Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

J P P Journal of Pharmacognosy and Phytochemistry

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; 6(3): 30-34
Received: 16-03-2017
Accepted: 17-04-2017

Jitendra Nagar
Department of Entomology, SKN College of Agriculture, SKN Agriculture University, Jobner, Rajasthan, India

SK Khinchi
Department of Entomology, SKN College of Agriculture, SKN Agriculture University, Jobner, Rajasthan, India

KC Kumawat
Department of Entomology, SKN College of Agriculture, SKN Agriculture University, Jobner, Rajasthan, India

Anita Sharma
Department of Entomology, SKN College of Agriculture, SKN Agriculture University, Jobner, Rajasthan, India

Correspondence
Jitendra Nagar
Department of Entomology, SKN College of Agriculture, SKN Agriculture University, Jobner, Rajasthan, India

Screening different varieties of okra [*Abelmoschus esculentus* (L.) Moench] against sucking insect pests

Jitendra Nagar, SK Khinchi, KC Kumawat and Anita Sharma

Abstract
Out of nine varieties of okra, *Abelmoschus esculentus* (L.) Moench screened against the sucking insect pests [leaf hopper, *Amrasca biguttula biguttula* (Ishida); whitefly, *Bemisia tabaci (*Genn.)], none of the variety was found completely free from the infestation of leaf hopper and whitefly, although they differed significantly in their degree of damage and pest number to harbour. The varieties IIVR-11and IIVR-10 were found as least susceptible, varieties Hisar Unnat, Pusa A-4, Versa Uphar, Pusa Sawani, Aparajita and Ankur-40 as moderately susceptible; and variety Anika as highly susceptible to the leaf hopper. The varieties IIVR-11 and IIVR-10 were found as least susceptible, varieties Hisar Unnat, Pusa A-4, Versa Uphar, Pusa Sawani and Aparajita as moderately susceptible; and varieties Ankur-40 and Anika as highly susceptible to the whitefly infestation. The morphological characters, *viz.,* plant height and days to initiation of flowering of different varieties of okra had positive significant effect on the infestation of leaf hopper and whitefly. Length and width of fruits had significant positive effect on infestation of leaf hopper while non-significant effect on infestation of whitefly. Hairiness (on shoot, leaf and fruit) and number of fruits per plant had negative significant effect on the infestation of leaf hopper and whitefly.

Keywords: Varieties screening, okra, Amrasca biguttula biguttula, Bemisia tabaci

1. 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, occupying an area over 532.66 thousand hectares with an annual production 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]. The okra crop is attacked by a number of insect pests right from germination to harvesting, viz., leaf hopper, Amrasca biguttula biguttula (Ishida); aphid, Aphis gossypii (Glover); whitefly, Bemisia tabaci (Genn.); shoot and fruit borer, Earias insulana (Boisd.) and E. 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, leaf hopper, 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]
Leaf hoppers suck the cell sap from lower surface of the leaves and inject toxic substances resulting in curling of leaves, as a result the plant growth is retarded. The severe infestation of the pest causes burning of leaves which fall later and results in 40-60 per cent decrease in yield. Whitefly transmits viral diseases from diseased to healthy plants as a vector (Narke and Suryawanshi, 1987) [10]. In order to prevent the infestation of the pests and to produce a quality crop, it is essential to manage the pest population with suitable measures. The resistant varieties of crops offer insect pest management at no additional cost. An insect resistant plant offer ideal prevention against insect damage, involved minimum cost of production and are eco-friendly. The use of resistant varieties is one of the most economical and effective methods of control. Keeping this in view, the present studies were undertaken to screen out some okra varieties against sucking insect pests.

2. Material and Methods
The experiment was conducted at Horticulture farm of S.K.N. College of agriculture, Jobner (Rajasthan) on okra crop under field conditions during *kharif*, 2014. Geographically, Jobner is located at longitude of 78º 28' east, latitude of 26º 26' north and at an elevation of 427 meter from Mean Sea Level (MSL) in Jaipur district of Rajasthan.

2.1 Layout and design
The experiment was laid out in simple Randomized Block Design (RBD) with nine varieties as treatments, each replicated thrice. Each variety was sown in individual plot of size of 2.10 x 1.8 $m^{2.}$ The spacing between row to row and plant to plant was kept 45 cm and 30 cm, respectively. All the recommendations as per package of practices were followed to raise the crop.

2.2 Method of observations
The observations were recorded at weekly interval right form their appearance to last picking of fruits of the crop. The population of sucking insect pests, *viz*., leaf hopper 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.

2.3 Leaf hopper, *A. biguttula biguttula*
The population of leaf hoppers was recorded by counting both nymphs and adults as per method described by Rawat and Sahu (1973) [12]. Counting of the leaf hoppers was done on three leaves, *i.e.* top, middle and bottom of each tagged plant.

2.4 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.

2.5 Harvesting
The green and tender fruits of marketable size were harvested manually at an interval of three days.

2.6 Interpretation of data
The data obtained on insect populations from experimental field were subjected to analysis of variance after transforming into $\sqrt{x+0.5}$. The mean insect populations of okra varieties recorded during the crop season were categorized on the basis of the following formula:

$$\bar{x} \pm \sigma$$

Where,
$\bar{x}$ = Mean of peak population
σ = Standard deviation of insect population

Mean insect population Per plant/ three leaves	Category
Below $\bar{x} - \sigma$	less susceptible
$\bar{x} - \sigma$ to $\bar{x} + \sigma$	moderately susceptible
Above $\bar{x} + \sigma$	highly susceptible

2.7 Morphological characters of okra varieties
The morphological characters of okra varieties *viz.,* plant height, hairiness (shoots, leaves and fruits), days to initiation of flowering, length and width of fruits and number of fruits per plant were recorded and correlate to the infestation of sucking insect pests on different okra varieties. Five plants from each replication of each variety were selected at last picking of fruits and the height was measured from the ground level to the tip of the main stem with the help of meter scale and then averaged out. To observe the hairiness, the discs of $1mm^2$ size were taken from shoots, leaves and fruits of randomly selected five plants in each plot. A binocular microscope was used to observe hairiness on selected discs. The number of hairs (trichomes) counted on each discs and then averaged out (Ramalho *et al.*, 1984) [11]. Days to flower initiation was recorded as the number of days taken from the sowing to flower initiation on randomly selected five plants in each plot and then averaged out. At the time of last picking five fruits of average size from each variety were selected in three replications. The length of fruits was measured from base to tip of the fruits and then averaged out. The width of fruits was measured from two points on each side of middle of fruit in such a way that ¼ th of fruit length was left on each end and then averaged out. The number of fruits per plant were recorded by counting total number of fruits on randomly selected five plants in each plot and then averaged out. The data on morphological characters were subjected to analysis of simple correlation with peak infestation of sucking insect pests on different okra varieties.

3. Results and Discussion
The certain varieties or strains of crops are attacked lesser by insects than others because of natural resistance. To minimize the losses caused by insect pests, growing of resistance varieties is one of the most important tools currently employed in the investigation. Nine varieties of okra were screened for their relative susceptibility to sucking insect pests. There were two sucking insect pests, *viz.,* Leaf hopper, *A. biguttula biguttula* and whitefly, *B. tabaci* observed infesting okra varieties.

3.1 Leaf hopper, *A. biguttula biguttula*
The data presented in the table1 revealed that none of the varieties of okra found completely free from the attack of leaf hopper. The infestation of leaf hopper was first observed in the second week of August (three weeks after sowing). Initially (on 14.08.14), the mean leaf hopper population ranged from 1.20 to 3.30/ three leaves. The maximum mean leaf hopper population was observed on variety Anika (3.30/ three leaves) followed by Ankur-40 (3.20/ three leaves) and these were found statistically at par with each other. Minimum leaf hopper population was observed on IIVR-11 (1.20/ three leaves) followed by Hisar Unnat (1.30/ three leaves) and Pusa A-4 (1.40/ three leaves). Variety IIVR-11 was found statistically at par with Hisar Unnat and Pusa A-4. In rest of the varieties, *i.e*., IIVR-10 (1.60/ three leaves), Versa Uphar (2.40/ three leaves), Pusa Sawani (2.50/ three leaves) and Aparajita (2.80/ three leaves) leaf hopper population were observed. The infestation of leaf hopper increased gradually and reached to its peak in third week of September, showed the mean leaf hopper population ranged from 11.20 to 20.30/ three leaves. The maximum infestation was observed on variety Anika (20.30/ three leaves) followed by Aparajita (18.40/ three leaves) and Ankur-40 (17.50/ three leaves), these were statistically differed with each other and found significantly inferior over rest of the varieties. The minimum infestation was observed on IIVR-10 (11.20/ three leaves) followed by IIVR-11 (11.60/ three leaves) and Hisar Unnat (13.20/ three leaves) and found significantly superior over rest of the varieties. The variety IIVR-10 was found statistically at par with variety IIVR-11. Varieties, Pusa A-4 (14.80/ three leaves), Pusa Sawani (15.80/ three leaves) and Versa Uphar (16.40/ three leaves) were stood in middle order of infestation. The mean leaf hopper population at all the intervals ranged from 5.04 to 11.41/ three leaves. The

maximum leaf hopper population was observed on variety Anika (11.41/ three leaves) followed by Ankur-40 (9.48/ three leaves) and Aparajita (9.08/ three leaves). The variety Ankur-40 was statistically at par with Aparajita. Minimum leaf hopper population was observed on variety IIVR-11 (5.04/ three leaves) followed by IIVR-10 (5.69/ three leaves) and Hisar Unnat (6.29/ three leaves). The variety IIVR-11 was found statistically at par with IIVR-10. The mean leaf hopper population on varieties, Pusa Sawani (8.85/ three leaves), Versa Uphar (8.25/ three leaves) and Pusa A-4 (6.81/ three leaves) were observed. These statistically differed with each other and categorized in middle order of infestation. According to mean leaf hopper population, the okra varieties were categorized as least susceptible (Mean leaf hopper population below 5.82/ three leaves), moderately susceptible (5.82 to 9.94/ three leaves) and highly susceptible (above 9.94/ three leaves) by considering the mean leaf hopper population on the basis of formula $\bar{x} \pm \sigma$. According to these criteria, the varieties IIVR-11and IIVR-10 were rated as least susceptible. The varieties, Hisar Unnat, Pusa A-4, Versa Uphar, Pusa Sawani, Aparajita and Ankur-40 were rated as moderately susceptible and variety Anika as highly susceptible. Based on the mean leaf hopper population at all the intervals, the ascending order of susceptibility of okra varieties against leaf hopper was IIVR-11 < IIVR-10 < Hisar Unnat < Pusa A-4 < Versa Uphar < Pusa Sawani < Aparajita < Ankur-40 < Anika.

The mean leaf hopper population varied from 5.04 (IIVR-11) to 11.41/ three leaves (Anika) in the present investigation. The results got support from the observations of Gonde *et al.* (2012) [4] who reported leaf hopper population 1.66 to 4.18/ leaf on different varieties of okra. The mean leaf hopper population was 6.29/ three leaves on variety, Hisar Unnat which existed as moderately susceptible in present results corroborate with the work of Meena (2004) [8] who reported leaf hopper population (3.47/leaves) on variety Hisar Unnat. The varieties Pusa A-4, Versa Uphar, Aparajita and Ankur-40 were existed as moderately susceptible in present experiment. The results get support with those of Mahal *et al.* (1991) [6], Mahal *et al.* (1993) [7], Kumar and Singh (2002) [5] and Bhat *et al.* (2007) [2] who found these varieties as moderately susceptible. The variety Pusa Sawani which was rated as moderately susceptible in present results did not get support from the observations of Gonde *et al.* (2012) [4] who reported that the variety Pusa Sawani was most preferred by leaf hopper.

Table 1: Screening of different varieties of okra against leaf hopper, A. biguttula biguttula in kharif, 2014

S. No.	Varieties	Mean jassid population/ three leaves*											
		14.08. 2014	21.08. 2014	28.08. 2014	04.09. 2014	11.09. 2014	18.09.2 014**	25.09 .2014	02.10. 2014	09.10. 2014	16.10. 2014	23.10. 2014	Mean
1.	IIVR-10	1.60	3.20	7.60	8.10	9.40	11.20	6.20	5.60	3.70	3.20	2.80	5.69
		(1.45)	(1.92)	(2.85)	(2.93)	(3.15)	(3.42)	(2.59)	(2.47)	(2.05)	(1.92)	(1.82)	(2.48)
2.	IIVR-11	1.20	2.40	4.40	7.80	9.20	11.60	5.20	4.60	3.80	3.10	2.20	5.04
		(1.30)	(1.70)	(2.21)	(2.88)	(3.11)	(3.48)	(2.39)	(2.26)	(2.07)	(1.90)	(1.64)	(2.35)
3.	Pusa A-4	1.40	2.50	6.20	9.60	11.20	14.80	9.50	6.20	5.80	4.60	3.10	6.81
		(1.38)	(1.73)	(2.59)	(3.18)	(3.42)	(3.91)	(3.16)	(2.59)	(2.51)	(2.26)	(1.90)	(2.70)
4.	Versa Uphar	2.40	4.40	9.40	12.20	14.80	16.40	10.40	7.60	5.40	4.40	3.40	8.25
		(1.70)	(2.21)	(3.15)	(3.56)	(3.91)	(4.11)	(3.30)	(2.85)	(2.43)	(2.21)	(1.97)	(2.96)
5.	Hisar unnat	1.30	2.80	8.80	10.20	11.40	13.20	6.50	4.80	4.20	3.80	2.20	6.29
		(1.34)	(1.82)	(3.05)	(3.27)	(3.45)	(3.70)	(2.65)	(2.30)	(2.17)	(2.07)	(1.64)	(2.61)
6.	Aparajita	2.80	5.20	10.50	13.20	15.80	18.40	10.40	8.50	6.70	5.20	3.20	9.08
		(1.82)	(2.39)	(3.32)	(3.70)	(4.04)	(4.35)	(3.30)	(3.00)	(2.68)	(2.39)	(1.92)	(3.09)
7.	Ankur40	3.20	6.50	9.60	12.50	16.20	17.50	13.30	9.40	7.50	5.20	3.40	9.48
		(1.92)	(2.65)	(3.18)	(3.61)	(4.09)	(4.24)	(3.71)	(3.15)	(2.83)	(2.39)	(1.97)	(3.15)
8.	Pusa sawani	2.50	6.20	9.80	13.20	14.20	15.80	11.20	9.20	7.20	5.20	2.80	8.85
		(1.73)	(2.59)	(3.21)	(3.70)	(3.83)	(4.04)	(3.42)	(3.11)	(2.77)	(2.39)	(1.82)	(3.06)
9.	Anika	3.30	7.20	13.60	15.20	17.50	20.30	16.60	12.40	8.60	6.50	4.30	11.41
		(1.95)	(2.77)	(3.75)	(3.96)	(4.24)	(4.56)	(4.14)	(3.59)	(3.02)	(2.65)	(2.19)	(3.45)
	S.E.m±	0.033	0.059	0.080	0.086	0.089	0.092	0.066	0.069	0.071	0.060	0.042	0.074
	CD at 5%	0.100	0.178	0.239	0.259	0.265	0.276	0.198	0.206	0.214	0.179	0.126	0.223

* Mean of three replications

** Peak population of jassid

Figures in the parentheses are $\sqrt{x+0.5}$ values

3.2 Whitefly, *B. tabaci*

The data presented in the table 2 revealed that none of the varieties of okra were found completely free from the attack of whitefly. The infestation of whitefly was first observed in the second week of August (three weeks after sowing). Initially, the mean whitefly population ranged from 0.40 to 3.80/ three leaves. The maximum mean whitefly population was observed on variety Ankur-40 (3.80/ three leaves) followed by Anika (3.60/ three leaves) and Aparajita (3.40/ three leaves) and Ankur-40 variety was found at par with Anika. Minimum whitefly population was observed on variety IIVR-11 (0.40 per three leaves) followed by Hisar Unnat (0.60 per three leaves) and IIVR-10 (0.90/ three leaves) and IIVR-11 was found statistically at par with Hisar Unnat. In rest of the varieties, *i.e.,* Versa Uphar (1.30/ three leaves), Pusa A-4 (1.40/ three leaves) and Pusa Sawani (3.20/ three leaves) whitefly population were observed and variety Versa Uphar was found statistically at par with Pusa A-4. The infestation of whitefly increased gradually and reached to its peak in third week of September. The mean whitefly population ranged from 12.40 to 22.50/ three leaves. The maximum whitefly population was observed on variety Anika (22.50/ three leaves) followed by Aparajita (21.40/ three leaves) and Ankur-40 (20.30/ three leaves). These were statistically differed with each other and found significantly inferior over rest of the varieties. The lowest infestation of whitefly was observed on variety IIVR-10 (12.40/ three leaves) followed by IIVR-11 (15.20/ three leaves) and Hisar Unnat (16.30/ three leaves), these were found significantly superior over rest of the varieties. The variety IIVR-11 was found at par with Hisar Unnat. The varieties, Pusa A-4 (17.60/

three leaves), Pusa Sawani (18.30/ three leaves) and Versa Uphar (19.20/ three leaves) whitefly population was observed and categorized in middle order of infestation. The mean whitefly population at all the intervals ranged from 6.10 to 12.41/ three leaves. The maximum whitefly population was observed on variety Anika (12.41/ three leaves) followed by Ankur-40 (11.50/ three leaves) and Aparajita (11.00/ three leaves), these were differed significantly with each other. Minimum whitefly population was observed on variety IIVR-11 (6.10/ three leaves) followed by IIVR-10 (6.50/ three leaves) and Hisar Unnat (7.45/ three leaves). The varieties, Pusa A-4, Versa Uphar and Pusa Sawani along with mean whitefly population was 8.48, 9.10 and 10.00/ three leaves, respectively and categorized as middle order of infestation.

According to mean whitefly population, the okra varieties were categorized as least susceptible (Mean whitefly population below 6.94/ three leaves), moderately susceptible (6.94 to 11.40/ three leaves) and highly susceptible (above 11.40/ three leaves) by considering the mean whitefly population on the basis of formula $\bar{x} \pm \sigma$. According to these criteria, the varieties IIVR-11 and IIVR-10 were rated as least susceptible. The varieties, Hisar Unnat, Pusa A-4, Versa Uphar, Pusa Sawani and Aparajita were rated as moderately susceptible, whereas the varieties, Ankur-40 and Anika as highly susceptible. Based on the mean whitefly population at all the intervals, the ascending order of susceptibility of okra varieties against whitefly was IIVR-11 < IIVR-10 < Hisar Unnat < Pusa A-4 < Versa Uphar < Pusa Sawani < Aparajita < Ankur-40 < Anika.

The minimum infestation was observed on variety IIVR-11 (6.10/ three leaves) followed by IIVR-10 (6.50/ three leaves) and Hisar Unnat (7.45/ three leaves), while maximum infestation (12.41/ three leaves) was observed on variety Anika during the crop growing season. The results got support from the observations of Gonde *et al.* (2012) [4] who reported whitefly population on the variety IIVR-11 (2.29/ leaf) and IIVR-10 (2.52/ leaf). The mean whitefly population was comparatively low (below 6.94/ three leaves) on the variety IIVR-11 and IIVR-10 and these categorized as least susceptible, whereas, on varieties Hisar Unnat, Pusa A-4, Versa Uphar, Pusa Sawani and Aparajita, the mean whitefly population was in middle order (between 6.94 to 11.40/ three leaves) and thus taken as moderately susceptible. The mean whitefly population was comparatively more (above 11.40/ three leaves) on variety Ankur-40 and Anika, and so have been designated as the highly susceptible. The present results did not get support from the observations of Meena (2004) [8] who reported Hisar Unnat and Pusa Sawani as less susceptible.

Table 2: Screening of different varieties of okra against whitefly, *B. tabaci* in *kharif*, 2014

S. No.	Varieties	Mean whitefly population/ three leaves*											
		14.08. 2014	21.08. 2014	28.08. 2014	04.09. 2014	11.09. 2014	18.09.2 014**	25.09. 2014	02.10. 2014	09.10. 2014	16.10. 2014	23.10. 2014	Mean
1.	IIVR-10	0.90	2.50	5.60	8.20	12.30	12.40	11.20	7.40	5.30	3.50	2.20	6.50
		(1.18)	(1.73)	(2.47)	(2.95)	(3.58)	(3.59)	(3.42)	(2.81)	(2.41)	(2.00)	(1.64)	(2.65)
2.	IIVR-11	0.40	2.10	4.80	7.50	10.80	15.20	9.70	6.80	4.80	3.20	1.80	6.10
		(0.95)	(1.61)	(2.30)	(2.83)	(3.36)	(3.96)	(3.19)	(2.70)	(2.30)	(1.92)	(1.52)	(2.56)
3.	Pusa A-4	1.40	3.50	6.80	10.40	14.60	17.60	13.40	8.80	7.20	5.40	4.20	8.48
		(1.38)	(2.00)	(2.70)	(3.30)	(3.89)	(4.25)	(3.73)	(3.05)	(2.77)	(2.43)	(2.17)	(3.00)
4.	Versa Uphar	1.30	6.10	8.40	12.60	15.50	19.20	11.20	9.30	7.50	5.60	3.40	9.10
		(1.34)	(2.57)	(2.98)	(3.62)	(4.00)	(4.44)	(3.42)	(3.13)	(2.83)	(2.47)	(1.97)	(3.09)
5.	Hisar unnat	0.60	2.80	5.90	8.70	13.20	16.30	12.20	8.30	6.20	4.50	3.20	7.45
		(1.05)	(1.82)	(2.53)	(3.03)	(3.70)	(4.10)	(3.56)	(2.97)	(2.59)	(2.24)	(1.92)	(2.82)
6.	Aparajita	3.40	7.80	10.80	15.20	17.10	21.40	14.50	10.40	8.50	7.20	4.60	11.00
		(1.97)	(2.88)	(3.36)	(3.96)	(4.20)	(4.68)	(3.87)	(3.30)	(3.00)	(2.77)	(2.26)	(3.40)
7.	Ankur40	3.80	8.10	12.20	14.80	17.90	20.30	15.20	12.30	9.80	7.20	5.00	11.50
		(2.07)	(2.93)	(3.56)	(3.91)	(4.29)	(4.56)	(3.96)	(3.58)	(3.21)	(2.77)	(2.35)	(3.46)
8.	Pusa sawani	3.20	7.40	11.50	14.40	16.70	18.30	13.60	9.40	7.60	5.20	3.40	10.00
		(1.92)	(2.81)	(3.46)	(3.86)	(4.15)	(4.34)	(3.75)	(3.15)	(2.85)	(2.39)	(1.97)	(3.24)
9.	Anika	3.60	8.70	11.50	16.20	18.20	22.50	18.50	13.30	10.50	8.20	5.40	12.41
		(2.02)	(3.03)	(3.46)	(4.09)	(4.32)	(4.80)	(4.36)	(3.71)	(3.32)	(2.95)	(2.43)	(3.60)
	S.E. m±	0.034	0.060	0.084	0.078	0.107	0.107	0.086	0.067	0.065	0.056	0.051	0.062
	CD at 5%	0.102	0.180	0.252	0.233	0.321	0.320	0.257	0.200	0.196	0.167	0.153	0.186

* Mean of three replications

** Peak population of whitefly

Figures in the parentheses are $\sqrt{x+0.5}$ values

3.3 Morphological characters of okra varieties

The data presented in the table 3 showed that the plant height of different okra varieties varied from 98.40 cm (IIVR-11) to 136.60 cm (Anika). The plant height had significant positive effect on the infestation of leaf hopper (r = 0.922) and whitefly (r = 0.880). Hairiness on shoot varied from 9 /mm^2 (Anika) to 18 /mm^2 (IIVR-11), on leaves varied from 11 /mm^2 (Anika) to 21 /mm^2 (IIVR-11) and on fruits varied from 6 /mm^2 (Anika) to 16 /mm^2 (IIVR-11) on okra varieties screened. Hairiness (on shoots, leaves and fruits) had significant negative effect on the infestation of leaf hopper (r = -0.969, -0.966 and -0.966) and whitefly (r = -0.851, -0.827 and -0.857). Days to initiation of flowering varied from 28 days (IIVR-11) to 42 days (Anika). Days to initiation of flowering have significant positive effect on the infestation of leaf hopper (r = 0.917) and whitefly (r = 0.823). The length of fruits varied from 13.50 cm (Pusa A-4) to 19.00 cm (Versa Uphar and Pusa sawani) and width of fruits varied from 1.85 cm (IIVR-11) to 2.40 cm (Versa Uphar). The length and width of fruits had significant positive effect on the infestation of leaf hopper (r = 0.748 and 0.519), while, non-significant positive effect on whitefly (r = 0.402 and 0.180). The number of fruits per plant varied from 9.80 (Anika) to 17.33 (IIVR-11). The number of fruits per plant had significant negative effect on the infestation of leaf hopper (r = -0.979) and whitefly (r = -0.842). The data on different

morphological characters revealed that plant height and days to initiation of flowering of different varieties of okra had positive significant effect on the infestation of leaf hopper and whitefly. Length and width of fruits had significant positive effect on infestation of leaf hopper while non-significant effect on infestation of whitefly. Whereas, hairiness (on shoot, leaf and fruit) and number of fruits per plant had negative significant effect on the infestation of leaf hopper and whitefly.

Table 3: Morphological characters of different okra varieties

S. No.	Varieties	Peak population/ three leaves		Plant height (cm)	Hairiness (mm^2)			Days to initiation of flowering	Length of fruits (cm)	Width of fruits (cm)	Number of fruits/ plant
		Leafhopper	White fly		Shoot	Leaves	Fruits				
1	IIVR-10	11.20	12.40	101.25	17	19	15	31	15.50	2.00	16.54
2	IIVR-11	11.60	15.20	98.4	18	21	16	28	14.25	1.85	17.33
3	Pusa A-4	14.80	17.60	107.5	15	16	13	36	13.50	1.98	14.24
4	Versa Uphar	16.40	19.20	110.2	13	14	11	35	19.00	2.40	13.60
5	Hisar Unnat	13.20	16.30	105.5	16	18	15	35	15.50	2.24	14.85
6	Aparajita	18.40	21.40	124.2	12	14	10	39	16.25	2.35	12.85
7	Ankur-40	17.50	20.30	130.9	10	13	9	41	18.33	2.13	10.75
8	Pusa Sawani	15.80	18.30	118.7	13	15	10	38	19.00	2.32	12.94
9	Anika	20.30	22.50	136.6	9	11	6	42	18.54	2.20	9.80
Correlation coefficient with peak jassid population				0.922**	-0.969**	-0.966**	-0.966**	0.917**	0.748*	0.519	-0.979**
Correlation coefficient with peak white fly population				0.880**	-0.851**	-0.827**	-0.857**	0.823**	0.402	0.180	-0.842**

* Significant at 5% level of significance
** Significant at 1% level of significance

4. Acknowledgement
The authors are thankful to the Dean, S.K.N. College of Agriculture, Jobner for providing necessary facilities and permission to conduct the experiments.

5. References

1. Anonymous. Final area and production of horticultural crops. Indian Horticulture Database, 2014. National Horticulture Board. 2013-14; 279-283.
2. Bhat, OK. Bhagat, KC. Gupta A. Vijay KK. Screening of okra genotypes against Amrasca biguttula biguttula (Ishida) and Earias vittella. Environment and Ecology. 2007; 25:434-439.
3. Dangi PR. Ameta OP. Incidence of okra fruit borer, E. vittella. National Conference on Applied Entomology, Sept. 26-28, 2005 held at Rajasthan College of Agriculture, Udaipur. 2005; 84-85.
4. Gonde AD, Kumar A. Raut AH, Wargantiwar RK, Phuke DP. Screening varieties of okra (Abelmoschus esculentus (L.) Moench) against important insect pests under agroclimatic conditions of Allahabad (UP). Trends in Biosciences. 2012; 5:249-251.
5. Kumar M, Singh AK. Varietal resistance of okra against cotton jassid, Amrasca biguttula biguttula under field conditions. Annals of Plant Protection Sciences. 2002; 10:381-383.
6. Mahal MS, Lal H, Singh R. Standardization of technique for screening okra germplasm for resistance against cotton jassid, Amrasca biguttula biguttula Ishida. Development and survival of nymphs. Journal of Insect Science. 1991; 4:135-137.
7. Mahal MS, Lal H, Singh R, Singh B. Field resistance in okra to the cotton jassid, Amrasca biguttula biguttula (Ishida) in relation to crop age. Journal of Insect Science. 1993; 6:60-63.
8. Meena NK. Management of key insect pests of okra, Abelmoschus esculentus (L.) Moench. Ph.D. Dissertation, Rajasthan Agricultural University, Bikaner, India, 2004.
9. Meena NK, Kanwat PM. Broad reconnaissance of insect pests of okra in semi–arid region of Rajasthan, pp. 261-262. National Conference on Applied Entomology, September 26-28, 2005, Rajasthan College of Agriculture, Udaipur, India, 2005.
10. Narke CG, Suryawanshi DS. Chemical control of major pests of okra. Pesticides. 1987; 21:37-42.
11. Ramalho FS, Parrott WL, Jenkins JN, McCarty Jr JC. Effects of cotton leaf trichomes on the mobility of newly hatched tobacco budworms (Lepidoptera: Noctuidae). Journal of Economic Entomology. 1984; 77:619-621.
12. Rawat RR, Sahu HN. Estimation of losses in growth and yield of okra due to Empoasca devastans Dist. and Erias sp. Indian Journal of Entomology. 1973; 35:252-254.