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Gummadidala Chaitanya
Student, Msc (Ag), Department of Entomology, SHUATS, Allahabad, Uttar Pradesh, India

Ashwani Kumar
Associate Professor, Department of Entomology, SHUATS, Allahabad, Uttar Pradesh, India

Venna Pushpa Latha
Student (Msc. Ag), Department of Entomology, SHUATS, Allahabad, Uttar Pradesh, India

Correspondence
Gummadidala Chaitanya
Student, Msc (Ag), Department of Entomology, SHUATS, Allahabad, Uttar Pradesh, India

Impact of abiotic factors on the population fluctuations of sucking insect pests (Jassids, white fly) on okra (*Abelmoschus esculentus* L.)

Gummadidala Chaitanya, Ashwani Kumar and Venna Pushpa Latha

Abstract
Impact of abiotic factors on the population fluctuations of sucking insect pests on okra crop were assessed in the present studies conducted at Research farm, Naini Agriculture Institute, Allahabad during Kharif season 2017. Incidence of white fly and jassids are started during 35th SW. However, peak population of Jassids had been observed during 43^{rd} SW and whiteflies peak population was observed at 43rd SW. In the field sucking insect population persisted up to 48th S.W. (1st week of December). The whitefly population was negatively influenced by morning R.H (r = -0.780) evening R.H. (r = -0.422) while negatively (r = -0.396), influenced by rainfall but not significantly influenced by other weather parameters. The Jassids incidence was also negatively influenced by morning R.H. (r = -0.754), Rain fall (r = -0.393)

Keywords: Okra crop, sucking insect population, seasonal incidence and abiotic factors

1. Introduction

Okra or bhindi [*Abelmoschus esculentus* (L.) Moench] also known as lady's finger, is an annual, herbaceous plant belonging to Malvaceae with erect growth habit. It is a bisexual plant with or without branches. Okra is native to Afro-Asian countries but also cultivated widely in India, Nigeria, Pakistan, Ghana, Egypt etc. [1]. In India it was cultivated in an area of 504 '000 ha, out of total vegetable cultivation of 9465 '000 ha with a production of 5794 '000 MT and productivity of 12.0 MT ha-1 during 2015-16 [2]. India being second largest vegetable production countries in the world, has produced 168506 '000 MT of vegetables with a productivity of 17.6 MT ha-1 during 2015-16. Okra fruits are cooked as vegetable, matured pods and stem have been used in paper industry where as whole plant is used as clarifier in jaggary production. The ripen seed of 'okra' are, sometimes roasted and ground as a coffee substitute, while the seed-powder has been used as substitute for the aluminum salts for water purification. Moreover, okra mucilage is suitable for medicinal and industrial applications

Okra crop is susceptible to various pest attacks in the field from early stage to maturity. Among the wide array of insect pests infesting okra crop, the sucking pests viz., aphid, A. gossypii, leafhopper A. biguttula biguttula, and whitefly, B. tabaci, were reported to be quite serious during all stages of the crop growth. Jassids (A. biguttula biguttula), both nymphs and adults, suck the cell sap usually from the ventral surface of the leaves and while feeding inject toxic saliva into plant tissues, turning affected leaves into yellowish and curl. Whitefly (B. tabaci), the milky white minute flies; nymphs and adults suck the cell sap from the leaves. The affected leaves are curled and dried. The affected plants show a stunted growth [4]. Whiteflies are also responsible for transmitting yellow vein mosaic virus. Aphids, (A. gossypii) are considered as the major pest of okra. It is a polyphagous pest, attacking a wide range of plant belonging to 46 families. The nymph and adult are found in large numbers and they suck the sap from different parts of the plants. There are many abiotic factors that favour the growth, development and reproduction of various insect pests, thus limit the production of okra.

2. Materials and Methods

An area of 50 m2 was raised with local okra variety "VRO-6" to study the population build-up of the sucking pest population during Kharif season, 2017 at Agriculture Research Farm, SHUATS, Allahabad. Okra seeds were sowed at a distance of 60 x 30 cm. The experimental plot was kept unsprayed during the course of investigation and all agronomical practices were adopted to render suitable crop growth. The pest population was recorded in this un-protected plot of okra at 7 days interval from the occurrence or initiation of the pest infestation and was continued up to end of the crop.

A total of 25 plants from five locations in the bulk plot @ 5 plants per each sampling area were selected and tagged for recording the observations on sucking pest population. In each plant 3 leaves one each from top, middle and bottom canopy were taken to count the sucking insect population. Weather data were collected from the metrological observatory available at Agriculture Research Farm, Naini Institute of Agricultural Sciences, SHUATS, Allahabad and correlated with the occurrence of the sucking insect population. Among weather parameters, relative humidity, temperature, rainfall and sunshine hours were considered for correlating with the occurrence of the insect pests of okra.

2.1 Statistical analysis

To work out the relationship between the occurrence of the insect pests of okra and the weather parameters, simple correlation method was adopted.

3. Results and Discussion

Impact of abiotic factors on the population fluctuations of sucking insect population The incidence of sucking pest population viz., jassid, A. biguttula biguttula and whitefly, B. tabaci along and correlation with meterological data were presented in Table 1 and Table 2.

Impact of abiotic factors on the population fluctuations of A. bigutula bigutula It can be observed from the data presented in the Table 2 indicated that incidence of jassids on okra crop started during 35th S.W (2 weeks after sowing) and observed up to 48th S.W (1st week of december). The initial mean population per three leaves recorded as 2.34 and the peek incidence was observed in the third week of October (43 rd S.W) with a mean population of 11.92 per three leaves. Thereafter, the population gradually decreased. It is evident from the data (Table 1 and Fig. 1) that, jassid population had nonsignificant, positive correlation with minimum temperature (r =0.066) maximum temperature (r = 0.461), evening R.H. (r = -0.337), and sunshine hours (r = 0.596) while rainfall (-0.393), morning humidity (-0.754) was negatively correlated but found nonsignificant. Incidence of jassids was started during 35th S.W.

Highest incidence of jassids was found during starting of October (43rd S.W) with a mean population of 11.21 per three leaves and at this time existence of maximum temperature (39.86 0C), minimum temperature (18.86 0C), morning R.H. (81.71%), evening R.H. (34.57%), rain fall (0.00 mm) and sunshine (8.97hours) were found suitable for population buildup. After 44 S.W the jassid population gradually declined and observed very least population in the month of November with a mean number of 1.08 jassids per three leaves, after that the jassid population disappeared. The relation of weather parameters and jassid incidence during Kharif season 2017 was worked out The results indicated that significant positive correlation observed between jassid population and maximum temperature (r = 0.461), minimum temperature (r = 0.066), sunshine hours (r = 0.527) while non-significant negative correlation exhibited with rain fall (r = -0.381), morning humidity (-0.754), evening humidity (-0.337) parameter found significant andnegative correlated with jassid incidence. Earlier singh *et al*. and Yadav *et al*. reported that jassid incidence on okra crop was noticed during 2 weeks after sowing and 3 weeks after sowing, respectively. Kulakarni *et al*. Purohit *et al*. and Kumawat *et al*. reported that peak incidence was noticed during end of September and these results more or less similar with the present findings. Further, Srinivasa and Singh *et al*. also found that the peak occurrence of jassids was observed during October month.

Impact of abiotic factors on the population fluctuations of B. tabaci The periodical week wise data on seasonal incidence of whitefly population Table 1 during 2017 revealed that the population was recorded in the range of to 2.34 whiteflies per three leaves from 35th S.W (September) to 48th S.W (November). It is indicating from the data that the population of whiteflies was high in the month of October, thereafter declined gradually and less whitefly population was observed in the month of November (46th S.W). The relationship between whitefly and weather parameters like maximum temperature (r = 0.528), minimum temperature (r = 0.026), and sunshine hours (r = 0.706) was found positive but non-significant while evening R.H. (r = -0.422), Morning R.H. (r = -0.780) rainfall (-0.396) was non-significantly negatively correlated. The appearance of whitefly the present observations are corroborated with the findings of Singh *et al*. and Kulakarni *et al*., who reported as whitefly initiation started 3 weeks after sowing and peak was observed during fortnight of October, respectively. Earlier, Hasan *et al*. reported peak whitefly population when the crop age 60 days old and these results are similar to the present observations. Singh *et al*. also reported that whitefly population gradually declined after peak and least whitefly population observed during 3rd week of November. While comparing the relative incidence, Sharma and Rishi reported a significant positive correlation of whitefly population buildup with relative humidity. The similar results were obtained by Ozur *et al*. and Mohansundaram and Sharma [227], who reported a positive but non-significant correlation of the population with temperature variation. Further a non-significant negative correlation was obtained by Sharma and Rishi (2005) in relation to rainfall and the whitefly population incidence

Table 1: Population dyanamics of whitefly [*Bemesia tabaci* (Gennadius)] during *kharif* season in 2017.

Standard week	Whitefly population / 3 leaves	Temperature		Humidity %		Rainfall (mm)	Wind Velocity	Sunshine (hr/day)
		Max.	Min.	Morning	Evening			
32nd	0	34.82	28	90.57	53.28	7.2	1.11	3.91
33rd	0	34.08	29.51	90	53	0	1.11	7.6
34th	0	35.25	29.34	87.57	52.48	0.6	2.35	7.02
35th	2.3	35.14	29.00	89.85	49.47	2.43	1.95	7.11
36th	4.5	36.77	30.31	83.43	45.14	0	1.64	7.21
37th	5.23	34.72	30.40	83.14	44.00	0	1.37	7.51
38th	4.26	36.00	28.60	89.71	56.57	3.31	1.22	7.89
39th	7.12	36.40	29.82	86.14	48.46	0.14	1.22	8.21
40th	8.20	36.53	30.23	71.00	49.57	0	0.99	8.63
41st	8.50	36.64	22.69	78.00	43.57	0	0.89	8.79
42nd	8.62	37.83	22.77	80.57	42.29	0	1.14	8.91
43rd	10.33	39.86	18.86	81.71	34.57	0	0.99	8.97

44th	7.44	36.46	17.07	84.29	39.14	0	1.07	8.22
45th	4.26	33.14	15.62	86.57	35.57	0	0.76	7.91
46th	2.51	32.14	15.97	90	42.29	0	0.75	7.83
47th	2.05	31.40	11.71	92.00	43.00	0	0.82	7.90
48th	2.00	27.48	8.94	92.24	39.14	0	0.73	7.72
	r	0.528	0.026	-0.780	-0.422	-0.396	-0.220	0.706
	Results	S	NS	S	NS	NS	NS	S

Table 2: Population dyanamics of jassid [*Amrasca biguttula bigutulla* (Ishida)] during *kharif* season in 2017

Standardd week	**Jassids population/ 3 leaves**	**Temperature**		**Humidity %**		**Rainfall (mm)**	**Wind Velocity**	**Sunshine (hr/day)**
		Max.	**Min.**	**Morning**	**Evening**			
32nd	0	34.82	28	90.57	53.28	7.2	1.11	3.91
33rd	0	34.08	29.51	90	53	0	1.11	7.6
34th	0	35.25	29.34	87.57	52.48	0.6	2.35	7.02
35th	2.34	35.14	29.00	89.85	49.47	2.43	1.95	7.11
36th	5.53	36.77	30.31	83.43	45.14	0	1.64	7.21
37th	6.12	34.72	30.40	83.14	44.00	0	1.37	7.51
38th	4.15	36.00	28.60	89.71	56.57	3.31	1.22	7.89
39th	7.56	36.40	29.82	86.14	48.46	0.14	1.22	8.21
40th	8.10	36.53	30.23	71.00	49.57	0	0.99	8.63
41st	8.21	36.64	22.69	78.00	43.57	0	0.89	8.79
42nd	9.00	37.83	22.77	80.57	42.29	0	1.14	8.91
43rd	11.21	39.86	18.86	81.71	34.57	0	0.99	8.97
44th	8.25	36.46	18.83	84.29	39.14	0	1.07	8.91
45th	4.33	33.9	17.83	86.57	35.57	0	0.76	8.22
46th	4.23	32.14	15.97	90	42.29	0	0.75	7.83
47th	3.26	31.40	11.71	92.00	43.00	0	0.82	7.90
48th	3.21	27.48	8.94	92.24	39.14	0	0.73	7.72
	r	0.461	0.066	-0.754	-0.337	-0.393	-0.401	0.596
	Results	S	NS	S	NS	NS	NS	S

5. Conclusion

Incidence of jassids was started during 36th SW (15days after sowing), while initial whitefly infestation was observed during 36th SW (third week after sowing). During study of pests non-significant positive correlation between sucking pests and the abiotic factors like maximum temperature, minimum temperature, and sunshine hours. However, certain parameters like morning and evening RH, rainfall showed non-significant negative correlation during experimentation with sucking insect population

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