity stages and hence becoming serious defoliator pest of soybean. In addition to soybean, green semilooper also feeds on the crops belonging to families compositae, leguminoceae, cruciferae, linaceae, cucurbitaceae, and chenopodiaceae (Singh and Rawat, 1980). In soybean, losses caused by green semilooper reported at flowering and podding stage was 50.21 per cent and foliage damage was 10.50-12.01 per cent (Singh and Singh, 1990). Defoliators like *Spodoptera litura* (Fab). *Thysanoplusia orichalcea* (Fab) damage soybean extensively by skelatization later stage and thus reducing the photosynthetic capacity of plants (Adimani, 1976). Keeping these facts in mind, the present investigation were undertaken life table of green semilooper in different meteorological weeks on soybean.

***Author for correspondence:** E-mail: lautemadhuri486@gmail.com

## Materials and Methods

The present investigation entitled "Life table studies of Green semilooper on soybean" was conducted in laboratory at Department of Agricultural Entomology, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *kharif* 2011-2012 to study the life table of green semilooper on soybean.

**Material**

Instruments- BOD incubator, Stereoscopic microscope Refrigerator, camera Lucida, weighing Balance etc.

**Insect Feeding material**

Fresh soybean leaves were used to feed the larvae.

The adult diet was prepared by dissolving following ingredients in the distilled water (boiled and cooled) and stored in amber color bottle in refrigerator.

1) Distilled water-500ml

2) Methyl-4-hydroxy benzoate-1gm

3) Honey-500ml

4) Sucrose-50gm

5) Formaldehyde (10%)-2ml

**Other material** - plastic trays, plastic vials, bell jars, muslin cloth, forecep, cotton swab, white thread, soft camel hair brush, adult emergence chamber, mating etc was used.

**Methodology**

**Experimental details**

1) Year of experiment : *Kharif* 2011-2012

2) Key insect pest : Green semilooper

3) Larval host : Soybean

4) Variety : JS 335

**Laboratory Studies of field collected stages of green semilooper**

Around 100 eggs of green semilooper were taken for life table studies. Eggs were reared in the laboratory and observations were recorded during each stage and each larval instar for mortality, survival, mortality factors during period of each stage by rearing each larva separately. Matured larvae were kept in the plastic trays for pupation and for further observations. Observations were recorded on the pupal mortality, adult emergence, pupal deformities, male female sex ratio etc. Known adult pairs were released in the mating chamber for mating and oviposition to record fecundity and adult longevity. Period of different life stages obtained from field collected eggs were also recorded. Generation survival rate and trend index was worked out and life table was constructed for soybean looper.

**Sampling procedure**

Sampling of green semilooper were carried out from the unsprayed soybean plot from the initiation of pest till incidence exists on the crop at 7 days interval, at every time 25 plants were examined for recording insect population.The samples were collected in morning hours. For Life table studies, different life stages of semilooper were collected as given bellow.

**Eggs**

Twenty five plants were randomly selected from the unsprayed soybean crop. Eggs were collected from unsprayed soybean crop. The collected eggs were reared in laboratory keeping single egg in small plastic vial.

**Larvae**

Larvae were recorded on 25 plants of soybean. The larvae belonging to small age group *i.e.* I, II and III instars (together) and bigger age group *i.e.* IV and V instars (together) were collected from plants at 7 days interval till the incidence exists. The larvae of these above mentioned two age group were collected separately from plants of soybean and kept individually in the small plastic vials containing the fresh leaves of soybean in the laboratory till pupation, as the larvae spun loose cocoon on the foliage and pupated within.

**Pupae**

The matured larvae were collected from soybean crop and they were allowed to pupate in the laboratory in the trays provided with soybean leaves.

**Adults**

The adults emerged out from the pupae obtained from field collected larval population, were collected. The known adult pairs were confined in oviposition chamber to record fecundity of female and adult longevity.

**Mode of sbservations**

**Eggs**

The eggs collected from the field were brought to the laboratory and reared till hatching or emergence of any parasitoid adults. The observations were made on the per cent natural mortality of eggs, number of the eggs hatching into larvae, per cent of parasitization in eggs.

**Larvae**

The larvae collected from the field were brought to the laboratory and reared on soybean leaves till pupation and mortality due to biotic factors, survival rate of each instar and unknown causes were recorded separately.

**Pupae**

In pupae, the observations were made on the number of matured larvae released for pupation, per cent pupation from field and laboratory population, per cent mortality/ survival rate of pupae, factors responsible for pupal mortality, per cent adult emergence and pupal period were recorded separately.

**Adult**

In adults, observations were made on the adult longevity of male and female, sex ratio, generation survival rate and trend index of field collected and laboratory reared population on soybean.

**Construction of life table**

The data collected on the population of various stages and the mortality occurring in each stage under the following headings were analysed as per Atwal and Bains (1974).

x = Age interval.

lx = No. of individuals alive at the beginning of age interval, x.

dx = No. of individuals die during age interval , x.

dxF = Mortality factor responsible for dx.

100qx = per cent mortality during age interval, x.

Sx = Survival rate within age interval, x.

**Criteria for filling the columns of life-table**

The criteria proposed by Harcourt (1963) for filling the data in the life table for each age interval (stage) was used in the present investigation.

**Eggs**

The lx for eggs was obtained by the summation of the number of eggs recorded at the various sampling dates during one month period starting from the appearance of the insect on the crop.

**Larvae**

The lx for larvae of green semilooper were also obtained by direct sampling during pest infestation.

**Pupae**

The lx was determined after substracting the mortality owing to parasitoid and other reasons from the population of (lx) prepupal larvae.

**Moth**

This 'lx' represents the number of pupae giving rise to adults. The mortality in the pupal stage due to parasitoids and other reasons was subtracted from 'lx'of pupae and thus 'lx'value for moths was determined.

**Trend Index (I)**

Trend index was simply 'lx' for eggs in the preceding months expressed as ratio of the succeeding one.

$$\text{Trend Index (I)} = \frac{N_2}{N_1}$$

Where,

$N_2$ = No. of eggs during the next season.

$N_1$ = No. of eggs during the same season

**Generation Survival (SG)**

The Generation Survival was an index of population trend without the effect of fecundity and adult mortality.

$$\text{Generation Survival (SG)} = \frac{N_3}{N_1}$$

Where,

$N_3$ = Population of adults in a generation.

$N_1$ = Population of eggs in the same generation.

**Analysis of causes and identification of key mortality factors**

The most important step in explaining the population fluctuations were to determine the stages in the life of the pest, which has major contribution to the index of population trend (I) and generation survival (SG). Separate budget for each month was prepared to find out the key mortality factors that influenced the population trend in different months. The method of key mortality factor analysis developed by Varley and Gradwell (1960) was used to detect density relationship of mortality factors. By this method, the killing power (k) of such mortality factors in each age group was estimated as the differences between logarithms of population density before and after its action. As a series of mortality factor operated in succession of a population the total killing power 'k' was equal to the sum of the killing power of K's

If, $K_1$ = log lx of egg stage - log lx of larval stage

$K_2$ = log lx of larval stage - log lx of pupal stage

$K_3$ = log lx of pupal stage - log lx of adult stage

Thus, 'k' will be equal to $K_1 + K_2 + K_3$

## Results and Discussion

**Life table for field collected population of Green semilooper on soybean during August**

Life table for field collected population of green semilooper were studied on soybean during *Kharif* 2011-2012. The results obtained are presented in (table 1). There was 26.47 per cent mortality among the eggs due to unknown reason. Larval mortality of 34 and 33.33 per cent was observed in younger larvae ($I^{st}$ to $III^{rd}$ instars) and Older larvae ($IV^{th}$ to $V^{th}$ instars), respectively. Larval population in younger larvae and older larvae was reduced to 8.0 and 24.24 per cent respectively, due to unknown reason. Fungal infection (*Nomuraea rileyi*) cause a mortality in larval population in younger larvae and older

**Table 1 :** Life table of green semilooper on soybean during August 2011.

| Age Interval X | No. of individuals alive in at beginning lx | No. dying during x dx | Factor responsible for dx dxf | Mortality per cent 100qx | Total mortaliy per cent | Survial rate within x **SX** |
|---|---|---|---|---|---|---|
| Eggs (N1) | 68 | 18 | Unknown (18) | 26.47 | 26.47 | 0.73 |
| Younger larve (I-III instar) | 50 | 17 | Unknown (4) | 8.0 | 34.0 | 0.66 |
| | | | NPV(3) | 6.0 | | |
| | | | *Nomuraea rileyi* (10) | 20.0 | | |
| Older larvae (IV-V instar) | 33 | 11 | Unknown (8) *Nomuraea rileyi* (3) | 24.24 9.09 | 33.33 | 0.67 |
| Pupae | 22 | 4 | Unknown (4) | 18.18 | | 0.81 |
| Moth | 18 | Sex 50% female | | | | 1 |
| Femalex2(N3) | 18 | | | | | 1 |
| Generation total | | 50 | | | 110.23 | |
| No. of actual eggs(N2) (in next month) | 48 | | | | | |
| Trend index (N2 /N1) | 0.72 | | | | | |
| Generation survival (N3/N1) | 0.26 | | | | | |

**Table 2 :** Budget of green semilooper, during August 2011.

| **Age interval X** | **No. of individuals alive at beginning** | **Log No.** | **K's** |
|---|---|---|---|
| Eggs | 68 | 1.8325 | 0.1336 |
| Younger larvae (I-III instar) | 50 | 1.6989 | 0.1804 |
| Older larvae (IV-V instar | 33 | 1.5185 | 0.1761 |
| Pupae | 22 | 1.3424 | 0.0872 |
| Adult | 18 | 1.2552 | 0.301 |
| Reproducing Females | 9 | 0.9542 | |
| | | | K = 0.8783 |

larvae was reduced 20 to 9.09 per cent. Nuclear Polyhedrosis Virus (NPV) causes mortality in younger larvae was 6.00 per cent. Pupal mortality was 18.18 per cent due to unknown reason. The generation survival value was 0.26. The negative value of trend index (0.70) indicates that the mortality factors operating during this period were effective in causing a decline in the pest population. Whereas, Earlier workers, Bisane and Katole (2008) in their studies on life table of *Helicoverpa armigera* (Hub) on pigeonpea, on the basis of absolute population of two years data showed that the egg stage recorded 9.35 per cent mortality due to unviability as no parasitoid was found in this stage during both seasons. The disease mortality by NPV was more in smaller larvae than bigger larvae. However mortality in pupae was 30 per cent due to unknown factors. The generation survival of *Helicoverpa armigera* from field collected life stages was 0.28.Some parameters could not be discussed due to want of literature. The budget of green semilooer for month of August 2011, showed that the maximum mortality occurred in the younger larvae ($I^{st}$ to $III^{rd}$ instars) as the 'k' value for this stage being the highest (0.1804). The

**Table 3 :** Life table of green semilooper on soybean during September.

| Age interval X | No. of individuals alive in at beginning lx | No. dying during x dx | Factor responsible for dx dxf | Mortality per cent 100qx | Total mortaliy per cent | Survial rate within x SX |
|---|---|---|---|---|---|---|
| Eggs (N1) | 48 | 6 | Unknown (6) | 12.50 | 12.50 | 0.87 |
| Younger larve (I-III instar) | 42 | 15 | Unknown (3) | 7.14 | 35.71 | 0.64 |
| | | | *Nomuraea rileyi* (9) | 21.42 | | |
| | | | NPV (3) | 7.14 | | |
| Older larvae (IV-V instar) | 27 | 8 | Unknown (8) | 29.62 | 29.62 | 0.70 |
| Pupae | 19 | 3 | Unknown (3) | 15.78 | 15.78 | 0.84 |
| Moth | 16 | Sex50% female | | | | 1 |
| Femalex 2 (N3) | 16 | | | | | 1 |
| Generation total | | 32 | | | 93.61 | |
| No.of actual eggs (N2) (in next month) | Nill | | | | | |
| Trend index (N2 /N1) | Nill | | | | | |
| Generation survival (N3/N1) | 0.33 | | | | | |

**Table 4:** Budget of green semilooper during September 2011.

| Age interval X | No. of individuals alive at beginning | Log No. | K's |
|---|---|---|---|
| Eggs | 48 | 1.6812 | 0.0580 |
| Younger larvae (I-III instar) | 42 | 1.6232 | 0.1919 |
| Older larvae (IV-V instar) | 27 | 1.4313 | 0.1526 |
| Pupae | 19 | 1.2787 | 0.04746 |
| Adult | 16 | 1.2041 | 0.301 |
| Reproducing Females | 8 | 0.9030 | |
| | | | K = 0.7782 |

next important factors of mortality in the older larvae (0.1761) due to unknown causes, followed by the eggs mortality (0.1336) and the 'k' value for pupal stage (0.0872) and for adult stage (0.301) (table 2).

### Life table of green semilooper on soybean during September

The data presented in table 3 revealed that there was 12.50 per cent mortality among the eggs due to unknown reason. Larval mortality 35.71 and 29.62 per cent in younger larvae ($I^{st}$ to $III^{rd}$ instars) and Older larvae ($IV^{th}$ to $V^{th}$ instars), respectively. Larval population in younger larvae and older larvae was reduced to 7.14 to 29.62 per cent due to unknown reason. Fungal infection *(Nomuraea rileyi)* cause a mortality in larval population in younger larvae was reduced 21.42 per cent. Nuclear polyhedrosis virus causes mortality in younger larvae was 7.14 per cent. Pupal mortality was 15.78 per cent. After $36^{th}$ MW the population of pest was not observed in soybean field population therefore trend index during second month could not be worked out and therefore this resulted to yield nil trend index (I) during second month, while the generation survival value was 0.33. The budget for month of September that the maximum mortality occurred in younger larvae ($I^{st}$ to $III^{rd}$) as the 'k' value

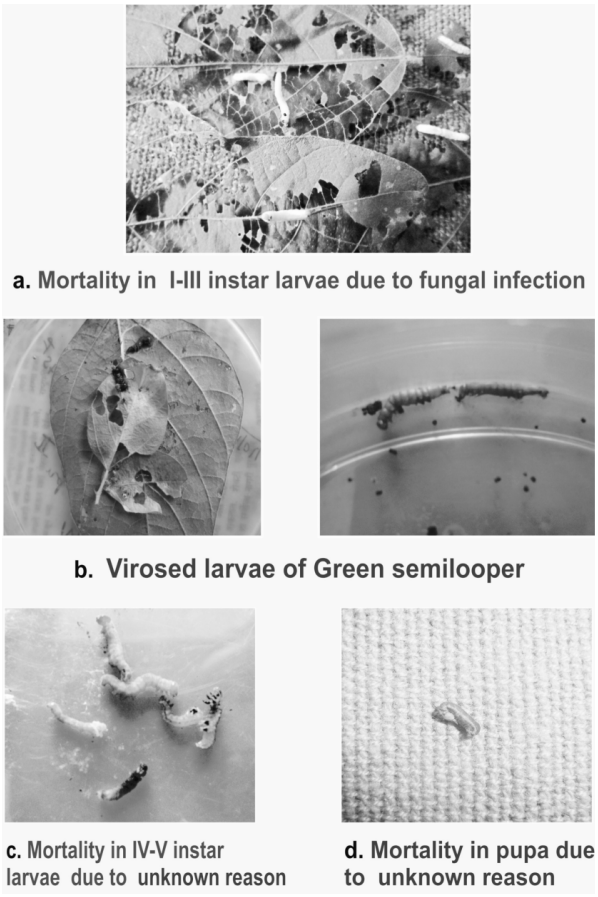


**Fig. 1 : a.** Mortality in I-III instar larvae due to fungal infection, **b.** Virosed larvae of Green semilooper, **c.** Mortality in IV-V instars larvae due to unknown reason, **d.** Mortality in pupa due to unknown reason.

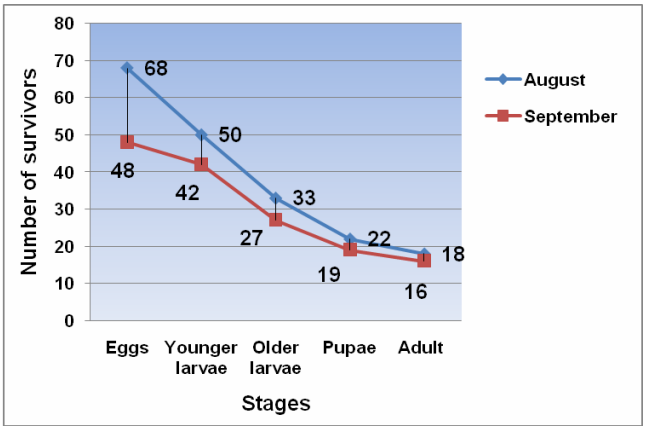


**Fig. 2 :** Survivorship curves of Green semilooper during two months on soybean.

for this stage being the highest (0.1919). The next important factors of mortality in the order were, the older larvae (0.1526) unknown reason and the 'k' value for pupal stage was (0.0746) and for adult stage (0.301). (table 4).

From these studies result and discussion it can be concluded that, among the life stages of green semilooper the larval stages were most vulnerable to fungal infection (*Nomuraea rileyi*). The egg stage and pupal stages were not affected by any parasitoid and hence these results will prove beneficial to plan, plant protection strategies against green semilooper.

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