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Relative Susceptibility of Okra varieties against major Insect Pests based on Morphometric and Biochemical characters

Priyanka*, Akhter Hussain, S. K. Khinchi and Sanju Piploda
Department of Entomology, SKN College of Agriculture (SKNAU) Jobner, (Rajasthan), India.

(Corresponding author: Priyanka)*
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ABSTRACT: The experiment was conducted at Horticulture farm S.K.N. College of Agriculture, Jobner (Rajasthan) during *Kharif*, 2017 to identify the infestation of major insect pests of okra (leaf hopper, whitefly and shoot and fruit borer). Ten okra varieties were screened to know their response on the basis of morphometric and biochemical characters. Based on the infestation of major insect pests of okra the grading is done as least, moderately and highly susceptible. The morphological characters of plant showed that the variety IIVR-11 which had more hairiness (trichome density), was found least susceptible for the leaf hopper, whitefly and shoot infestation. Whereas, the variety Parbhani Kranti was found to be most susceptible which had less hairiness to the variety IIVR-11. The total phenols had significant negative effect with leaf hopper and whitefly and non-significant effect with shoot and fruit borer and free amino acid had significant positive effect with leaf hopper, whitefly and shoot infestation but non-significant with fruit infestation.

Keywords: Biochemical, leaf hopper, Morphological, Shoot and fruit borer, Susceptible, Whitefly.

INTRODUCTION

Okra [*Abelmoschus esculentus* (L.) Moench] commonly known as Bhindi or lady's finger, belongs to family Malvaceae, is a popular fruit vegetable crop due to its high nutritional and medicinal values and is said to be originated from tropical Africa. Host plant resistance is one of the most cost-effective and safe methods. Development of suitable resistant/ tolerant varieties is an ideal component at no additional cost, compatible with other methods of pest control and free from environmental pollution against buildup of pest population. Resistant varieties are considered as a noteworthy alternative of insecticide in insect pest management. Plant resistance is an effective tool to combat the insect pest. Host physical characteristics influence the infestation degree (Kamakshi and Srinivasan 2008). The richness of herbivore insect's assemblages is strongly influenced by the plants structural diversity i.e. by distribution of plant structures in vertical plane. Besides, it is also affected by plants architectural attributes i.e. by the availability and distribution of plant parts or structure in space above the ground (Brown and Southwood 1987). The defensive (secondary) metabolites can be either constitutive stored as inactive forms phytoanticipins or induced in response to the insect or microbe attack (phytoalexins) War *et al.* (2012). Considering the above facts, the present study was conducted to identify the antixenotic and antibiotic mechanisms of resistance in different okra varieties against major insect pests.Various biophysical and biochemical characters of the plants play an important role by providing resistance against number of insect pests (Halder *et al.*, 2006; Halder and Srinivasan 2011).

MATERIAL AND METHODS

The crop was sown in a simple Randomized Block Design (RBD) with ten varieties of okra *viz*. Kashi Satdhari, Pusa -A-GR, Pusa Makhmali, Arka Abhay, Arka Anamika, IIVR-11, VRO-4, Parbhani Kranti, VRO-6 and VRO-5 as treatments, each replicated thrice. Each variety was sown in individual plot of size 2.7×2.1 m^2. The spacing between row to row and plant to plant was kept 45 cm and 30 cm, respectively. The crop was sown on 8th July, 2017.

Morphometric characters: Morphological characters of okra varieties such as, plant height, hairiness (trichome density), days to initiation of flowering, length and width of fruits and number of fruits per plant, were registered. Plant height was measured by selecting Five plants randomly in centimetres from the ground level to the tip of main stem with the help of metre scale and averaged out. Hairiness (trichome density) to observe the hairiness, the discs of 1 mm^2 were taken from shoots and leaves of randomly selected. A binocular microscope was used to observe hairiness on selected discs. The numbers of hairs (trichomes) counted on each discs were averaged out. (Ramalho *et al.*, 1984). Days to flower initiation was recorded as the number of days taken from the sowing to flower initiation on randomly selected five plants and

then averaged out. Length of fruits was measured from base to tip of the fruits and then averaged out. Width of fruits was measured from two points on each side of middle of fruit in such a way that 1/4th of fruit length was left on each end and then averaged out. Diameter of fruits (cm) was measured using a Vernier calliper at the centre of the fruit and then averaged out. 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.

Biochemical analysis. The total phenols and free amino acids were estimated from leaves of the plants at the time of peak population. The following methods were used**:**

Estimation of total phenol: Total phenol was estimated by the method described earlier by Bray and Thorpe (1954). 50 mg of fresh leaf material was taken and homogenized in 5 ml hot alcohol (80 per cent) at 5000 rpm for 10 minutes. Supernatant fraction thus separated was cooled and final volume was made up to 10 ml with 80 per cent alcohol. Out of this, 0.5 ml was taken in a test tube and the volume was made up to 1 ml with distilled water. Folin's reagent (0.5) was added and it was kept at room temperature for three minutes. One ml of 20 per cent sodium carbonate solution, freshly prepared was added and the volume of the mixture was made up to 10 ml with distilled water. The test tube was placed in boiling water bath for one minute. The mixture was cooled and absorbance was measured at 650 nm with the help of Spectronic-20. Standard curve prepared by taking the known amount of phenol.

Estimation of free amino acid: The amount of free amino acid was estimated by ninhydrin reagent method (Moore and Stein, 1958). Amino acid was measured in ethanol solution fraction in which 100 mg of leaf material was taken and homogenized in 80 per cent ethanol (v/v). Homogenate was centrifuged thrice and the supernatant fraction thus separated was made up to 25 ml with 80 per cent ethanol. Suitable quantity of aliquot (0.5 ml) was taken in test tube, dried in oven at 60°C and cooled. One ml distilled water was added to it followed by one ml ninhydrin reagent. Samples were kept in boiling water bath for 20 minutes. After cooling, 5 ml of toluene solution was added. The absorbance was measured with Spectronic-20 at 570 nm. Standard curve was prepared by taking known amount of glycine. The solution used in determining the free amino acids were prepared as follows:

1. Citrate buffer (0.2 m, pH 5.0): Dissolved 5.88 g of tri-sodium citrate in 50 ml dH_2O and adjusted pH to 5.0 with citric acid solution using pH meter. Made up the volume to 100 ml with dH_2O.

2. Ninhydrin reagent: Ninhydrin reagent was prepared by dissolving 400 mg of ninhydrin and 16 mg stannous chloride in a mixture of 10 ml citrate buffer + 10 ml cellusolve.

RESULT AND DISCUSSION

Different varieties of okra were screened on the basis of their morphometric and biochemical characteristics. Ten varieties of okra Kashi Satdhari, Pusa -A-GR, Pusa Makhmali, Arka Abhay, Arka Anamika, IIVR-11, VRO-4, Parbhani Kranti, VRO-6 and VRO-5 were included for relative resistance to major insect pests.

A. Morphomatric Characters

The plant height, width of fruits, Length of fruits, diameters of fruits and number of fruits per plant of okra varieties were studied that remained non-significant with the major insect pests of okra (leaf hopper, whitefly and shoot and fruit borer). Halder *et al.* (2015) who reported the shoot and fruit borer had non-significant correlation with plant height, width of fruits and length of fruit are corroborates with present findings. Trichome density showed significant negative correlation with leaf hopper population (r= -0.75) and whitefly population (r= -0.76). The variety IIVR-11 had maximum hairiness and low leaf hopper population (4.52 leaf hoppers/ three leaves) and whitefly population of (4.02 per three leaves). The results are corroborates with the findings of Halder *et al.* (2016) against leaf hopper population. Trichomes showed non-significant correlation with infestation of shoot and fruit borer on shoots and fruits basis. Anitha and Karthika (2018); Kumar *et al.* (2021) showed negative association between trichome density with fruit infestation which lent a good support to the present investigation. Days to flowering showed positive significant correlation with leaf hopper population, whitefly population and shoot infestation. Fruit infestation showed non-significant correlation with days to flowering. Yadav (2015) reported the significant correlation between the shoot infestation and days to flowering which was conformity with the present findings. The fruit yield obtained ranged from 94.17 to 119.22 qt/ ha. The minimum yield obtained from variety Parbhani Kranti and maximum from variety Arka Abhay. The increasing pattern of yield in different varieties of okra was found in order: Parbhani Kranti, Kashi Satdhari, Pusa-A-GR, Arka Anamika, IIVR-11, VRO-4, Pusa Makhmali, VRO-6, VRO-5 and Arka Abhay.

B. Biochemical Character

The least susceptible varieties (IIVR-11, VRO-4 and VRO-6) contained higher amount of total phenols as compared to highly susceptible varieties (Parbhani Kranti, and Kashi Satdhari). Significant negative correlation between leaf hopper (r= -0.85) and whitefly population (r= -0.83) and total phenols. The present results are in agreement with the Halder *et al.* (2016) who reported the phenol content was significant with leaf hopper population. Non-significant correlation between shoot and fruit borer and phenol content which was corroborates with the findings of Halder *et al.* (2015).The least susceptible varieties (IIVR-11, VRO-4 and VRO-6) contained low free amino acids as compared to highly susceptible varieties (Parbhani Kranti, and Kashi Satdhari). The variety (Parbhani Kranti) having highest free amino acid concentration also infested heavily by the sucking insect pests (leaf hopper and whitefly) and shoot infestation.

Table 1: Morphometric characters of okra varieties and their relationship with major insect pests.

Sr. No.	Varieties	Mean leaf hopper population /three leaves	Mean whitefly population/ three leaves	Mean per cent shoot infestation	Mean per cent fruit infestation	Plant height (cm)	Length of fruits (cm)	Diameter of fruits(cm)	Width of fruits (cm)	Trichome density (mm^2)	Days to flower	No. of fruits/ plant
1.	Kashi satdhari	11.12	10.90	6.07	17.24	105.43	13.56	3.37	1.92	14	42	15
2.	Pusa A-GR	8.44	8.93	6.81	17.58	117.89	12.17	3.30	1.73	16	44	13
3.	Pusa Mukhmali	5.32	5.09	5.11	11.99	109.78	15.30	4.00	2.00	15	41	25
4.	Arka Abhay	6.94	7.06	4.51	19.83	123.79	14.70	4.54	2.13	18	40	16
5.	Arka Anamika	7.99	7.47	5.57	16.77	105.67	15.60	4.13	2.37	18	39	20
6.	IIVR-11	4.52	4.02	3.04	15.31	99.4	16.35	4.92	1.98	20	31	17
7.	VRO-4	5.03	4.55	4.86	15.75	114.56	11.93	2.37	1.57	19	32	19
8.	Parbhani Kranti	11.71	11.46	7.31	21.48	145.78	14.56	4.40	2.67	13	43	22
9.	VRO-6	7.54	7.91	5.26	16.16	120.86	13.84	3.90	1.43	16	38	26
10.	VRO-5	7.16	6.94	3.41	12.89	127.38	14.60	4.70	1.78	15	34	20
Correlation coefficient with mean leaf hopper population						0.48(NS)	-0.18(NS)	-0.02(NS)	0.45(NS)	-0.75*	0.71*	-0.13(NS)
Correlation coefficient with mean whitefly population						0.51(NS)	-0.24(NS)	-0.03(NS)	0.37(NS)	-0.76*	0.75*	-0.1(NS)
Correlation coefficient with mean per cent shoot infestation						0.39(NS)	-0.44(NS)	-0.41(NS)	0.33(NS)	-0.59(NS)	0.83*	-0.03(NS)
Correlation coefficient with mean per cent fruit infestation						0.49(NS)	-0.16(NS)	0.01(NS)	0.51(NS)	-0.13(NS)	0.46(NS)	-0.32(NS)

* Significant at 5 per cent level NS = non-significant

Table 2: Biochemical characters of okra varieties and their relationship with major insect pests.

Sr. No.	Var	Mean leaf hopper population/three leaves*	Mean whitefly population/ three leaves	Mean per cent infestation of shoot borer	Mean per cent infestation of fruit borer	Total phenols(%)	Free amino acids (%)
1.	Kashi satdhari	11.12	10.90	6.07	17.24	2.30	4.64
2.	Pusa A-GR	8.44	8.93	6.81	17.58	2.70	4.08
3.	Pusa Mukhmali	5.32	5.09	5.11	11.99	3.48	3.23
4.	Arka Abhay	6.94	7.06	4.51	19.83	3.24	3.67
5.	Arka Anamika	7.99	7.47	5.57	16.77	2.70	3.90
6.	IIVR-11	4.52	4.02	3.04	15.31	4.89	2.83
7.	VRO-4	5.03	4.55	4.86	15.75	4.30	2.87
8.	Parbhani Kranti	11.71	11.46	7.31	21.48	1.92	4.89
9.	VRO-6	7.54	7.91	5.26	16.16	4.36	3.65
10.	VRO-5	7.16	6.94	3.41	12.89	3.41	3.13
Correlation coefficient with mean leaf hopper population						-0.85*	0.96*
Correlation coefficient with mean whitefly population						-0.83*	0.96*
Correlation coefficient with mean per cent shoot infestation						-0.75(NS)	0.84*
Correlation coefficient with mean per cent fruit infestation						-0.52(NS)	0.70(NS)

* Significant at 1 per cent level NS = non-significant

Table 3: Yield performance of different okra varieties screened.

Sr. No.	Varieties	Mean population				Yield (Kg/ plot)	Yield (q/ ha)
		Mean leaf hopper population/three leaves	Mean whitefly population/three leaves	Mean per cent shoot infestation	Mean per cent fruit infestation		
1.	Kashi satdhari	11.12	10.90	6.07	17.24	5.38	94.88
2.	Pusa A-GR	8.44	8.93	6.81	17.58	5.69	100.35
3.	Pusa Mukhmali	5.32	5.09	5.11	11.99	6.53	115.16
4.	Arka Abhay	6.94	7.06	4.51	19.83	6.76	119.22
5.	Arka Anamika	7.99	7.47	5.57	16.77	6.23	109.87
6.	IIVR-11	4.52	4.02	3.04	15.31	6.47	114.10
7.	VRO-4	5.03	4.55	4.86	15.75	6.50	114.63
8.	Parbhani Kranti	11.71	11.46	7.31	21.48	5.32	94.17
9.	VRO-6	7.54	7.91	5.26	16.16	6.57	115.87
10.	VRO-5	7.16	6.94	3.41	12.89	6.66	117.46
S.Em ±							2.65
CD (P=0.05)							7.88

Significant positive correlation with degree of infestation of leaf hopper (r= 0.96), whitefly (r= 0.96), and shoot infestation (r = 0.84) and free amino acids. The present results are in agreement with that of Le Sujuan *et al.* (2001) who reported biochemical mechanism of resistance to *R. padi* on wheat. Chen (2002) stated resistance in *Capsicum* cultivar for *Myzus persicae* due to amino acid concentration. The cultivars having higher amount of free amino acid were more infested by *Myzus persicae*. Malik (1988) also reported the role of amino acids in relation to aphid *L. erysimi* resistance in *Cruciferous species.* Kumar (2016) reported the significant positive correlation between free amino acid and sucking pests (leaf hopper and whitefly) which corroborates with the present findings.

CONCLUSION

The morphological characters of plant showed that the variety IIVR-11 which had more hairiness (20 per sq. mm trichome density), was found least susceptible for the leaf hopper, whitefly and shoot infestation. Whereas, the variety Parbhani Kranti was found to be most susceptible which had less hairiness (13 per sq. mm trichome density). The biochemical parameters showed that the variety IIVR-11 which had higher amount of total phenols (4.89%) and lower amount of free amino acids (2.83%) was found least susceptible for the major insect pests infestation. Whereas, the variety Parbhani Kranti was found to be most susceptible which contained these parameters contrary to the variety IIVR-11.

FUTURE SCOPE

Main focus of this research to reduce the insecticide toxicity, environmental pollution, the extermination of natural enemies and eventually, build-up of insecticide resistance in the pests make chemical control a risky and unsatisfactory pest management strategy. Increase production & income of farmers through host plant resistance mechanism. In the future, host plant resistance should be utilized as an important component of Integrated Pest Management.

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Conflict of Interest. None.

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