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Population dynamics of major insect pests of brinjal

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Abstract
The field experiment was conducted at the Field of Bio-control Research and Production Centre, College of Agriculture, Jabalpur, during the *Rabi* season (2023-24). Brinjal variety VNR-212 was sown in a 60 m^2 plot, damage of insect pests were recorded and correlated with the weather data. Result revealed that the peak incidence of sucking insects *viz.,* aphids (18.33 aphids per six leaves per plant), jassids (4.28 jassids per six leaves per plant) and whiteflies (13.10 whiteflies per six leaves per plant) were observed during the 8th, 8th and 10th standard weeks, respectively. The peak incidence of brinjal shoot and fruit borer was recorded during the 9th and 13th standard weeks with 18.82% shoot infestation and 36.41% fruit infestation, respectively. Correlation analysis was revealed that Aphids and jassids population significantly positive correlated with wind speed, while whiteflies population were significantly positive correlated with maximum temperature, sunshine and evaporation. Fruit infestation was significantly positive correlated with maximum temperature but was significantly negative correlated with evening relative humidity and wind speed.

Keywords: Brinjal, Insect pests, weather factors, correlation

Introduction

Brinjal (*Solanum melongena* L.) is a vegetable grown and consumed throughout the world. It is known by several names such as aubergine, eggplant and brinjal. It is an agronomically and economically important plant member of Solanaceae family with a significant foundation source of various vital pharmaceuticals and nutraceuticals compounds (Naeem and Ugur. 2020)[11]. Globally, brinjal production is 58.64 million metric tonnes (MMT) and China is the world's largest producer (37 MMT) followed by India (12.87 MMT) during 2021-22. In India, it was cultivated area of about 7,44 thousand hectares (Th ha) with production of 12.87 MMT. While in Madhya Pradesh, brinjal was cultivated in 56.70 Th ha with production of 1,115.56 thousand tons (Anonymous, 2022) [2].

Insect pests are the primary factors contributing to low brinjal productivity due to plant damage. Notable, BSFB (*Leucinodes orbonalis* Guenee), hadda beetle (*Epilachna punctata* Fabricius), aphid (*Aphis gossypii* Glover), jassid (*Amrasca biguttula biguttula* Ishida) and whitefly (*Bemisia tabaci* Gennadius) are the major pests of brinjal. Of these, the brinjal shoot and fruit borer (BSFB) is considered the most destructive pest in Asia, causing significant harm, especially during the fruiting stage (Abirami *et al.*, 2021) [1]. Yield losses due to BSFB range from 25.82–92.50%, with a yield reduction of 20–60%. Aphids, jassids, and whiteflies, which are sucking insects, inflict significant damage, especially during winter, causing plant losses of 26–46% (Kumar *et al*., 2022) [8]. For, managing the pest population of these pest below the economic threshold level is essential for getting higher yield and returns for profitable cultivation. But for any successful integrated pest control program sound knowledge about the population dynamics of the pests is necessary. Thus, the present study was undertaken to assess the population dynamics of major insect pests of brinjal.

Materials and Methods

The field experiment was conducted at the Field of Bio-control Research and Production Centre, College of Agriculture, Jabalpur, during the *Rabi* season in the year 2023-24. Observations of different insect pests were recorded twice in SW from transplanting to maturity of the crop or until their availability, data was collected from 10 randomly selected plants per plot. The pest infestation observations followed the proposed by Chaukikar *et al.*,

(2020) [5]. For sucking pests, including aphids, jassids and whiteflies, infestation levels were assessed by examining six leaves per plant, selecting two leaves from the upper, middle and lower canopy of the plant. Observations on shoot and fruit infestation by the BSFB were recorded as proposed by Chaukikar *et al.*, (2020) [5]. For shoot infestation, the initial signs of infection were identified by drooping or withering of the shoots. To assess the extent of shoot infection, the total number of infected and healthy shoots from selected plants were recorded and counted. The percentage of shoot infestation by BSFB was then calculated using the following formula: (Number of infected shoots / Total number of shoots) × 100**.** For fruit infestation, the damage was recorded separately for each plot, with data collected on a total plot basis. The following formula was used to determine the percentage of fruit infestation by BSFB: (Number of infected fruits / Total number of fruits) × 100. Data of weather parameters were collected from the Department of Agrometeorology, College of Agricultural Engineering, JNKVV, Jabalpur, Madhya Pradesh. The weather parameters and insect pests' population dynamics correlations were calculated by using OPSTAT software.

Results and Discussion

The experimental results were revealed that the population dynamics of sucking pest, aphid (*Aphis gossypii* Glov.) (Hemiptera: Aphididae), the first incidence of aphid was observed in 51st standard weeks (SW) (with 0.33 aphids per 6 leaves), and they are present until the harvesting (14th SW). The peak incidence of aphid was observed in 8th SW with 18.33 aphids per 6 leaves (Table 1). The results were similarly findings with result documented by Kadgonkar *et al.*, (2018) [6], Prashanth *et al.*, (2023) [12] and Borah and Saikia, (2017) [3]. The correlation reveled that the aphid population significantly positive correlated with wind speed (r = 0.52*) (Table 2), with the regression equation $\hat{Y}$ = 4.29 + 4.63x (R^2 = 0.27) (figure1). Prashanth *et al.*, (2023) [12] also reported that aphid population had positively correlated with wind speed in brinjal.

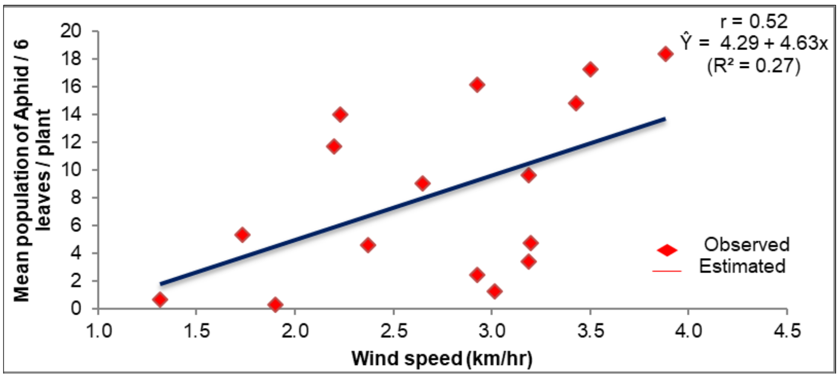

Fig 1: Regression of wind speed on aphid incidence on brinjal

The incidence of Jassid, *Amrasca biguttula biguttula* (Ishi.) (Hemiptera: Cicadellidae), was firstly recorded during the 50th SW (with 0.10 jassids per 6 leaves), and they present on the crop until harvest in the 12th SW (0.93 jassids per 6 leaves). The peak population of jassids, were observed in the 8th SW with population 4.28 per 6 leaves) (Table 1). The results were showed similar finding with result of Mourya *et al*., (2023) [10]; Borah and Saikia, (2017) [3] and Sheojat *et al*., (2022) [13]. The Correlation studies revealed that the jassids population were significantly positive correlated with wind speed (r = 0.52*) (Table 2), with the regression equation $\hat{Y}$ = 0.33 + 0.78x (R^2 = 0.27) (figure 2). The present study contradicts with that of Kadgonkar *et al.*, (2018) [6] as they also reported jassids population non-significance with wind speed.

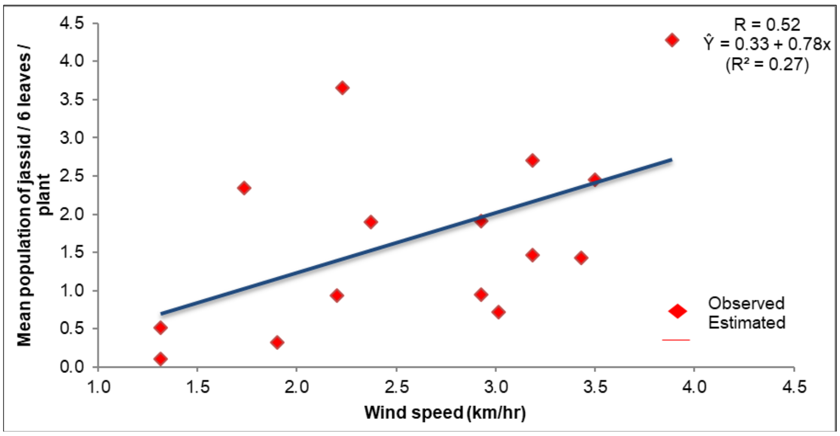

Fig 2: Regression of wind speed on jassid incidence on brinjal

Whitefly, *Bemisia tabaci* (Genn.) (Hemiptera: Aleyrodidae) incidence was firstly observed during the 49th SW with a population of 0.08 adult whiteflies per 6 leaves, and they remained on the crop until harvest in the 14th SW (4.07 adult whiteflies per 6 leaves). The peak population of whiteflies were observed in 10th SW with population 13.10 adult whiteflies per 6 leaves (Table 1). The present findings are partially in accordance with the findings of Chandrakumar *et al.*, (2008) [4], Kadgonkar *et al.*, (2018) [6], Lal *et al.*, (2019) [9] and Prashanth *et al.*, (2023) [12]. Correlation findings revealed that the whitefly population had a significant positive correlation with maximum temperature (r = 0.51*) with regression equation [Y = 8.01 + 0.50x (R^2 = 0.26)], sunshine hours (r = 0.54*) with regression equation [Y = 2.45 + 1.24x (R^2 = 0.29)], and evaporation (r = 0.56*) [Y = 1.11 + 1.79x (R^2 = 0.31)] (Table 2 and figure 3,4 & 5).This finding is similar with those of Chandrakumar *et al.*, (2008) [4] and Prashanth *et al.*, (2023) [12] as they reported that maximum temperature, sunshine and evaporation exhibited significant positive influence on the whitefly population.

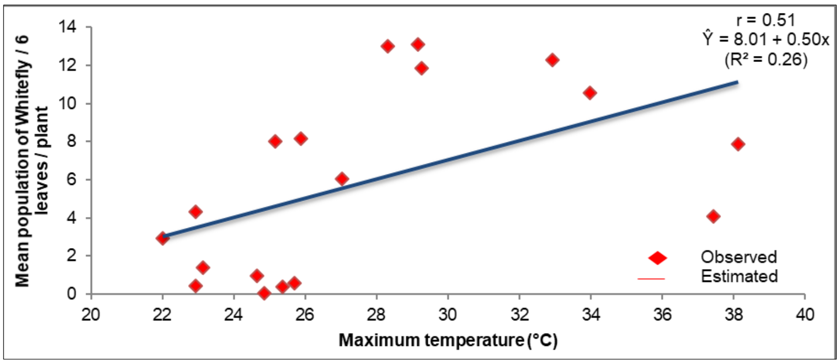

Fig 3: Regression of maximum temperature on whitefly incidence on brinjal

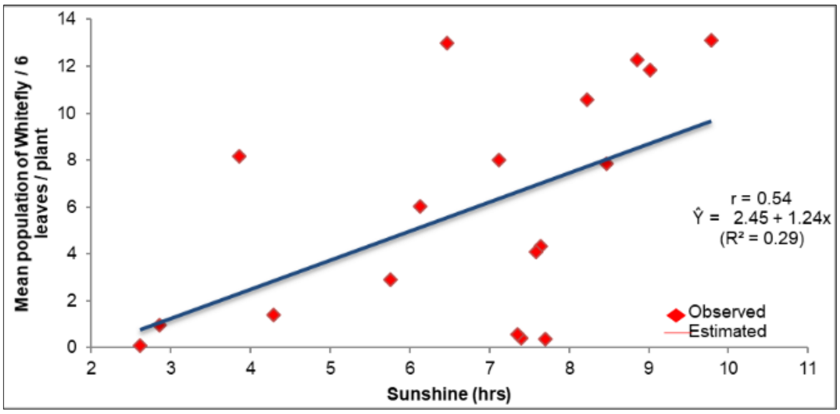

Fig 4: Regression of sunshine on whitefly incidence on brinjal

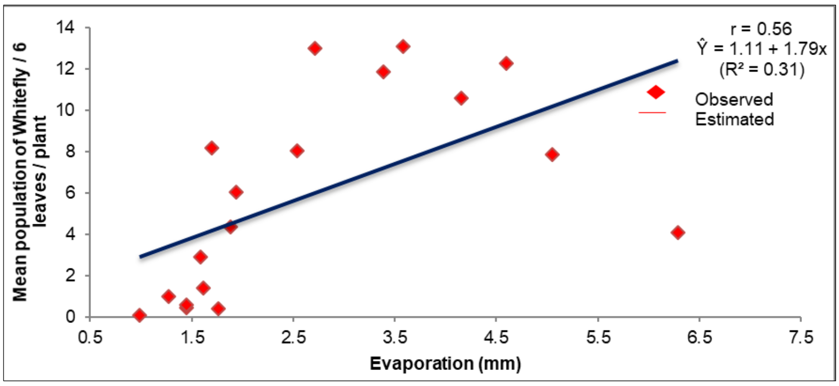

Fig 5: Regression of evaporation on whitefly incidence on brinjal

The incidence of brinjal shoot and fruit borer (BSFB), *Leucinodes orbonalis* (Guen.) (Lepidoptera: Pyralidae) was observed in vegetative and reproductive stage to cause damage the crop by shoot and fruit infestation, respectively. Shoot infestation by BSFB was firstly recorded during 3rd SW with 2.69% infestation and persisted on the crop until harvest in the 14th SW (4.28% infestation). The peak of shoot infestation, was observed in 9th SW with 18.82% infestation (Table 1). Tripura *et al.*, (2018) [14] reported that the peak shoot infestation to be 21% which is close with the present finding. Sheojat *et al.*, (2022) [13] reported first incidence of shoot and fruit borer in 50th SW showed contradict with present finding. The correlation studies reported that the shoot infestation was non significantly correlated with all-weather parameters.

Fruit infestation was firstly observed in 8th SW with 12.50% infestation caused by BSFB and persisted until harvest in the 15th SW (21.95%). The highest percentage of fruit infestation, (36.41%), was observed during the 13th SW (Table 1). The similar finding of study observed with research of Abirami *et al.*, (2021) [1] reported that the peak infestation of fruit with 27.67%. The maximum fruit infestation 34.26% was recorded by Kumar *et al.*, (2021) [7]. Correlation.

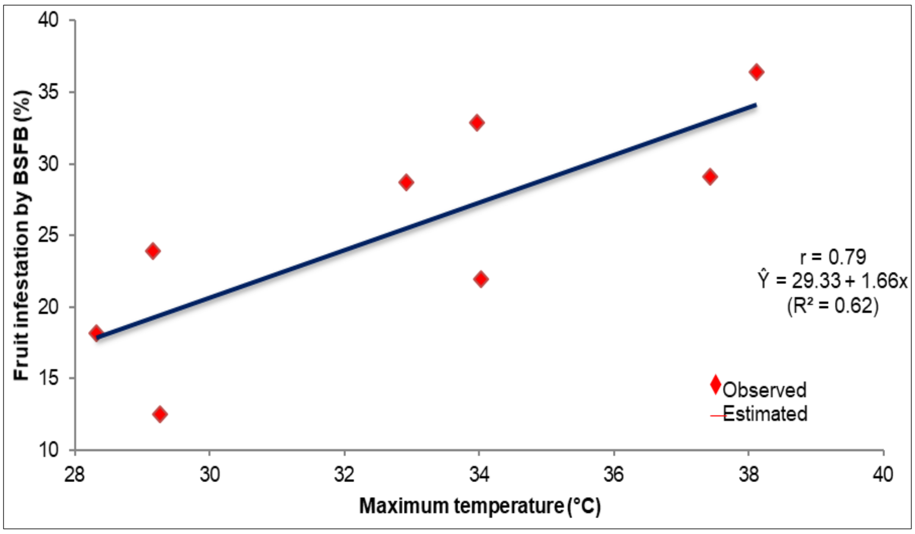

Fig 6: Regression of maximum temperature on fruit infestation by BSFB

studies revealed that fruit infestation by BSFB showed a significant positive correlation with maximum temperature (r = 0.79*) and significant negative correlations with evening relative humidity and wind speed (r = -0.74* and -0.74*) respectively (Table 2 and figure 6, 7& 8). The regression equations were $\hat{Y} = 29.33 + 1.66x$ ($R^2 = 0.62$), $\hat{Y} = 48.41 - 0.67x$ ($R^2 = 0.55$), and $\hat{Y} = 55.52 - 9.27x$ ($R^2 = 0.56$). Sheojat *et al.*, (2022) [13] reported significant positive correlation with maximum temperature as well as the correlation was positive with minimum and maximum temperature are reported by Tupe *et al.*, (2022) [15] which were similar with the present investigation results.

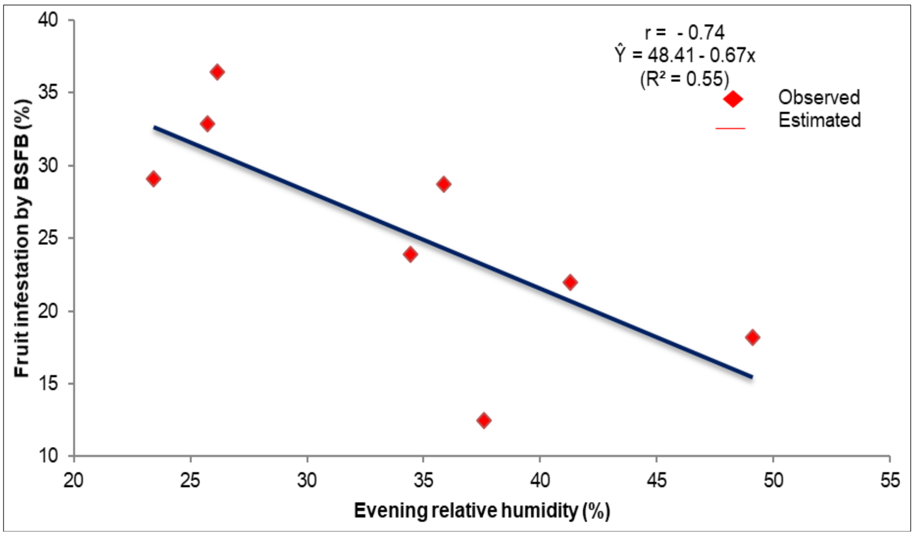

Fig 7: Regression of evening relative humidity on fruit infestation by BSFB

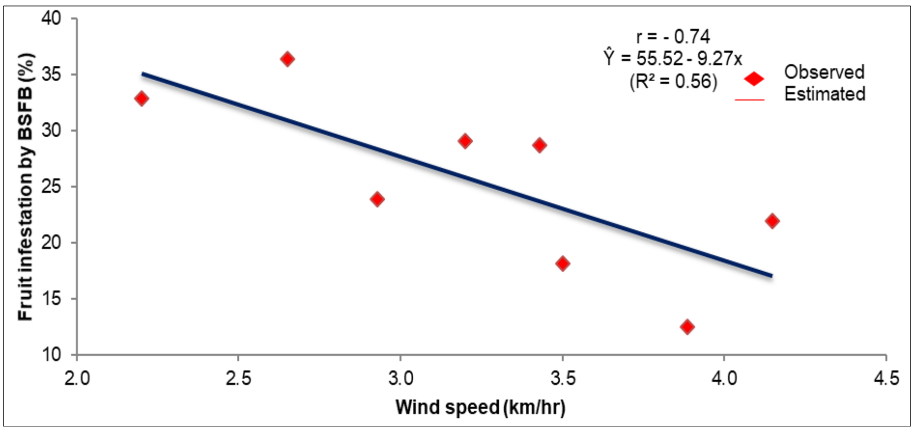

Fig 8: Regression of wind speed on fruit infestation by BSFB

Table 1: Incidence of arthropods on brinjal at Jabalpur during *rabi* season2023-24

SW	Mean insect pest population				
	Per 6 leaves / plant			Mean shoot & fruit borer infestation (%)	
	Adult	Nymph + Adult			
	Whitefly	Aphid	Jassid	Shoot	Fruit
49	0.08	0.00	0.00	0.00	0.00
50	0.37	0.00	0.10	0.00	0.00
51	0.42	0.33	0.32	0.00	0.00
52	0.58	0.68	0.51	0.00	0.00
1	0.98	1.28	0.72	0.00	0.00
2	1.39	2.44	0.95	0.00	0.00
3	2.91	3.42	1.46	2.69	0.00
4	4.33	4.58	1.89	4.67	0.00
5	6.03	5.36	2.34	7.05	0.00
6	8.02	9.65	2.70	9.83	0.00
7	8.17	14.02	3.66	14.39	0.00
8	11.86	18.33	4.28	17.59	12.50
9	12.98	17.27	2.45	18.82	18.18
10	13.10	16.11	1.91	16.80	23.93
11	12.26	14.79	1.43	13.56	28.72
12	10.56	11.68	0.93	12.38	32.87
13	7.86	9.05	0.00	8.95	36.41
14	4.07	4.77	0.00	4.28	29.10
15	0.00	0.00	0.00	0.00	21.95

Table 2: Correlation of abiotic factors on arthropods on brinjal

Weather Parameters	Correlation co-efficient (r)				
	Insect pests				
	Whitefly	Aphid	Jassid	BSFB infestation (%)	
				Shoot	Fruit
n	18	16	15	12	8
Max. Temperature (^{0}C)	0.51*	0.40^{NS}	0.19^{NS}	0.11^{NS}	0.79*
Min. Temperature (^{0}C)	0.33^{NS}	0.43^{NS}	0.38^{NS}	0.27^{NS}	0.37^{NS}
Sunshine (hrs)	0.54*	0.43^{NS}	0.05^{NS}	0.23^{NS}	0.15^{NS}
Rainfall (mm)	0.07^{NS}	0.21^{NS}	0.23^{NS}	0.37^{NS}	-0.22^{NS}
Morn. RH (%)	-0.46^{NS}	-0.43^{NS}	-0.28^{NS}	-0.07^{NS}	-0.32^{NS}
Even. RH (%)	-0.46^{NS}	-0.30^{NS}	0.02^{NS}	0.03^{NS}	-0.74*
Wind speed (Km/hr)	0.41^{NS}	0.52*	0.52*	0.34^{NS}	-0.74*
Morn. VP (mm)	0.19^{NS}	0.34^{NS}	0.22^{NS}	0.23^{NS}	0.57^{NS}
Even. VP (mm)	-0.01^{NS}	0.18^{NS}	0.28^{NS}	0.44^{NS}	-0.10^{NS}
Evap.(mm)	0.56*	0.42^{NS}	0.26^{NS}	0.02^{NS}	0.57^{NS}
Rainy days (nos.)	0.28^{NS}	0.41^{NS}	0.29^{NS}	0.51^{NS}	-0.36^{NS}

NS= non-significant, * = significant at 5%, n= Number of observations, BSFB= Brinjal shoot and fruit borer

Conclusion

the present study was concluded, the population dynamics of key insect pests affecting brinjal crops, including aphids, jassids, whiteflies, and the brinjal shoot and fruit borer. Correlation analysis revealed significant, non-significant positive, and negative relationships between pest populations and meteorological factors. These findings contribute to a better understanding of the factors influencing pest dynamics and can inform the development of effective pest management strategies.

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