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Population dynamics of leafhopper, *Amrasca biguttula biguttula* (Ishida) and whitefly, *Bemisia tabaci* (Gennadius) on okra

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Abstract
The present investigation was Okra leafhopper, *Amrasca biguttula biguttula* (Ishida) and whitefly, *Bemisia tabaci* (Gennadius) on okra was carried out at Central Research Field, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, (U.P.), India. This research was conducted for during *kharif* season (July to December) 2016. The leafhopper/ whitefly was noticed when the crop was in vegetative stage. The data presented in revealed that the infestation of leafhopper/whitefly on okra commenced in the 35th SMW (august last week) (0.8)/ (1.2) i.e. four weeks after sowing which gradually increased and reached to peak (12.40)/ (11.53) in the 42nd SMW (October third week) 35.05^{0}C and 25.7^{0}C maximum and minimum temperatures, 89.7% and 51.8% morning and evening relative humidity and 00.0 mm rainfall. That showed significant positive correlation with sunshine (r= 0.54)/(r= 0.61) while remaining abiotic factors showed non-significant effect. As soon as the fruiting started, the incidence of the insect pest started to decline and disappeared during 48th SMW (November last week).

Keywords: *Amrasca biguttula biguttula, Bemisia tabaci*, Okra, Seasonal incidence

Introduction
Okra *Abelmoschus esculentus* (L.) Moench is most popular vegetable of the family Malvaceae which is locally known as Bhendi and Lady's finger. In India, it is grown both in summer and rainy seasons. It is widely cultivated as a summer crop in North India and also as a winter crop in Gujarat, Andhra Pradesh, Karnataka and Tamil Nadu (Gautam *et al*., 2015) [6].

The major okra growing states includes, West Bengal (14%), Bihar (12%), Gujrat (12%), Andhra Pradesh (10%), Odisha (9%), Jharkhand (7%), Chhattisgarh (7%), Telangana (6%), Madhya Pradesh (5%), Maharastra (4%), Haryana (3%), Assam (3%), Uttar Pradesh (2%), and others (6%) (Anonymous, 2014a). Globally India ranks first in okra production (72% of the total world production) having area of 533 hectares with an annual production of 6346 million tons and productivity of 11.9 million tons/ha. The crop is grown throughout India, Andhra Pradesh is the leading okra producing state which has production of around 1184.2 thousand tons from an area of 78.90 thousand ha, with a productivity of 15 tons ha^{-1}. It is followed by West Bengal (862.1 thousand tons from 74.00 thousand ha with 11.70 tons/ha productivity. In Uttar Pradesh area, production and productivity of okra is 12.19 ha, 148.64 tones, 12.2 metric tons per hectare (Anonymous 2015-16).

The importance of vegetable in human diet is well known since time immemorial as they supply all main component of human diet. Among vegetables okra is tender fruits and used as vegetables or in culinary preparations as sliced and dried pieces. It is also used for thickening gravies and soups, because of its high mucilage content. The roots and stems of okra are used for cleaning cane juice. Matured fruits and stems containing crude fiber are used in paper industry. It has good nutritional value, particularly the high content of Vitamin C (30 mg/100 g), Calcium (90 mg/100 g), Iron (1.5 mg/100 g) and other minerals like magnesium and potassium, Vitamin A and B, fats and carbohydrates (Singh *et al*., 2013) [14]

Table 1: Nutritional value per 100 g of okra

Contains	Unit	Contains	Unit
Energy	33kcal	Riboflavin(B_2)	0.06mg (5%)
carbohydrates	7.45 g (140 kj)	Vitamin C	23mg (28%)
sugars	1.48 g	Vitamin E	0.27 mg (2%)
dietary fibers	3.2 g	Vitamin K	31.3 µg (30%)
Fat	0.19g	calcium	82mg (8%)
protein	2g	iron	0.62 mg (5%)
water	90.19g	magnesium	57 mg (16%)
Vitamin A	36µg (7%)	potassium	299mg (6%)
Thiamine(B_1)	0.2 mg (17%)	zinc	0.58 mg (6%)

(Kumar *et al*., 2013) [9] The pest problem is the main limiting factor in the production of okra. Among, 72 species of insects attacking okra, the most serious pests are leafhopper [*Amrasca biguttula bigutulla* (Ishida)], whitefly [*Bemisia tabaci* (Gen.)] aphid, [*Aphis gossypii* (Glover)], shoot and fruit borer [*Earias insulana* (Boisduval) and *E. vitella* (Fab.)] and American bollworm [*Helicoverpa armigera* (Hub.)] (Rawat and Saha, 1973) [12]. These pests are most serious causing 45-57.1% damage to fruits (Shrinivasan and Krishna Kumar, 1983 and Nderitu *et al*., 2008) [11]. On the other hand, the sucking pest complex of okra consisting of aphid, leaf hopper, white flies, thrips and mites causes 17.46% yield loss and if failure to control them in initial stages, damage was reported to cause 54.04% yield loss (Chaudhary and Daderch, 1989 and Anitha and Nandihalli, 2008) [5, 1].

Materials and Methods

The study on population dynamics of leafhoppers, *Amrasca biguttula biguttula* (Ishida) and whiteflie, *Bemisia tabaci* (Gennadius) was the conducted at the Central Research Field, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, (U.P.), India. during *kharif* season (Jul.-Oct.) 2016. On okra variety BND 777 were sown @ 10 kg.ha-1 by dibbling method. Plot size : 2m x 1m, Total no. of plots : 24, Seed rate : 10 kg/ha, Row to row distance : 45cm, Plant to plant : 30cm.

The observation was recorded on weekly intervals throughout the cropping season. To assess the incidence of different sucking pest per plant was counted and recorded at weekly intervals on randomly selected plants. The observations on number of leafhoppers *(Amrasca biguttula biguttula)* and whiteflies *(Bemisia tabaci)* was recorded from top, middle and bottom three leaves from each designated plants.

The results showed that earliest occurrence of insect leafhoppers *(Amrasca biguttula biguttula)* and whiteflies *(Bemisia tabaci)* season commenced from 35th standard week (August fourth week) with an average population of 0.8 and 1.20 insect. The population increased and gradually reached peak level of 12.4 insect at 42nd standard week (October third week) and 11.53 insect at 41th standard week (October second week). Table No.2. That is Weekly meteorological data throughout the experimental period was procured from the Meteorological Department, SHUATS.

Results and Discussion

Have been presented in this chapter along with discussion on the experimental finding in the light of scientific reasoning and their conformity with the previous researchers.

Leafhopper

The results showed that earliest occurrence of leafhopper, *Amrasca biguttula biguttula* (Ishida) in 2016 *kharif* season commenced from 35th standard week (August fourth week) with an average population of 0.8 insect. The population increased and gradually reached peak level of 12.4 insect at 42nd standard week (October third week) Table 4.1. Thereafter, declined trend was observed due to fall of maximum and minimum temperatures as optimum weather condition are decreasing.

Among all the weather parameter only sunshine (hr/day) 0.541 was significant and positively correlated with leafhopper population, whereas temperature max. and mini. and humidity evening were positively correlated but non-significant.

Results are in close agreement with, Mohapatra (2008) [10] who reported that the pest infested the crop from 30th std. week to 50th std week. And the peak population of *A. biguttula biguttula, B. tabaci* was attained during 41st std. week. Similarly, Kalkal *et al*. (2015) [8] observed the puputaion of leafhopper which were significant and positively correlated with temperature while negatively correlated with rainfall.

Whitefly

The results showed that earliest occurrence of whitefly, *Bemesia tabaci* (Gennadius) in 2016 *kharif* season commenced from 35th standard week (August fourth week) with an average population of 1.20 insect. The population increased and gradually reached peak level of 11.53 insect at 41th standard week (October second week). (Table 4.1).Thereafter, declined trend was observed due to fall of maximum and minimum temperatures as optimum weather condition are decreasing.

Among all the weather parameter only sunshine (hr/day) 0.611 was significant and positively correlated with whitefly population, whereas temperature max. and mini. and humidity evening were positively correlated but non-significant. Results are close agreement with, Mohapatra (2008) [10] infested the crop from30th std. week to 50th std week. Peak population of *B. tabaci* was attained during 44th std., week (oct. 29- Nov. 4) Similarly, Ghosh (2014) [7] reported that peak incidence of *Bemisia tabaci* on okra was during 42nd-43rd standard meteorological week.

Table 2: Population dynamics of leafhopper, *Amrasca biguttula biguttula* (Ishida) and whitefly, *Bemesia tabaci* (Gennadius) during *kharif* season in 2016.

Standard week	Leafhopper (/3 leaves)	Whitefly (/3 leaves)	Temperature (^{0}C)		Humidity (%)		Rainfall (mm)	Wind Velocity (km/hr)	Sunshine (hr/day)
			Max.	Min.	Morning	Evening			
32	0	0	33.80	27.14	88.20	55.40	4.30	1.28	5.10
33	0	0	33.10	27.00	91.70	56.70	25.90	2.22	2.70
34	0	0	34.40	27.10	88.70	55.70	6.20	2.55	5.60
35	0.80	1.20	35.80	27.20	90.50	53.40	6.90	1.68	5.00
36	2.80	3.93	35.10	27.20	87.80	53.80	0.60	2.20	8.00
37	5.67	6.27	35.20	27.20	89.40	54.20	4.90	1.20	8.30
38	8.33	7.20	33.20	26.87	89.14	62.50	1.10	0.80	6.60
39	8.93	9.27	30.20	26.20	89.40	66.20	8.02	0.60	5.20
40	10.40	10.60	34.60	26.60	87.40	53.80	6.30	2.20	7.40
41	11.53	11.80	34.40	26.30	89.80	52.20	1.40	1.01	8.50
42	12.40	11.53	35.05	25.70	89.70	51.80	0	0.80	8.70
43	12.13	10.27	34.30	24.80	90.20	53.70	0	1.01	8.70
44	9.13	8.67	33.90	19.80	90.70	54.40	0	1.08	8.50
45	7.53	6.73	33.14	18.20	91.80	55.70	0	1.02	6.90
46	3.33	4.47	32.70	16.90	91.40	53.80	0	0.60	8.50
47	0	2.53	31.90	15.30	92.00	48.50	0	0.60	8.40
48	0	0	29.50	15.15	92.80	54.00	0	0.50	6.30

Table 3: Correlation between leafhopper, *Amrasca biguttula biguttula* (Ishida) and whitefly, *Bemesia tabaci* (Gennadius) weather parameter during *kharif* season 2016.

	Leafhopper *Amrasca biguttula biguttula*			Whitefly *Bemesia tabaci*		
	r value	F -test	T -test	r value	F -test	T -test
Temp. Max. (^{0}C)	0.216	NS	0.855	0.209	NS	0.801
Temp. Min. (^{0}C)	0.192	NS	0.758	0.153	NS	0.598
Humidity Morning (%)	-0.259	NS	1.039	-0.266	NS	1.067
Humidity Evening (%)	0.144	NS	0.564	0.084	NS	0.325
Rainfall (mm)	-0.326	NS	1.338	-0.353	NS	1.460
Wind velocity (km/hr)	-0.276	NS	1.114	-0.299	NS	1.212
Sunshine (hr/day)	0.541	S	2.494	0.611	S	2.990

T table = 2.31

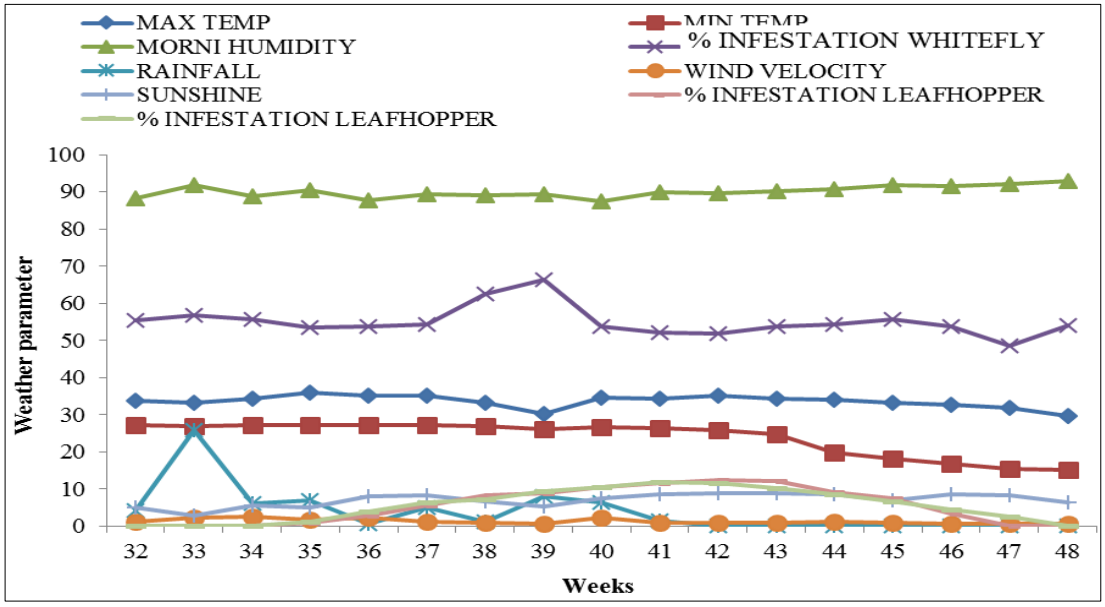

Fig 1: Population dynamics of leafhopper, *Amrasca biguttula biguttula* (Ishida) and whitefly, *Bemesia tabaci* (Gennadius) during *kharif* season in 2016

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