Original Research Article

Relative abundance of Insect Pests on French bean(*Phaseolusvulgaris* L.) in relation to abiotic factors

ABSTRACT

The present investigation was carried out during *Rabi* 2021-22. The incidence of insect pests like aphid, whitefly, Jassid, leaf miner, pod borer was initiated after sowing till harvesting. The highest incidence of Jassid was observed on French bean crop at 9th SMW (7.20 per cage) and lowest 1st SMW (0.30 per cage), Aphid 8thSMW (45.20 aphids per 10cm terminal shoot) and 52thSMW (2.60 aphids per 10cm terminal shoot). The highest incidence of whitefly observed in 8th SMW (20.70 per cage) and lowest 2nd SMW (0.60 per cage).The highest incidence of Leaf miner was recorded in 11th SMW (40.50% leaf damage) and lowest in 51th SMW (1.50% leaf damage). The highest incidence of pod borer was noticed in 9th SMW (8.70 larvae per plant) and lowest in 1st SMW (0.30 larvae per plant). The Jassid population showed highly significant positive correlation with sunshine and positive significant correlation with maximum temperature and positive non-significant correlation with minimum temperature whereas, significant negative correlation with rainfall and negative non-significant correlation with relative humidity. The aphid population showed highly significant positive correlation with sunshine and positive non-significant correlation with minimum and maximum temperature. The whitefly population showed highly significant positive correlation with sunshine and positive non-significant correlation with minimum and maximum temperature. The leaf miner population showed positive highly significant correlation with minimum and maximum temperature and significant positive correlation with relative humidity. The pod borer population showed highly significant correlation with maximum temperature and sunshine.

Comment [UW1]: Make a short conclusion Knowledge of the impact of abiotic factors on the main insect can help in pest management.

Keywords:*French bean, Jassid, Aphid, Whitefly, Leaf miner, Pod borer.*

1. INTRODUCTION

The Leguminosae family includes the French bean (*Phaseolus vulgaris* L.), a significant and extremely lucrative vegetable and pulse crop in India. Mesoamerica was the origin place of the French bean (Bitocchi*et al.*, 2012) [1]. Rajmah, common bean, kidney bean, haricot bean, salad bean, snap bean, and string bean are some other names for *P. vulgaris.* There are about 80 cultivated and wild species in the huge genus *Phaseolus*, but *P. vulgaris* is the one that is most frequently cultivated.French bean is widely grown in India due to the short duration and nutritional benefits. The crop has been introduced in northern plains during *Rabi* season also. Considering the nutritive value, 100g of green pod contains 1.70g protein, 0.10g fat, 4.5g carbohydrate, 1.80g fiber and is also rich in minerals and vitamins. It contains calcium (50 mg), phosphorous (28.00 mg), iron (1.70 mg), carotene (132.00 mg), thiamine (0.08 mg), riboflavin (0.06 mg) and vitamin C (24.0 mg) per 100 g of edible part. Additionally, it has some medical qualities that are helpful in managing diabetes and some

heart issues, and it is a wonderful all-natural treatment for bladder burn. It is both carminative and reparative in its effects on diarrhea and constipation (Duke, 1981) [2].

Jharkhand, Karnataka, Andhra Pradesh, Maharashtra, Tamil Nadu, Odisha, Bihar, Nagaland, Meghalaya, Sikkim, Mizoram, Jammu and Kashmir, Himachal Pradesh, and West Bengal are the principal states where French beans are grown. (RinkiKumari and Shukla, 2017). In Karnataka French bean is being grown in Chikkamagaluru, Hassan and Shivamogga. In hilly region, it is grown during *Kharif*and in lower hill region, sown as spring crop. In north-east plains and hilly tracts of Maharashtra, it is cultivated during *Rabi*. It is highly sensitive to frost and water logging. The average French bean production and productivity in India was 6.75 lakh tonnes and 27.94 t/ha, respectively, on an area of 2.42 lakh ha. On a surface of 15.80 lakh ha, the global production and productivity were 242.21 tonnes and 153.30 t/ha, respectively (FAOSTAT, 2018) [3].

Leguminous plant species are susceptible to a wide range of biotic stressors, pest insects, and diseases. The French bean's agricultural output is severely hampered by pest and disease issues, especially in the tropics (Graham and Vance, 2003) [4]. In India, disease and insect infestation are the main causes of low productivity in the French bean cropThe French bean crop has been affected by reports of over 37 different insect pest species (Mondal*et al.* 2018) [5]. Among them several serious insect pests attack the French bean of which aphids (*Aphis craccivora*), leafhopper (*Amrascabiguttulabiguttula*), whitefly (*Bemisiatabaci*), and thrips (*Caliothripsindicus*) (Sahu*et al*., 2021; Anonymous, 2015)[6] [7] and foliage feeders viz., serpentine leaf miner (*Liriomyzatrifolli*) and bean stem fly (*Ophiomyia* spp.) are the major insect pests. The spotted pod borer (*Marucavitrata*) and red spider mite (*Tetranychus* spp.) are other pests that attack French beans (Nderitu*et al.,* 2007) [8]. In addition to causing direct damage by feeding the sap suckers are the vectors of viral diseases in French bean. Whitefly act as a vector for more than 100 plant viruses, which cause disease to many commercial crops in different parts of the world (Jones *et al.,* 2003) [9]. Which adversely influence the quality and quantity of yield (Oyewale and Bamaiyi, 2013; Kataria and Kumar, 2016) [10] [11]. Considering above facts, the present study was conducted to find out Relative abundance of Insect Pests on French bean in relation to abiotic factors.

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2. MATERIAL AND METHODS

The Monitoring Seasonal incidence of Insect pest of French bean was conducted at Student's Instructional Farm (SIF), Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India during *Rabi*, 2021-22 on French bean Variety Chitra. The plot size kept 6 × 6 m with field border 1.0m and line to line spacing kept 30 cm and plant to plant spacing kept 10 cm.

The population build-up of insect pest was recorded from 10 randomly selected plants and the numbers of Insect plant present was the counted at weekly intervals on a Standard Meteorological weekly basis from the appearance of insects till the harvesting.

"Direct visual counting method" was adopted for the estimation of the population of whitefly and jassids by using rectangular split cage. The incidence of leaf miner was recorded by counting total number of leaves and damaged leaves by leaf minerTotal number of larvae present on per plant was counted to estimate the population of pod borer. Total10 plants were randomly selected to observe the incidence insect pests. The observations were noted at weekly intervals during morning hours between 6.00 AM to 7.30 AM.

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3. RESULTS AND DISCUSSION

Relative abundance of Insect Pests in French bean

Jassid (*A. biguttulabiguttula*)

The incidence of Jassid was seen first time during 51th SMW (0.80Jassid per cage). The peak population was observed at 9th SMW (7.20 Jassid per cage)during this period temperature maximum and minimum ranged from (27.10°C and 11.40°C). Whereas, the relative humidity (morning) was also maximum (79.60%) and no rainfall, and sunshine (9.0 hrs). Though, the minimum population was recorded at 1stSMW (0.30 jassid per cage), during *Rabi* season, 2021-22.The present findings are in accordance to Sahoo and Giraddi (2021) [12] who found that the peak population leafhopper was observed from vegetative to flowering stage. The present findings are similar to Singh and Yadav (2013) [13] who found the mean population of jassids 0.4-5.80/cage and 0.20-7.40/cage, respectively. Incidence of the jassids and whiteflies started in 50th standard week with 0.40/cage and 0.20/cage, respectively.

Aphid (*Aphis craccivora*)

The mean population of aphid (*A. craccivora)* was observed at first time on 51th SMW during *Rabi*, 2021-22. The mean population of *A. craccivora*showed its peak (45.20 per 10 cm terminal shoot) during 8th SMW.The results are in conformity with Kishor*et al.* (2017) [14] who found that the incidence of aphid (*Aphis craccivora*) started from 53rd Meteorological Standard Week (MSW) (23.80 aphid/10 cm apical twigs). The aphid population gradually increased and reached its peak (35.40 aphids/10cm apical twigs) on 7thMSW (22ndFebruary) and thereafter its population gradually decreased from 8thMSW on 4thweek of February (31.30 aphids/10 cm apical twigs) to 12thMSW (4thweek of March) (9.0 aphids/10cm apical twigs).

Whitefly (*Bemisiatabaci*)

The Population of whitefly (*B. tabaci*) was recorded at first time on 51thSMW during *Rabi*, 2021-22. The highest incidence (7.20per cage) of whitefly was recorded at 8th Standard Meteorological Week.These findings are similar to Rani *et al*. (2016) [15] who found that the incidence of whitefly, *Bemisiatabaci* (Gennadius) population was noticed from the second week of November to second week of December during first season with peak incidence during the third week of November and a mean population of 0.12 per leaf. Whereas during second season, its population was noticed from second week of February to second week of March with peak incidence during the last week of February and a mean population of 0.28 per leaf.

Leaf miner (***Liriomyzatrifolii*)**

The mean population of serpentine leaf miner (*L. trifolii*) was observed at first time at 45thSMW. The highest attack (40.50%leaf miner damage) of leafminer damage was observed at Standard Meteorological Week number 11thduring *Rabi* season 2021-22.The present findings are in accordance to Sahoo and Giraddi(2021) [16] who found that the peak of leaf miner was observed from vegetative to maturity stage. The present findings are in conformity with Khaliq*et al.* (2022) [17] who found that first appearance being during the 49th standard meteorological week (SMW) 0.95 miners/leaf which reached its peak (11.00 miners/leaf) during the 4th SMW reached to minimum (1.26 miners/leaf) during the 12th SMW. These findings are similar to Mahesh *et al.* (2016) [18] reported that the

population of leaf miner appeared on the crop from seedling stage till pod maturation (15-70 days after sowing) and the maximum number of insect pests infested the crop during vegetative and flowering stage.

Pod borer (*Helicoverpaarmigera*)

The Incidence of pod borer (*H. armigera*) was recorded at first time on 1stSMW during *Rabi* season 2021-22. The highest population (8.70 larvae per plant) of pod borer was recorded at 9th Standard Meteorological Week.The results are similar to Jakkaray *et.al* (2020) [19] who found that the pod borer incidence started from the first week of January (1stMSW) and continued till January last week (5thMSW). The lowest and highest population of bean pod borer was 0.35 larvae per plant noticed in January first week and 1.89 larvae per plant in the third week (3rdMSW), respectively.

Effect of abiotic factors on relative abundance of insect pests in French bean

The correlation between incidence of major insect pest and abiotic factors viz., maximum temperature (°C), minimum temperature (°C), relative humidity (%) and rainfall (mm), and sunshine (hrs.) have been described under this section.

Jassid (*A. biguttulabiguttula*)

The incidence of Jassid had positive non-significant and positive significant correlation with minimum & maximum temperature, respectively (=0.489 and =0.645*) whereas, nonsignificant negative correlation was observed with relative humidity (=-0.488). The rainfall showed significant negative correlation (=-0.645*), whereas sunshine had highly significant positive correlation (=0.856**) during *Rabi* season 2021-22.The present findings are similar with Kumar et al. (2020) found that that jassid population had positive and highly significant correlation with maximum temperature while minimum temperature. The present study is in conjunction with the findings of Anandmurthy*et al.* (2018) [20] revealed that maximum temperature showed a significant positive correlation with jassid population in summer cowpea.

Aphids (*A. craccivora*)

The incidence of aphids had positive non-significant correlation with temperature (minimum and maximum) (=0.363 and =0.437, respectively)whereas, non-significant negative correlation with relative humidity (=-0.328), rainfall had highly significant negative correlation (=-0.697**), while sunshine had highly significant positive correlation (=0.765**) during Rabi season 2021-22.The present findings are similar with Katria*et al.* (2017)[21] the population was showing positive with high temperature. The present findings are also similar with Chandra *et al.* (2010) [22] who found that aphids were non-significant positive correlation with maximum temperature and significant negative with rainfall during both the years in French bean crop.

Whitefly (*B. tabaci*)

The observed incidence of whitefly had non-significant positive correlation with temperature (minimum and maximum) (=0.430 and =0.539, respectively) whereas, nonsignificant negative correlation with relative humidity (=-0.506), significant negative correlation (=-0.624*)with rainfall, highly significant positive correlation (=0.811**)with sunshine during Rabi season 2021-22.The Similar work had been reported by Ghosh (2014) [23] who reported that maximum temperature and minimum relative humidity showednonsignificant positive

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correlation with whitefly population. The present findings are similar with Singh *et al.* (2019) [24] who revealed that the whitefly, *B. tabaci* population with maximum temperature significant positive correlation (r = 0.764) but minimum temperature, relative humidity and rainfall revealed negative correlation.

Leaf miner (*L. trifolli*)

The incidence of leaf miner showed positive highly significant correlation with temperature (minimum and maximum) (=0.802** and =0.880**), respectively whereas, significant positive correlation with relative humidity (=0.582*), significant negative correlation (=-0.597*) with rainfall, highly significant positive correlation (=0.875**) with sunshine during Rabi season 2021-22. The present findings are similar with Mazumdar*et al.* (2015) [25] found that in French bean and Cowpea there was significantly positive relation of temperature, whereas wind speed showed negative relation to Agromyzid infestation on cultivated crops.

Pod borer (*H. armigera*)

The pod borer incidence had positive non-significant and highly significant correlation with temperature (minimum and maximum) (=0.570 and =0.691**, respectively) whereas, nonsignificant negative correlation with relative humidity (-0.489), highly significant negative correlation (=-0.628**) with rainfall, highly significant positive correlation (=0.847**)with sunshine during *Rabi* season 2021-22.The present findings are partially similar of the Tamang*et al.* (2017) [26] who found that Pod borer population exhibited highly significant positive correlation with minimum temperature.

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Table1:Incidence of pest spectra on French bean under the influence of weather factors during *Rabi* 2021-22

SMW	Date	Temperature(ºC)		Rainfall (mm)	Relative humidity (%)	Sun shine (hrs.)	Jassids /Cage	Aphids/10 cm terminal shoot	White fly/ Cage	Leaf miner damage (%)	Larval pop. of pod borer/ plant
		Min.	Max.								
51	17-23 Dec 2021	5.90	21.60	0.00	77.30	5.00	0.80	5.80	2.60	1.50	0.00
52	24-31 Dec 2021	9.40	20.90	15.00	81.50	2.60	0.50	2.60	1.50	2.70	0.00
1	1-7 Jan 2022	9.30	19.40	14.20	82.50	2.60	0.30	3.50	0.90	5.20	0.30
2	08-14 Jan 2022	10.60	20.20	11.60	87.50	2.20	0.40	4.20	0.60	4.70	0.70
3	15-21 Jan 2022	5.70	15.90	0.00	86.75	2.00	1.20	15.90	4.30	8.20	1.80
4	22-28 Jan 2022	8.30	17.30	8.80	87.45	2.90	0.90	9.50	1.20	10.70	0.90
5	29Jan-04Feb 2022	8.90	19.60	3.00	86.70	4.90	1.00	17.50	2.60	12.30	1.20
6	05-11 Feb 2022	8.20	20.60	0.00	86.35	4.90	3.80	28.00	8.50	14.50	3.50
7	12-18 Feb 2022	9.90	24.00	0.00	80.40	8.30	4.20	39.50	16.20	21.50	4.30
8	19-25 Feb 2022	13.50	25.60	0.00	77.70	8.10	5.50	45.20	20.70	28.70	6.50
9	26 Feb -5 Mar 2022	11.40	27.10	0.00	79.60	9.00	7.20	30.50	15.60	35.30	8.70
10	05-11Mar 2022	12.50	29.10	0.00	77.30	7.80	4.40	25.20	10.70	38.20	6.30
11	12-18 Mar 2022	16.20	32.00	0.00	77.10	8.30	2.70	15.30	5.20	40.50	3.70

SMW= Standard Meteorological Weeks

Table 2: Role of abiotic factors on incidence on pest spectra in French bean during *Rabi* 2021-22

Insect Pests	Weather Parameters				
	Temperature(C)		Rainfall (mm)	Relative Humidity (%)	Sunshine (hrs.)
	Min.	Max.			
Jassid	0.489	0.645*	-0.645*	-0.488	0.856**
Aphid	0.363	0.437	-0.697**	-0.328	0.765**
Whitefly	0.430	0.539	-0.624*	-0.506	0.811**
Pod borer	0.802**	0.880**	-0.597*	0.582*	0.875**

***Correlation is significant at the 0.05 level, **Correlation is significant at the 0.01 level.**

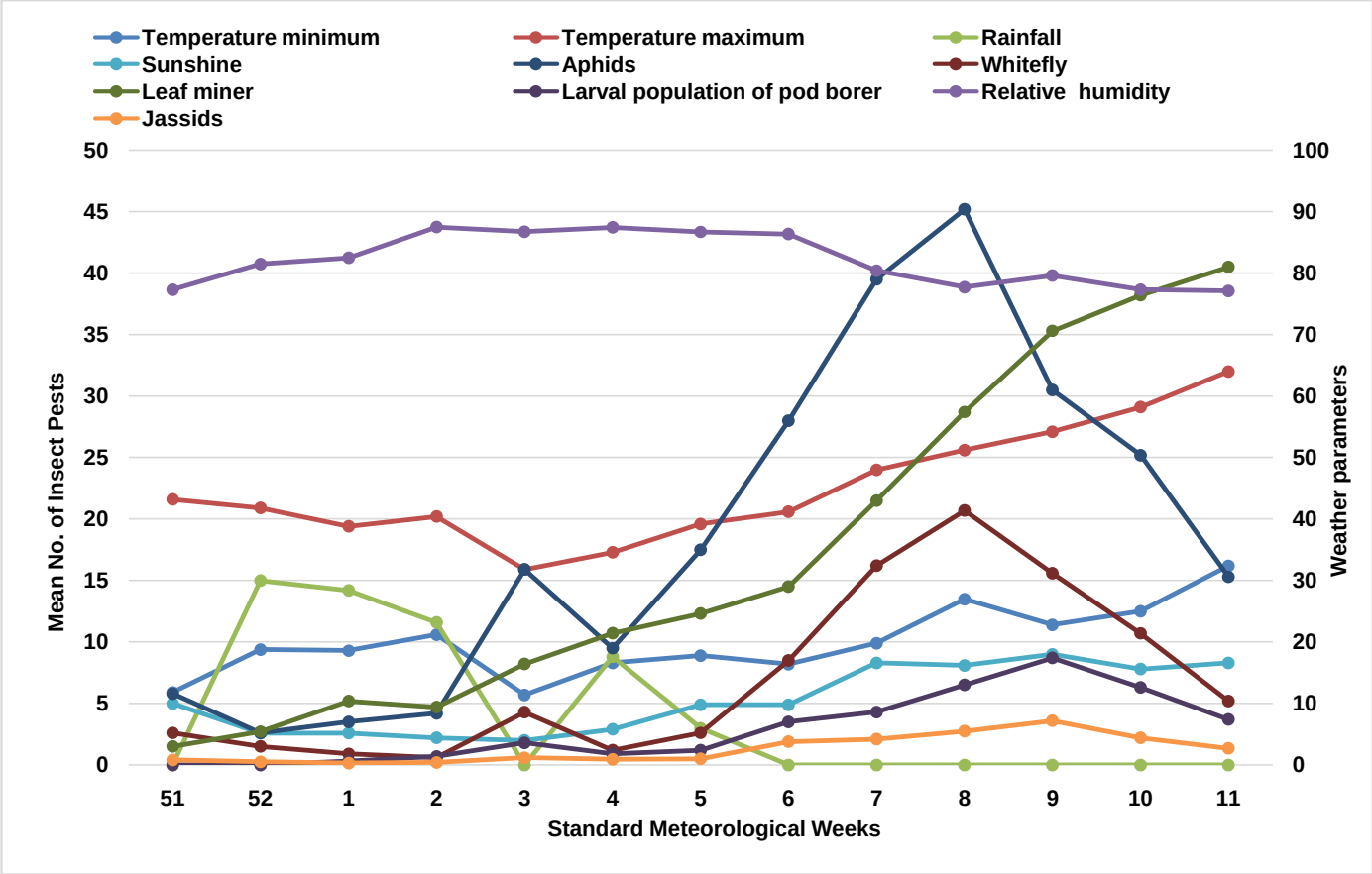

Fig. 1: Incidence of pest spectra on French bean under the influence of weather factors during *Rabi* 2021-22.

4. CONCLUSION

The incidence of insect pests like aphid, whitefly, Jassid, leaf miner, pod borer was initiated after sowing till harvesting. The highest incidence of Jassid was observed on French bean crop at 9th SMW (7.20 per cage) and lowest 1st SMW (0.30 per cage), Aphid 8thSMW (45.20 aphids per 10cm terminal shoot) and 52thSMW (2.60 aphids per 10cm terminal shoot). The highest incidence of whitefly observed in 8th SMW (20.70 per cage) and lowest 2nd SMW (0.60 per cage).The highest incidence of Leaf miner was recorded in 11th SMW (40.50% leaf damage) and lowest in 51th SMW (1.50% leaf damage). The highest incidence of pod borer was noticed in 9th SMW (8.70 larvae per plant) and lowest in 1st SMW (0.30 larvae per plant). The Jassid population showed highly significant positive correlation with sunshine and positive significant correlation with maximum temperature and positive non-significant correlation with minimum temperature whereas, significant negative correlation with rainfall and negative non-significant correlation with relative humidity. The aphid population showed highly significant positive correlation with sunshine and positive non-significant correlation with minimum and maximum temperature. The whitefly population showed highly significant positive correlation with sunshine and positive non-significant correlation with minimum and maximum temperature. The leaf miner population showed positive highly significant correlation with minimum and maximum temperature and significant positive correlation with relative humidity. The pod borer population showed highly significant correlation with maximum temperature and sunshine. The information generated in the present research can be successfully utilized to formulated effective insect pest management strategies in French bean.

CONSENT (WHERE EVER APPLICABLE)

Not applicable

ETHICAL APPROVAL (WHERE EVER APPLICABLE)

Not applicable

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