



Screening of wild okra against okra leafhopper insect, *Amarasca biguttula biguttula*

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ABSTRACT

A total 76 germplasm accessions of wild okra (*Abelmoschus moschatus* ssp. *moschatus*) along with 4 checks were evaluated against okra leafhopper *Amarasca biguttula biguttula* Ishida in field condition during *kharif* 2017 and 2019. Of the 76 wild okra accessions used for two years of field screening, negligible preference of okra leafhopper insect exhibited towards nine wild okra accessions namely EC360586, EC360794, EC360830, EC360900, EC359730, EC359836, EC359870, EC360351 and EC361171 with hopper population in the range of 1.33 to 1.44/leaf while moderate preference of okra leafhopper was observed to another 11 wild okra accessions during first year of field screening (*kharif* 2017). During the second year (*kharif* 2019) of field screening, negligible preference of okra leafhopper was recorded on five accessions, viz. EC360586, EC360794, EC360830, EC360900 and EC361171 with hopper population in the range of 1.33 to 1.45/leaf while moderate preference response of okra leafhopper was observed on two wild okra accessions only. Whereas, high to very high preference response of okra leafhopper was observed on the remaining wild okra accessions during both the years of field screening and all were found susceptible. Based on two years field screening of wild okra accessions against okra leafhopper, five wild okra accessions, viz. EC360586, EC360794, EC360830, EC360900 and EC361171 were found resistant against okra leafhopper. The hopper burn symptoms were also negligible on these 5 accessions.

Keywords: Germplasm, Leafhopper, Okra, Resistant, Screening

Okra, *Abelmoschus esculentus* (L.) Moench is an important and largely cultivated commercial vegetable crop grown throughout India and other Asian and African countries. In the world, it occupies a land area of 2.73 million ha with a total production of 9.95 million tonnes (FAO 2019). However, in India, okra is grown in an area of 511 thousand ha with production of 5848.6 thousand metric tonnes and productivity of 11.40 tonnes/ha (Anonymous 2017b). There are many biotic and abiotic factors involved in okra's economic yield loss, low productivity and quality deterioration. Insect pest and diseases are major factors contributing towards low yield of okra worldwide (Ghosal *et al.* 2013). More than 72 insect pests species are reported to cause damage to okra crop. Among them, okra leafhopper (*Amarasca biguttula biguttula* Ishida), whiteflies (*Bemisia tabaci*), aphid (*Aphis gossypii*), fruit and shoot borer (*Earias vitelli*) are important one (Dikshit *et al.* 2001, Srinivasa and Rajendran 2003). Okra leaf hopper is considered as

serious insect pest attacking the okra crop (Uthamsamy and Balasubramanian 1978, Meena *et al.* 2010, Prithiva *et al.* 2019). Nymph and adult both suck the sap from ventral leaf surface and inject toxic saliva into the plant tissues. The characteristic symptom of leafhopper attack is phytotoxemia (hopper burn) caused by desapping of leaves by nymphs and adults (Hooda *et al.* 1997). In severe attack, plants are stunted and unable to produce flowers and fruits.

Due to lack of host plant resistance in cultivated okra, generally insecticides are being used as major plant protection measures all over India. Their constant use in okra crop resulted in high level of toxicity to non-target species and increased pesticide residue problem in okra fruits. Wild relatives of okra like *A. moschatus* ssp. *moschatus* are known an important source of resistance against many insect pests. Hence, it was thought imperative to screen available germplasm of wild okra, *A. moschatus* ssp. *moschatus* against okra leafhopper. Finding of this study may be helpful in the development of resistant okra cultivars against okra leafhopper insect through resistant breeding programme by breeders.

MATERIALS AND METHODS

An experiment was conducted during *kharif* 2017 and 2019 at the research farm of ICAR-National Bureau of Plant Genetic Resources, Pusa campus, New Delhi, India. A total

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76 wild okra (*A. moschatus* ssp. *moschatus*) accessions (Table 1) were screened against okra leafhopper. Out of the 76 wild okra accessions, 74 accessions are exotic collections (EC) comprising 70 accessions from International Board of Plant Genetic Resources, Singapore; 2 accessions each from Nepal and Sri Lanka and 2 indigenous collections (IC) from Maharashtra and Arunachal Pradesh. The experiment was conducted in an Augmented Block Design (ABD) with one row in three replications for each genotype with spacing 30×30 cm plant to plant and 75 cm × 75 cm row to row.

The observations on the number of okra leafhoppers (both nymphs and adults) were recorded thrice on three leaves (upper, middle and lower) of 3 randomly selected plants in each row during vegetative stage at 25 days intervals. Further, the mean and critical difference (CD)

values were calculated to know the leafhopper preferences to wild accessions and were graded into four groups: (i) Negligible preference (genotypes with values < Mean-CD), (ii) Moderate preference (genotypes with values between Mean-CD and <Mean), (iii) High preference (genotypes with values between and equal to Mean and Mean+CD) and (iv) Very high preference (genotypes with values > Mean+CD) (Manoharan *et al.* 1982).

Statistical analysis: The data on number of okra leafhoppers per leaf were subjected to Augmented Block Design (ABD) statistical analysis using R Programming (version Ri386 3.6.2) to compute standard error, critical difference and coefficient of variance.

RESULTS AND DISCUSSION

A total of 76 germplasm accessions of wild okra along with 4 checks were evaluated against okra leafhopper in field condition during *kharif* 2017 and 2019. It is evident from the results that none of the accession was completely immune to the okra leafhopper infestation. Of the 76 wild okra accessions, negligible preference of okra leafhopper was observed toward the nine wild okra accessions, *viz.* EC360586, EC360794, EC360830, EC360900, EC359730, EC359836, EC359870, EC360351 and EC361171 during *kharif* 2017 (Table 2). The mean population of okra leafhopper per leaf on these wild okra accessions was observed in the range of 1.33–1.44 hopper/leaf. However, moderate preference of okra leafhopper was observed to another eleven wild okra accessions, *viz.* EC360736, EC360675, EC360819, EC360828, EC360855, EC360911, EC360245, EC360337, EC360945, EC361132 and IC140985

Table 1 List of wild okra accessions used for screening against okra leaf hopper

Accession No.	Accession No.	Accession No.
EC360586	EC361018	EC361200
EC360794	EC361111	EC361284
EC360830	EC361131	IC141055
EC360900	EC360665	EC360484
EC359730	EC360820	EC360554
EC359836	EC360826	EC360629
EC359870	EC360853	EC316077
EC360351	EC316073	EC359408
EC361171	EC329394	EC359715
EC360736	EC359709	EC359787
EC360675	EC359828	EC360193
EC360819	EC359906	EC360927
EC360828	EC360095	EC361006
EC360855	EC360332	EC361014
EC360911	EC360410	EC361019
EC360245	EC360915	EC361022
EC360337	EC360953	EC361082
EC360945	EC360964	EC361129
EC361132	EC361003	EC361170
IC-40985	EC361007	EC361231
EC360672	EC361020	EC361264
EC360735	EC361044	EC361261
EC360787	EC361067	VRO 6 (Check)
EC360900-A	EC361137	Pusa Sawani (Check)
EC359653	EC361138	Parbhani Kranti (Check)
EC359878	EC361148	Arka Anamika (Check)
EC360331	EC361178	

Table 2 Screening of germplasm accessions of wild okra against okra leafhopper insect

Accessions/ cultivar	Mean number of okra leafhoppers/leaf and Preference			
	Kharif 2017		Kharif 2019	
	Mean number of leafhoppers/leaf	Preference	Mean number of leafhoppers/leaf	Preference
EC360586	1.33 (1.4) ^a	Negligible	1.45 (1.4) ^a	Negligible
EC360794	1.33 (1.4) ^a	Negligible	1.33 (1.4) ^a	Negligible
EC360830	1.44 (1.4) ^a	Negligible	1.44 (1.4) ^a	Negligible
EC360900	1.44 (1.4) ^a	Negligible	1.33 (1.4) ^a	Negligible
EC359730	1.33 (1.4) ^a	Negligible	5.56 (2.5) ^{bc}	High
EC359836	1.44 (1.4) ^a	Negligible	4.45 (2.2) ^b	Moderate
EC359870	1.33 (1.4) ^a	Negligible	5.45 (2.4) ^{bc}	High
EC360351	1.44 (1.4) ^a	Negligible	5.33 (2.4) ^{bc}	High
EC361171	1.44 (1.4) ^a	Negligible	1.45 (1.4) ^a	Negligible
EC360736	4.11 (2.1) ^b	Moderate	5.22 (2.4) ^{bc}	High
EC360675	4.45 (2.2) ^{bc}	Moderate	5.67 (2.5) ^{bc}	High

Cond.

Table 2 (Continued)

Accessions/ cultivar	Mean number of okra leafhoppers/leaf and Preference			
	Kharif 2017		Kharif 2019	
	Mean number of leafhoppers/ leaf	Preference	Mean number of leafhoppers/ leaf	Preference
EC360819	4.33 (2.2) ^{bc}	Moderate	6.33 (2.6) ^c	High
EC360828	4.22 (2.2) ^{bc}	Moderate	5.56 (2.5) ^{bc}	High
EC360855	4.22 (2.2) ^{bc}	Moderate	5.45 (2.4) ^{bc}	High
EC360911	4.45 (2.2) ^{bc}	Moderate	5.22 (2.4) ^{bc}	High
EC360245	4.45 (2.2) ^{bc}	Moderate	5.89 (2.5) ^{bc}	High
EC360337	4.56 (2.2) ^{bc}	Moderate	5.00 (2.3) ^{bc}	High
EC360945	4.45 (2.2) ^{bc}	Moderate	5.56 (2.5) ^{bc}	High
EC361132	4.56 (2.2) ^{bc}	Moderate	5.67 (2.5) ^{bc}	High
IC-40985	4.45 (2.2) ^{bc}	Moderate	4.58 (2.2) ^{bc}	Moderate
EC360672	4.89 (2.3) ^{bcd}	High	6.33 (2.6) ^c	High
EC360735	4.78 (2.3) ^{bcd}	High	5.33 (2.4) ^{bc}	High
EC360787	5.00 (2.3) ^{bcd}	High	6.11 (2.6) ^c	High
EC360900-A	4.78 (2.3) ^{bcd}	High	5.67 (2.5) ^{bc}	High
EC359653	4.89 (2.3) ^{bcd}	High	5.56 (2.5) ^{bc}	High
EC359878	5.00 (2.3) ^{bcd}	High	5.44 (2.4) ^{bc}	High
EC360331	5.00 (2.3) ^{bcd}	High	5.56 (2.5) ^{bc}	High
EC361018	4.89 (2.3) ^{bcd}	High	5.45 (2.4) ^{bc}	High
EC361111	5.00 (2.3) ^{bcd}	High	5.00 (2.3) ^{bc}	High
EC361131	4.89 (2.3) ^{bcd}	High	5.33 (2.4) ^{bc}	High
EC360665	5.11 (2.4) ^{bcd}	High	5.56 (2.5) ^{bc}	High
EC360820	5.45 (2.4) ^{bcd}	High	5.45 (2.4) ^{bc}	High
EC360826	5.11 (2.4) ^{bcd}	High	5.11 (2.4) ^{bc}	High
EC360853	5.44 (2.4) ^{bcd}	High	6.00 (2.5) ^{bc}	High
EC316073	5.44 (2.4) ^{bcd}	High	6.00 (2.5) ^{bc}	High
EC329394	5.44 (2.4) ^{bcd}	High	5.11 (2.4) ^{bc}	High
EC359709	5.45 (2.4) ^{bcd}	High	5.00 (2.3) ^{bc}	High
EC359828	5.44 (2.4) ^{bcd}	High	5.67 (2.5) ^{bc}	High
EC359906	5.45 (2.4) ^{bcd}	High	5.01 (2.3) ^{bc}	High
EC360095	5.33 (2.4) ^{bcd}	High	5.45 (2.4) ^{bc}	High
EC360332	5.22 (2.4) ^{bcd}	High	5.22 (2.4) ^{bc}	High
EC360410	5.44 (2.4) ^{bcd}	High	5.11 (2.4) ^{bc}	High
EC360915	5.22 (2.4) ^{bcd}	High	5.45 (2.4) ^{bc}	High
EC360953	5.22 (2.4) ^{bcd}	High	5.44 (2.4) ^{bc}	High
EC360964	5.22 (2.4) ^{bcd}	High	5.33 (2.4) ^{bc}	High
EC361003	5.33 (2.4) ^{bcd}	High	5.78 (2.5) ^{bc}	High
EC361007	5.11 (2.4) ^{bcd}	High	5.11 (2.4) ^{bc}	High
EC361020	5.33 (2.4) ^{bcd}	High	5.56 (2.5) ^{bc}	High
EC361044	5.22 (2.4) ^{bcd}	High	5.00 (2.3) ^{bc}	High

Cond.

Table 2 (Concluded)

Accessions/ cultivar	Mean number of okra leafhoppers/leaf and Preference			
	Kharif 2017		Kharif 2019	
	Mean number of leafhoppers/ leaf	Preference	Mean number of leafhoppers/ leaf	Preference
EC361067	5.33 (2.4) ^{bcd}	High	5.89 (2.5) ^{bc}	High
EC361137	5.11 (2.4) ^{bcd}	High	5.00 (2.3) ^{bc}	High
EC361138	5.33 (2.4) ^{bcd}	High	5.44 (2.4) ^{bc}	High
EC361148	5.33 (2.4) ^{bcd}	High	5.33 (2.4) ^{bc}	High
EC361178	5.45 (2.4) ^{bcd}	High	5.67 (2.5) ^{bc}	High
EC361200	5.44 (2.4) ^{bcd}	High	6.22 (2.6) ^{bc}	High
EC361284	5.33 (2.4) ^{bcd}	High	5.11 (2.4) ^{bc}	High
IC141055	5.44 (2.4) ^{bcd}	High	5.00 (2.3) ^{bc}	High
EC360484	5.56 (2.5) ^{cd}	High	5.44 (2.4) ^{bc}	High
EC360554	5.56 (2.5) ^{cd}	High	5.56 (2.5) ^{bc}	High
EC360629	5.89 (2.5) ^{cd}	High	6.00 (2.5) ^{bc}	High
EC316077	5.56 (2.5) ^{cd}	High	5.44 (2.4) ^{bc}	High
EC359408	5.56 (2.5) ^{cd}	High	5.11 (2.4) ^{bc}	High
EC359715	5.56 (2.5) ^{cd}	High	6.00 (2.5) ^{bc}	High
EC359787	5.67 (2.5) ^{cd}	High	6.22 (2.6) ^{bc}	High
EC360193	5.67 (2.5) ^{cd}	High	5.22 (2.4) ^{bc}	High
EC360927	6.00 (2.5) ^{cd}	High	6.00 (2.5) ^{bc}	High
EC361006	5.67 (2.5) ^{cd}	High	5.33 (2.4) ^{bc}	High
EC361014	5.56 (2.5) ^{cd}	High	5.33 (2.4) ^{bc}	High
EC361019	5.56 (2.5) ^{cd}	High	5.11 (2.4) ^{bc}	High
EC361022	6.00 (2.5) ^{cd}	High	5.56 (2.5) ^{bc}	High
EC361082	6.00 (2.5) ^{cd}	High	5.22 (2.4) ^{bc}	High
EC361129	5.89 (2.5) ^{cd}	High	6.00 (2.5) ^{bc}	High
EC361170	5.56 (2.5) ^{cd}	High	6.45 (2.6) ^c	High
EC361231	5.89 (2.5) ^{cd}	High	5.56 (2.5) ^{bc}	High
EC361264	5.67 (2.5) ^{cd}	High	5.45 (2.4) ^{bc}	High
EC361261	6.22 (2.6) ^d	Very high	5.56 (2.5) ^{bc}	High
VRO 6 (Check)	5.00 (2.34) ^{bcd}	High	5.00 (2.3) ^{bc}	High
Pusa Sawani (Check)	4.67 (2.27) ^{bc}	High	5.33 (2.4) ^{bc}	High
P a r b h a n i Kranti (Check)	4.11 (2.14) ^b	Moderate	5.00 (2.3) ^{bc}	Moderate
Arka Anamika (Check)	4.89 (2.32) ^{bcd}	High	5.78 (2.5) ^{bc}	High
SEd	0.127		0.129	
CD (5%)	0.311		0.315	

Figure in parenthesis are square root transformed values; The values within a column with different letters are significantly different at 5% level of significance.

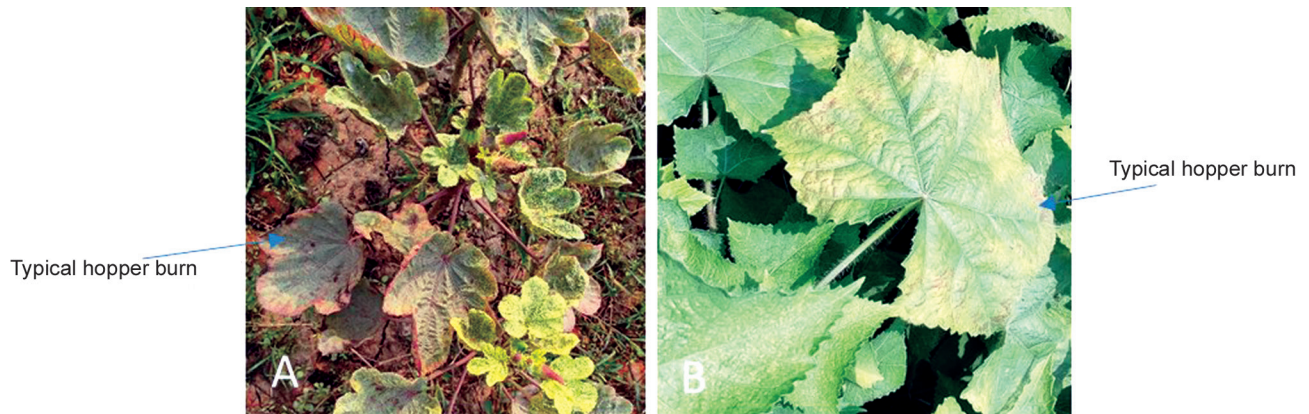


Fig 1 Typical hopper burn symptom on okra (A) susceptible check, (B) wild okra.

during first year (*kharif* 2017) of field screening. The mean population of okra leafhopper per leaf on these wild okra accessions was observed in the range of 4.11–4.56 hoppers/leaf (Table 2). During the second year (*kharif* 2019) of field screening, negligible preference of okra leafhopper was recorded to five wild okra accessions, viz. EC360586, EC360794, EC360830, EC360900 and EC361171 only (Table 2). The mean population of okra leafhopper per leaf on these wild okra accessions was in the range of 1.33–1.45 hoppers/leaf while moderate preference response of okra leafhopper was observed on two wild okra accessions, viz. EC359836 and IC140985 with leafhopper population in the range of 4.45–4.58 hoppers/leaf. However, on the remaining wild okra accessions during both the years of screening, high

to very high preference response of okra leafhopper was recorded and all of them were found susceptible. The mean population of okra leafhopper per leaf on these susceptible wild okra accessions was in the range of 4.78–6.45 hoppers/leaf (Table 2). Among the four checks, Parbhani Kranti was moderately preferred by the leafhoppers while other check, viz. Pusa Sawani, Arka Anamika and VRO-6 were highly preferred. Based on 2 years screening of wild okra against leafhopper, it was concluded that five wild okra accessions, viz. EC360586, EC360794, EC360830, EC360900 and EC361171 were found resistant to okra leafhopper insect (Table 2). These five wild okra accessions were almost free from hopper burn symptoms due to low preference of okra leafhopper during both the seasons of field screening

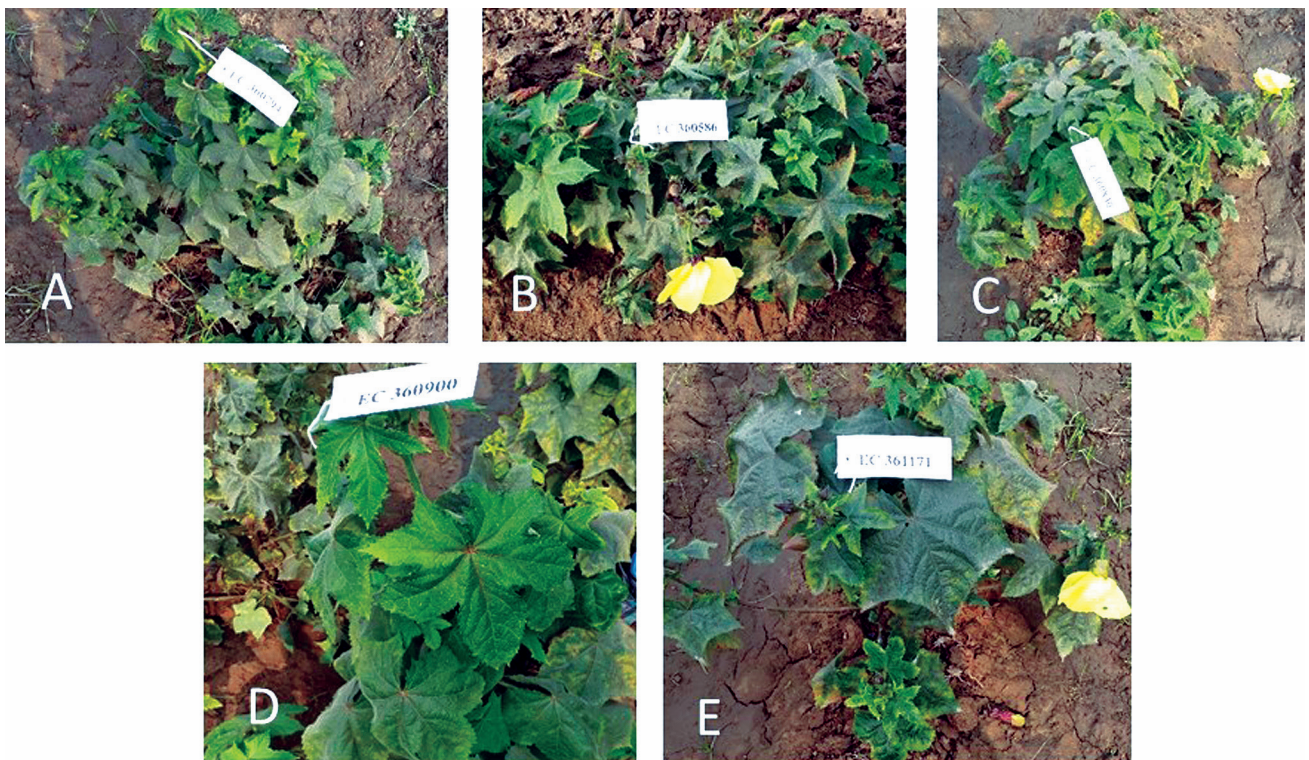


Fig 2 Resistant wild okra accession, against leaf hopper. (A): EC360794, (B): EC360586, (C): EC360830, (D): EC360900, (E): EC361171.

(Fig 1 and 2).

Although very few studies have been conducted on screening of okra wild species against leafhopper. Several workers have advocated that presence of secondary plant metabolites like terpenoids, phenolics, quinones, alkaloids, flavonoids, cynogenic glycosides and glucosinolates etc impart resistance to herbivores in wild okra plant (Mello and Silva-Filho 2002, Baldwin 2010). Hooda *et al.* (1997) postulated that higher trichome density, longer trichome length and higher concentration of sugars, silica, potassium, tannins and phenols in the leaves of resistant cultivars were associated with resistance to leafhopper. Uthamasamy (1985a and b) reported that okra varieties resistant to leaf hopper contained more total chlorophyll, xanthophyll and carotene contents. Singh *et al.* (2006) observed high level of tolerance for leaf hopper in *A. caillei* and *A. moschatus* while Anitha and Nandihalli (2009) have reported no resistant genotypes and varieties in *A. esculentus*. Gangopadhyay *et al.* (2017) studied biotic stress on several species/genotypes of wild okra and found that minimum (1.4) and maximum (39.0) leafhopper population (measured by mean number of nymphs/5 leaves) on EC306713-A and EC306724 of *A. caillei* respectively. Besides, EC306713-A of *A. caillei*, three accessions of *A. manihot* (IC344738, IC433438 and IC433667), one accession each of, *A. moschatus* (IC140986) and *A. tuberculatus* (IC090402) were found resistant to leafhopper. It was also observed that presence of more hair on leaf surface of wild okra species as compared to cultivated one could have contributed to higher field resistance. Singh *et al.* (1988) reported that incidence of leafhopper was negatively correlated with hair density on lower leaf surface of okra. Prabu *et al.* (2009) studied resistance in wild and cultivated okra against leafhopper and observed that mean leafhopper (jassid) population per leaf was maximum in cultivated okra while minimum in wild okra. The wild species *A. moschatus* harboured a lower leafhopper (nymph) population per leaf. They also concluded that larger leaf area might have harbored more leafhopper population. Nerkar (1990) reported that the species *A. moschatus* due to its laminal hairiness was found to be highly resistant to leaf hopper (jassids). As far as check varieties are concerned, it is clear that Pusa Sawani cultivar was comparatively more preferred by the leafhopper (jassid), *A. biguttula biguttula*. The same may be compared with findings of several other researchers (Khambete and Desai 1996, Narayanan and Muthiah 2017, Prithiva *et al.* 2019). Present study shall be helpful in the development of okra leafhopper resistant okra cultivars since five wild okra accessions, viz. EC360586, EC360794, EC360830, EC360900 and EC361171 exhibited a good level of resistance to okra leafhopper insect constantly for two growing seasons, *i.e.* kharif 2017 and kharif 2019.

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