Screening of different Okra [*Abelmoschus esculentus* (L.) Moench] Varieties Against Major Sucking Pests

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Abstract: Investigations on Screening of different Okra Varieties Against Major Sucking Pests conducted at the Instructional Farm of College of Agriculture, (SKRAU, Bikaner), Rajasthan, during *kharif,* 2020. Out of ten okra varieties screened against the major sucking pests *viz* leaf hopper and whitefly, none of the variety was found completely free from the attack of leaf hopper and whitefly. The peak population of sucking insect pest was categorized by using the formula $\overline{X} \pm \sigma$. The varieties Kashi Pragati and Arka Anamika were ranked as less susceptible, varieties Kashi Chaman, Varsha Uphar, Hisar Unnat, Arka Abhay and Pusa Bhindi 5 were categorizated as moderately susceptible, whereas, Pusa A4, Pusa Makhmali and Pusa Sawani were categorizated as highly susceptible to leaf hopper infestation. In case of whitefly, the varieties Arka Anamika, Kashi Pargati were observed less susceptible, whereas Kashi Chaman, Arka Abhay, Varsha Uphar, Hissar Unnat and Pusa Bhindi 5 varieties emerged as moderately susceptible,while Pusa Makhmali, Pusa A4 and Pusa Sawani emerged as highly susceptible varieties of okra crop against whitefly *B. tabaci*.

Key-words: Screening, leaf hopper, whitefly, Arka Anamika, Kashi Chaman, Varsha Uphar, Hisar Unnat, Arka Abhay, Pusa Bhindi 5, Kashi Pragati, Pusa A4, Pusa Makhmali, Pusa Sawani, Bikaner, *kharif*.

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1. Introduction

Okra [*Abelmoschus esculentus* (L.) Moench] belongs to family Malvaceae is also known as lady finger, gumbo, or bhindi, is an important vegetable crop of the tropical and subtropical regions of the world. The crop can be grown throughout the year and commonly cultivated in *kharif* and summer season. It is native of tropical Africa. India is the largest producer of okra. In India, Gujarat is leading state in production of okra with 921.72 thousand metric tonnes. In Rajasthan area and production of okra is 4.15 thousand ha and 21.39 thousand metric tonnes respectively (Anonymous, 2018). Okra is a multipurpose crop valued for its tender and delicious pods. In West Africa, leaves, buds, and flowers of okra are also consumed. Okra is a very good source of dietary fibre, magnesium, manganese, potassium, vitamin K, vitamin C (30mg/100g), B1, and B6, and folate (1.5mg/100g) (Aykroyd, 1963).

Insect pests are one of the most limiting factors for accelerating yield potential of okra. The crop is prone to damage by various insects, fungi, nematodes and viruses, although there is wide variability in their degree of infestation. Some of the important insect pests which are considered most important to limit the crop

yield are aphid (*Aphis gossypii* Glover), whitefly (*Bemisia tabaci* Genn), leaf hopper (*Amrasca biguttula biguttula* Ishida), fruit borer *(Earias vitella* Boisd), *Earias insulana* (Boisd), *Helicoverpa armigera* Hubner and red spider mite (*Tetranychus cinnabarinus* Boisduval). The leaf hopper, *A. biguttula biguttula* sucks the cell sap from the lower surface of the leaves and inject toxic substance in it, resulting upward curling and yellowing of leaf margins and stunted plant growth. The severe infestation causes burning of leaves which fall down latter, this results 40-60% yield losses (Narke and Suryawanshi, 1987). The whitefly also sucks the cell sap from the lower surface of leaves which lower vitality of the plants. It excretes honeydew on leaf surface, which results in development of sooty mould, which check the process of photosynthesis. Therefore, the growth of plant is adversely affected. This insect transmits viral diseases and acts as vector of 'yellow veins mosaic' virus in the plants. This is also known as Vein-Clearing disease of okra (Nath *et al*. 1992). The damage potential of *A. biguttula biguttula* and *B. tabaci* certainly proved these are undoubtedly the series pest of okra and they should be given prime importance in entomological research. A little work has been done on Screening of different okra varieties against leaf hopper and whitefly of okra under the agro-climatic conditions of zone IC and it is needed to sort out the precise nature or extent of relationship, which exists between major sucking pests and weather factors to determine varieties susceptibility and to formulate effective pest control strategies for sustainable management of major sucking pests.

2. Materials and methods

The present investigations were conducted at Instructional Farm College of Agriculture, Bikaner (Rajasthan) on okra crop under field conditions, during *kharif*, 2020. The experiment was laid out in a simple randomized block design with ten varieties (Arka Anamika, Kashi Chaman, Varsha Uphar, Hisar Unnat, Arka Abhay, Pusa Bhindi 5, Kashi Pragati, Pusa A4, Pusa Makhmali, Pusa Sawani) and each replicated thrice. The plot size was 2.25 x 3.0 m^2 with row to row and plant to plant distance of 45 cm and 30 cm, respectively. The crop was sown on 1st August in *kharif*, 2020.

The observation on major sucking insect pests of okra were recorded soon after the appearance of the pests at weekly intervals till the harvesting of the crop. The crop was allowed for natural infestation. To record the population of sucking pests viz., leaf hopper and whitefly five plants of okra were randomly selected from each plot and tagged. The okra yield was recorded at harvest. The data recorded on population of major sucking pests of okra at weekly interval were subjected to analysis of variance after transforming them into $\sqrt{X+0.5}$. On the basis of population, susceptibility of okra varieties/genotypes to major sucking pests were determined. The okra varieties/genotypes were categorized on the basis of peak population of major sucking pests of okra during the crop season by using the following formula as adopted by Gadekar *et al*. (2015):

$\overline{X} \pm \sigma$

Where
$\overline{X}$ =Mean of pest population at peak.
σ = standard deviation of pests population at peak.

So as categorized were made as

1. Less susceptible
2. Moderately susceptible
3. Highly susceptible

3. Results and Discussions

Based on weekly observations, ten varieties of okra namely, Arka Anamika, Pusa A4, Pusa Bhindi 5, Varsha Uphar, Arka Abhay, Pusa Sawani, Pusa Makhmali, Kashi Chaman, Kashi Pragati and Hisar Unnat were screened for their relative susceptibility against major sucking pests of okra during *kharif*, 2020 under field conditions

Leaf hopper, *A. biguttula biguttula*

The first observation recorded on 20 August 2020, indicated that a significant difference existed among the varieties of okra against leaf hopper (Table 1 & 2 and Fig. 1). Initially (34th SMW) the mean leaf hopper population was low on all the ten varieties after that the infestation of leaf hopper increased gradually and reached to its peak in the third week of September (38th SMW). The minimum infestation was recorded on Kashi Pragati (17.60/ three leaves) followed by Arka Anamika (20.53/ three leaves) and Kashi Chaman (22.00/ three leaves). These varieties did not differ statistically in their degree of infestation to leaf hopper and found significantly superior over rest of the varieties. The varieties Varsha Uphar, Hisar Unnat, Arka Abhay and Pusa Bhindi 5 stood in middle order of susceptibility to leaf hopper. The maximum infestation was observed on variety, Pusa Sawani (39.60/ three leaves) followed by Pusa A4 (36.80/ three leaves) and Pusa Makhmali (37.59/ three leaves) and these varieties were found statistically comparable with each other. The population started to decline and reached to negligible level in the third week of November.

The peak population of sucking insect pest was categorized by using the $\overline{X} \pm \sigma$ formula. The varieties Kashi Pragati and Arka Anamika were ranked as less susceptible, The present findings get support the findings of Gonde *et al*. (2012) and Narayanan and Muthiah (2017) who reported Kashi Pragati as least susceptible to leaf hopper. Meena (2004), Bhat *et al*. (2007), Patel *et al*. (2012), Srivastava *et al*. (2015), Patel *et al*.(2015), Kadu *et al*. (2018) reported Arka Anamika as least susceptible to leaf hopper, corroborate with the present findings while Priyanka *et al*. (2020) reported Arka Anamika and Kashi Pragati as moderately susceptible variety against leaf hopper partially supported the present findings. Varieties Kashi Chaman, Varsha Uphar, Hisar Unnat, Arka Abhay and Pusa Bhindi 5 were categorizated as moderately susceptible, Nagar *et al*. (2017b) reported Hisar Unnat, Varsha Uphar as moderately susceptible variety against leaf hopper corroborate with the present findings. Srivastava *et al*. (2015), Kadu *et al*. (2018) and Priyanka *et al*. (2020) reported Arka Abhay as moderately susceptible while Bhat *et al*. (2007) who reported Arka Abhay and Varsha Uphar as moderately susceptible variety to leaf hopper akin with the present findings. whereas, Pusa A4, Pusa Makhmali and Pusa Sawani were categorizated as highly susceptible to leaf hopper infestation. The results of present findings get conformity with the findings of Jat (2019),

Badiger and Yadav (2019) who reported Pusa A4 as a highly susceptible variety against leaf hopper. Priyanka *et al*. (2020) reported Pusa Makhmali as a moderately susceptible variety against leaf hopper partially support the present findings. The results are in full conformity to Gonde *et al*. (2012), Srivastava *et al*. (2015), Narayanan and Muthiah (2017) and Badiger and Yadav (2019) who reported Pusa sawani as a highly susceptible variety to leaf hopper.

Whitefly, *B. tabaci*

The observations of whitefly population was assessed at weekly intervals starting from initiation of population (third week of August) to disappearance of population (third week of November) during *kharif*, 2020. On the basis of data recorded and presented in Table 3 & 4 and Fig. 2 revealed that none of the variety was observed free from the infestation of whitefly. Initially the minimum population was recorded on Arka Anamika followed by Kashi Pargati and Kashi chaman. The population of whitefly increased gradually from the last week of August and the peak population was recorded in the second week of October (41St SMW) on all the ten varieties. The minimum population recorded on Arka Anamika followed by Kashi Pargati, Kashi Chaman and Arka Abhay, varied between 10.20 to 16.10 per three leaves. The variety Varsha Uphar, Hisar Unnat and Pusa Bhindi 5 ranked in middle group of infestation against whitefly and these varieties were observed statistically at par. The variety Pusa Sawani harboured maximum whitefly population followed by Pusa A4 and Pusa Makhmali and these varieties were statistically at par with each other in their degree of infestation. The population started to decline in the third week of October on all the varieties and reached to negligible level in the third week of November.

The peak population of sucking insect pest was categorized by using the $\overline{X} \pm \sigma$ formula. The varieties Arka Anamika, Kashi Pargati existed as less susceptible, The results are in full conformity to Patel *et al*. (2015) and Jat (2019) who reported Arka Anamika as least susceptible to whitefly while Meena (2004) and Priyanka *et al*. (2020) reported Arka Anamika as moderately susceptible to whitefly partially akin the present findings. The present findings get support from the findings of Narayanan and Muthiah (2017) who reported Kashi Pragati as least susceptible to whitefly however the findings of Bhalu *et al*.(2019) and Priyanka *et al*. (2020) reported Kashi Pragati as moderately susceptible to whitefly partially corroborate the present findings. Varieties Kashi Chaman, Arka Abhay, Varsha Uphar, Hissar Unnat and Pusa Bhindi 5 varieties ranked as moderately susceptible. The present finding get support from the findings of Jat (2019), Priyanka *et al*. (2020) who reported Arka Abhay, Nagar *et al*. (2017b) Varsha Uphar, Nagar *et al*. (2017b) and Jat (2019) Hissar Unnat as moderately susceptible variety to whitefly on okra corroborate the present findings. Hissar Unnat was reported as a less susceptible variety to whitefly by Meena (2004) partially support the present findings. Whereas Pusa Makhmali, Pusa A4 and Pusa Sawani ranked as highly susceptible varieties of okra against B.tabaci. Badiger and Yadav (2019) and Jat (2019) who reported Pusa A4 as a highly susceptible to whitefly, akin the present finding. Narayanan and Muthiah (2017), Bhalu *et al*. (2019), Badiger and Yadav (2019) who reported Pusa Sawani as a highly susceptible to whitefly on okra corroborate the present findings, while Nagar *et al*. (2017b) who reported Pusa Sawani as moderately susceptible to whitefly partially support the present findings. The work of Priyanka *et al*. (2020) who reported Pusa Makhmali as

moderately susceptible to whitefly, partially confirms the present finding. The present results are not in agreement with the findings of Meena (2004) who reported Pusa Sawani as a less susceptible to whitefly.

Table 2 Categorization of susceptibility of different okra varieties against leaf hopper during *kharif*, 2020

S. No.	Peak Leaf hopper Population	Categories	Name of Varieties
1	Below <21.51	Less Susceptible	Kashi Pragati, Arka Anamika
2	21.51 To36.48	Moderately Susceptible	Kashi Chaman, Varsha Uphar, Hisar Unnat, ArkaAbhay,PusaBhindi 5
3	Above >36.48	Highly Susceptible	Pusa A4,PusaMakhmali, PusaSawani

Mean of Peak population ($\overline{X}$) = 29.00 Standard deviation (σ) = 7.49

Table 4 Categorization of susceptibility of different okra varieties against whitefly during *kharif*, 2020

S. No.	Peak Whitefly Population	Categories	Name of Varieties
1	Below <13.39	Less Susceptible	Arka Anamika,Kashi Pragati
2	13.39 to 24.60	Moderately Susceptible	Kashi Chaman, Arka Abhay, Varsha Uphar, Hissar Unnat, Pusa Bhindi 5
3	Above >24.60	Highly Susceptible	Pusa Makhmali, Pusa A4, Pusa Sawani

Mean of Peak population ($\overline{X}$) = 19.00 Standard deviation (σ) = 5.60

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Table 1. Relative susceptibility of okra varieties against leaf hopper, *A. biguttula biguttula* during *Kharif*, 2020

Varieties	Leaf hopper population** / 3 leaves at weekly intervals														Overall Mean
	34	35	36	37	38	39	40	41	42	43	44	45	46	47	
Arka Anamika	0.80	1.15	3.15	6.60	20.53	13.75	10.25	9.25	7.66	5.45	3.20	2.50	0.35	0.15	6.06
	(1.11)*	(1.28)	(1.90)	(2.62)	(4.59)	(3.75)	(3.23)	(3.10)	(2.84)	(2.43)	(1.92)	(1.69)	(0.92)	(0.81)	(2.30)
Pusa A4	3.45	5.40	10.60	29.15	36.80	28.35	23.65	19.30	17.65	15.15	11.25	9.15	6.15	1.10	15.51
	(1.93)	(2.39)	(3.32)	(5.44)	(6.10)	(5.37)	(4.89)	(4.43)	(4.25)	(3.95)	(3.42)	(3.10)	(2.56)	(1.25)	(3.74)
Pusa Bhindi 5	2.80	4.20	6.95	22.15	31.00	25.65	20.55	16.35	14.50	12.20	9.70	7.40	4.60	0.75	12.77
	(1.80)	(2.13)	(2.71)	(4.76)	(5.61)	(5.11)	(4.58)	(4.10)	(3.84)	(3.55)	(3.18)	(2.79)	(2.20)	(1.11)	(3.39)
Varsha Uphar	1.40	1.95	4.95	17.10	27.53	19.20	14.80	12.95	11.20	8.90	5.80	4.00	1.00	0.20	9.36
	(1.36)	(1.54)	(2.32)	(4.17)	(5.29)	(4.42)	(3.90)	(3.66)	(3.42)	(3.03)	(2.47)	(2.04)	(1.21)	(0.84)	(2.83)
Arka Abhay	2.30	3.15	5.60	19.00	29.20	23.50	18.10	15.20	12.20	9.96	7.50	5.10	3.20	0.55	11.04
	(1.67)	(1.90)	(2.46)	(4.40)	(5.43)	(4.89)	(4.30)	(3.93)	(3.56)	(3.22)	(2.81)	(2.35)	(1.92)	(1.00)	(3.13)
Pusa Sawani	3.75	7.10	11.25	30.20	39.60	30.40	27.80	23.10	21.15	17.80	13.80	10.50	7.45	2.80	17.62
	(2.04)	(2.75)	(3.42)	(5.54)	(6.32)	(5.56)	(5.31)	(4.84)	(4.64)	(4.26)	(3.75)	(3.30)	(2.81)	(1.80)	(4.02)
Pusa Makhmali	3.33	4.94	8.40	26.40	37.59	26.70	22.75	18.70	16.10	14.40	10.60	8.25	5.60	0.95	14.62
	(1.93)	(2.31)	(2.96)	(5.18)	(6.17)	(5.21)	(4.80)	(4.37)	(4.07)	(3.83)	(3.33)	(2.94)	(2.41)	(1.20)	(3.62)
Kashi Chaman	1.10	1.50	3.25	7.25	22.00	17.80	12.60	11.00	9.33	6.50	4.33	3.40	0.50	0.20	7.20
	(1.25)	(1.41)	(1.93)	(2.77)	(4.74)	(4.25)	(3.60)	(3.36)	(3.10)	(2.64)	(2.19)	(1.97)	(0.99)	(0.84)	(2.50)
Kashi Pragati	0.60	1.00	2.35	4.50	17.60	12.10	8.10	7.20	5.45	4.60	2.10	1.60	0.25	0.10	4.83
	(1.04)	(1.22)	(1.66)	(2.19)	(4.25)	(3.53)	(2.92)	(2.74)	(2.34)	(2.22)	(1.59)	(1.43)	(0.86)	(0.77)	(2.05)
Hisar Unnat	1.80	2.55	5.10	18.25	28.10	21.10	16.45	13.40	11.80	9.44	6.40	4.50	2.10	0.30	10.09
	(1.49)	(1.72)	(2.35)	(4.31)	(5.34)	(4.63)	(4.11)	(3.71)	(3.50)	(3.14)	(2.62)	(2.22)	(1.59)	(0.89)	(2.97)
S.Em.±	0.20	0.19	0.20	0.24	0.17	0.23	0.25	0.28	0.21	0.25	0.21	0.25	0.21	0.08	0.21
C.D.(p=0.05)	0.58	0.58	0.60	0.71	0.52	0.69	0.76	0.83	0.61	0.74	0.63	0.74	0.63	0.24	0.63
CV (%)	21.64	17.98	14.03	9.97	5.61	8.60	10.60	12.68	10.07	13.29	13.39	18.07	21.14	13.27	13.60

*Figures in Parentheses are √X+0.5 values.
** Mean of three replications.

Fig. 1 Relative susceptibility of okra varieties against leaf hopper, *A. biguttula biguttula* during *Kharif*, 2020

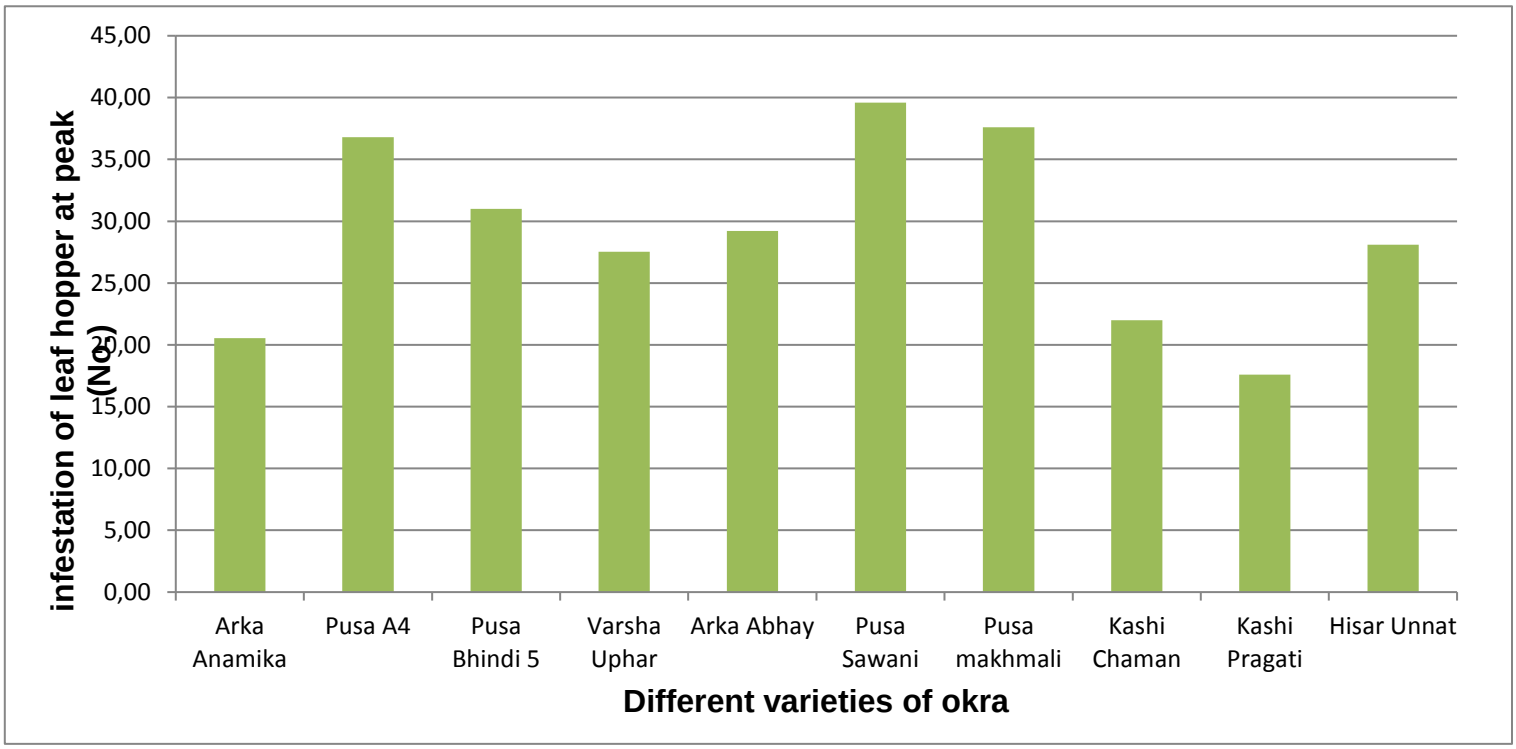

Table 3. Relative susceptibility of okra varieties against whitefly, *B. tabaci* during *Kharif*, 2020

Varieties	Whitefly population** / 3 leaves at weekly intervals														Overall Mean
	34	35	36	37	38	39	40	41	42	43	44	45	46	47	
Arka Anamika	0.00	0.25	1.23	2.00	4.39	5.20	7.40	10.20	9.70	8.84	2.40	1.30	0.65	0.25	3.84
	(0.71)*	(0.86)	(1.31)	(1.57)	(2.20)	(2.36)	(2.79)	(3.24)	(3.16)	(3.03)	(1.67)	(1.31)	(1.06)	(0.86)	(1.87)
Pusa A4	2.10	3.15	5.50	6.60	14.80	16.90	19.20	24.95	22.25	18.20	10.00	8.20	4.10	2.32	11.31
	(1.61)	(1.91)	(2.44)	(2.63)	(3.90)	(4.16)	(4.43)	(5.03)	(4.76)	(4.31)	(3.23)	(2.90)	(2.14)	(1.67)	(3.22)
Pusa Bhindi 5	1.60	2.20	4.00	5.00	13.90	16.00	17.75	20.72	19.00	16.00	8.20	7.00	2.95	1.68	9.71
	(1.40)	(1.63)	(2.08)	(2.28)	(3.78)	(4.04)	(4.27)	(4.60)	(4.40)	(4.02)	(2.94)	(2.67)	(1.81)	(1.46)	(2.96)
Varsha Uphar	1.00	1.40	3.40	4.40	13.20	15.60	17.00	20.30	18.40	15.20	7.30	6.35	1.50	1.20	9.02
	(1.22)	(1.38)	(1.97)	(2.21)	(3.70)	(4.00)	(4.18)	(4.56)	(4.33)	(3.96)	(2.79)	(2.61)	(1.41)	(1.30)	(2.83)
Arka Abhay	0.80	1.42	3.43	4.30	10.00	10.75	14.70	16.10	15.60	14.40	6.40	5.08	1.20	1.00	7.51
	(1.11)	(1.38)	(1.98)	(2.19)	(3.15)	(3.33)	(3.88)	(4.07)	(4.00)	(3.84)	(2.59)	(2.36)	(1.28)	(1.21)	(2.61)
Pusa Sawani	2.20	3.40	6.00	8.10	15.20	17.20	21.00	26.20	23.20	19.00	11.20	9.00	5.00	2.80	12.11
	(1.61)	(1.97)	(2.53)	(2.93)	(3.96)	(4.19)	(4.61)	(5.16)	(4.86)	(4.41)	(3.41)	(3.03)	(2.34)	(1.70)	(3.34)
Pusa Makhmali	2.00	2.85	5.20	6.27	14.20	16.25	18.00	24.62	20.00	17.20	9.40	8.00	3.35	2.00	10.67
	(1.57)	(1.83)	(2.39)	(2.59)	(3.82)	(4.07)	(4.25)	(5.01)	(4.49)	(4.19)	(3.12)	(2.90)	(1.94)	(1.56)	(3.12)
Kashi Chaman	0.50	1.00	1.83	2.90	8.80	9.20	12.00	14.20	12.85	12.80	4.80	4.00	1.10	0.85	6.20
	(0.97)	(1.21)	(1.53)	(1.84)	(3.03)	(3.10)	(3.46)	(3.82)	(3.62)	(3.60)	(2.24)	(2.03)	(1.26)	(1.15)	(2.35)
Kashi Pragati	0.20	0.50	1.53	2.60	4.64	8.40	10.20	12.08	11.40	10.60	3.40	3.00	1.00	0.45	5.00
	(0.83)	(0.99)	(1.42)	(1.76)	(2.25)	(2.95)	(3.22)	(3.52)	(3.41)	(3.29)	(1.93)	(1.79)	(1.21)	(0.97)	(2.11)
Hisar Unnat	1.20	2.00	3.60	4.87	13.40	15.80	17.50	20.60	18.75	15.60	7.80	6.80	2.75	1.56	9.45
	(1.29)	(1.57)	(2.02)	(2.29)	(3.73)	(4.02)	(4.23)	(4.59)	(4.37)	(3.98)	(2.85)	(2.68)	(1.70)	(1.38)	(2.91)
S.Em.±	0.13	0.08	0.14	0.20	0.24	0.27	0.33	0.13	0.29	0.30	0.27	0.33	0.19	0.21	0.22
C.D.(p=0.05)	0.39	0.23	0.42	0.58	0.71	0.80	0.98	0.39	0.85	0.89	0.79	0.98	0.57	0.62	0.66
CV (%)	18.27	9.28	12.33	15.17	12.32	12.90	14.50	5.21	11.96	13.49	17.16	23.51	20.75	27.43	15.31

*Figures in Parentheses are √X+0.5 values.
** Mean of three replications.

Fig 2. Relative susceptibility of okra varieties against whitefly,*B. tabaci* during *Kharif*, 2020