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Seasonal abundance and impact of abiotic factors on major sucking pests of brinjal

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Abstract
The study was carried out to find out the seasonal abundance and impact of abiotic factors on major sucking pests of brinjal. Brinjal variety BR-112 was transplanted on first fortnight of July, 2020 at Research Farm of the Department of Entomology, CCS Haryana Agricultural University, Hisar. The results revealed that the population of whitefly adults and nymphs, jassids, aphids and red spider mite on brinjal was initiated in 28th and 30th, 31st, 48th and 30th Standard Meteorological Week (SMW), respectively. The population build-up of whitefly adults arrived at peak in 42nd SMW when temperature (maximum and minimum) and relative humidity (morning and evening) were 34.2 and 13.7 ^{0}C and 76.4 and 22.2 per cent, respectively. The adults of whitefly showed significant positive correlation with maximum temperature while significant negative correlation with morning and evening relative humidity. Whereas jassid population attained its peak in 44th SMW when maximum and minimum temperature was 30.4 and 9.8 ^{0}C with 85.4 and 24.0 per cent morning and evening relative humidity, respectively. The peak of aphid population was recorded in 51st SMW when maximum and minimum temperature was 19.7 and 3.0 ^{0}C with 91.9 and 42.1 per cent morning and evening relative humidity, respectively. The correlation matrix indicated a significant negative correlation of jassid and aphid minimum temperature while jassid and aphid population recorded non-significant negative correlation with sunshine hours and rainfall. Red spider mite population attained its peak in 40th SMW when maximum and minimum temperature was 36.6 and 18.2 ^{0}C with 78.7 and 28.7 per cent morning and evening relative humidity, respectively. The temperature (maximum and minimum) and sunshine hours showed positive non-significant effect, while relative humidity exhibited significant negative correlation with on population build-up of red spider mite.

Keywords: Abiotic factors, aphid, brinjal, jassid, red spider mite, whitefly

Introduction

Brinjal belongs to Solanaceae family and originated in India. Globally there are 3 species cultivated, brinjal eggplant (*Solanum melongena* L.), scarlet eggplant (*Solanum aethiopicum* L.) and gboma eggplant (*Solanum macrocarpon* L.), later two are cultivated in little amount in sub-Saharan Africa (Daunay *et al.* 2012) [5]. Brinjal is originated from India and Pakistan in third century, then it spread to China in fourth century and African region in ninth century (Bhaskar and Ramesh Kumar, 2015, Sekara *et al*., 2007) [3, 16]. Brinjal is one of India's most common vegetables, with a diverse climatic range cultivated in various agro-climatic regions. It is one of the few crops that can withstand high temperatures and heavy rainfall. Brinjal is rich in vitamins, protein, free reducing sugar, and minerals like phosphorus, sulphur, and calcium. It's fruits mostly use as vegetables in the country due to its nutritional content, which consists of minerals such as iron, phosphorus, calcium and vitamins such as A, B and C.

In the production of brinjal, China is the leading country shares of 63.1% of total production *viz.* is 34.10MT followed by India with a share of 23.7% and production around 12.18MT then Egypt with 2.7% share and 1.41MT production. The total area of brinjal in India is 7.27 lakh ha with total production of 12.68 million tonnes (Anonymous, 2019) [2]. The highest area in brinjal is covered by West Bengal 1.6 lakh ha followed by Orissa and Gujrat *i.e.* 1.2 and 0.71 lakh ha respectively. There are various factors responsible for low productivity in brinjal including both abiotic and biotic factors. Among the biotic factors, insect pests cause considerable loss from nursery to harvesting stage of the crop (Regupathy *et al.* 1997) [15]. Nayer *et al.* (1995) [11] reported 53 insect pest species and from all these insect pests major insect pests of brinjal are brinjal shoot and fruit borer (BSFB), *Leucinodes orbonelis* L.; Hadda beetle *Epilachna vigintiopunctata* F.; and among sucking insect pest Whitefly, *Bemisia tabaci* G.; Jassid, *Amrasca biguttula bigutulla* I.; Aphid, *Aphis gossypii* G.; Red spider mite, *Tetraychus urticae.*, are major sap-sucking insect pests.

Material ad Methods

The study was carried out to find out the seasonal abundance and impact of abiotic factors on major sucking pests of brinjal. Brinjal variety BR-112 was transplanted on first fortnight of July, 2020 at Research Farm of the Department of Entomology, CCS Haryana Agricultural University, Hisar following the recommended agronomic practices except the insecticidal sprays in randomized block design with five replications in plot size of 200 m^2. The climate of Hisar region is semi-arid and is characterized by hot and dry winds during summer months and dry and severe cold conditions during winter months. The maximum and minimum temperature shows wide range of fluctuations during summer, while the temperature below freezing point accompanied by frost may also be recorded during winter months (December-January), which is very common feature of this region. The rainfall is confined mainly to the monsoon months from July to September but light showers cyclonic rains also occur sometimes during winter and spring months.

The data was recorded after the transplanting date till the harvest of crop. Five random plants were selected except the border plants and tagged for observation recording. Three leaves were selected from the upper, middle, and lower parts of each tagged plant. The nymphal and adult population of the jassid, aphid, and whitefly was counted from underneath surface of an upper, middle and lower leaf of five randomly tagged plants. The population of red spider mite was also recorded on three leaves per 4 cm^2 area of leaf from an upper, middle and bottom canopy of the plant. The meteorological observations were collected from the Department of Meteorology, CCS HAU, Hisar. The correlation was done between sucking pests of crop and abiotic factors *i.e.*, relative humidity, maximum and minimum temperature, bright sunshine hour and rainfall.

Statistical Analysis

The data were subjected to statistical analysis and simple correlation was worked out between the population of sucking pests and abiotic factors *viz.* relative humidity, maximum and minimum temperature, bright sunshine hour and rainfall by using Pearson's correlation coefficient-

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2]\,[n\sum y^2 - (\sum y)^2}}$$

where,
r = correlation coefficient
x = Abiotic factors (Independent variables)
y = Number of observations
n = Pest infestation (Dependent variables)

Results and Discussion

The data (Table 1 and Figure 1) revealed the abundance of different sap sucking pests in brinjal agrosystem. The incidence of whitefly adults and nymphs varied from 0.13 to 38.87 and 0.67 to 70.13 per three leaves and was maximum (38.87 and 70.13/ 3 leaves) during 42nd Standard Meteorological Week (SMW) and minimum (0.13 and 0.67/ 3 leaves) during 49th and 46th SMW, respectively when maximum and minimum temperature, morning and evening relative humidity and sunshine and precipitation were 34.2 and 13.7 °C, 76.4 and 22.2 per cent and 7.1 hours and 0.0 mm, respectively. Omprakash *et al.* (2013) [12] and Ajabe *et al.* (2019) [1] also reported that whitefly started built-up from first week after transplanting and attained its peak in the month of October and then population declined up to crop maturity.

The data presented in Table 2 revealed that whitefly showed significant positive correlation with maximum temperature while significant negative correlation with morning and evening relative humidity. Present studies are in agreement with Humane *et al.* (2020) [7], who reported that whitefly population showed positive correlation with maximum temperature and sunshine hours, while it shows negative correlation with morning & evening relative humidity and rainfall. Yadav *et al.* (2016) [19] also reported that whitefly showed positive significant correlation with mean temperature and negative correlation with mean relative humidity and rainfall.

Peak activity of jassids was noticed during 44th SMW when maximum and minimum temperature was 30.4 and 9.8 ^{0}C with 85.4 and 24.0 per cent morning and evening relative humidity, respectively. The peak of aphid population was recorded in 51st SMW when maximum and minimum temperature was 19.7 and 3.0 ^{0}C with 91.9 and 42.1 per cent morning and evening relative humidity, respectively. The correlation matrix indicated a significant negative correlation of jassid and aphid population with minimum temperature while jassid and aphid population recorded non-significant negative correlation with sunshine hours and rainfall. Present studies are in agreement with earlier study by Omprakash *et al.* (2013) [12], who reported that jassids attained their peak in last week of October during 2010-11 and 2011-12. Ajabe *et al.* (2019) [1], who reported that the aphid population had negative correlation with minimum temperature, evening relative humidity, rainfall & sunshine hours, whereas relative humidity of morning was positively correlated with aphid population. These findings are also in agreement with Mohapatra (2008), who documented that minimum temperature, relative humidity, rainfall and sunshine hours have negative correlation with aphid population. Ramya and Veeravel (2010) [14], also stated that rainfall had negative correlation with aphid population build-up. These findings are also in agreement with Shaikh and Patel (2013) [17], who reported that minimum temperature, evening relative humidity and rainfall had a significant negatively correlation with jassids population. Yadav *et al.* (2016) [19] also reported that jassid had negative non-significant correlation with total rainfall. Dahatonde *et al.* (2014) [4] reported that sunshine hours had negative non-significant correlation with jassid population. Red spider mite population attained its peak in 40th SMW when maximum and minimum temperature was 36.6 and 18.2 ^{0}C with 78.7 and 28.7 per cent morning and evening relative humidity, respectively. The temperature (maximum and minimum) and sunshine hours showed positive non-significant effect, while relative humidity exhibited significant negative correlation with on population build-up of red spider mite.

Present findings are similar to findings of Ghosh (2013) [6], who reported that the red spider mite remained active throughout the growing season and maximum population was recorded in 42nd standard metrological week. Earlier reports also suggest that maximum & minimum temperature showed positive correlation (Monica *et al.*, 2014) [10], humidity and rainfall showed negative correlation (Tripathi *et al.*, 2013 [18] and Patil and Nandihalli, 2009) [13] with abundance of red spider mite.

Table 1: Seasonal abundance of major sucking pests of brinjal during *Kharif* 2020

Months	S.M.W.	Mean insect population/3 leaves					Mean Temperature (°C)		Mean Relative Humidity (%)		Sunshine Hour	Cumulative Rainfall (mm)
		Whitefly		Jassid	Aphid	Red spider mite	Maximum	Minimum	Morning	Evening		
		Adult	Nymph									
July	28	9.60	0.00	0.00	0.00	0.00	36.0	26.5	89.3	63.7	8.0	0.0
	29	1.30	0.00	0.00	0.00	0.00	34.6	25.9	91.8	75.4	5.7	111.1
	30	4.30	1.33	0.00	0.00	3.47	34.5	26.8	87	59.9	7.3	14.7
August	31	11.90	0.93	0.27	0.00	1.47	36.4	27	84.4	65.6	6.6	0.0
	32	2.33	0.00	0.20	0.00	0.40	35.3	27.5	87.9	62.1	6.6	32.8
	33	3.62	9.60	0.33	0.00	0.67	35.3	26.9	89.8	77.1	6.7	17.5
	34	6.36	8.93	0.33	0.00	3.67	32.6	25.4	91.1	75.6	6.4	11.7
September	35	13.13	11.20	0.07	0.00	2.27	33.9	25.6	90.3	63.5	6.8	0.0
	36	3.67	12.80	0.40	0.00	0.53	34.2	25.1	93.5	66.6	5.1	32.5
	37	13.40	11.33	0.33	0.00	1.53	36.3	24.9	88	49.3	8.3	0.0
	38	7.63	21.67	0.27	0.00	0.27	37.6	24.7	87	47.9	7.6	7.0
	39	18.20	22.67	0.53	0.00	3.20	36.9	22.3	85.1	39.2	7.4	0.0
October	40	21.67	19.13	0.47	0.00	4.93	36.6	18.2	78.7	28.7	8.2	0.0
	41	25.13	6.67	0.87	0.00	2.00	35.6	16.3	86.1	28.3	7.9	0.0
	42	38.87	70.13	0.93	0.00	4.40	34.2	13.7	76.4	22.2	7.1	0.0
	43	11.00	41.07	0.87	0.00	3.47	33	12.8	79.6	25.7	6.5	0.0
November	44	7.53	50.33	1.13	0.00	1.93	30.4	9.8	85.4	24	5.6	0.0
	45	4.47	6.80	0.20	0.00	1.53	29.7	10.5	90.9	32.9	3.2	0.0
	46	0.67	0.67	1.07	0.00	1.13	25.6	12.6	89	49.8	2.7	18.2
	47	0.27	1.87	0.27	0.00	0.20	23.1	7.7	87.6	43.3	6.5	0.0
December	48	0.27	0.87	0.67	0.33	0.27	23.3	8.4	92	42.4	6.6	1.7
	49	0.13	1.33	0.80	0.13	0.87	25.5	9.1	90.2	52.7	5.9	0.0
	50	0.00	0.00	0.33	0.53	0.07	20.8	5.0	95.7	62.6	5.3	0.0
	51	0.00	0.00	0.20	0.67	0.27	19.7	3.0	91.9	42.1	6.2	0.0

Table 2: Correlation between population of sucking pests of Brinjal and weather Components

Abiotic components	Mean population of pests				
	Whitefly		Jassid	Red spider mite	Aphid
	Adult	Nymph			
Max. Temp.	0.540**	0.276NS	-0.177 NS	0.396 NS	-0.758**
Min. Temp.	0.155 NS	-0.118 NS	-0.489*	0.109 NS	-0.623**
R.H. Morning	-0.765**	-0.711**	-0.414*	-0.727**	0.446*
R.H. Evening	-0.508*	-0.610**	-0.633**	-0.429*	-0.011 NS
Sunshine Hour	0.500*	0.153 NS	-0.214 NS	0.282 NS	-0.133 NS
Rainfall	-0.288 NS	-0.225 NS	-0.304 NS	-0.289 NS	-0.169 NS

** Significance at 1%
* Significance at 5%
NS- Non significant

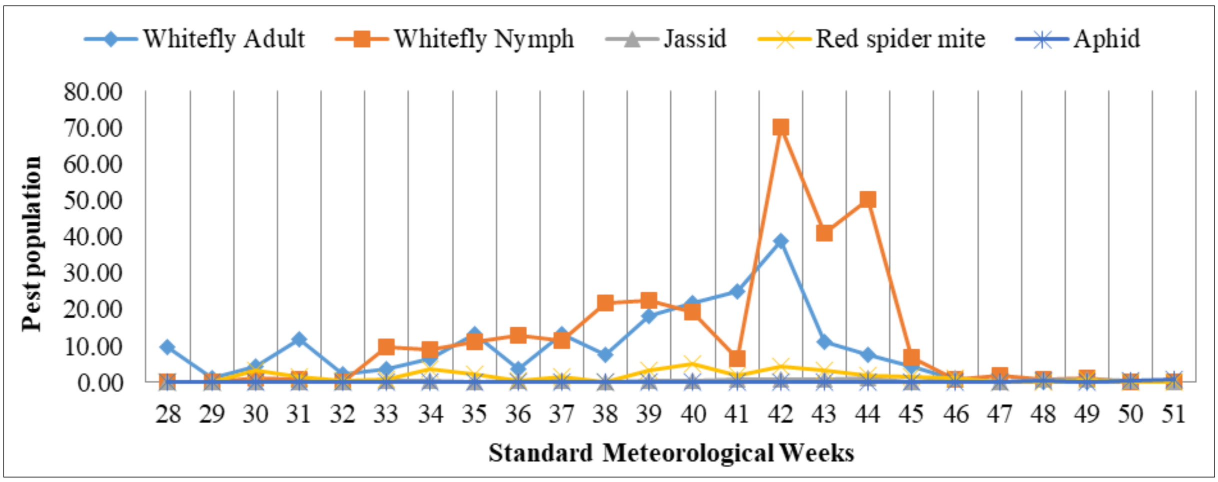

Fig 1: Seasonal abundance of sucking pests of brinjal under field condition during *Kharif*, 2020

Conclusion

The present investigation provides a basic study for population dynamics of major sap sucking pests of brinjal. It can be concluded from the results that seasonal fluctuations of major sap sucking pests of brinjal crop is greatly influenced by abiotic factors and peak activity of whitefly, jassids and red spider mite are observed during October-November. The statistically significant values indicated that occurrence of pests population was due to prevailing weather conditions. The management of brinjal pests should therefore be promoted and tailored from September onwards using an integrated pest management strategy.

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