

# Biology and Seasonal Incidence of Fruit Borer, *Helicoverpa armigera* (Noctuidae: Lepidoptera) on Tomato

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**Abstract**—Detailed studies on bio-ecology of this pest were conducted in laboratory by taking 25 individuals and rearing them in incubator at  $21\pm 1^{\circ}\text{C}$  and  $65\pm 5$  per cent RH. Observations showed that the incubation period of the eggs under laboratory conditions ranged between 3 to 4 days with an average of  $3.4 \pm 0.47$ . The duration of the first, second, third, fourth, fifth and sixth instar varied from 2, 3 to 4, 4 to 5, 7 to 8, 7 to 9 and 2 to 3 days with an average of  $2.0 \pm 0.0$ ,  $3.4 \pm 0.54$ ,  $4.6 \pm 0.54$ ,  $7.6 \pm 0.54$ ,  $7.8 \pm 1.09$  and  $2.6 \pm 0.54$  days respectively. The total pupal period completed in 5-7 days with an average of  $6.2 \pm 1.095$  days. The adult female period was 6 days and male period was 5 days, respectively. The female fecundity ranged between 636 to 648 eggs/female. The infestation of *H. armigera* on tomato started from 19<sup>th</sup> February, 2014 with the peak infestation of 3.8 insects per plant noticed on 16<sup>th</sup> April, 2014. Fruit borer exhibited significant positive correlation with maximum temperature and minimum temperature whereas a significant negative correlation with maximum relative humidity and minimum relative humidity and rainfall.

**Keywords:** Abiotic factors, Biology, *Helicoverpa armigera*, Seasonal incidence, Tomato.

## 1. INTRODUCTION

Tomato (*Lycopersicon esculentum*) belongs to the genus *Lycopersicon* under Solanaceae family. Tomato is the world's largest vegetable crop after potato and sweet potato, but it tops the list of canned vegetables. This crop is subject to the attack of number of insect pests. Among the important insect pests, the sucking pest, *Helicoverpa armigera* is considered as one of the major limiting factor affecting its production and quality as this pest can infest the crop from nursery stage to maturity [1]. The increasing infestation of this pest in tomato fields has raised a number of questions regarding the factors responsible for its population build up under natural conditions. To suppress the insect pest population below economic injury level, management practices need to be developed through regular crop pest surveillance and monitoring. The basic information on biology and seasonal incidence in relation to prevailing environmental conditions is required for the development of pest forewarning system. Keeping this in view, the present studies were undertaken so as to formulate efficient pest management tactics for this pest in Aligarh region.

## **2. MATERIALS AND METHODS**

The present studies were carried out under controlled conditions in the Department of Plant Protection and at the experimental fields of Faculty of Agricultural Sciences, AMU, Aligarh (India) during 2013-2014.

### **2.1: Studies on biology of *Helicoverpa armigera***

#### **2.1.1: Maintenance of the laboratory culture of *Helicoverpa armigera***

To maintain the culture of *H. armigera*, the moths (male and female) were collected from the tomato plants from the experimental field. They were placed in transparent glass jars covered with a fine muslin cloth. The inner surface of jars was lined with a black paper sheet, which provided clear visibility of eggs on the surface. 10% honey solution on a cotton swab was placed in each jar for moth feeding. Eggs laid on the bottom were collected for further multiplication and use. Second instar onwards the larvae were reared individually to prevent cannibalism.

#### **2.1.2: Life history parameters**

Twenty five eggs were collected from stock and kept in Petri dishes for hatching. The newly emerged larvae were feeding on fruits of tomato. Observations regarding the number of instars and pupal period were also recorded. Observations on pre-oviposition, oviposition and post oviposition period, adult longevity and fecundity were recorded. Data is given in Table 1.

#### **2.2: Seasonal incidence of *Helicoverpa armigera* in tomato crop in relation to weather parameters**

To study the seasonal incidence, 50 plants were randomly selected from the experimental field, tagged and observations were taken weekly from December, 2013 to April, 2014. The total number of larvae was recorded from upper, middle and lower parts of the plant. The data was taken at one week interval.

The observations on fruit borer population were correlated with weather factors to determine their influence on population fluctuation. To determine the quantitative relationship between fruit borer population and weather parameters *viz.* maximum temperature, minimum temperature, maximum relative humidity, minimum relative humidity and rainfall were taken as independent variables. Meteorological data on these parameters were collected from Observatory of Physics Department, Faculty of Sciences, Aligarh Muslim University, Aligarh during the period of experimentation. The data so generated from weekly observations were subjected to Pearson's Correlation analysis by using the language programme "SPSS 13.0" unless stated otherwise. Data is given in Table 2.

## **3. RESULTS AND DISCUSSIONS**

### **3.1: Biology of *Helicoverpa armigera***

#### **Eggs**

The eggs were spherical in shape with a flattened base. The colour in the beginning was yellow-white, which become dark brown before hatching.

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### **Incubation period**

The incubation period of the eggs under laboratory conditions ranged between 3 to 4 days with an average of  $3.4 \pm 0.47$ .

### **Larval Period**

The larva passed through six instars before becoming pupa. The duration of the first, second, third, fourth, fifth and sixth instar varied from 2, 3 to 4, 4 to 5, 7 to 8, 7 to 9 and 2 to 3 days with an average of  $2.0 \pm 0.0$ ,  $3.4 \pm 0.54$ ,  $4.6 \pm 0.54$ ,  $7.6 \pm 0.54$ ,  $7.8 \pm 1.09$  and  $2.6 \pm 0.54$  days respectively. The total larval period completed in 28 days.

### **Pupal Period**

Pupa was broadly round anteriorly but tapering posteriorly. The freshly formed pupa was light green yellow in colour. It become light brown and further darkened prior to the emergence of moth. The total pupal period completed in 5-7 days with an average of  $6.2 \pm 1.095$  days.

### **Adult**

The adult was brownish gray in colour. The forewings were pale brown with a marginal series of black dots, having black kidney shaped mark on under side. The hind wings were lighter in colour with a dark patch present at the outer end. However, the tip of abdomen of females was marked by a tuft of hair. The adult female period was 6 days and male period was 5 days, respectively.

### **Fecundity**

The female fecundity ranged between 636 to 648 eggs/female with an average of  $642 \pm 1.167$  eggs/female.

### **3.2: Seasonal incidence of *Helicoverpa armigera* in tomato crop in relation to weather parameter**

The infestation of *H. armigera* on tomato started from 19<sup>th</sup> February, 2014 with the peak infestation of 3.8 insects per plant noticed on 16<sup>th</sup> April, 2014. Declining trend in pest population was noticed with minimum infestation of 0.2 insects per plant on 30<sup>th</sup> April, 2014. Studies on correlation of fruit borer incidence with weather parameters revealed that fruit borer exhibit significant positive correlation with maximum temperature ( $r= 0.6098$ ) and minimum temperature ( $r=-0.5533$ ) and significant negative correlation with maximum relative humidity ( $r=- 0.6290$ ) and minimum relative humidity ( $r=-0.4740$ ) and rainfall ( $r= -0.3096$ ). This study is in conformity with the results of Nadaf et al [2].

The decline in pest infestation may be due to maturity and drying of plants. It is also reported that weather parameters appeared to be major regulatory factors for fruit borer infestation under field conditions.

**Table 1: Life – stage Parameters of *Helicoverpa armigera***

S. No.	Stage of the insect	Min.	Max.	Av. ± S.d
1.	Egg period	3	4	3.4 ± 0.547
2.	Larval period			
	1) 1 <sup>st</sup> instar	2	2	2.0 ± 0.0
	2) 2 <sup>nd</sup> instar	3	4	3.4 ± 0.547
	3) 3 <sup>rd</sup> instar	4	5	4.6 ± 0.547
	4) 4 <sup>th</sup> instar	7	8	7.6 ± 0.547
	5) 5 <sup>th</sup> instar	7	9	7.8 ± 1.095
	6) 6 <sup>th</sup> instar	2	3	2.6 ± 0.547
3.	Total larval period	28	28	28 ± 0.0
4.	Pupal period	5	7	6.2 ± 1.095
5.	Adult period			
	Male	5	5	5.0 ± 0.0
	Female	6	6	6.0 ± 0.0
6.	Total life period			
	Male	41	43	42.0 ± 0.214
	Female	42	45	43.5 ± 0.227
7.	Fecundity	636	648	642 ± 1.167
8.	Temperature	18.3	42	27.9 ± 3.819
9.	Relative humidity	17	90	48.0 ± 16.125

**Table 2: Seasonal Incidence of *Helicoverpa armigera* in Tomato in the year 2014**

Period (15/01/2014 to 30/04/2014)	Mean <i>Helicoverpa armigera</i> population per 50 plant	Temperature		Humidity %		Rainfall
		Min	Max	Min	Max	
15-01-2014	0.0	4.4	18.6	69	97	00.0
22-01-2014	0.0	8.0	16.4	72	97	44.0
29-01-2014	0.0	8.6	21.6	62	98	11.0
05-02-2014	0.0	5.0	25.2	72	97	00.0
12-02-2014	0.0	5.4	26.0	51	88	3.6
19-02-2014	1.5	6.0	21.8	54	98	00.0
26-02-2014	1.75	7.6	23.8	55	98	0.2
05-03-2014	1.85	9.0	24.6	48	96	14.8
12-03-2014	2.0	11.4	27.6	43	96	10.0
19-03-2014	2.5	12.4	32.2	39	91	00.0
26-03-2014	2.9	14.6	31.4	41	84	5.0
02-04-2014	4.0	16.4	32.6	31	76	00.0
09-04-2014	6.0	16.4	37.8	30	63	00.0
16-04-2014	3.8	17.4	38.0	27	52	00.0
23-04-2014	1.4	18.0	36.6	35	90	7.0
30-04-2014	0.2	20.8	40.2	19	48	00.0

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**Table 3: Correlation of weather parameters with population of fruit borer**

<b>Infestation</b>	<b>Minimum Temperature</b>	<b>Maximum Temperature</b>	<b>Minimum RH</b>	<b>Maximum RH</b>	<b>Rainfall</b>
<i>Helicoverpa armigera</i>	0.5533	0.6098	- 0.6290	- 0.4740	- 0.3096

#### **4. ACKNOWLEDGEMENTS**

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