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Impact of abiotic and biotic factors on population of tomato fruit borer, *Helicoverpa armigera* (Hubner) at Chhattisgarh

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Abstract
Impact of the various abiotic and biotic parameters on population of tomato fruit borer, *Helicoverpa armigera* (Hubner) was studied during 2016-17 and 2017-18 at the area of Horticulture Research cum instructional farm of vegetable science, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur, Chhattisgarh. On the basis of pooled mean various abiotic parameters *viz.* Maximum temperature, minimum temperature, wind velocity and evaporation and biotic parameters *viz.* larvae were showed highly positive significant impact on the population of *Helicoverpa armigera* but in case of morning relative humidity show highly negative significant impact were shown. During this period, pooled two year mean maximum temperature, minimum temperature, relative humidity, rainfall, wind velocity and sunshine was 33.9^{0}C, 19.4^{0}C, 67%, 2.8mm, 3.4 Km hr-^{1} and 7.1 hr day-^{1} respectively. The maximum larvae by *Helicoverpa armigera* was noticed during first week of March (10th SMW) with 5.05 larvae plant^{-1}. There was a highly positive significant trend of correlation between the larvae population and maximum temperature, minimum temperature and wind velocity with 'r' value of 0.856**, 0.811** and 0.722** respectively at 5 per cent level of significance and regression line was worked out for no. of fruit borer laid $Y= -17.44+0.63X_1$, $Y=-4.51+0.48X_2$ and $Y=-2.33+1.92X_4$ R^2 0.73, 0.65 and 0.52 but in case of morning relative humidity (r = -0.776**) highly negative significant $Y= 17.74-0.19X_3$ R^2 0.60 and rain fall (r = 0.315) and sunshine (0.137) positive non-significant correlation was observed.

Keywords: Fruit borer, abiotic factors, biotic factors, *Helicoverpa armigera,* tomato, correlation

Introduction
Tomato, *Lycopersicon esculentum* (Miller) new name *Solanum lycopersicon*, is one of the most popular and nutritive vegetable crops grown all over the world. Tomato belongs to family Solanaceae and is native of Peru and México. Tomato is the most important vegetable grown widely both for fresh marketing and processing. India is next only to the China in area and production of vegetables. It is grown as an offseason vegetable in the hills of India and farmers fetch good income after sending their produce in the plains from June to September. The fruit can be eaten raw or cooked. Tomato in large quantities is used to produce soup, juice, ketchup, puree, paste and powder. Tomato, *Lycopersicon esculentum* (Mill.) is an important vegetable crop grown around the world occupying the daily food regime of a majority of people (Hussain and Bilal, 2007) [4]. Tomato crop is being cultivated in an area of about 808.54 thousand hectares in India with a production of 19696 thousand MT and productivity of 24.36 MT/hectares. In Chhattisgarh it covers an area of about 56.63 thousand hectares with a production of 953.16 thousand MT and productivity of 16.83 t ha^{-1} (Indiastat, 2017) [1]. Tomato fruit borer is highly destructive pest causing serious damage and responsible for significant yield loss up to 55 per cent (Talekar *et al.* 2006) [13]. However, tomato fruit borer causes 40-50 per cent damage to the tomato crop (Pareek and Bhargava 2003) [10].

Material and Methods
Population of tomato fruit borer, *Helicoverpa armigera* (Hubner) larvae were recorded during the year 2016-17 and 2017-18 at Raipur districts of Chhattisgarh. The population of *Helicoverpa armigera* (Hubner) larvae was observed on 5 randomly selected plants. For the case of study and findings, meteorological data were pooled out at weekly interval". Among weather parameters relative humidity (morning and evening), maximum temperature, minimum temperature and rainfall were considered for correlating with occurrence of the insects pests of tomato (Shukla *et al*., 2005, Meena *et al*., 2010) [12, 7].

To work out the relationship between the occurrence of the insect pests of tomato and the weather parameters, correlation and multiple linear regressions (MLR) method was adopted (Panse and Sukhatne, 1985) [9].

Results and Discussion

Various abiotic and biotic parameters were recorded along with *Helicoverpa armigera* larvae population during 2016-17 and 2017-18 at the area of Horticulture Research cum instructional farm of vegetable science, College of Agriculture, IGKV, Raipur, Chhattisgarh. The data on infestation of fruit borer, *Helicoverpa armigera* was first appeared in fourth week of December with 0.51 fruit borer larvae plant^{-1}. Maximum fruit borer were (5.29 larvae plant^{-1}) noticed during first week of march (10th SMW) (Table 2 & Fig. 1); during this period rainfall (5.5 mm), maximum (33 ^{0}C) and minimum (19.2 ^{0}C) temperature, morning relative humidity (69%), evening relative humidity (36%), wind velocity (3.3 Km/h) and bright sunshine hours (6.7 hours/day) prevailed during 2016-17 (Table 1). Thereafter, the fruit borer was gradually decreased and reached 4.12 fruit borer larvae plant^{-1} during second week of March. The numbers of fruit borer was correlated with prevailing rainfall, temperature, relative humidity, sunshine hours and wind velocity. There was a non-significant positive correlation between the fruit borer population and rain fall and sunshine with ‘r’ value of 0.23 and 0.30, respectively at 5 per cent level of significance (Table 3) but in case of maximum temperature (0.873**), minimum temperature (0.826**) and wind velocity (0.746**) highly positive significant correlation with fruit borer observed and regression line was worked out for no of fruit borer laid $Y= -19.09+0.69X_1$, $Y=-5.59+0.55X_2$ and $Y=-1.86+1.92X_4$, R^2 0.76, 0.68 and 0.55 (Table 4). Where, ‘Y’ was estimated number of fruit borer which explained by regression equation for any value of independent variable (X_1= Maximum temperature, X_2= Minimum temperature, X_3= Relative humidity and X_4= wind velocity) and R^2 was number of fruit borer population which explained by regression equation. Evening relative humidity (r=-0.407) was observed negative non-significant trend of correlation. Morning relative humidity (r=-0.793**) highly negative significant correlation with fruit borer observed and regression line was worked out for no. of fruit borer laid $Y=14.65-0.16 X_3$, R^2 0.62 (Table 4).

However, during the year 2017-18 the number of fruit borer larvae population was first appeared in first week of January (0.43 larvae plant^{-1}). The maximum no. fruit borers (4.80 larvae plant-1) were noticed during first week of March (10th SMW) (Table 2 & Fig.1). During this period rainfall, maximum and minimum temperature, morning relative humidity, evening relative humidity, wind velocity and bright sunshine hours were recorded 0.0 mm, 34.7 ^{0}C, 19.6 ^{0}C, 65%, 22%, 3.4Km/h & 7.4 hours/day, respectively (Table 1). Thereafter, the no. fruit borer larvae laid gradually decreased 2.10 larvae plant^{-1} during second week of March. Similarly, there was a highly positive significant trend of correlation was found between the larvae population and maximum temperature and minimum temperature with ‘r’ value of 0.726** and 0.681** regression line was worked out for no. of fruit borer laid $Y= -13.17+0.49X_1$ and $Y=-2.67+0.34X_2$, R^2 0.52 and 0.46 (Table 4). But in case of morning relative humidity (r = -0.630**) highly negative significant and wind velocity (r= 0.580*) positive significant trend of correlation was observed and regression line was worked out for no. of fruit borer laid $Y= 17.20-0.18X_3$, R^2 0.39 and $Y=-1.58+1.42X_4$, R^2 0.33 (Table 4). But in case of rain fall (r=0.256) and evening relative humidity and sunshine -0.083 and -0.081 negative non-significant correlation with fruit borer observed Where, ‘Y’ was estimated number of fruit borer which explained by regression equation for any value of independent variable (X_1= Maximum temperature, X_2= Minimum temperature, X_3= Relative humidity and X_4= wind velocity) and R^2 was number of fruit borer population which explained by regression equation Where, ‘Y’ was no. of larvae and X was prevailing weather parameters (Table 4).

On the basis of pooled mean of the number of larvae of fruit borer was first appeared in last week of December with 0.26 larvae plant^{-1}. The peak population (5.05 larvae plant^{-1}) was observed during first week of March (10th SMW) (Table 2). During this period the pooled rainfall (2.75 mm), maximum (33.85 ^{0}C) and minimum (19.4 ^{0}C) temperature, relative humidity (67%), wind velocity (3.35 Km/h) and bright sunshine hours (7.05 hours/day) prevailed (Table 1). Thereafter, the larvae number gradually decreased & reached 3.80 larvae plant^{-1} during second week of March. There was a highly positive significant trend of correlation between the larvae population and maximum temperature, minimum temperature and wind velocity with ‘r’ value of 0.856**, 0.811** and 0.722** respectively at 5 per cent level of significance and regression line was worked out for no. of fruit borer laid $Y= -17.44+0.63X_1$, $Y=-4.51+0.48X_2$ and $Y=-2.33+1.92X_4$ R^2 0.73, 0.65 and 0.52 (Table 4) but in case of morning relative humidity (r = -0.776**) highly negative significant $Y= 17.74-0.19X_3$ R^2 0.60 and rain fall (r = 0.315) and sunshine (0.137) positive non-significant correlation was observed. (Table 4). Where, ‘Y’ was estimated number of fruit borer which explained by regression equation for any value of independent variable (X_1= Maximum temperature, X_2= Minimum temperature, X_3=Relative humidity and X_4=Wind velocity) and R^2 was number of fruit borer population which explained by regression equation Where, ‘Y’ was no. of larvae and X was prevailing weather parameters (Table 4).

Kharpuse (2005) [6] and Mandal (2012) [8] reported that *Helicoverpa armigera* to be an important fruit borer pest of tomato during the entire reproductive stage of the crop. The present findings are in accordance with Parihar and Singh (1986) [11] they stat that larval population of *Helicoverpa armigera* on tomato was found to be low up to the 1st week of February and thereafter increased rapidly reaching a peak in last week of March. Similarly Deka *et al.* (1989) [3] also observed that the maximum density of *Helicoverpa armigera* from mid-February to first week of March. Yadav *et al.* (1991) [14] found significant and positive correlation *of Helicoverpa armigera* with maximum and minimum temperature and negatively correlation with relative humidity. Similarly Kakati *et al.* (2005) [5] also reported that the *H. armigera* population expressed significant and positive correlation with rainy days (0.428) and other positive association *i.e.* relative humidity evening (0.414), minimum temperature (0.289) and maximum temperature (0.224). Also, negative association was exhibited with relative humidity morning (-0.086). Chula *et al*. (2017) [2] stat that the larval population showed a positive correlation with minimum, maximum temperatures and rainfall (r = 0.652, 0.762 and 0.158 respectively), however it showed negative correlation with relative humidity (r = -0.369 and - 0.830).

Table 1: Weekly meteorological data recorded during the crop growth period 2016-17 and 2017-18 IGKV, raipur

Meteorological Week No.	Month	Date	Max. Temp (^0C)	Min. Temp (^0C)	Rainfall (mm)	Relative humidity (%) Morning	Relative humidity (%) Evening	Wind Velocity	Sun shine (hr day^{-1})
48	November	26-02	30.2	12.5	0.0	86.0	26.5	1.5	8.7
49	December	03-09	28.7	13.7	0.0	87.5	34.5	1.9	8.0
50	December	10-16	29.3	12.1	0.0	84.0	29.0	2.0	8.3
51	December	17-23	28.2	9.9	0.0	86.5	26.5	1.7	8.2
52	December	24-31	28.3	9.7	0.0	85.5	26.0	1.5	8.1
1	January	01-07	28.0	11.1	0.0	80.0	29.0	1.8	7.1
2	January	08-14	27.7	11.0	2.8	82.5	29.0	2.3	7.7
3	January	15-21	29.2	10.9	0.0	85.0	24.5	1.7	8.7
4	January	22-28	29.3	12.3	0.0	83.0	27.0	2.1	8.1
5	January	29-04	30.6	11.5	0.0	74.5	21.5	2.1	9.6
6	February	05-11	31.8	15.2	0.0	79.5	30.0	2.2	7.8
7	February	12-18	29.7	15.2	8.2	84.5	36.0	3.3	7.4
8	February	19-25	33.8	15.6	0.0	73.0	19.5	2.4	9.8
9	February	26-04	34.9	16.5	0.0	74.5	18.5	2.3	9.6
10	March	05-11	33.9	19.4	2.8	67.0	29.0	3.4	7.1
11	March	12-18	33.6	18.7	0.6	65.5	25.5	3.7	7.6

Table 2: Seasonal weekly incidence of *Helicoverpa armigera* larvae during the crop growth on tomato at weekly interval, period during *rabi* 2016-17 and 2017-18

SMW	DATE	Fruit borer larvae plant^{-1}		
		2016-17	2017-18	Pooled
48	26 Nov-02 Dec	0.00	0.00	0.00
49	03 Dec-09 Dec	0.00	0.00	0.00
50	10 Dec-16 Dec	0.00	0.00	0.00
51	17 Dec-23 Dec	0.00	0.00	0.00
52	24 Dec-31 Dec	0.51	0.00	0.26
1	01 Jan-07 Jan	0.70	0.43	0.57
2	08 Jan-14 Jan	0.89	0.98	0.94
3	15 Jan-21 Jan	1.54	1.10	1.32
4	22 Jan-28 Jan	1.91	2.32	2.12
5	29 Jan-04 Feb	2.09	2.89	2.49
6	05 Feb-11 Feb	2.67	3.50	3.09
7	12 Feb-18 Feb	3.12	3.59	3.36
8	19 Feb-25 Feb	3.84	3.91	3.88
9	26 Feb-04 March	4.90	4.60	4.75
10	05 March-11 March	5.29	4.80	5.05
11	12 March-18 March	4.12	2.10	3.80
Seasonal mean		1.97	1.89	1.93

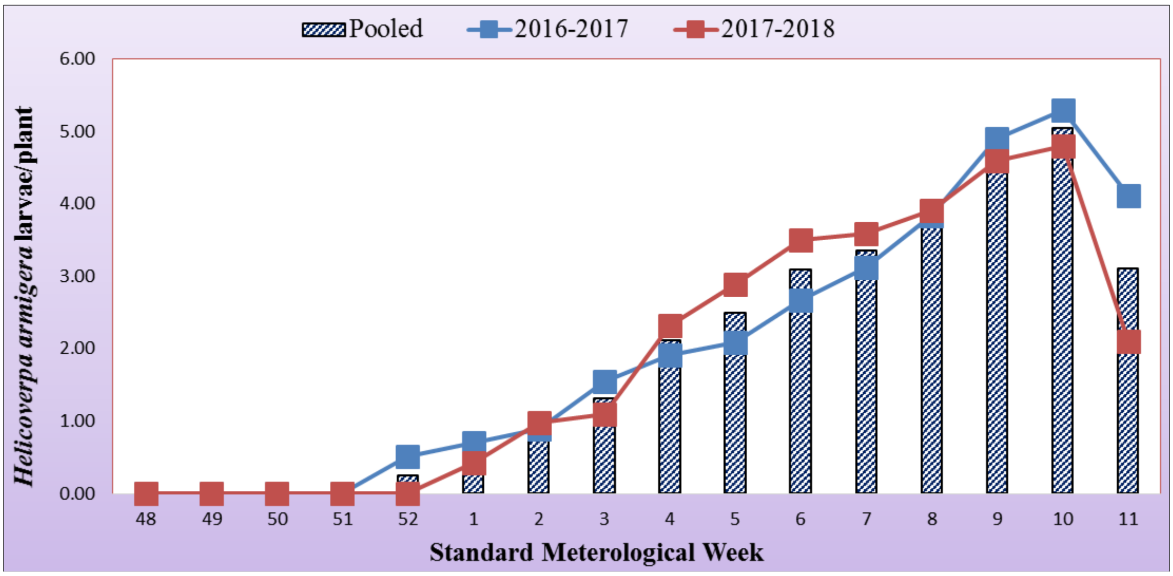

Fig 1: Fruit borer larvae population on tomato during 2016-17 and 2017-18

Table 3: Correlation coefficient on the incidence of *Helicoverpa armigera* larvae of tomato with weather parameters

Weather parameter	Correlation coefficient (r)		
	Fruit borer		
	2016-17	2017-18	Pooled
Maximum Temperature (^{0}C)	0.873**	0.726**	0.856**
Minimum Temperature (^{0}C)	0.826**	0.681**	0.811**
Rain fall (mm)	0.234	0.256	0.315
Morning relative humidity	-0.793**	-0.630**	-0.776**
Evening relative humidity	-0.407	-0.083	-0.309
Wind velocity (km/h)	0.746**	0.580*	0.722**
Sunshine hours (hours)	0.302	-0.081	0.137

*****:Significant (5%)
******: Highly significant (1%)

Table 4: Regression line analysis for *Helicoverpa armigera* larvae with maximum temperature, minimum temperature, morning relative humidity and wind velocity during 2016-17 and 2017-18:

Regression equation			R^2		
2016-17	2017-18	Pooled	2016-17	2017-18	Pooled
$Y= -19.09+0.69X_1$	$Y= -13.17+0.49X_1$	$Y= -17.44+0.63X_1$	0.76	0.52	0.73
$Y=-5.59+0.55X_2$	$Y= -2.67+0.343X_2$	$Y=-4.51+0.48X_2$	0.68	0.46	0.65
$Y=14.65-0.16X_3$	$Y= 17.20-0.18X_3$	$Y= 17.74-0.19X_3$	0.62	0.39	0.60
$Y= -1.86+1.92X_4$	$Y= -1.58+1.42X_4$	$Y=-2.33+1.92X_4$	0.55	0.33	0.52

Where,
Y= Estimated of fruit borer
X_1= Maximum temperature (^{0}C)
X_2= Minimum temperature (^{0}C)
X_3= Morning relative humidity I
X_4= Wind velocity (Km hr^{-1})
R^2= Coefficient of Determination

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References

1. Anonymous. Indiastat. Ministry of agriculture and farmers welfare, Govt. of India, 2017-18.
2. Chula MP, Jat SL, Kumar A, Nitharwal RS. Seasonal incidence of tomato fruit borer, *Helicoverpa armigera* (Hubner) and their correlation with abiotic factors. Journal of Pharmacognosy and Phytochemistry. 2017; 6(4):1445-1447.
3. Deka NK, Prasad D, Chand P. Plant growth *Helicoverpa armigera* incidence and again yield of chickpea as affected by Date of sowing. J Agric. Res. Birsa. Agric. Univ. 1989; 1(2):191-168.
4. Hussain B. Efficacy of different insecticides on tomato fruit borer, *Helicoverpa armigera*. Journal of Entomology. 2007; 4(1):64-67.
5. Kakati M, Saikia OK, Nath RK. Seasonal history and population build-up of tomato fruit borer, *Heliothis armigera* (Hb.) Crop Res. 2005; 6(2):371-373.
6. Kharpuse YK. Studies on seasonal incidence and role of botanical against major insect pests of tomato (*Lycopersicon esculentum* M.). M.Sc. (Ag.) (Ent.) Thesis submitted to J.N.K.V.V., Jabalpur (M.P.), 2005, 1-53.
7. Meena NK, Kanwat PM, Sharma JK. Seasonal incidence of leafhopper and whitefly on okra, *Abelmoschus esculentus* (L.) Monech. Disease Reporter. 2010; 62:259-262.
8. Mondal B, Mondal P, Bhattyacharyya KAD. Seasonal incidence of different insect pests of tomato (*Lycopersicon esculentum* Mill.) and their correlation with abiotic factor in lateritic zone of West Bengal. Journal of Entomology and Zoology Studies. 2012; 7(1):1426-1430.
9. Panse VG, Sukhatne PV. Statistical methods for agricultural workers. ICAR, New Delhi, 1985, 381.
10. Pareek PL, Bhargava MC. Estimation of avoidable losses in vegetables caused by borers under semi-arid condition of Rajasthan. Insect Environ. 2003; 9:59-60.
11. Parihar SBS, Singh BR. Incidence of *Heliothis armigera* (Hub.) a fruit borer on tomato. Indian J Plant Prot. 1986; 13(2):133-136.
12. Shukla S, Kumar A, Awasthi BK. Study of bio-efficacy of botanicals against tomato crop. Vegetable Sciences. 2005; 32(2):210-212.
13. Talekar NS, Open RT, Hanson P. *Helicoverpa armigera* management: a review of AVRDC's research on host plant resistance in tomato. Crop Protec. 2006; 5:461-467.
14. Yadav LP, Lai SS, Ahmad R, Sachan JN. Influence of abiotic factors on vegetative abundance of pod borer of chickpea (*Cicer arietinnni*). Indian J Agric. Set. 1991; 61(7):572-575.