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Field assessment of different okra genotypes for them resistance to insect pest complex

AS Vaja, RK Thumar and DJ Parmar

Abstract
A field experiment was conducted during summer, 2021 and 2022 at Anand Agricultural University, Anand to screen ten different genotypes/varieties of okra against insect pests. The results indicated that the genotype, AOL 20-03 recorded minimum incidence of jassid, whitefly, mite, shoot and fruit damage due to shoot and fruit borer, *Earias vittella* and fruit borer, *Helicoverpa armigera* and categorized as resistant. Whereas, maximum incidence of sucking pest *viz.*, jassid, whitefly and mite were recorded in genotypes, GAO 5 and AOL 16-01 and categorized as susceptible. The genotype, AOL 16-01 was found susceptible against infestation of lepidopteran pest *viz*., *E. Vittella* and *H. Armigera*.

Keywords: Okra, jassids, whitefly, mites, shoot and fruit borer, fruit borer

Introduction
Okra, *Abelmoschus esculentus* (L.) Moench, which is one of the important vegetable crops of *Malvaceae* family, is known as *Bhindi* in India (Navneet *et al*., 2018) [7]. Green tender fruits of okra are consumed as a vegetable in different forms. These fruits are rich in vitamins, calcium, potassium and other mineral matters. The mature okra seed is a good source of oil and protein has been known to have superior nutritional quality, which is rich in unsaturated fatty acids such as linoleic acid which was essential for human nutrition, its mature fruit and stems contain crude fibre, which is used in the paper industry (Kumar *et al*., 2013) [5]. In India, okra is one of the most important vegetable crops grown for its tender green fruits during the summer and *Kharif* seasons. In the year 2020-21 India ranked first in production followed by Nigeria in (Anonymous, 2022) [2]. Okra crop is attacked by several pests and diseases causing considerable damage at different stages of growth. Among the insect pests of okra, jassid, *Amrasca biguttula biguttula* (Ishida), whitefly, *Bemisia tabaci* (Gennadius), mite, *Tetranychus cinnabarinus* (Boisd.) and shoot and fruit borer, *Earias insulana* (Boisd.), *Earias vittella* (Fab.) are the major pests (Nagar *et al*., 2017) [6]. Management of insect pests is a basic requirement for the higher and quality yield of field crops. The use of resistant varieties in integrated pest management is specificity, cumulative effect, persistence, harmony with the environment, ease of adoption and compatibility with other tactics of pest management (Akbar and Khan, 2015) [1]. Hence, one of the important strategies for the management of insect pests is the use of resistant genotypes/cultivars. Therefore, the present investigation was carried out to screen the different okra genotypes/cultivars for their resistance to insect pest complex.

Material and Methods
The field experiment was conducted during summer, 2021 and 2022 at Main Vegetable Research Station, Anand Agricultural University, Anand (Gujarat). The experiment was laid out in Randomized Block Design with ten genotypes/cultivars *viz*., AOL 15-30, AOL 16-01, AOL 18-06, AOL 19-10, AOL 20-03, GAO-5, GO-6, Kashi Kranti, Red One Long, Phule Prajatika replicated thrice. Each genotype was sown in 2.7 × 1.5 m plot size with the spacing of 45 × 15 cm. All recommended cultural practices were followed for raising the crop except the plant protection measures.

Observation of sucking pests
For recording observations on the population of sucking pests *viz*., jassid, *A. Biguttula biguttula* and whitefly, *B. Tabaci* five plants were randomly selected from each plot. From each selected plants, one leaf each from top, middle and lower canopy was observed and number of individuals of sucking pests were counted at weekly interval starting from one week

after germination till the termination of crop. In case of jassid number of nymphs as well as adults were counted and in case of whitefly only number of adults were counted from each leaf. Whereas, the observations of mite, *Tetranychus urticae* population was recorded per one cm^2 leaf area.

Observation of lepidopteran pests

Observations on per cent shoot and fruit damage due to lepidopteran pests *viz*., *E. vittella* and *H. armigera* were worked out. Shoot infestation due to *E. vittella* was worked out by counting the withered terminal shoots out of all the shoots of five randomly selected plants from each genotype per replication. Damage to fruits due to fruit borers was recorded during each picking by counting number of healthy and damaged fruits from each genotype per replication. Per cent shoot and fruit damage due to fruit borers was calculated by using formula:

$$\text{Shoot damage (\%)} = \frac{\text{Number of damaged shoots}}{\text{Total number of shoots}} \times 100$$

$$\text{Fruit damage (\%)} = \frac{\text{Number of damaged fruits}}{\text{Total number of fruits}} \times 100$$

Categorization of okra genotypes/cultivars

The okra genotypes were grouped into six categories of resistance to insect-pests *viz*., highly resistant, resistant, moderately resistant, moderately susceptible, susceptible and highly. For the purpose, mean value of individual genotype ($\bar{x}_i$) was compared with mean value of all genotypes ($\bar{X}$) and Standard Deviation (SD) following the scale adopted by Patel *et al*. (2002) [8]. The scale used for the categorisation is as under.

Category of resistance	Scale for resistance
Highly Resistant (HR)	$\bar{X}i \leq (\bar{X} - 2SD)$
Resistant (R)	$(\bar{X} - 2SD) < \bar{X}i \leq (\bar{X} - SD)$
Moderately Resistant (MR)	$(\bar{X} - SD) < \bar{X}i \leq \bar{X}$
Moderately Susceptible (MS)	$\bar{X} < \bar{X}i \leq (\bar{X} + SD)$
Susceptible (S)	$(\bar{X} + SD) < \bar{X}i \leq (\bar{X} + 2SD)$
Highly Susceptible (HS)	$\bar{X}i > (\bar{X} + 2SD)$

Results and Discussion

During the present investigation population of sucking pests *viz*., jassid, whitefly and might as well as fruit damage due to lepidopteran pests *viz*., shoot and fruit borer, *E. vittella* and fruit borer, *H. armigera* were recorded. The experimental results obtained on resistance of okra genotypes against insect pest incidence have been discussed here.

Jassid, *A. biguttula biguttula*

The mean population of jassid ranged between 1.44 to 3.01 jassids per leaf (Table 1). Genotype, AOL 20-03 found superior by registering the lowest mean population of (1.44 jassids/leaf) whereas, genotype AOL 16-01 recorded the highest (3.01 jassids/leaf) mean population. The chronological order of merit, based on population of jassids recorded per leaf was: AOL 20-03 (1.44) > AOL 18-06 (1.66) > Red One Long (1.78) > Phule Prajatika (1.85) > GO 6 (1.95) > Kashi Kranti (2.26) > AOL 19-10 (2.35) > AOL 15-30 (2.45) > GAO 5 (2.94) > AOL 16-01 (3.01).

Whitefly, *B. Tabaci*

The pooled data calculated for two years revealed that mean population of whitefly ranged from 0.29 to 1.06 whiteflies per leaf with lowest mean population of 0.29 whitefly per leaf in AOL 20-03, while genotype AOL 16-01 recorded the highest (1.06 whiteflies/leaf) mean population (Table 1). The chronological order of merit, based on population of whitefly recorded per leaf was: AOL 20-03 (0.29) > AOL 18-06 (0.43) > Red One Long (0.47) > Phule Prajatika (0.54) > GO 6 (0.58) > Kashi Kranti (0.70) > AOL 1910 (0.76) > AOL 15-30 (0.82) > GAO 5 (0.99) > AOL 16-01 (1.06).

Mite, *T. Urticae*

The mean population of mite during summer, 2021 and 2022 revealed that average mean population of mite ranged from 1.52 to 3.31 mites per cm^2 leaf area (Table 1). The genotype AOL 20-03 was the most promising and recorded the lowest mean population (1.52 mites/ cm^2 leaf area) whereas, genotype AOL 16-01 recorded the highest mean population (3.31 mites/ cm^2 leaf area). The sequential order of merit, based on population of mite recorded per cm^2 leaf area was: AOL 20-03 (1.52) > AOL 18-06 (1.97) > Red One Long (2.03) > Phule Prajatika (2.09) > GO 6 (2.16) > Kashi Kranti (2.54) > AOL 19-10 (2.62) > AOL 15-30 (2.72) > GAO 5 (3.23) > AOL 16-01 (3.31).

Shoot damage due to *E. Vittella*

The pooled data on the per cent shoot damage varied significantly from 1.75 to 8.16 per cent with minimum damage being in AOL 20-03 (1.75 %) while maximum damage being in the genotype AOL 16-01 (8.16 %) (Table 2). The chronological order of superiority, based on per cent shoot damage by *E. Vittella* recorded was: AOL 20-03 (1.75) > Red One Long (2.78) > GO 6 (3.10) > Phule Prajatika (3.69) > AOL 18-06 (4.03) > AOL 19-10 (5.67) > AOL 15-30 (6.01) > Kashi Kranti (6.20) > GAO 5 (6.47) > AOL 16-01 (8.16).

Fruit damage due to *E. Vittella*

The overall pooled data on per cent fruit damage by *E. Vittella* calculated for summer, 2021 and 2022 varied from 3.32 to 9.32 per cent (Table 2). The data showed that among all the screened okra genotypes, AOL 20-03 found superior by registering the lowest 3.32 per cent fruit damage whereas genotype AOL 16-01 recorded the highest (9.32%) fruit damage. The chronological order of superiority, based on per cent fruit damage noted was: AOL 20-03 (3.32) > Red One Long (4.50) > GO 6 (4.85) > Phule Prajatika (5.27) > AOL 18-06 (5.63) > AOL 19-10 (6.39) > AOL 15-30 (6.78) > Kashi Kranti (7.04) > GAO 5 (7.49) > AOL 16-01 (9.32).

Fruit damage due to *H. Armigera*

Overall pooled data calculated for 2021 and 2022 revealed that the per cent fruit damage ranged from 5.48 to 14.55 per cent (Table 2). Among the screened okra genotypes, AOL 20-03 found superior by registering the lowest fruit damage (5.48%) whereas, genotype AOL 16-01 recorded the highest (14.55%) fruit damage. The chronological order of merit, based on per cent fruit damage recorded was: AOL 20-03 (5.48) > Red One Long (7.02) > GO 6 (7.36) > Phule Prajatika (7.83) > AOL 18-06 (8.25) > AOL 19-10 (9.79) > AOL 15-30 (10.49) > Kashi Kranti (10.89) > GAO 5 (11.30) > AOL 16-01 (14.55).

While shifting the past literatures, scanty information is available on this aspect from the published reports due to uncommonness of genotypes/cultivars. Although, work done by some of the earlier researchers on okra variety GAO 5 against insect-pest were discussed here. Bhalu *et al*. (2019) [3] concluded that (2.90 whiteflies/leaf) recorded in GAO 5 among the different screened varieties of okra. Whereas, Patel (2014) [9] noted the incidence of mite was (5.93 /4.5 cm^2 leaf area) in GAO 5. Dave and Pandya (2017) [4] reported that among the 14 okra genotypes, GAO 5 shows 10.05 and 11.93 per cent shoot and fruit damage, respectively. However, Subbireddy *et al*. (2018) [10] also recorded minimum fruit damage was 8.19 per cent in GAO 5 by shoot and fruit borer.

Categorization of okra genotypes/cultivars for their resistance

Jassid

Based on mean number of jassids per leaf, none of the genotype/variety categorized in to Highly Resistant (HR) and Highly Susceptible (HS) (Table 3). Genotype AOL 20-03 recorded less than 1.64 but more than 1.11 jassids/leaf and categorized under the resistant (R). Genotypes AOL 18-06, Red One Long, Phule Prajatika and GO 6 recorded less than 2.17 but more than 1.64 jassids/ leaf and categorized under Moderately Resistant (MR). Genotypes Kashi Kranti, AOL 19-10 and AOL 15-30 recorded less than 2.69 but more than 2.17 jassids/ leaf and categorized under Moderately Susceptible (MS). Genotypes GAO 5 and AOL 16-01 recorded less than 3.22 but more than 2.69 jassids/ leaf and categorized under Susceptible (S).

Whitefly

Based on number of whiteflies/leafs, none of the genotype categorized in to group of Highly Resistant (HR) and Highly Susceptible (HS) presented in Table 3. Genotype AOL 20-03 recorded less than 0.42 but more than 0.17 whitefly/leaf and categorized under the resistant (R). Genotypes AOL 18-06, Red One Long, Phule Prajatika and GO 6 recorded less than 0.66 but more than 0.42 whitefly/leaf and categorized under Moderately Resistant (MR). Genotypes Kashi Kranti, AOL 19-10 and AOL 15-30 recorded less than 0.91 but more than 0.66 whitefly/leaf and categorized under Moderately Susceptible (MS). Genotypes GAO 5 and AOL 16-01 recorded less than 1.16 but more than 0.91 whitefly/leaf and categorized under Susceptible (S).

Mite

None of the genotype categorized in to group of Highly Resistant (HR) and Highly Susceptible (HS) against mite (Table 3). Genotype AOL 20-03 recorded less than 1.85 but more than 1.28 mites/ cm^2 leaf area and categorized under the resistant (R). Genotypes AOL 18-06, Red One Long, Phule Prajatika and GO 6 recorded less than 2.42 but more than 1.85 mites/ cm^2 leaf area and categorized under Moderately Resistant (MR). Genotypes Kashi Kranti, AOL 19-10 and AOL 15-30 recorded less than 2.99 but more than 2.42 mites/ cm^2 leaf area and categorized under Moderately Susceptible (MS). Genotypes GAO 5 and AOL 16-01 recorded less than 3.56 but more than 2.99 mites/ cm^2 leaf area and categorized under Susceptible (S).

Shoot damage due to *E. Vittella*

The per cent shoot damage by *E. Vittella* (Table 4), none of the genotype categorized in to group of Highly Resistant (HR) and Highly Susceptible (HS). Genotypes AOL 20-03 and Red One Long recorded less than 2.78 per cent but more than 0.77 per cent shoot damage and categorized under the resistant (R). Genotypes GO 6, Phule Prajatika and AOL 18-06 recorded less than 4.79 per cent but more than 2.78 per cent shoot damage and categorized under Moderately Resistant (MR). Genotypes AOL 19-10, AOL 15-30, Kashi Kranti, and GAO 5 recorded less than 6.80 per cent but more than 4.79 per cent shoot damage and categorized under Moderately Susceptible (MS). Genotype AOL 16-01 recorded less than 8.80 per cent but more than 6.80 per cent shoot damage and categorized under Susceptible (S).

Fruit damage due to *E. Vittella*

Based on per cent fruit damage by *E. Vittella* (Table 4), none of the genotype categorized in to group of Highly Resistant (HR) and Highly Susceptible (HS). Genotype AOL 20-03 recorded less than 4.35 per cent but more than 2.63 per cent fruit damage and categorized under the resistant (R). Genotypes Red One Long, GO 6, Phule Prajatika and AOL 18-06 recorded less than 6.06 per cent but more than 4.35 per cent fruit damage and categorized under Moderately Resistant (MR). Genotypes AOL 19-10, AOL 15-30, Kashi Kranti, and GAO 5 recorded less than 7.77 per cent but more than 6.06 per cent fruit damage and categorized under Moderately Susceptible (MS). Genotype AOL 16-01 recorded less than 9.49 per cent but more than 7.77 per cent fruit damage and categorized under Susceptible (S).

Fruit damage due to *H. armigera*

The details of okra genotypes fall under respective category of susceptibility are presented in Table 4 and it was indicated that none of the okra genotype/cultivar fall under categories as Highly Resistant (HR) and Highly Susceptible (HS). Genotype AOL 20-03 recorded less than 6.66 per cent but more than 4.02 per cent fruit damage and categorized under the resistant (R). Genotypes Red One Long, GO 6, Phule Prajatika and AOL 18-06 recorded less than 9.30 per cent but more than 6.66 per cent fruit damage and categorized under Moderately Resistant (MR). Genotypes AOL 19-10, AOL 15-30, Kashi Kranti, and GAO 5 recorded less than 11.93 per cent but more than 9.30 per cent fruit damage and categorized under Moderately Susceptible (MS). Genotype AOL 16-01 recorded less than (14.57%) but more than (9.30%) fruit damage and categorized under Susceptible (S).

Table 1: Incidence of sucking insect-pests on okra genotypes/cultivars (pooled: summer, 2021 and 2022)

Sr. No.	Genotypes/ Cultivars	No. of jassids/ leaf			No. of whitefly/ leaf			No. of mites/1 cm^2 leaf area		
		2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
1	AOL 15-30	1.71d	1.73d	1.72f	1.13d	1.17e	1.15f	1.74c	1.85c	1.79c
		(2.41)	(2.49)	(2.45)	(0.77)	(0.87)	(0.82)	(2.51)	(2.93)	(2.72)
2	AOL 16-01	1.90e	1.85e	1.87g	1.21e	1.28f	1.25g	1.92d	1.98d	1.95d
		(3.10)	(2.91)	(3.01)	(0.98)	(1.15)	(1.06)	(3.19)	(3.43)	(3.31)

3	AOL 18-06	1.46ab	1.48b	1.47b	0.95b	0.98b	0.97b	1.51b	1.63b	1.57b
		(1.64)	(1.69)	(1.66)	(0.40)	(0.47)	(0.43)	(1.78)	(2.17)	(1.97)
4	AOL 19-10	1.67d	1.71d	1.69ef	1.10d	1.14e	1.12ef	1.70c	1.84c	1.77c
		(2.27)	(2.42)	(2.35)	(0.72)	(0.81)	(0.76)	(2.38)	(2.88)	(2.62)
5	AOL 20-03	1.40a	1.38a	1.39a	0.87a	0.91a	0.89a	1.40a	1.44a	1.42a
		(1.46)	(1.41)	(1.44)	(0.25)	(0.33)	(0.29)	(1.45)	(1.59)	(1.52)
6	GAO 5	1.87e	1.83e	1.85g	1.19e	1.25f	1.22g	1.90d	1.96d	1.93d
		(3.01)	(2.86)	(2.94)	(0.91)	(1.07)	(0.99)	(3.11)	(3.35)	(3.23)
7	GO 6	1.55c	1.58c	1.57d	1.02c	1.06cd	1.04d	1.56b	1.70b	1.63b
		(1.90)	(2.01)	(1.95)	(0.54)	(0.62)	(0.58)	(1.94)	(2.38)	(2.16)
8	Kashi Kranti	1.64d	1.68d	1.66e	1.08d	1.11de	1.09e	1.67c	1.81c	1.74c
		(2.19)	(2.33)	(2.26)	(0.66)	(0.73)	(0.70)	(2.30)	(2.79)	(2.54)
9	Red One Long	1.50bc	1.52bc	1.51bc	0.97bc	1.01bc	0.99bc	1.52b	1.66b	1.59b
		(1.74)	(1.82)	(1.78)	(0.43)	(0.51)	(0.47)	(1.83)	(2.24)	(2.03)
10	Phule Prajatika	1.52bc	1.54bc	1.53cd	1.00bc	1.04bc	1.02cd	1.54b	1.67b	1.61b
		(1.82)	(1.88)	(1.85)	(0.50)	(0.57)	(0.54)	(1.88)	(2.31)	(2.09)
S.E.M. ±Treatment (T)		0.028	0.024	0.019	0.020	0.021	0.015	0.036	0.036	0.026
Period (P)		0.030	0.025	0.019	0.019	0.020	0.014	0.030	0.030	0.022
Year (Y)		-	-	0.008	-	-	0.006	-	-	0.012
T x P		0.094	0.081	0.062	0.060	0.063	0.044	0.095	0.096	0.069
T x Y		-	-	0.026	-	-	0.021	-	-	0.037
P x Y		-	-	0.028	-	-	0.019	-	-	0.031
T x P x Y		-	-	0.087	-	-	0.062	-	-	0.097
F Test (T)		Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
C. V. (%)		10.00	8.56	9.29	9.85	10.03	9.93	10.03	9.48	9.88

Note: 1. Figures outside parentheses are $\sqrt{x + 0.5}$ transformed values and those inside are retransformed values
2. Treatments means with the letter(s) in common are not significantly different by Duncan's New Multiple Range Test (DNMRT) at 5% level of significance
3. Significant parameters and its interactions: P, Y and P × Y

Table 2: Infestation of fruit borers on okra genotypes/cultivars during summer, 2021 and 2022

Sr. No.	Genotypes/ Cultivars	Shoot damage (%) by *E. Vittella*			Fruit damage (%)					
					E. Vittella			*H. armigera*		
		2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
1	AOL 15-30	13.57de	14.81d	14.19de	14.93ef	15.26de	15.10g	18.29f	19.51ef	18.90e
		(5.50)	(6.54)	(6.01)	(6.64)	(6.93)	(6.78)	(9.85)	(11.16)	(10.49)
2	AOL 16-01	16.04f	17.15e	16.59f	17.51h	18.04g	17.77i	21.49h	23.35h	22.42g
		(7.63)	(8.70)	(8.16)	(9.05)	(9.59)	(9.32)	(13.42)	(15.71)	(14.55)
3	AOL 18-06	11.47c	11.70c	11.59c	13.65d	13.80c	13.73e	16.29d	17.10d	16.70c
		(3.95)	(4.11)	(4.03)	(5.57)	(5.69)	(5.63)	(7.87)	(8.65)	(8.25)
4	AOL 19-10	13.08d	14.48d	13.78d	14.45e	14.84d	14.64f	17.62e	18.84e	18.23d
		(5.12)	(6.25)	(5.67)	(6.22)	(6.56)	(6.39)	(9.17)	(10.42)	(9.79)
5	AOL 20-03	6.76a	8.45a	7.61a	10.33a	10.68a	10.50a	13.05a	14.03a	13.54a
		(1.39)	(2.16)	(1.75)	(3.22)	(3.43)	(3.32)	(5.10)	(5.88)	(5.48)
6	GAO 5	14.13e	15.34d	14.74e	15.60g	16.16f	15.88h	19.06g	20.24g	19.65f
		(5.96)	(7.00)	(6.47)	(7.23)	(7.74)	(7.49)	(10.66)	(11.96)	(11.30)
7	GO 6	9.44b	10.86bc	10.15b	12.70c	12.76b	12.73c	15.32bc	16.15bc	15.74b
		(2.69)	(3.55)	(3.10)	(4.83)	(4.88)	(4.85)	(6.98)	(7.74)	(7.36)
8	Kashi Kranti	13.86de	14.98d	14.42de	15.15fg	15.62ef	15.38g	18.61fg	19.92fg	19.27ef
		(5.74)	(6.68)	(6.20)	(6.83)	(7.25)	(7.04)	(10.18)	(11.61)	(10.89)
9	Red One Long	8.52b	10.69b	9.61b	12.10b	12.39b	12.25b	14.91b	15.82b	15.36b
		(2.20)	(3.44)	(2.78)	(4.40)	(4.61)	(4.50)	(6.62)	(7.43)	(7.02)
10	Phule Prajatika	11.10c	11.03bc	11.07c	13.22cd	13.32c	13.27d	15.82cd	16.68cd	16.25c
		(3.71)	(3.66)	(3.69)	(5.23)	(5.31)	(5.27)	(7.43)	(8.23)	(7.83)
S.E.M. ± Treatment (T)		0.336	0.344	0.249	0.191	0.193	0.136	0.234	0.243	0.168
Period (P)		0.238	0.243	0.176	0.234	0.236	0.166	0.286	0.298	0.206
Year (Y)		-	-	0.111	-	-	0.061	-	-	0.075
T x P		0.751	0.768	0.557	0.740	0.747	0.525	0.904	0.943	0.652
T x Y		-	-	0.352	-	-	0.192	-	-	0.238
P x Y		-	-	0.249	-	-	0.235	-	-	0.292
T x P x Y		-	-	0.788	-	-	0.743	-	-	0.922
F Test (T)		Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
C. V. (%)		11.03	10.28	11.03	9.18	9.05	9.11	9.19	8.99	9.08

Note: 1. Figures outside parentheses are $\sqrt{x + 0.5}$ transformed values and those inside are retransformed values
2. Treatments means with the letter(s) in common are not significantly different by Duncan's New Multiple Range Test (DNMRT) at 5% level of significance
3. Significant parameters and its interactions: P, Y and P × Y

Table 3: Categorization of okra genotypes/ cultivars for their susceptibility to sucking insect-pests (Pooled: Summer, 2021 and 2022)

Category of resistance	Scale	Genotypes/ cultivars
Population of jassid/ leaf	**$\bar{X}$= 2.17**	SD = 0.53
Highly Resistant (HR)	$\bar{X}_i \leq 1.11$	-
Resistant (R)	$1.11 < \bar{X}_i \leq 1.64$	AOL 20-03
Moderately Resistant (MR)	$1.64 < \bar{X}_i \leq 2.17$	AOL 18-06, Red One Long, Phule Prajatika, GO 6
Moderately susceptible (MS)	$2.17 < \bar{X}_i \leq 2.69$	Kashi Kranti, AOL 19-10, AOL 15-30
Susceptible (S)	$2.69 < \bar{X}_i \leq 3.22$	GAO 5, AOL 16-01
Highly susceptible (HS)	$\bar{X}_i > 3.22$	-
Population of whitefly/ leaf	**$\bar{X}$= 0.66**	**SD =0.25**
Highly Resistant (HR)	$\bar{X}_i \leq 0.17$	-
Resistant (R)	$0.17 < \bar{X}_i \leq 0.42$	AOL 20-03
Moderately Resistant (MR)	$0.42 < \bar{X}_i \leq 0.66$	AOL 18-06, Red One Long, Phule Prajatika, GO 6
Moderately susceptible (MS)	$0.66 < \bar{X}_i \leq 0.91$	Kashi Kranti AOL 19-10, AOL 15-30
Susceptible (S)	$0.91 < \bar{X}_i \leq 1.16$	GAO 5, AOL 16-01
Highly susceptible (HS)	$\bar{X}_i > 1.16$	-
Population of mite/ cm^2 leaf area	**$\bar{X}$= 2.42**	**SD = 0.57**
Highly Resistant (HR)	$\bar{X}_i \leq 1.28$	-
Resistant (R)	$1.28 < \bar{X}_i \leq 1.85$	AOL 20-03
Moderately Resistant (MR)	$1.85 < \bar{X}_i \leq 2.42$	AOL 18-06, Red One Long, Phule Prajatika, GO 6
Moderately susceptible (MS)	$2.42 < \bar{X}_i \leq 2.99$	Kashi Kranti AOL 19-10, AOL 15-30
Susceptible (S)	$2.99 < \bar{X}_i \leq 3.56$	GAO 5, AOL 16-01
Highly susceptible (HS)	$\bar{X}_i > 3.56$	-

Note: $\bar{X}$ = Mean value of all genotypes/cultivars
$\bar{X}_i$ = Mean value of individual genotypes/cultivars
SD = Standard deviation

Table 4: Categorization of okra genotypes/ cultivars for their susceptibility to infestation of fruit borers (Pooled: Summer, 2021 and 2022)

Based on per cent damage		
Category of resistance	**Scale**	**Genotypes/ cultivars**
Shoot damage, *E. vittella*	**$\bar{X}$= 4.79**	**SD = 2.01**
Highly Resistant (HR)	$\bar{X}_i \leq 0.77$	-
Resistant (R)	$0.77 < \bar{X}_i \leq 2.78$	AOL 20-03, Red One Long
Moderately Resistant (MR)	$2.78 < \bar{X}_i \leq 4.79$	GO 6, Phule Prajatika. AOL 18-06
Moderately susceptible (MS)	$4.79 < \bar{X}_i \leq 6.80$	AOL 19-10, AOL 15-30, Kashi Kranti, GAO 5
Susceptible (S)	$6.80 < \bar{X}_i \leq 8.80$	AOL 16-01
Highly susceptible (HS)	$\bar{X}_i > 8.80$	-
Fruit damage, *E. vittella*	**$\bar{X}$= 6.06**	**SD = 1.71**
Highly Resistant (HR)	$\bar{X}_i \leq 2.63$	-
Resistant (R)	$2.63 < \bar{X}_i \leq 4.35$	AOL 20-03
Moderately Resistant (MR)	$4.35 < \bar{X}_i \leq 6.06$	Red One Long, GO 6, Phule Prajatika, AOL 18-06
Moderately susceptible (MS)	$6.06 < \bar{X}_i \leq 7.77$	AOL 19-10, AOL 15-30, Kashi Kranti, GAO 5
Susceptible (S)	$7.77 < \bar{X}_i \leq 9.49$	AOL 16-01
Highly susceptible (HS)	$\bar{X}_i > 9.49$	-
Fruit damage, *H. armigera*	**$\bar{X}$= 9.30**	**SD = 2.64**
Highly Resistant (HR)	$\bar{X}_i \leq 4.02$	-
Resistant (R)	$4.02 < \bar{X}_i \leq 6.66$	AOL 20-03
Moderately Resistant (MR)	$6.66 < \bar{X}_i \leq 9.30$	Red One Long, GO 6, Phule Prajatika. AOL 18-06
Moderately susceptible (MS)	$9.30 < \bar{X}_i \leq 11.93$	AOL 19-10, AOL 15-30, Kashi Kranti, GAO 5
Susceptible (S)	$11.93 < \bar{X}_i \leq 14.57$	AOL 16-01
Highly susceptible (HS)	$\bar{X}_i >$ (14.57	-

Note: $\bar{X}$ = Mean value of all genotypes/cultivars
$\bar{X}_i$ = Mean value of individual genotypes/cultivars
SD = Standard deviation\

Conclusion

The results clearly revealed that there was a wide variation in the behaviour of insect pests on different okra genotypes. The resistant genotype AOL 20-03 may be utilized suitably in future breeding programmes to identify the source of resistance.

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