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Population Succession of tomato fruit borer (*Helicoverpa armigera*) on tomato (*Lycopersicon esculentum* Mill.) agro-ecosystem in eastern region of U. P.

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Abstract The first appearance of *Heliverpa armigera* was recorded in 50th and 52nd standard week, but to a low ebb (0.12 and 0.10 larvae per meter row) irrespective of the year of study. The initial population gradually increased and remained confined to vegetative growth but it rapidly increased during fruiting stage and attained its peak in 15th standard week (2nd week of April). Thereafter, the pest population declined. Rainfall and relative humidity were negatively correlated with the pest activity, whereas the maximum and minimum temperature, were positive correlation with relative humidity. Likewise, maximum and minimum temperatures were positively associated in enhancing the pest populations build up. The maximum temperature demonstrated negative impact with relative humidity in the build up of larval population of *Helicoverpa armigera*.

Keywords: *Helicoverpa armigera*, seasonal incidence, tomato

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Introduction

India is a leading vegetables producing country in the world. Presently vegetable cultivation occupies 6.09 million hectares area with an annual production of 84.8 million tones. The country being blessed with the unique gift of nature of diverse climates in distinct seasons, it makes possible to grow an array of vegetables whose number exceeds more than the hundred types.

However, potato being the stable food and easy to mix in several preparations ranks first (27.3 %) in total production of vegetable followed by other important solanaceous vegetable like brinjal (9.4 %) and tomato (9.0 %) cauliflower and cabbage are the most preferred winter vegetables and their total share in the country's vegetable production is 5.2 and 6.4 % respectively (Anonymous, 2006).

Vegetables crops occupy a prominent position in the human diet owing to their richness in vitamins and minerals. The role played by the vegetables, as a protective food in human diet need no advocacy. In our country, more than 70 types of vegetable are grown but maximum emphasis has been given an important vegetable like Tomato, Brinjal, Chilli, Cauliflower, Cabbage, Pea and few important Cucurbits. Among them tomato (*Lycopersicon esculentum* Mill.), belonging to solanaceae, is one of the most popular and widely grown vegetable. The area under this crop is 478 million hectares with the production 60616 million tones annually.

The production and quality of tomato fruits are considerably affected by array of insect pests infesting at different stages of crop growth. The key insect-pests of tomato include jassids (*Amrasca bigutulla bigutulla*, Ishida), aphid (*Aphis gossypi* Glover and *Myzus persicae* Sulzer), white fly (*Bemisia tabaci* Gennadius), cutworm (*Agrotis sp.*), tobacco caterpillar (*Spodoptera litura* Fabr.) and Tomato fruit borer (*Helicoverpa armigera*

Hubner), which infest and hamper the growth of plants. Out of these insect-pests, tomato fruit borer (*Helicoverpa armigera* Hub.) is the major constraints in the higher production of tomato fruits.

Materials and methods

The experiment was laid out at vegetable research farm of Udai Pratap Autonomous College, Varanasi, U.P. during *Rabi* seasons of 2005-06 and 2007. The soil type of experimental fields was sandy loam with an average fertility. The fields were well prepared and leveled having good drainage and adequate irrigation facility. All agronomical practices (e.g. raising of nursery, transplanting, fertilizer application, irrigation and cultural practices etc.) were done as per recommendations. No pesticide was applied on the plants. The meteorological observations during entire period of investigation were recorded from the observatory of Institute of Agricultural Sciences, Banaras Hindu University, Varanasi.

Seasonal incidence of fruit borer, *Helicoverpa armigera* was recorded from the tomato field. Population fluctuation of *H. armigera* was determined by weekly observation of number of larval population per meter row length. Fluctuation in abundance was also recorded in terms of bored fruits (on number basis) in each picking. Thereafter percentage of bored fruits was worked out by counting bored fruits. Seasonal abundance of tomato fruit borer was recorded in terms of number of larvae per meter row length and per cent fruit damage by *Helicoverpa armigera* Hubner. The variety Kashi Hemant was used for experiment. The results thus obtained were correlated with prevailing meteorological conditions viz., rainfall, temperature and relative humidity to signify the impact of environmental factors on pest activity.

Results and discussion

Seasonal incidence of tomato fruit borer, *Helicoverpa armigera* Hub. was recorded on the basis of population of larvae and percentage of fruits bored (infested) by the pest at weekly interval. The occurrence of *Helicoverpa armigera* larvae was noticed in 50th standard week during 2005-06 and in 52nd standard week in 2006-07 (Table- 1 and- 2). The initial population was noticed to a low ebb i.e. 0.12 larvae per meter row length in 2005-06 and 0.10 larvae per meter row length during 2006-07. During both the years of experimentation pest population was lower from December to February and remained confined on vegetative growth. The pest attained its peak i.e. 3.81 and 4.20 larvae per meter row length in 15th standard week (second week of April) during both the years of investigation. After second week of April, the population went on declining till harvest of the crop (last picking).

Table 1: Seasonal incidence of tomato fruit borer, *Helicoverpa armigera* Hub. during 2005-06.

Week No.	Rainfall (mm)	Temperature (^{0}C)		Relative Humidity (%)		No. of fruit borer larvae/m row length
		Max.	Min.	Max.	Min.	
45.	0.00	29.0	13.0	88	39	-
46.	0.00	29.1	13.0	75	30	-
47.	10.0	28.2	11.4	91	31	-
48.	0.00	28.8	12.9	91	37	-
49.	0.00	25.2	10.8	76	31	-
50.	0.00	24.4	07.4	91	34	0.12
51.	0.00	23.7	09.6	89	46	0.15
52.	0.00	26.6	08.9	90	49	0.16
01.	0.00	24.5	08.7	89	35	0.20
02.	0.00	22.4	07.5	82	34	0.31
03.	0.00	25.3	10.7	88	44	0.32
04.	0.00	18.8	07.7	86	45	0.33
05.	0.00	25.7	10.3	89	52	0.40
06.	0.00	26.7	11.5	89	58	0.41
07.	0.00	29.6	13.7	81	41	0.62
08.	0.00	27.7	15.6	76	38	0.63
09.	0.00	30.0	13.9	76	36	0.63
10.	15.7	29.7	16.7	81	54	0.75
11.	01.8	29.7	15.5	85	70	0.81
12.	0.00	35.0	14.5	58	28	1.00
13.	0.00	36.0	16.5	52	18	1.32
14.	0.00	39.5	20.0	67	16	2.45
15.	0.00	40.1	22.3	46	14	3.81
16.	01.6	36.0	21.1	58	25	2.54
17.	0.00	38.4	24.2	60	30	1.20

While considering the impact of environmental factors in regulating the pest population, it is evident from the table that rainfall (X_1) played a significant negative (r = -0.2979) role in the pest population build up during 2005-06 and non significant negative role in second year of study. However, maximum temperature (X_2) exhibited positive and significant (r = 0.7911 and 0.7477) impact in enhancing the larval population build up during both the years of experimentation. Likewise, minimum temperature (X_3) also exhibited positive and significant role (r = 0.7039 and 0.7196) in increasing the larval population of *Helicoverpa armigera*. As regards the impact of relative humidity (X_4), surprisingly it manifested statistically significant negative role during both the years of experimentation.

While accounting the impact of abiotic factors studied by the present author in combination with each other, it may be seen from the table that rainfall demonstrated a non significant negative association with maximum temperature in both the years of study. Likewise, minimum temperature also did not exhibit any significant role against this pest. However, it was positively

significant in association with relative humidity (r = 0.4389) in 2005-06 and positively non significant during next year. As regards the impact of maximum temperature with minimum temperature and relative humidity, it is amply documented from the table that there was positive and significant association (r = 0.9024 and 0.9492) with minimum temperature in increasing larval population of *H. armigera* during both the respective years of study. However, it was negatively correlated with relative humidity (table- 3). In the same way minimum temperature was also found significant and negatively correlated (r = -0.6547) with relative humidity in 2005-06 while it exhibited non significant association during next year in build up of pest population.

The appearance of fruit borer, *Helicoverpa armigera* larvae was recorded in 50th standard week during 2005-06 and 52nd standard week during the month of December 2006-07 (Table- 1 and .2). The initial population of *Helicoverpa armigera* was noted to a low ebbs i.e. 0.12 and 0.10 larvae per meter row length in 2005-06 and 2006-07, respectively. The population of the pest gradually increased and remained confined on vegetative growth as a leaf feeder but attained its peak in 15th standard week i.e. at the fruiting stage. Thereafter, the pest population declined. The present findings was found in full agreement with the findings of several earlier workers. Tahhan and Hariri (1982) and Yadav *et al.*, (1983) noted April month is a peak period of larval population of the pest which was found in conformity with the observations of present author. In this context Kay (1989) and Pandey *et al.*, (1997) also asserted the pest abundance during March to May and its peak in the month of April. Ravi and Verma (1997) reported the seasonal incidence of *Helicoverpa armigera* in chickpea by first week of January, which reached its peak in the middle of March. Thus, the earlier findings have been found in alignment with the present investigation. Fluctuations in peak period of the pest may be due to the variation in climate, sowing time, host plant, agronomical practices etc.

Table 2: Seasonal incidence of tomato fruit borer, *Helicoverpa armigera* Hub. during 2006-07.

Week No.	Rainfall (mm)	Temperature (^{0}C)		R.H. (%)		No. of fruit borer larvae/m row length
		Max.	Min.	Max.	Min.	
45.	0.00	30.8	16.4	86	43	-
46.	0.00	29.9	14.7	86	41	-
47.	0.00	28.5	14.4	79	39	-
48.	0.00	25.6	09.4	73	27	-
49.	0.00	28.3	11.4	79	34	-
50.	0.00	25.8	10.7	80	41	-
51.	0.00	25.1	10.1	92	46	-
52.	0.00	23.8	07.3	87	44	0.10
01.	0.00	22.3	05.8	79	34	0.11
02.	0.00	22.5	07.1	87	35	0.13
03.	0.00	23.6	07.0	73	30	014
04.	0.00	24.7	07.2	76	40	0.42
05.	0.00	27.9	12.1	80	37	0.43
06.	35.6	22.2	13.1	89	70	0.51
07.	30.6	23.1	12.1	81	55	0.59
08.	01.4	26.1	09.9	80	43	0.67
09.	32.2	26.2	13.0	80	50	0.67
10.	0.00	28.0	11.4	6 5	32	0.81
11.	38.2	26.3	15.2	77	58	0.82
12.	0.00	32.0	16.8	67	36	1.09
13.	0.00	35.7	16.7	60	28	1.39
14.	0.00	37.6	18.3	45	16	2.98
15.	0.00	37.1	22.1	56	28	4.20
16.	0.40	39.2	24.2	54	27	2.60
17.	02.8	40.3	24.4	53	28	1.32

As regards the impact of abiotic factors in regulating pest population, it is evident from present findings that rainfall had the negative role irrespective of the years of study. The maximum and minimum temperature exhibited significant and positive impact in pest population build up. However, relative humidity manifested significant negative role in enhancing the population of fruit borer. Considering the combined impact rainfall was not significant with maximum and minimum temperature but positive with relative humidity. Maximum temperature was positively correlated with minimum temperature but negative with relative humidity and similarly minimum temperature was also negatively correlated with relative humidity. Contrary to the present findings Meng *et al.*, (1962) reported that larval population of *Helicoverpa armigera* (Hubner) was positively affected by different magnitude of high rainfall with 80.00 per cent relative humidity was found conductive in population build up, off course, the crop was cotton raised in *Kharif* season. Whereas, the present author studied the effect of rainfall and relative humidity on this pest, infesting tomato crop in winter season.

Sharma and Chaudhari (1988) uphold the views of the present author who also found the impact of temperature positively associated with the population build up of *Helicoverpa armigera* on tomato crop. The findings of Devi *et al.*, (1991) also revealed that maximum temperature (25.9-27.5^{0}C) is conductive in enhancing the population of *Helicoverpa armigera*. Similarly, Sharma (1997) found that fruit borer was active throughout the year but its peak activity on tomato crop was April, as also recorded by the present author.

While considering the fruit infestation by *Helicoverpa armigera* it was found that the initiation of the fruit damage by this pest was found in first week of March, which progressively increased and reached its peak in

Table 3: Correlation matrix of *H. armigera* larvae and abiotic factors in tomato crop.

During 2005-06.					
Characters	**Larvae Y_1**	**Total rain fall X_1**	**Maximum temperature X_2**	**Minimum temperature X_3**	**Relative humidity X_4**
Y_1	1.0000	-0.2979**	0.7911	0.7039**	-0.8107**
X_1	-	1.0000	-0.2656	0.2183	0.4389**
X_2	-	-	1.0000	0.9024**	-0.8576**
X_3	-	-	-	1.0000	0.6547**
X_4	-	-	-	-	1.0000
During 2006-07					
Y_1	1.0000	-0.1290	0.7477**	0.7196**	-0.5655**
X_1	-	1.0000	-0.1446	-0.2685	0.1962
X_2	-	-	1.0000	0.9492**	-0.8305**
X_3	-	-	-	1.0000	0.7811
X_4	-	-	-	-	1.0000

* Significant at 5 per cent level, ** Significant at 1 per cent level.

second week of April during both the years of study. Thereafter, the fruit infestation was declined in the successive pickings. Similar results have also been obtained by Parihar and Singh (1986) who found significantly higher fruit infestation in the April than the fruits picked up in the month of March. As regards the impact of abiotic factors on fruit infestation, the impact was in the same pattern as observed in the case of population build up i.e. temperature played positive relation enhancing the relative humidity and rainfall had the negative association with the fruit infestation.

सारांश

हेलिकोवर्पा आर्मीजेरा का प्रथम रूप आदर्श सप्ताह 50 वाँ एवं 52 वां में अंकित किया था लेकिन वर्ष का निम्न एवं (0.12 एवं 0.10 डिम्ब प्रति मिटर पंक्ति) का अध्ययन था। प्रारम्भिक जनसंख्या वास्तव में वानस्पतिक वृद्धि के साथ बढ़ी एवं अवशेष स्थायी रहा बल्कि यह फल स्तर के दौरान तेजी से बढ़ा और 15 वे आदर्श सप्ताह (2 सप्ताह अप्रैल) में उच्च स्तर पर था। यहा कि विनाशकारी कीट संख्या ह्रास हुई। वर्षा सवं सम्बन्धीत नमी कीट की क्रिया के साथ नकारात्मक सम्बन्ध था। जहां की अधिकतम एवं न्यूनतम तापक्रम, सम्बिन्धीत नमी के साथ सकारात्मक सम्बन्ध था। इसी तरह, अधिकतम एवं न्यूनतम तापक्रम कीट की जनसंख्या अधिकतम सकारात्मक सम्बन्ध के साथ थी। अधिकतम तापक्रम हेलीकोवर्पा आर्मीजेरा के डिम्ब जनसंख्या के निर्माण में सम्बन्धित नमी के साथ नकारात्मक असर था।

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