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Effect of abiotic factors on sucking insect-pests of okra, *Abelmoschus esculentus* (L.) Moench in western plain zone of U.P.

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Abstract
The present investigation was carried out to study the effect of abiotic factors on sucking insect-pests of okra in Western Plain Zone of U.P. in randomized block design with three replications and nine treatments at Horticulture Research Centre of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut. At weekly intervals, insect-pest population were recorded by randomly selecting five plants per plot. The population of white flies (*Bemisia tabaci*), jassid (*Amrasca biguttula biguttula*) and aphid (*Aphis gossypii*) were recorded on three leaves (top, middle and bottom leaves of the plant). On 22nd August during 34th SW (20th to 26th August) the aphid, *Aphis gossypii* (Glover) was first recorded. The major activity period was noted from August to September. The maximum activities of insects were observed during 35th SW (27th August to 2nd September). During this period highest and lowest temperature were 32.6°C and 21.1°C respectively, whereas, morning and evening relative humidity were 88.3 and 38.7% respectively. On 29 July during 34th SW (20th to 26th August) the jassid, *A. biguttula biguttula* was first recorded. Major activity period of insects were August to September. On 22nd August during 34th SW (20th to 26th August) the whitefly, *Bemisia tabaci* Genn. Was first recorded.

Keywords: Population dynamics, temperature, white fly, fruit borer, bhindi

Introduction
Okra (*Abelmoschus esculentus* L.) is an important vegetable crop grown throughout the year in India. Okra (bhindi) belongs to family Malvaceae. It is grown in many tropical and subtropical parts of the world. The soft okra fruits are used as vegetables or in culinary preparations as sliced and dried pieces. Thickening gravies and soups of okra are used because of its high mucilage content. Okra's roots and stems are used for cleaning cane juice (Chauhan, 1972) [3]. It has superior nutritional value, particularly the high content of calcium (90 mg/100g), vitamin C (30mg/100 g), iron (1.5 mg/100 g) and additional minerals like magnesium and potassium, fats and carbohydrates, vitamin A and B (Aykroud, 1963) [2]. As high as 72 species of insects- pest have been recorded on okra (Srinivas Rao and Rajendran, 2003) [9] of which, the sucking pests comprising of mite (*Tetranychus cinnabarinus* Boisduval), Aphids (*Aphis gossypii* Glover), whitefly (*Bemisia tabaci* Gennadius) and leafhopper (*Amrasca biguttula biguttula* Ishida), causes major damage to the crop. Fruit borers later stage cause considerable losses to the crop to the tune of 91.6 per cent (Pareek and Bhargava, 2003) [8]. Krishnaiah (1980) [5] reported about 40-56 per cent losses in okra caused by insects. Besides various reasons for low productivity, heavy damage is inflicted by fruit borer and causes direct losses in yield of marketable fruits and vitality of plant resulting in 54.04 per cent net yield loss (Sivakumar *et al*., 2003) [10]. Okra shoot and fruit borer, *Earias vittella* (Fab.) is one of the key insect of okra. This pest causes 36-90 % loss in the fruit yield of okra (Misra *et al*., 2002) [7]. 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. 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.

Materials and Methods

The experiment was conducted at Horticulture Research Centre (HRC) of the Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, (Uttar Pradesh) India during *Kharif* 2018. An okra variety Improved Bhindi Kiran-397 was sown in 2nd week of June 2018. In the experiment Randomized Block Design (RBD) was used with three replications and nine treatments including control. The plot size for each treatment was kept 4 x 3 m^2 and spacing between rows and plant was kept 45×30 cm. Population of whitefly, jassid, aphid (total nymphs + adults) were noticed on six leaves per plant viz., each from 2 top, 2 middle and 2 bottom plant canopy. The incidence of shoot and fruit borer (*Earias* spp.) was recorded on the basis of per cent fruit damage. These observations were recorded in unprocessed plots. Observations of weather data (higher and lower temperature, sunshine and evening relative humidity, wind speed, sun shine hours, total rainfall per week, no. of rainy days per week, morning and evening vapour pressure and evaporation etc.) were noticed at Horticulture Research Centre (HRC) of the Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, (Uttar Pradesh) India.

Results & Discussion

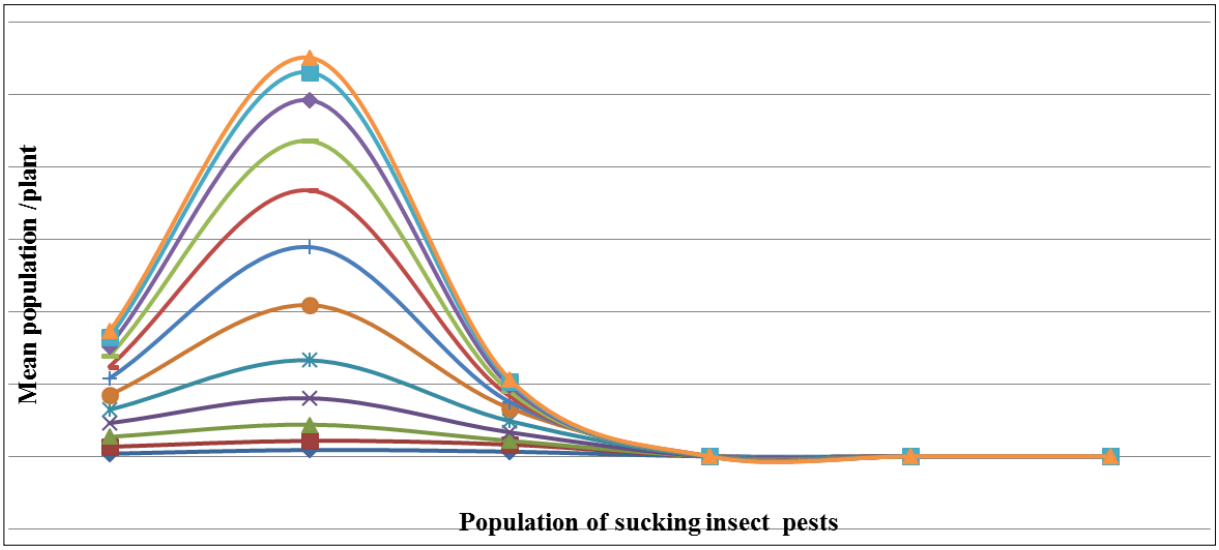
At weekly interval the major insect pest population was recorded on randomly selected 5 plants per plot. On three leaves (upper, middle and lower leaves of the plant) the population of aphids (*Aphis gossypii*), jassids (*Amrasca biguttula biguttula*), whiteflies (*Bemisia tabaci*) and thrips (*Thrips tabaci*) was recorded. The aphid, *Aphis gossypii* (Glover) was first recorded on 22nd August during 34th SW (20th to 26th August). The major activity period was recorded from August to September. The peak activity of the pest during 35th SW (27th August to 2nd September). During this period highest and lowest temperature were 32.6°C and 21.1°C respectively, whereas, sunrise and sunset relative humidity were 88.3 and 38.7% respectively. On 29 July during 34th SW (20th to 26th August) the jassid, *A. biguttula biguttula* was first recorded. August to September was the Major activity period. On 22nd August during 34thSW (20th to 26th August) whitefly *Bemisia tabaci* (Genn.) was first recorded. From August, the major activity period was recorded. In conformity to the present findings Aarwe (2016) [1] reported two highest point of infestation of *A. biguttula biguttula* during 36th and 37th SW at Jabalpur. In conformity to the present findings, the interactions between the aphid and weather parameters showed positive correlation with rainfall and relative humidity, while negative correlation with maximum and minimum temperature respectively. In supportive to the present findings Nath *et al.* (2011) [6] reported the highest point of infestation activity of *B. tabaci* was recorded 33rd SW. Whereas Harinkhere (2014) [4] recorded the highest point of infestation of whitefly during 44th SW of Jabalpur.

Conclusion

On 22nd August during 34th SW the aphid *Aphis gossypii* (Glover) was first recorded. In the month of August to September, the major activity period was recorded. The peak activity of the pest during 35th SW. On 29 July during 34th SW the jassid, *A. biguttula biguttula* was first recorded. August to September was the major activity period. The whitefly, *Bemisia tabaci* Genn. Was first recorded on 22nd August during 34th SW. In the month of August the major activity period was recorded.

Table 1: Population with respect to the effect of abiotic factors on sucking insect pest of okra

Insect pest/natural enemies			SMW/Date of observation (mean population/plant) (population/plant) (population/plant)										Overall mean
	29 22/7/18	30 29/07	31 5/08	32 12/08	33 19/08	34 26/08	35 2/09	36 09/09	37 16/09	38 23/09	39 30/09	40 7/10	
Jassid	1.83	4.5	6.87	9.31	9.50	10.23	11.36	8.12	7.44	6.90	5.90	4.22	7.20
Aphid	4.42	6.33	11.21	18.25	26.22	38.25	40.17	39.24	34.16	28.26	19.32	10.12	22.99
Whitefly	3.23	4.87	2.69	5.81	7.80	8.89	4.35	3.85	3.42	3.75	2.85	1.75	4.44



Graph 1: Weekly population of sucking insect pests of okra during *Kharif* 2018.

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