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Effect of abiotic factors on Incidence of sucking insect pests and their major natural enemies of Okra

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Abstract
The present research was aimed to study the seasonal incidence of major sucking pests and their natural enemies on okra, *Abelmoschus esculentus* (L.) Moench under field conditions at Department of Entomology, S.K.N. College of Agriculture, Jobner, Rajasthan during *kharif*, 2014. The crop revealed that two sucking pests *viz*., jassid, *Amrasca biguttula biguttula* (Ishida) and whitefly, *Bemisia tabaci* (Genn.) appeared as major sucking pests. The incidence of jassid and whitefly was first commenced in the second week of August and reached to peak (16.50 jassids and 18.80 whiteflies per three leaves) in the third week of September, at 34.5 ^{0}C maximum temperature, 22.1 ^{0}C minimum temperature, 71.0 per cent relative humidity, thereafter, the insect population started declining. The correlation studies revealed that the infestation of jassid and whitefly on okra crop showed non-significant correlation with maximum temperature (r = -0.02 and -0.03), minimum temperature (r = 0.30 and 0.33) and rainfall (r = 0.45 and 0.48), while positive significant correlation with relative humidity (r = 0.65 and 0.64) and predatory lady bird beetle (r = 0.98 and 0.97). The predatory lady bird beetle, *Menochilus sexmaculatus* Fab. was also recorded during the crop season. The population of lady bird beetle was first recorded in the third week of August which gradually increased and reached to peak (4.70 beetles/ five plants) in the third week of September, thereafter, their population started to decline. The correlation studies showed a non-significant correlation with maximum temperature, minimum temperatures and rainfall, while, significant correlation with relative humidity. Lady bird beetles showed a significant effect on the pest species.

Keywords: Abiotic factors, sucking insect pests, Natural enemies and okra, *A. esculentus*

Introduction

Okra [*Abelmoschus esculentus* (L.) Moench] commonly known as *Bhindi* or lady's finger (family: Malvaceae) is a popular fruit vegetable crop due to its high nutritional and medicinal values. In India, it is cultivated throughout the country for its immature tender fruits. The crop occupies an area over 532.66 thousand hectares with an annual production to the tune of 6346.37 thousand metric tonnes. In Rajasthan, it is grown in an area of 3.95 thousand hectares with an annual production of 12.27 thousand metric tonnes (Anonymous, 2013-14) [1]. It is attacked by a number of insect pests right from germination to harvesting, *viz*., jassid, *Amrasca biguttula biguttula* (Ishida); aphid, *Aphis gossypii* (Glover); whitefly, *Bemisia tabaci (*Genn.); shoot and fruit borer, *Earias insulana* (Boisd.), *Earias vittella* (Fab.); leaf roller, *Sylepta derogata* (Fab.); red cotton bug, *Dysdercus koenigii* (Fab.); mite, *Tetranychus cinnabarinus* (Boisd.); green plant bug, *Nezara viridula* (Linn.); blister beetle, *Mylabris pustulata* (Thunb.) and green semilooper, *Anomis flava* (Fab.). Among these pests, jassid, *A. biguttula biguttula* and whitefly, *B. tabaci* are most important sucking insect pests of okra in Rajasthan (Dangi and Ameta, 2005; Meena and Kanwat, 2005) [3, 9].

The jassids suck the cell sap from lower surface of the leaves and inject toxic substance resulting in curling of leaves, as a result of which the plant growth is retarded. The severe infestation of the pest causes burning of leaves which fall latter and results in 40-60 per cent decrease in yield. The whitefly transmits viral diseases from diseased to healthy plants as a vector (Narke and Suryawanshi, 1987) [11].

To minimize the losses caused by insect pests in okra crop, the weather conditions prevailing in a region play an important role in occurrence and subsequent build-up of pest population. As such the studies were undertaken the effect of abiotic factors on incidence of sucking insect pests and their major natural enemies of okra.

Materials and Methods

The present investigations were conducted at Horticulture farm of S.K.N. College of agriculture, Jobner (Rajasthan) on okra crop under field conditions during *kharif*, 2014. The seeds of okra crop were sown at the rate of 10 kg ha^{-1} in all experimental plots. Before sowing seeds were treated with Thiram at the rate of 2.0 g kg^{-1} seed. *Kharif* season crops need irrigation during long spell of drought for quick plant growth and formation of fruits, the okra crop was irrigated at 10 days interval. Thinning and gap filling was done during early stage of plant growth.

Meteorological data

Data on weather factors, *viz.*, weekly maximum and minimum temperatures, relative humidity and rainfall were obtained from the meteorological observatory, Department of Agronomy, S.K.N. College of agriculture, Jobner. To record the sucking insect pests of okra variety, Pusa Sawani was sown in six plots of 2.10 x 1.8 m^2 size keeping row to row and plant to plant distance of 45 and 30 cm, respectively. The population of insect pests and natural enemies were recorded at weekly interval right form their appearance to last picking of fruits of the crop. The population of sucking insect pests, *viz*., jassid and whitefly were recorded in early morning hours by visually counting (absolute counting). For this, five plants were randomly selected and tagged in each plot, further three leaves (top, middle and bottom) from each plant were also tagged.

Jassid, *A. biguttula biguttula*

The population of jassids was recorded by counting both nymphs and adults as per method described by Rawat and Sahu (1973) [13]. Counting of the jassids was done on three leaves, *i.e.* top, middle and bottom of each tagged plant.

Whitefly, *B. tabaci*

The population of whiteflies was recorded by counting both nymphs and adults visually on whole plant in the initial stage and on three leaves in later stage, selected from the top, middle and bottom of each tagged plant. For counting the whitefly population, the leaf was held at the petiole by thumb and fore finger and thumbed until the entire underside of leaf was clearly visible. With the help of a magnifying lense, the whitefly present on the lower side of leaf was counted.

Natural enemies

The population of natural enemies, *viz., Menochilus sexmaculatus* was recorded on five plants selected randomly in each replication and population per plant were calculated. Weekly data on different abiotic factors were also recorded and were subjected to simple correlation studies.

Interpretation of data

The data recorded on insect pests, natural enemies and meteorological parameters were used for statistical analysis. The simple correlation was computed between population of these pests, natural enemies and abiotic factors, *viz.*, maximum and minimum temperatures, relative humidity and rainfall.

Results and Discussion

Studies the okra crop variety, Pusa Sawani was found to be infested with jassid, *A. biguttula biguttula* (Ishida) and whitefly, *B. tabaci* (Genn.). Moreover, the infestation of other insect pests was very low, hence observations, in respect to them were not incorporated. In the present study, the insect pests, *viz.*, jassid and whitefly were reported as major sucking pests of okra in *Kharif*, 2014. The results are in agreement with those of Lal *et al.* (1990) [8], Borah (1995) [2], Lal (1997), Kumawat *et al.* (2000) [6], Meena and Kanwat (2005) [9], Yadav *et al.* (2007) [15], Meena *et al.* (2010) [10], Kumawat (2011) [7] and Singh *et al.* (2013) [14] who reported these pests as sucking insect pests of okra.

The data revealed that the infestation of jassid on okra crop first commenced in the second week of August (2.80/ three leaves) which gradually increased and reached to peak (16.50/ three leaves) in the third week of September at 34.5 ^{0}C maximum temperature, 22.1 ^{0}C minimum temperature, 71.0 per cent relative humidity, thereafter, the population started declining. The correlation studies indicated that the infestation of jassid on okra crop showed non-significant correlation with maximum temperature (r = -0.02), minimum temperature (r = 0.30) and rainfall (r = 0.45), while, significant correlation with relative humidity (r = 0.65) and predatory lady bird beetle (r = 0.98).

The population of whitefly on okra crop was recorded throughout the crop season. The infestation first started from second week of August with initial mean population of 3.40/ three leaves and reached to peak (18.80/ three leaves) in third week of September at 34.5 ^{0}C maximum temperature, 22.1 ^{0}C minimum temperature, 71.0 per cent relative humidity, thereafter, the population started declining. The maximum and minimum temperatures and rainfall had non-significant correlation with whitefly population, whereas relative humidity and predatory lady bird beetle showed significant correlation (r = 0.64 and 0.97).

The infestation of jassid and whitefly on okra crop commenced in the second week of August and reached to its peak (16.50 jassids and 18.80 whiteflies/ three leaves) in the third week of September at 34.5 ^{0} and 22.1 ^{0}C maximum and minimum temperature, 71.0 per cent relative humidity and nil rainfall. The present findings are corroborated with that of Borah (1995) [2], Lal (1997), Meena and Kanwat (2005) [9] and Meena *et al.* (2010) [10] who reported that the infestation of jassid and whitefly on okra was started in the month of August and reached to maximum in September. Likewise, Yadav *et al.* (2007) [15] and Kumawat (2011) [7] reported peak infestation of jassid and whitefly in the second and third week of September, respectively. Meena and Kanwat (2005) [9] reported maximum infestation of jassid and whitefly on okra crop in the first fortnight of September support the present findings.

The correlation studies revealed that the infestation of jassid and whitefly on okra crop showed non-significant correlation with temperature and rainfall, while significant correlation with relative humidity (r = 0.65 and 0.64) and predatory lady bird beetle (r = 0.98 and 0.97). Gogoi *et al.* (2000) [4] reported that meteorological parameters played an important role in the population buildup of cotton jassid. Meena *et al.* (2010) [10] reported that abiotic parameters (maximum and minimum temperature, rainfall and relative humidity) had non-significant correlation with the population of jassid and whitefly. Nath *et al.* (2011) [12] reported that jassid and whitefly infestation non-significantly correlated with abiotic parameters (maximum and minimum temperature, sun shine hours, rainfall and relative humidity). This difference may be due to different ecological conditions and different crops on which the experiment was conducted.

Lady bird beetle, *M. sexmaculatus*

Besides the pest species, the incidence of predatory ladybird beetle, *M. sexmaculatus* was recorded during the cropping

season. The incidence commenced in the third week of August with a population of 0.80/ five plants. The population of the predator gradually increased and reached to peak (4.70/ five plants) at 34.5 ^{0}C maximum, 22.1 ^{0}C minimum and 71.00 per cent relative humidity in the third week of September, thereafter their population started to decline. The correlation matrix indicated a non-significant correlation with maximum and minimum temperatures (r = -0.05 and 0.29, respectively) and rainfall (r= 0.47), whereas significant correlation with relative humidity (r= 0.61). Its population showed a significant effect on sucking insect pests, jassid and whitefly.

The abundance of predatory lady bird beetle, *M. sexmaculatus* was also recorded during the cropping season. The population commenced in the third week of August, gradually increased and reached to peak in the third week of September, thereafter, started to decline from fourth week of September to fourth week of October. The correlation matrix indicated a non-significant correlation with maximum temperature, minimum temperature and rainfall, while significant correlation with relative humidity. Ladybird beetles showed a significant effect on the pest species. The present findings are in agreement with Meena and Kanwat (2010) [10] who reported that the population *M. sexmaculatus* commenced from first week of August and reached to its peak in first week of October. There were non-significant correlations of maximum temperature and rainfall with *M. sexmaculatus* population, while significant correlation existed with relative humidity.

Table 1: Meteorological observations recorded during the course of study (July 2014 to October, 2014)

Standard Meteorological week (SMW)	Period		Temperature (^{0}C)		Average relative humidity (%)	Total rainfall (mm)
	From	To	Maximum	Minimum		
32	06/08/2014	12/08/2014	29.1	24.0	89.0	31
33	13/08/2014	19/08/2014	31.8	24.6	71.0	00
34	20/08/2014	26/08/2014	36.7	23.7	57.0	00
35	27/08/2014	02/09/2014	34.1	24.1	77.0	17
36	03/09/2014	09/09/2014	29.9	24.1	79.0	40
37	10/09/2014	16/09/2014	31.9	23.2	78.0	36
38	17/09/2014	23/09/2014	34.5	22.1	71.0	00
39	24/09/2014	30/09/2014	34.9	18.8	67.0	00
40	01/10/2014	07/10/2014	36.3	19.3	52.0	00
41	08/10/2014	14/10/2014	34.0	18.4	57.0	08
42	15/10/2014	21/10/2014	30.7	16.4	57.0	07
43	22/10/2014	28/10/2014	34.0	17.6	51.0	01
44	29/10/2014	04/11/2014	31.7	15.4	54.0	00

Table 2: Effect of abiotic and biotic factors on the sucking insect pests on okra crop in *kharif*, 2014

S. N.	Standard Meteorological week (SMW)	Date of observation	Temperature (^{0}c)		Average relative humidity (%)	Total rainfall (mm)	Mean populations/ three leaves		*Menochilus sexmeculatus*/ five plants
			Maximum	Minimum			Jassid	White fly	
1	33	14/08/2014	31.8	24.6	71.0	00	2.80	3.40	0.00
2	34	21/08/2014	36.7	23.7	57.0	00	5.20	6.80	0.80
3	35	28/08/2014	34.1	24.1	77.0	17	10.20	12.40	1.90
4	36	04/09/2014	29.9	24.1	79.0	40	12.20	14.70	2.80
5	37	11/09/2014	31.9	23.2	78.0	36	14.40	16.20	4.50
6	38	18/09/2014	34.5	22.1	71.0	00	16.50	18.80	4.70
7	39	25/09/2014	34.9	18.8	67.0	00	12.20	12.90	2.60
8	40	02/10/2014	36.3	19.3	52.0	00	8.20	10.20	1.60
9	41	09/10/2014	34.0	18.4	57.0	08	6.30	7.80	1.20
10	42	16/10/2014	30.7	16.4	57.0	07	4.40	5.60	0.50
11	43	23/10/2014	34.0	17.6	51.0	01	3.20	3.90	0.30
Correlation coefficient with jassid population			-0.02NS	0.30NS	0.65*	0.45NS	-	-	0.98*
Correlation coefficient with whitefly population			-0.03NS	0.33NS	0.64*	0.48NS	-	-	0.97*
Correlation coefficient with *Menochilus sexmeculatus*			-0.05NS	0.29NS	0.61*	0.47NS	-	-	-

* Significant at 5 per cent level, NS = Non significant

Conclusion

It is concluded that the jassid, *A. biguttula biguttula* and whitefly, *B. tabaci* were observed as major sucking pests feeding on okra. The peak incidence of jassid and whitefly was observed in third week of September and predator population also peaked in third week of September. The population of jassid and whitefly had positive significant correlation with relative humidity and predatory lady bird beetle. Predator, *M. sexmaculatus* population had significant correlation with relative humidity and sucking insects, jassids and whiteflies.

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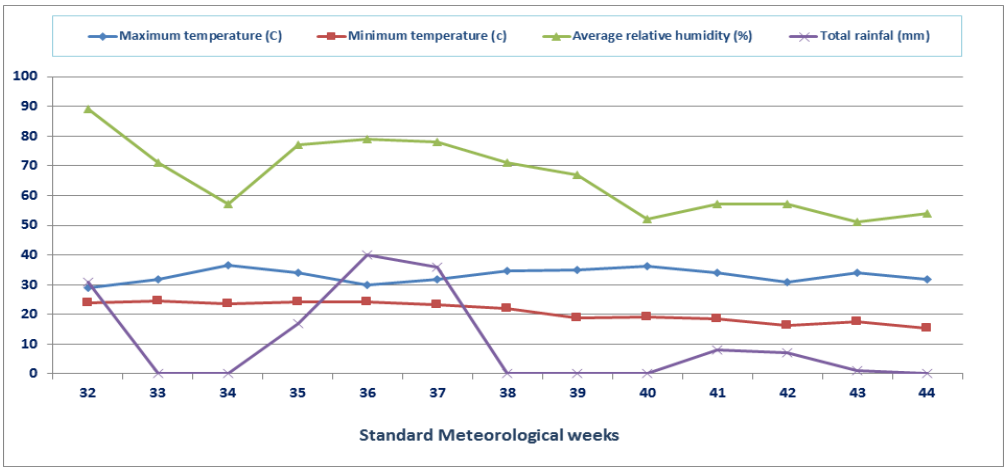

Fig 1: Meteorological observations recorded during the course of study (July 2014 to October, 2014)

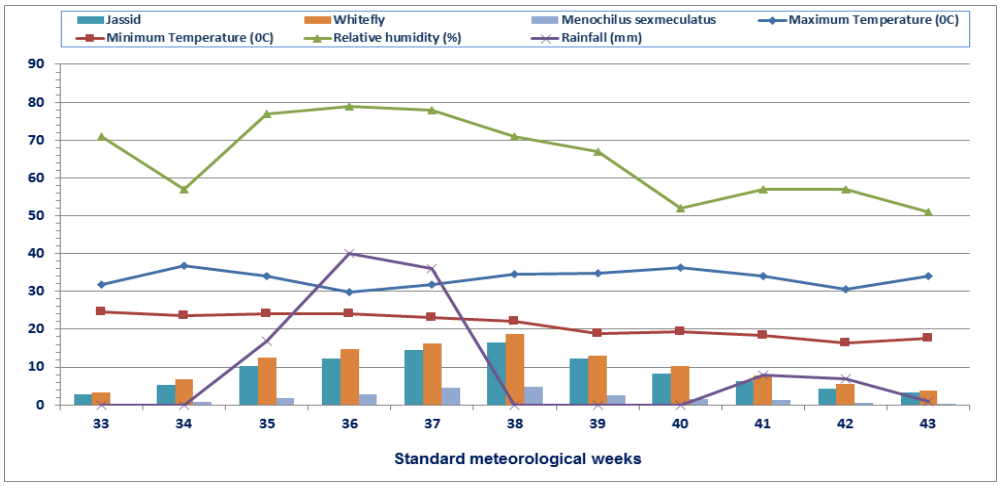

Fig 2: Effect of abiotic and biotic factors on the sucking insect pests on okra crop in *kharif*, 2014

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