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Influence of Environmental Factors on Population Fluctuation of Fruit Borer Infesting Chilli (*Capsicum annum* L.)

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ABSTRACT: In India, chilli fruit borer is a polyphagous pest that attacks a wide range of crops, including chillies. This pest is a major concern for agricultural practices in India and can cause substantial economic losses for farmers. The larvae of the chilli fruit borer feed on the flowers, buds, and developing fruit of chilli plants, leading to reduced yields and crop quality. Effectively addressing chili fruit borer infestations is a formidable task due to their rapid reproductive rate, capacity to develop resistance to pesticides, broad range of host plants, global distribution, and the intricate interplay of factors like temperature, humidity, and crop physiology that influence their population dynamics, so conduct a field experiment on population fluctuation of fruit borer (*Spodoptera litura* Fabricius) on chilli (*Capsicum annum* L.) crop was studied during October to March 2020-21, at experimental farm, Agricultural Research Station, Ummedganj, Kota (Rajasthan). The study revealed that the population of fruit borer (3.67 larvae/plant) was appeared after 13th week of transplanting of chilli seedling (3rd SMW). The fruit borer peak population (4.13 larvae/ plant) was observed in the 7th SMW (17th week after transplanting) when, maximum temperature, minimum temperature, morning relative humidity, evening relative humidity and rainfall (26.80°C, 10.30°C, 85.00 per cent ,63.00 per cent and 0.00 mm, respectively). Correlation of fruit borer larval population with weather parameters revealed that maximum temperature, minimum temperature, evening relative humidity and rainfall showed negatively correlated (r= -0.0212, -0.4538, -0.2887 and -0.2289, respectively), while, morning relative humidity was positively correlated (r= 0.0996).

Keywords: Chilli, Correlation, Fruit Borer, Peak, Population.

INTRODUCTION

Chilli (*Capsicum annuum* L.) belongs to the family Solanaceae is an important spice cum vegetable crop commonly used in Indian diet (Parvathi and Yurnus 2000). The two cultivated species (*Capsicum annum* L. and *Capsicum frutescens* L.; family Solanaceae) are raised in the tropics and subtropics with a temperature range of 20-25 °C considered as ideal. The therapeutic effect of chillies is due to capsaicin, protein, fixed oil, thiamine and ascorbic acid (Pawar *et al*., 2011). Chillies have high amount of iron, potassium and magnesium (Anonymous, 2013). Nutritionally, it is a rich source of vitamin A, B and C. India is the second largest producer of vegetables in the world (NHB, 2017). India is the largest producer as well as consumer of chilli in the world with the production of 44.17 lakh tonne and area is 4.18 lakh ha (Anonymous 2021). The major chilli growing states are Andhra Pradesh, Maharashtra, Karnataka, Tamilnadu and Rajasthan. A number of factors are responsible for low yield that include adverse climate, poor quality seeds, diseases, insect and mites significantly affects both the quality and production of chilli. The yield losses range from 50-90 % due to insect pests of chilli. Major insect pests of chilli in southern rajasthan include sap sucking pests, *viz*., thrips (*Scirthothrips dorsalis* Hood), aphids (*Aphis gossypii* Glover), mites (*Polyphagotarsonemus latus* Banks), whiteflies (*Bemisia tabaci* Genn) and the fruit borer (*Spodoptera litura* Fabricius). Among these insect pests' young larvae of fruit borer feed on flower buds and young fruits by making a circular hole at the base of the pedicel of chilli fruit resulting in premature dropping of flowers and fruits. In later stage, the larvae feed on seeds usually with its head inside the fruit and rest of the body outside. Due to variation in the agro climatic conditions of different regions insects show varying trends in their incidence also in nature and extent of damage to the crop. Besides, some known and unknown factors also play a key role in determining the incidence and dominance of a particular pest or pest complex. Hence a region-oriented study on seasonal incidence of fruit borer would give an idea about peak period of their activity and may be helpful in developing pest management strategies.

MATERIALS AND METHODS

Field experiment was conducted at Agricultural Research Station, Ummedganj-Kota, which falls under Agro-climatic Zone V (Humid South Eastern Plain Zone) of Rajasthan, which is situated at 12 Km away in Eastern part of Kota, altitude of 258 meter above mean sea level and at 25˚11′0″ N Latitude and 75˚50′0″ E Longitude. The region fall under Agro-climatic Zone V (Humid South Eastern Plain Zone) of Rajasthan. For raising seedling for experimentation, seeds of chilli variety "US611" were sown in well prepared nursery tray in first week of September, 2020 in the shed net house of Department of Horticulture, College of Agriculture, Ummedganj-Kota. Chilli variety "US 611" 43 days old seedlings were uprooted in the month of Oct. 2020 for transplanting in the field maintaining 60 cm row to row distance and 45 cm plant to plant spacing and all the agronomical practices *viz*., irrigation, fertilizer application and intercultural operations were followed as recommended for chilli crop in the package of practices to raise the crop. Observation on population of fruit borer was counted on randomly selected and tagged five plants in each plot at weekly intervals during morning hours between 7: 00 AM. to 8.30 AM. Damage and healthy fruits were counted separately from 5 tagged plants in each plot and mean of per plant was worked out. Mean number of major insect pest population was calculated and then after correlation was worked out with weather parameters. The weekly meteorological data on temperature, relative humidity and rain fall were recorded during the experimental period. Simple correlation was worked out between insect pest population and abiotic factors as per the Karl Pearson's coefficient of correlation formula (Steel and Torry 1980):

$$r_{xy} = \frac{\Sigma XY - \frac{\Sigma X \Sigma Y}{n}}{\sqrt{\left(\Sigma X^2 - \frac{(\Sigma X)^2}{n}\right)\left(\Sigma Y^2 - \frac{(\Sigma Y)^2}{n}\right)}}$$

Where,

r_{xy} = Simple correlation coefficient

X = Variable *i.e.* abiotic component.

(Average temperature, relative humidity and total rainfall)

Y = Variable *i.e.* mean number of insect pests per plant

n = Number of observations.

The correlation coefficient (r) values were subjected to the test of significance using t-test (Gupta *et al*, 2016)

$$t = \frac{r}{\sqrt{1 - r2}} \times \sqrt{n-2}$$

The calculated t-value obtained was compared with tabulated t-value at 5% level of significance.

RESULT AND DISCUSSION

The mean population of fruit borer (*S. litura*) and correlation with weather parameters is presented in Table 1 and Fig. 1. The fruit borer was observed throughout the crop growth period from third week of January to last week of March. Fruit borer population was gradually increased and reached it's peak (4.13 larvae/ plant) after 17th week of transplanting (7th SMW) and their after fruit borer population decrease and remained active up to 22nd weeks after transplanting (12th SMW) with mean population 1.67 fruit borer /3 leaves. During peak period maximum temperature, minimum temperature, morning relative humidity, evening relative humidity and rainfall (26.80, 10.30, 85.00 per cent, 63.00 per cent and 0.00 mm, respectively).

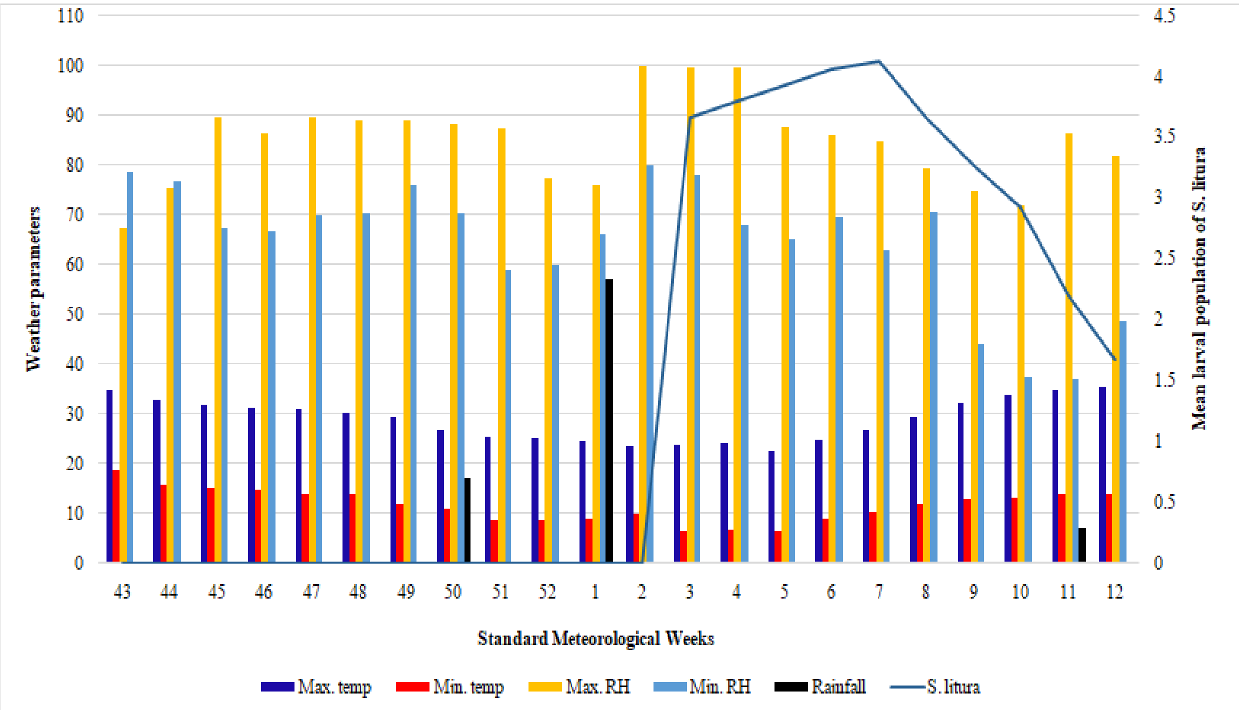

Fig. 1. Effect of abiotic factors on the incidence of fruit borer (*S. litura*) infesting chilli (*C. annum*) during *rabi* 2020-21.

Table 1: Effect of abiotic factors on the incidence of fruit borer (*S. litura*) infesting chilli (*C. annum*) during *rabi* 2020-21.

SMW (Duration)	Week after transplanting (Date of observation)	Temperature (°C)		Relative humidity (%)		Rainfall (mm)	*S. litura* (No. of larvae/ plants)
		Max.	Min.	Morning	Evening		
43rd (22 Oct – 28 Oct)	1st (23-Oct 2020)	34.74	18.64	67.57	78.71	0.00	0.00
44th (29 Oct – 04 Nov)	2nd (30-Oct 2020)	32.93	15.75	75.50	76.83	0.00	0.00
45th (05 Nov – 11 Nov)	3rd (6-Nov 2020)	31.96	15.30	89.57	67.29	0.00	0.00
46th (12 Nov – 18 Nov)	4th (13-Nov 2020)	31.39	14.86	86.43	66.71	0.00	0.00
47th (19 Nov – 25 Nov)	5th (20-Nov 2020)	30.81	14.00	89.71	70.00	0.00	0.00
48th (26 Nov – 02 Dec)	6th (27-Nov 2020)	30.46	13.71	89.00	70.29	0.00	0.00
49th (03 Dec – 09 Dec)	7th (4-Dec 2020)	29.24	12.00	89.00	76.14	0.00	0.00
50th (10 Dec – 16 Dec)	8th (11-Dec 2020)	26.67	10.86	88.29	70.43	17.00	0.00
51th (17 Dec – 23 Dec)	9th (18-Dec 2020)	25.60	8.71	87.43	59.14	0.00	0.00
52th (24 Dec – 31 Dec)	10th (25-Dec 2020)	25.10	8.63	77.38	60.00	0.00	0.00
1st (01 Jan – 07 Jan)	11th (1-Jan 2021)	24.60	9.00	76.00	66.00	57.00	0.00
2nd (08 Jan – 14 Jan)	12th (8-Jan 2021)	23.39	10.14	99.86	80.14	0.00	0.00
3rd (15 Jan – 21 Jan)	13th (15-Jan 2021)	23.89	6.36	99.71	78.00	0.00	3.67
4th (22 Jan – 28 Jan)	14th (22-Jan 2021)	24.24	6.64	99.57	68.14	0.00	3.80
5th (29 Jan – 04 Feb)	15th (29-Jan 2021)	22.60	6.50	87.70	65.30	0.00	3.93
6th (05 Feb – 11 Feb)	16th (5-Feb 2021)	24.70	9.00	86.00	69.60	0.00	4.07
7th (12 Feb – 18 Feb)	17th (12-Feb 2021)	26.80	10.30	85.00	63.00	0.00	4.13
8th (19 Feb – 25 Feb)	18th (19-Feb 2021)	29.40	12.00	79.40	70.70	0.00	3.67
9th (26 Feb – 04 Mar)	19th (26-Feb 2021)	32.40	13.00	74.70	44.30	0.00	3.27
10th (05 Mar – 11 Mar)	20th (5-Mar 2021)	34.00	13.10	72.00	37.40	0.00	2.93
11th (12 Mar – 18 Mar)	21st (12-Mar 2021)	34.70	14.00	86.60	37.00	7.00	2.20
12th (19 Mar – 25 Mar)	22th (19-Mar 2021)	35.50	14.00	82.00	48.60	0.00	1.67
Correlation							
Max. Temp.(°C)							**-0.2120**
Min. Temp.(°C)							**-0.4538**
Morning R.H. (%)							**0.0996**
Evening R.H. (%)							**-0.2887**
Rainfall (mm)							**-0.228**

SMW: Standard Meteorological Week

Correlation of fruit borer larval population with weather parameters revealed that maximum temperature, minimum temperature, evening relative humidity and rainfall showed negatively correlated (r= -0.0212, -0.4538, -0.2887 and -0.2289, respectively). While, morning relative humidity was positively correlated (r= 0.0996). The present investigation is supported by Pathipati *et al*. (2014) exhibited significant negative correlation between infestation of *S. litura* and maximum temperature, minimum temperature and rainfall and significantly positive correlated with morning relative humidity. The present results of correlation study supported with the findings of Meena *et al*. (2017) fruit borer population exhibited negative correlation with minimum temperature, minimum relative humidity and average rainfall. Rajput *et al*. (2017) also found that the significant negative correlation between fruit borer population and evening relative humidity. Saini *et al.* (2017) supported the present results of correlation study with the observation showed that the larval population was negative correlation with rainfall.

CONCLUSIONS

The incidence of fruit borer (*S. litura*) was commenced in the 3rd week of January (3rd SMW) and touched it's peak (4.13 larvae/plant) in the 2nd week of February (7th SMW). Correlation of fruit borer larval population with weather parameters revealed that maximum temperature, minimum temperature, evening relative humidity and rainfall showed negatively correlated.

FUTURE SCOPE

The fruit borer stands out as a significant threat to chili plants. Effectively managing this pest requires comprehensive insights into its occurrences across different phenological stages of the crop. The data collected on pest incidence and its connection with weather conditions in this current study serves as a valuable resource for constructing a crop-pest ecological model. This model can be utilized to predict pest incidence ahead of time, enabling farmers to take timely action against the pest based on forewarnings, thus ensuring the implementation of necessary measures for effective pest control.

Author contributions. Conceived and designed the analysis (HPM & BKP); Collected the data (LSS & MSM); Contributed data or analysis tools (HPM, BKP & LSS); Performed the analysis (LSS & HPM); Wrote the paper (LSS).

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Conflict of interest. None.

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