International Journal of Ecology and Environmental Sciences
www.ecologyjournal.in
Online ISSN: 2664-7133; Print ISSN: 2664-7125; Impact Factor: RJIF 5.28
Received: 20-09-2020; Accepted: 30-09-2020; Published: 25-10-2020
Volume 2; Issue 4; 2020; Page No. 312-315

Seasonal incidence of lepidopteran pests in French bean (*Phaseolus vulgaris* L.)

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Abstract
Seasonal incidence of lepidopteran pests in French bean was studied at Krishi Vgyana Kendra farm, University of Agricultural and Horticultural Sciences, Shivamogga. During *Kharif*, the bean pod borer, *Maruca vitrata* and lablab leaf webber, *Omoides indicata* was commenced from the first week of September (36th MSW) and second week of August (32nd MSW), respectively. The lowest population of *M. vitrata* was recorded in first week of September *i.e.*, 1.20 larvae per plant (36th MSW) and highest was recorded in the last week of September (39th MSW) with 2.30 larvae per plan and showed a significant negative correlation with the minimum relative humidity (r = -0.690), whereas *O. indicata* population was minimum (0.80) in the second week of August and maximum (1.52) in the last week of September (39th MSW), however a significant positive effect of maximum temperature was found on the population of *O. indicata*. During *Rabi, M. vitrata* incidence started from first week of January (1st MSW) and continued till January last week (5th MSW) and *O. indicata* was first observed during the December second week (50th MSW). The lowest and highest population of bean pod borer was 0.35 larvae per plant noticed in January first week (36th MSW) and 1.89 larvae per plant in the third week (3rd MSW), respectively and these population had significant negative correlation with minimum relative humidity (r = -0.732). The minimum and maximum population of *O. indicata* was 0.20 and 1.40 larvae per plant recorded in the second week of December (50th MSW) and last week of January (5th MSW), respectively and got significant positive effect from maximum temperature (r = 0.794). The remaining weather parameters showed non-significant relationship with lepidopteran pest population during both *Kharif* and *Rabi* 2019-20.

Keywords: french bean, *maruca vitrata, omooides indicata,* weather parameters

1. Introduction
French bean (*Phaseolus vulgaris* L.) is an important and highly profitable vegetable and pulse crop in India, belongs to leguminosae family. French bean originated in Mesoamerica (Bitocchi *et al*., 2012) [1]. It is also known as common bean, kidney bean, haricot bean, salad bean, snap bean, rajmah and string bean. The genus *Phaseolus* is large, including approximately 80 cultivated and wild species, but *P. vulgaris* is the most widely cultivated species.

The cultivation of French bean was started 7000 years ago by the Indian tribes settled in Tehuacan Valley of Mexico and in Callejon de Huaylas, Peru. When Christopher Columbus returned from his second voyage to the New World in the year 1493, he brought French beans with him to the Mediterranean region. French beans were considered to be rare to find and expensive but soon became one of the commonly used beans in the 19th century. In France, French beans were introduced in the year 1597 by the Conquistadors.

French bean is grown extensively because of its short duration and for nutritional values. It is a good source of protein, calcium, phosphorus, iron, carotene, thiamine, riboflavin and vitamin A and C (Karasu and Oz, 2010) [5]. In India, it is grown for tender vegetables, shelled green beans and dry beans. It occupies an important position among various *Kharif* pulses and vegetable crops grown in India at an altitude ranging from 700 m to 2500 m. Benefits of French beans are, cures frequent urination, improves intestinal absorption, eyesight, bone structure and good for osteoporosis, good diet for jaundice and diabetes patients, reduces the severity of asthma, reducing and preventing inflammation of the joints in case of rheumatoid arthritis, aids in preventing colon cancer, constipation and lowering high cholesterol.

French bean is grown mainly in the states of Jharkhand, Karnataka, Andhra Pradesh, Maharashtra, Tamil Nadu, Odisha, Bihar, Nagaland, Meghalaya, Sikkim, Mizoram, Jammu and Kashmir, Himachal Pradesh and West Bengal (Rinkikumari and Shukla, 2017) [12]. In Karanataka French bean is being grown in Chikkamagaluru, Hassan and Shivamogga.

In India, the average production and productivity of French bean were 6.75 lakh tonnes and 27.94 t/ha, respectively in an Area of 2.42 ha. In the world, the production and productivity were 242.21 tonnes and 153.30 t/ha, respectively in an area of 15.80 lakh ha (FAOSTAT, 2018) [2].

Leguminous plant species are susceptible to many biotic stresses, insect pests and diseases. Pest and disease problems are the major constraints to agricultural productivity of the common bean, particularly in the tropics (Graham and Vance, 2003) [4].

Worldwide, yield losses due to insect pests alone have been estimated to the tune of 35 per cent to 100 per cent annually (Singh and Schwartz, 2011) [14]. In India, the French bean productivity is low mainly due to attack of insect pests and diseases. The insect pest like legume pod borer, *Maruca vitrata* cause considerable economic damage (Nderitu *et al*., 2007) and (Oyewale and Bamaiyi, 2013) [9, 10]. To know the population fluctuation of lepidopteran pests like *Omoides indicata* and *Maruca vitrata* in French bean the present work was conducted for two seasons in 2019-2020.

2. Materials and methods

The present investigation on 'Seasonal incidence of lepidopteran pests in french bean (*Phaseolus vulgaris* L.)' was carried out under field condition at Krishi Vigyana Kendra (KVK) farm, University of Agricultural and Horticultural Sciences (UAHS), Shivamogga during 2019-20.

Krishi Vigyan Kendra (KVK), Shivamogga lies between at 75°51 E longitude and 13°42 N altitude of 695 meters above the mean sea level. It lies in the Southern Transitional Zone (STZ-VII) of Karnataka. The places lying in and around receive an average annual rainfall of about 829 mm from Southwest and Northwest monsoons distributed well over the season.

The *Omoides indicata* and *Maruca vitrata* larvae were collected from ten randomly selected plants and recorded their incidence at weekly intervals on French bean at KVK farm, Shivamogga during *Kharif* and *Rabi* seasons of 2019-20 in an area of about 121 m^2. Throughout the study period, the insects were properly collected, killed and pinned properly on their thoracic region. The population of these pests were correlated with weather parameters.

3. Results and discussion

3.1 *Kharif* 2019

3.1.1 Bean pod borer, *Maruca vitrata*

The bean pod borer, *M. vitrata* was commenced from the first week of September and the lowest population was recorded in the first week of September *i.e.*, 1.20 larvae per plant (36th MSW) and the highest was recorded in the last week of September (39th MSW) with 2.30 larvae per plant. The mean number of bean pod borer larvae per plant was 0.50±0.85 (Table 5). The correlation coefficient indicated that there was a significant negative correlation observed in the minimum relative humidity (r = -0.690) and statistically found a non-significant negative correlation with the rainfall (r = -0.183) and maximum relative humidity (r = -0.477). The maximum and minimum temperature showed a non-significant positive correlation with the correlation coefficient (r) of 0.620 and 0.570, respectively (Table 6). The regression equation of $Y= -44.457+0.000X_1-0.195X_2+2.572X_3+0.070X_4-0.120X_5$ was obtained by subjecting the data into multiple linear regression analysis. Whereas X_1, X_2, X_3, X_4 and X_5 were rainfall, maximum temperature, minimum temperature, minimum relative and maximum relative humidity, respectively. The coefficient of determination (R^2) was 45.10 per cent, this much of influence was noticed from the weather parameters (Table 6). The above-mentioned result was similar with the records of Singh and Singh (2014), Yadav and Singh (2015) Yadav *et al*. (2015) and Reddy *et al*. (2017). [11, 13, 16, 17].

3.1.2 Lablab leaf webber, *Omoides indicata*

The incidence of lablab leaf webber, *O. indicata* was first seen during the second week of August (32nd MSW) till the harvesting of beans with the population ranged from 0.80 to 1.52 larvae per plant. The population was minimum (0.80) in the second week of August and maximum (1.52) in the last week of September (39th MSW). The mean number was 0.65 ± 0.51 larvae per plant (Table 5). The significant positive effect of maximum temperature was found on the population of lablab leaf webber which was 0.701 but found a non-significant positive effect of minimum temperature (r = 0.449) and rainfall (r = 0.011) on pest population. The minimum and maximum relative humidity had a non-significant negative influence on pest population with the 'r' value of -0.362 and -0.513, respectively (Table 6). There was 79.80 per cent of influence of weather parameters on the lablab leaf webber population with the regression equation of $Y= -28.098 + 0.004X_1 + 0.571X_2 -0.123X_3 + 0.143X_4 + 0.029X_5$ (Table 6). The present result was in conformity with that of Meena *et al.* (2018) and Favatti *et al.* (2018) [7, 3]. They reported *O. indicata* population was started in the month of August and peak population observed in the month of September month and significant positive correlation was observed with the temperature.

Table 5: Seasonal incidence of lepidopteran pests in French bea during *Kharif* and *Rabi* 2019-20

Time			Larvae per plat	
Seasons	**Months**	**MSW**	***Maruca vitrata***	***Omoides indicata***
Kharif 2019	July	30	0.00	0.00
	August	31	0.00	0.00
		32	0.00	0.80
		33	0.00	1.20
		34	0.00	0.60
		35	0.00	0.40
	September	36	1.20	0.20
		37	0.00	0.80
		38	1.50	1.00
		39	2.30	1.52
Mean±SD			0.50±0.85	0.65±0.51
Rabi 2019-20	November	48	0.00	0.00
	December	49	0.00	0.00
		50	0.00	0.20
		51	0.00	0.40
		52	0.00	1.00
	January	1	0.74	0.80
		2	0.86	0.60
		3	1.89	0.80
		4	0.67	0.40
		5	0.35	1.40
Mean±SD			0.45±0.61	0.56±0.45

Note: MSW; Mean Standard Week

3.2 *Rabi* 2019-20

3.2.1 Bean pod borer, *Maruca vitrata*

Commencement of the bean pod borer, *M. vitrata* was started from the first week of January (1st MSW) and continued till January last week (5th MSW). The lowest and highest population of bean pod borer was 0.35 larvae per plant noticed in January first week (36th MSW) and 1.89 larvae per plant in the third week (3rd MSW), respectively. The mean number of bean pod borer larvae per plant was 0.45±0.61 (Table 5). The correlation coefficient indicated that the significant negative correlation was observed between the minimum relative humidity (r = -0.732) and the number of larvae per plant. Statistically, non-significant negative correlation was obtained with the rainfall (r = -0.269), minimum temperature (r = -0.583) and maximum relative humidity (r = -0.438). The non-significant positive correlation was found between bean pod borer population and maximum temperature (r = -0.580) (Table 6). The regression equation of $Y= 20.267-0.119X_1-0.735X_2+0.666X_3+0.009X_4-0.152X_5$ was obtained when data subjected to the multiple linear regression analysis. The coefficient of determination (R^2) was 63.20 per cent

of influence was noticed from the weather parameters on bean pod borer population (Table 6). The present findings were in support with the reports of the Kishor *et al.* (2019), Yadav *et al.* (2015), and Naik (2014) [6, 15, 17, 8].

3.2.2 Lablab leaf webber, *Omoides indicata*

The lablab leaf webber, *O. indicata* was first observed during the December second week (50th MSW) with the range of population was from 0.20 to 1.40 larvae per plant. The minimum and maximum population of 0.20 and 1.40 larvae per plant recorded in the second week of December (50th MSW) and last week of January (5th MSW), respectively. There was 0.56±0.45 mean number of lablab leaf webber larvae recorded per plant (Table 5). The correlation coefficient between weather parameters and population of lablab leaf webber was obtained and indicated that the significant positive correlation between the pest density and the maximum temperature (r = 0.794) at 1 per cent level of significance and the non-significant positive correlation was obtained with maximum relative humidity (r = 0.207). Statistically, the rainfall (r = -0.425), minimum temperature (r = -0.379) and the minimum relative humidity (r = -0.617) were correlated negatively non-significant with bean pod borer population (Table 6). The regression equation was $Y= -5.465-0.044X_1-0.026X_2+0.372X_3+0.053X_4-0.070X_5$ obtained through the multiple linear regression analysis.

The coefficient of determination (R^2) was 83.70 per cent of influence was noticed from the weather parameters on lablab leaf webber population (Table 6) and these results were in line with the findings of Sonune *et al.* (2010) and Favatti *et al.* (2018) [15, 3].

Table 6: Correlation coefficient (r), Co-efficient of determination (R^2) and regression equation between different insect pests and mites on French bean with weather parameters during *Kharif* and *Rabi* 2019-20 under field condition

Pests	Correlation coefficient (r) Meteorological parameters					R^2	Regression Equation
	Rainfall (mm)	Temperature (^{0}C)		Relative humidity (%)			
	(X_1)	Max (X_2)	Min (X_3)	I (X_4)	II (X_5)		
Kharif 2019							
Maruca vitrata	-0.183	0.620	0.570	-0.477	-0.690*	0.451	$Y=-44.457+0.000X_1-0.195X_2+2.572X_3+0.070X_4-0.120X_5$
Omoides indicata	0.011	0.701*	0.449	-0.362	-0.513	0.798	$Y= -28.098+0.004X_1+0.571X_2-0.123X_3+0.143X_4+0.029X_5$
Rabi 2019-20							
Maruca vitrata	-0.269	0.580	-0.583	-0.438	-0.732*	0.632	$Y= 20.267-0.119X_1-0.735X_2+0.666X_3+0.009X_4-0.152X_5$
Omoides indicata	-0.425	0.794**	-0.379	0.207	-0.617	0.837	$Y= -5.465-0.044X_1-0.026X_2+0.372X_3+0.053X_4-0.070X_5$

R2: Co-efficient of determination; n=10 *Correlation is Significant at the 0.05 level; ** Correlation is Significant at the 0.01 level X1= Rainfall, X2= Maximum temperature, X3= Minimum temperature, X4= Maximum relative humidity, X5= Minimum relative humidity.

4. Acknowledgment

This study was carried out with the support of the Department of Agricultural Entomology, University of Agricultural and Horticultural Sciences, Shivamogga for providing laboratory and Krishi Vigyana Kendra, Shivamogga for providing field for the study. We thank the Department, as well as all those who have contributed to it.

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