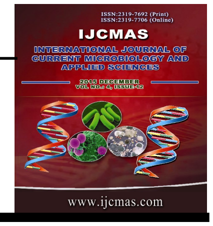

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Original Research Article

Evaluation of Shoot Fly Tolerance Derived Lines in Sorghum

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A B S T R A C T

The present study was undertaken to estimate the various genetic variability parameters of shoot fly resistance with its components and among the components themselves. The study was carried out with 38 derived genotypes of sorghum. Field trail was conducted in a randomized block design with three replication during *kharif* 2005. The observations were recorded on thirteen characters *viz.*, days to 50 per cent flowering, plant height, panicle length, panicle breadth, yield per plant, 100 seed weight, number of eggs per plant, trichomes density per mm^2, chlorophyll content reducing sugar content, total sugar content, recovery of infested plant and dead heart counts. The treatment differences among the genotypes were highly significant for investigation indicating the presence of high amount of genetic variability. In general genotypic coefficient of variation was higher than phenotypic coefficient of variation. The correlation studies indicate that dead heart was positively and significantly associated with number of eggs per plant and chlorophyll content. Almost all the AKENT except some observed the shoot fly tolerant as compared to check genotype, AKENT-52, AKENT-51, AKENT-53, AKENT-54, AKENT-55, AKENT-16, AKENT-34, AKENT-36, AKENT-37, AKENT-35, AKENT-38, AKENT-39, AKENT-40, AKENT-42, AKENT-44, AKENT-45, AKENT-47, AKENT-50 and AKENT-24 lines were found to be most promising among all the genotype in respect of shoot fly resistance character and good yield.

K e y w o r d s

Shoot Fly, *Atherigona soccata,* trichomes density, Sorghum

Introduction

Jowar is an important cereal crop of India and mostly grown for double purpose i.e. for food and fodder. It has several industrial uses also. Maharashtra is one of the major sorghum growing state in India and in Vidarbha *kharif* sorghum is dominating. Sorghum hybrids are being grown about 90 per cent area in these regions. The sorghum shoot fly (*Atherigona soccata* Randani) is one of the major pest of the sorghum crop in India. The pest is very much troublesome in delayed plantings and also in earlier plantings when the preceding dry season has been interrupted by frequent showers of rains. Due to this several losses occur in yield. This is a severe threat to this crop. The problem has become accute with the introduction of exotic dwarfs which are susceptible to shoot fly. Breeding for resistance or tolerance to the pest is the ideal and ultimate solution to the problem. The sorghum shoot fly (*Atherigona soccata* Rondani) is one of the major pest of the sorghum crop in India. The problem has become acute with the introduction of exotic dwarfs which are susceptible to shoot fly. Breeding for resistance or tolerance to the pest is the ideal and ultimate solution to the problem.

In the view of the merge genetic information available, the present investigation was undertaken to study the variability for shoot fly resistances in derived lines among the characters related to shoot fly tolerant.

Materials and Method

The present investigation was comprised of thirty derivatives of promising crosses and four susceptible lines (check AKms-14B, ICS-70B, ms-2219B, AKms-17B) and four resistance lines (check IS-18551, IS-2205, ICSV-700, ICSV-705) used as checks in a randomized block design with three replication during *kharif* 2005. The observations were recorded on five randomly selected plants from each genotypes per replication on thirteen characters *viz.*, days to 50 per cent flowering, plant height, panicle length, panicle breadth, yield per plant, 100 seed weight, number of eggs per plant, trichomes density per mm^2, chlorophyll content reducing sugar content, total sugar content, recovery of infested plant and dead heart counts. The generated variability in material and object was to select segregants with good agronomic base with resistant or tolerant and to study whether further improvement in shoot fly resistant and its contributing traits is possible or not.

Result and Discussion

The analysis of variance revealed that variability existed in generated material is highly significant, since significant variation have been observed in all the traits under study. This indicates that there is a scope to improve upon all the characters by selection on making crosses among the lines under study.

Phenotypic Coefficient of Variation

It was observed from the Table 2 that the phenotypic coefficient of variation ranged from 6.91 to 37.88 per cent. It was higher for the trichomes density per mm^2 (37.88%) followed by yield per plant (36.59%), number of eggs/plant (29.66%), 100 seed weight (25.95%), dead heart counts (25.10%), reducing sugar content (24.53%), panicle length (14.01%), chlorophyll content (13.54%), panicle breadth (13.25%), total sugar content (11.14%), plant height (10.33%), recovery of infested plant (9.90%) and days to 50 per cent flowering (6.91%).

Genotypic Coefficient of Variation

It was observed from the Table 2 that the genotypic coefficient of variation ranged from 6.22 to 36.33 per cent.

Yield per plant exhibited highest genotypic coefficient of variation (36.33%) followed by trichomes density/mm^2 (34.88%), number of eggs/plant (26.44%), 100 seed weight (24.78%), reducing sugar content (23.04%), dead heart counts (21.34%), panicle length (12.00%), total sugar (10.47%), chlorophyll content (9.91%), recovery of infested plant (9.14%), panicle breadth (8.56%), plant height (8.03%) and days to 50 per cent flowering (6.22%).

Heritability in Broad Sense

It was also observed from the same table that the heritability in broad sense ranged from 41.80 to 98.40 per cent. The highest heritability were observed in yield per plant (98.40%) followed by 100 seed weight (91.10%), total sugar (88.40%), reducing sugar (88.30%), recovery of infested plant (85.10%), trichomes density per mm^2 (84.80%), days to 50 per cent flowering (80.90%), number of eggs per plant (79.50%), panicle length (73.40%), dead heart counts (72.30%), plant height (60.50%), chlorophyll content (53.50%) and panicle breadth (41.80%).

Expected Genetic Advance Over Mean

The expected genetic advance expressed in percentage of mean for various traits indicated the ranged from 0.16 to 36.22 per cent. The highest expected genetic advance expressed in percentage was for yield/plant (36.22%) followed by recovery of infected plants (12.18%), dead heart counts (9.09%) days to 50 per cent flowering (9.03%), panicle length (4.77%), trichomes density/mm^2 (3.17%), plant height (2.48%), panicle breadth (1.76%) 100 seed weight (1.13%), number of eggs/plant (0.88%), chlorophyll content (0.31%), total sugar (0.17%) and reducing sugar content (0.16%).

Variation for Mean Performance of Genotypes

The analysis of variance revealed that variability existed in generated material is highly significant, since significant variation have been observed in all the traits under study. This indicates that there is a scope to improve upon all the characters by selection on making crosses among the lines under study.

Mean of all genotypes showed significant difference for days to 50 per cent flowering. The genotypes AKENT-34 recorded earlines (67 days), while ICSV 700 late as (90 days). Difference in days to 50 per cent flowering might be due to variation in genotype and changing environmental condition.

AKENT-34 is found to be resistant or tolerant genotype because of its earliness with more chance of escaping shoot fly attack at seedling stage due to their vigorous growth rate at seeding stage. Some other genotypes such as AKENT-21 (72 days), AKENT-48 (71 days), AKENT-22 (69 days), AKENT-16 (69 days) and AKENT-47 (68 days) are also reported in resistant genotype because they are at par with AKENT-34 (67 days). Similar result observed by Dalvi *et al*. (1990). He reported that vigorously growing promising varieties reduced the incidence of shoot fly. But ICSV-700 is reported as late genotype found to be resistant because of late flowering seemed favourable in decreasing shoot fly damage and advantageous in improving shoot fly resistance (Maiti *et al*., 1994).

Plant height measured at 21 days and it was ranged from 15.60 to 22.93 cm. Seedling height gives a relative idea about growth rate of genotypes. Fast growth rate is highly associated with shoot fly resistance. The genotype AKENT-52 found significantly tallest (22.93 cm) at seedling stage (21 days after sowing) which was resistant to shoot fly due to faster growth at seedling stage. Some genotypes such as IS-18551 (22.40 cm), AKENT-34 (21.33 cm), AKENT-51 (21.27 cm), AKENT-55 (21.27 cm), AKENT-54 (21.07 cm), AKENT-44 (20.67 cm), IS-2205 (20.60 cm), AKENT-50 (20.33 cm) and AKENT-53 (20.33 cm) were also recorded as resistant lines. The results in present investigation showed similarity with the finding of Singh (1998). He reported that resistant genotype grow faster and escape from dead heart formation which confirm the present findings. Jadhao *et al*. (1986)

indicated that the entries having more height and initial faster growth were found resistant to shoot fly. Dalvi *et al*. (1990) also reported that vigorously growing promising varieties reduced the incidence of shoot fly. The results of the present study are in conformity with above observations.

Panicle length and panicle breadth are similar characters which are important component characters of yield. The genotype AKENT-52 found significantly longest panicle (26.68 cm) which give the greater yield. The other genotypes AKENT-54 (26.53 cm), ms-2219B (26.45 cm), AKENT-16 (26.43 cm), AKENT-23 (26.43 cm), AKENT-34 (25.53 cm), AKENT-44 (24.93 cm),AKENT-49 (24.73 cm), AKENT-19 (24.33 cm), AKms-14B (24.22 cm), AKENT-50 (24.20 cm), AKENT-7 (24.00 cm), AKENT-47 (23.90 cm), AKENT-24 (23.60 cm), AKms-17B (23.53 cm), ICSV-705 (23.27 cm), AKENT-55 (22.33 cm), AKENT-51 (23.23 cm) and AKENT-35 (23.20 cm) also recorded high yield which were at par with AKENT-52. Similar result observed by Patil *et al*. (1980) and Patel and Sukhani (1990[b]).

The genotype AKENT-51 registered significantly maximum panicle breadth (19.00 cm) and recorded the highest yield because particularly panicle breadth may also be contributing to the yield.

AKENT-47 (18.60 cm), IS-18551 (18.47 cm), AKENT-54 (17.77 cm), AKENT-52 (17.62 cm), AKENT-49 (17.07 cm), AKENT-7 (16.90 cm), AKENT-23 (16.60 cm), AKms-17B(16.50 cm), ICS-70B (16.49 cm), AKENT-46 (16.14 cm), AKENT-45 (16.13 cm), AKENT-50 (16.13 cm), AKENT-53 (16.13 cm), AKENT-37 (16.08 cm) and AKENT-24 (16.00 cm) were at par with AKENT-51. Similar result has been observed by Patil (1990).

For the grain yield per plant the genotype AKENT-52 recorded highest yield (85.50 g) followed by the genotypes AKENT-53 (75.65 g). Similar result obtained by Mote and Bapat (1983). And they reported that the promising derived genotype the shoot fly resistance have desirable yield contributing characters like height, maturity, seed weight and Shinde *et al*. (1983) found similar result in their studies.

For 100 seed weight AKENT-37 recorded significantly highest value (3.41 g) and it was found at par with AKENT-53 (3.39 g), ICS-70B (3.34 g) and AKENT-51 (3.18 g) 100. Thus, the seed weight is found highly associated with yield per plant. Similar results was observed by Patil (1980). He reported positive association between grain yield and 100 seed weight.

Generally more number of eggs were laid on susceptible varieties than those laid on tolerant one (Dalvi *et al*., 1990). The significantly lowest eggs laying per plant (0.53 eggs/plant) was recorded by the genotypes ICSV-705 and which was found to be at par with IS-18551 (0.93 egg/plant) and IS-2205 (1.00 eggs/plant). It was followed by the AKENT-51 recorded lowest eggs laying per plant (1.17 eggs/plant) and was found to be at par with AKENT-38 (1.67 eggs/plant), AKENT-24 (1.60 eggs/plant), AKENT-40 (1.60 eggs/plant), AKENT-45 (1.57 eggs/plant), AKENT-42 (1.50 eggs/plant), AKENT-3 (1.50 eggs/plant), AKENT-53 (1.50 eggs/plant), AKENT-50 (1.40 eggs/plant) and AKENT-54 (1.27 eggs/plant). The low laying of eggs per plant is always desirable to shoot fly resistant. The presence of trichomes is predominant attribute to shoot fly resistance which confirm the resistance in sorghum to shoot fly. Significantly the highest number of trichomes density per mm^2 (8.67 trichomes/mm^2) was noticed under the genotype AKENT-36 and which was found to be at par with genotypes IS-18551 (8.33 trichomes/mm^2), AKENT-34 (7.67 trichomes/mm^2), AKENT-23 (7.33 trichomes/mm^2) and AKENT-35 (7.33 trichomes/mm^2). It was followed by the genotype IS-2205 which recorded 7.00 trichomes/mm^2 and it was found at par with ICSV-700 (6.67 trichomes/mm^2), AKENT-16 (6.00 trichomes/mm^2), AKENT-19 (6.00 trichomes/mm^2), AKENT-22 (6.00 trichomes/mm^2) and AKENT-53 (5.67 trichomes/mm^2).

More number of trichomes on leaf surface provide more resistant to shoot fly. AKENT-36 recorded more trichomes number on leaf surface which were followed by ICSV-700 (6.67 trichomes/mm^2), AKENT-16 (6.00 trichomes/mm^2), AKENT-19 (6.00 trichomes/mm^2), AKENT-22 (6.00 trichomes/mm^2) and AKENT-53 (5.67 trichomes/mm^2).

Thus, this more number of trichomes per leaf provides shoot fly resistance to the plants (Maiti *et al.*, 1980) reported that presence of trichomes interferes with the migration of maggots to the growing point. Trichomes were found on both surface of the leaf, but tend to be more numeous on the adaxial surface. The present finding showed similarity with the finding of Jadhao *et al.* (1986). Similarly Maiti (1980) also reported that presence of trichomes on leaf surface reduce the shoot fly damage. Similarly Jayanthi (1999) observed season specificity for the expression of trichomes, inheritance of trichomes was complex and recessive type.

Significantly lowest chlorophyll content (1.75 mg/gm) was recorded by the genotype AKENT-53 and which was found to be at par with AKENT-45 (2.15 mg/g), AKENT-49 (2.10 mg/g), AKENT-7 (2.08 mg/g), AKENT-22 (2.07 mg/g), AKENT-19 (2.06 mg/g), AKENT-37 (2.06 mg/g), ICSV-705 (2.05 mg/g), AKENT-39 (2.05 mg/g), AKENT-38 (2.04 mg/g), AKENT-52 (2.02 mg/g), AKENT-55 (1.99 mg/g), AKENT-54 (1.97 mg/g), AKENT-24 (1.95 mg/g), AKENT-21 (1.93 mg/g), AKENT-50 (1.91 mg/g), AKENT-16(1.84 mg/g), AKENT-51 (1.84 mg/g), IS-18551 (1.84 mg/g), ICSV-700 (1.84 mg/g), AKENT-35(1.82 mg/g), AKENT-36 (1.82 mg/g), AKENT-34 (1.77 mg/g) and IS-2205 (1.77 mg/g).

Low chlorophyll content found significantly associated with shoot fly resistant. Similar results have been observed by Singh and Jotwani (1980) reported that chlorophyll content was significantly lower in resistant varieties as compared to susceptible varieties. Rasker and Sukhani (1985) observed significantly higher chlorophyll content in susceptible varieties than resistance ones. Similar trend is found in the present investigation.

Significantly lowest reducing sugar content at 24 days after sowing (0.22%) was recorded by the genotype IS-18551 and it was found at par with AKENT-54 (0.29%), AKENT-7 (0.28%), AKENT-16 (0.26%), AKENT-56 (0.25%), AKENT-36 (0.24%), AKENT-53 (0.24%) and IS-2205 (0.23%). These lines are found resistant to shoot fly and this might be due to reducing sugar content. Similar results were observed by Singh and Jotwani (1980)

The genotype IS-18551 was found with significantly lowest total sugar content (0.68%) and it was at par with the genotype ICSV-700 (0.74%), AKENT-36 (0.70%), AKENT-53 (0.69%) and IS-2205 (0.69%). These genotypes were found resistant because resistant of its low sugar content. Similar results have been observed by Singh and Jotwani (1980). They reported that both reducing sugar and total sugar were significantly lower in resistant varieties as compared to the susceptible check.

Significantly highest recovery of infested plants (98.94%) was recorded by ICSV-705 and which was found at par with genotypes ICSV-700 (97.83%), IS-18551 (96.90%), AKENT-38 (96.16%), IS-2205 (95.22%), AKENT-21 (94.95%), AKENT-49 (94.60%) and AKENT-37 (93.24%). Highest recovery of infested plant was associated with shoot fly resistant.

Thus, these above genotypes having highest recovery resistant to shoot fly damage were registered as resistant genotypes. The results in present investigation showed similarity with the finding of Mote and Jadhao (1993) and they further reported that the plant which produced dead heart at late stage gave higher recovery. Kenneth (1969) reported that recovery resistance had a slight negative correlation with number of seedling damage.

Significant lowest dead heart counts (10.10%) was recorded by genotype ICSV-705 and which was found to be at par with the genotypes AKENT-24 (16.88%), AKENT-21 (16.52%), AKENT-52 (16.38%), AKENT-37 (15.27%), AKENT-19 (14.60%), AKENT-45 (14.52%), AKENT-50 (14.10%), AKENT-51 (14.02%), IS-2205 (13.34%), AKENT-55 (13.02%), AKENT-53 (12.87%), AKENT-49 (12.83%), IS-18551 (11.94%) and ICSV-700 (10.80%).

These genotypes showed low dead heart percentage due to several reasons i.e. low sugar content, low chlorophyll content, low number of eggs per plant and high trichomes density per mm^2 and faster growth at seedling stage. Probably due to all these, they recorded low dead heart percentage and registered resistance for shoot fly. Similar results have been observed by Dalvi *et al*. (1990). Jadhao and Mote (1986) observed minimum number of eggs per plant on resistant variety IS-18551 with low dead heart percentage.

Heritability Studies

Present investigation views heritability estimates in two ways -

Heritability estimates of quantitative characters for their improvement by selection (since they are govern by additive variance) to improve yield and improvement through yield component characters.

Heritability of susceptibility/resistance of genotypes for shoot fly damage.

Present study showed the high heritability estimates in yield per plant (98.40%) followed by 100 seed weight (91.10%), total sugar (88.40%), reducing sugar (88.30%), recovery of infested plant (85.10%), trichomes density per mm^2 (84.80%) and days to 50 per cent flowering (80.90%). However, medium heritability was recorded for some important traits like number of eggs per plant (79.50%), panicle length (73.40%), dead heart counts (72.30%) and plant height (60.50%). Some important characters like chlorophyll content (53.50%) and panicle breadth (41.80%) have shown comparatively low heritability estimates indicating lesser response to selection and improvement. Doggett (1970) reported high heritability for recovery of resistance.

The results in present investigation showed similarity with finding of Borikar *et al*. (1981) reported that high heritability was observed in eggs per plant followed by dead heart percent. Stock *et al*. (1958) state that the relative amount of heritable portion of variation can be assessed through heritable percentage.

Table.1 Mean Performance of Genotypes for Different Characters

Sr. No.	Genotype	Days to 50% flowering	Plant height (cm)	Panicle length (cm)	Panicle breadth (cm)	Yield/ plant (g)	100 seed weight (g)	No. of egg/plant	Trichomes density /mm^2	Chlorophyll content (mg/g)	Reducing sugar (%)	Total sugar (%)	Recovery of infested plant (%)	Dead heart (%)
1.	AKENT-56	80.00	18.53	19.42	13.27	31.69	2.24	2.77	4.67	2.23	0.25	0.75	86.84 (68.79)	25.80 (30.10)
2.	AKENT-7	79.33	15.60	24.00	16.90	52.87	2.19	2.13	5.00	2.08	0.28	0.78	90.44 (71.99)	23.42 (28.46)
3.	AKENT-16	69.00	19.20	26.43	13.87	51.92	2.80	2.23	6.00	1.84	0.26	0.76	77.08 (59.04)	29.39 (34.49)
4.	AKENT-19	76.00	18.93	24.33	15.47	44.61	2.14	1.78	6.00	2.06	0.34	0.84	92.65 (74.64)	14.60 (19.80)
5.	AKENT-21	72.33	20.07	20.13	12.23	23.30	1.52	1.95	3.33	1.93	0.38	0.88	94.95 (77.32)	16.52 (21.92)
6.	AKENT-22	69.33	19.27	20.73	13.23	36.03	2.35	1.82	6.00	2.07	0.31	0.78	87.42 (69.25)	18.36 (23.77)
7.	AKENT-23	79.67	19.20	26.43	16.60	60.37	2.62	1.87	7.33	2.23	0.29	0.76	91.37 (72.93)	24.17 (29.57)
8.	AKENT-24	80.67	17.47	23.60	16.00	54.35	2.30	1.60	4.67	1.95	0.40	0.86	90.42 (72.39)	16.88 (22.18)
9.	AKENT-34	67.67	21.33	25.53	13.73	71.47	1.12	2.55	7.67	1.77	0.29	0.79	85.64 (67.79)	18.14 (23.33)
10.	AKENT-35	73.00	16.80	23.20	15.13	51.66	2.97	2.10	7.33	1.82	0.34	0.84	84.29 (66.91)	24.28 (29.69)
11.	AKENT-36	75.33	19.93	20.23	14.88	36.15	2.41	2.07	8.67	1.82	0.24	0.70	90.34 (72.13)	21.17 (26.57)
12.	AKENT-37	77.67	16.93	22.70	16.08	64.97	3.41	1.50	4.67	2.06	0.30	0.76	93.24 (75.16)	15.27 (20.41)

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Sr. No.	Genotype	Days to 50% flowering	Plant height (cm)	Panicle length (cm)	Panicle breadth (cm)	Yield/ plant (g)	100 seed weight (g)	No. of egg/plant	Trichomes density /mm^2	Chlorophyll content (mg/g)	Reducing sugar (%)	Total sugar (%)	Recovery of infested plant (%)	Dead heart (%)
13.	AKENT-38	80.00	19.13	21.87	12.97	43.80	2.85	1.67	3.67	2.04	0.34	0.80	96.16 (78.81)	18.80 (23.82)
14.	AKENT-39	81.67	17.00	20.80	14.47	50.07	2.39	1.85	4.67	2.05	0.42	0.86	84.00 (66.44)	19.91 (25.05)
15.	AKENT-40	81.67	18.20	22.53	14.13	48.35	2.38	1.60	4.33	2.20	0.43	0.90	83.22 (65.87)	24.22 (29.62)
16.	AKENT-41	84.33	18.33	15.55	14.73	25.50	2.61	2.00	2.67	2.37	0.47	0.97	75.31 (60.22)	20.13 (25.34)
17.	AKENT-42	80.67	17.13	17.60	14.78	26.28	1.19	1.50	3.67	2.43	0.43	0.90	82.65 (65.47)	18.83 (23.83)
18.	AKENT-43	82.33	16.13	22.57	15.12	42.77	2.64	1.78	4.67	2.35	0.35	0.81	88.41 (70.14)	19.65 (24.79)
19.	AKENT-44	77.33	20.67	24.93	15.55	51.89	2.89	2.08	5.00	2.24	0.35	0.81	85.40 (67.58)	21.65 (27.05)
20.	AKENT-45	80.33	20.20	22.07	16.13	73.16	2.87	1.57	3.67	2.15	0.49	0.96	85.27 (67.45)	14.52 (19.72)
21.	AKENT-46	73.00	18.73	22.51	16.14	42.14	2.38	2.09	4.67	2.21	0.44	0.94	93.08 (74.76)	21.01 (26.22)
22.	AKENT-47	68.00	20.00	23.90	18.60	72.85	2.75	2.27	2.33	2.69	0.48	0.98	75.66 (59.78)	19.13 (24.29)
23.	AKENT-48	71.67	20.20	21.60	15.07	61.21	1.88	1.87	2.67	2.45	0.48	0.99	87.55 (69.11)	18.99 (24.02)
24.	AKENT-49	82.00	19.40	24.73	17.07	63.07	2.55	1.73	4.00	2.10	0.41	0.91	94.60 (76.61)	12.83 (17.93)
25.	AKENT-50	79.00	20.33	24.20	16.13	66.46	1.64	1.40	3.67	1.91	0.36	0.80	90.72 (72.34)	14.10 (19.16)

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Sr. No.	Genotype	Days to 50% flowering	Plant height (cm)	Panicle length (cm)	Panicle breadth (cm)	Yield/ plant (g)	100 seed weight (g)	No. of egg/plant	Trichomes density /mm^2	Chlorophyll content (mg/g)	Reducing sugar (%)	Total sugar (%)	Recovery of infested plant (%)	Dead heart (%)
26.	AKENT-51	82.00	21.27	23.23	19.00	65.27	3.18	1.17	4.67	1.84	0.42	0.88	88.55 (70.24)	14.02 (19.05)
27.	AKENT-52	81.67	22.93	26.68	17.62	85.50	1.95	1.95	4.67	2.02	0.35	0.81	88.99 (70.68)	16.38 (21.78)
28.	AKENT-53	77.67	20.33	22.33	16.13	75.65	3.39	1.50	5.67	1.75	0.24	0.69	90.11 (71.74)	12.87 (18.27)
29.	AKENT-54	79.67	21.07	26.53	17.77	62.51	2.06	1.27	5.00	1.97	0.29	0.75	90.72 (72.27)	19.03 (24.09)
30.	AKENT-55	81.33	21.27	24.73	14.27	75.43	2.03	2.33	4.00	1.99	0.31	0.77	89.90 (71.64)	13.02 (18.94)
31.	IS-18551	86.33	22.40	18.37	18.47	16.29	1.71	0.93	8.33	1.84	0.22	0.68	96.90 (78.12)	11.94 (17.04)
32.	IS-2205	84.33	20.60	16.40	14.67	25.87	1.64	1.00	7.00	1.77	0.23	0.69	95.22 (77.03)	13.34 (18.44)
33.	ICSV-700	90.67	20.13	17.60	14.13	34.70	1.98	1.20	6.67	1.84	0.34	0.74	97.83 (82.77)	10.80 (15.90)
34.	ICSV-705	76.33	17.13	23.27	14.42	45.71	1.41	0.53	5.33	2.05	0.39	0.81	98.94 (84.37)	10.10 (15.17)
35.	AKms-14B	79.67	17.67	24.22	14.37	27.79	2.33	1.93	2.33	2.22	0.44	0.83	85.69 (67.84)	32.97 (38.37)
36.	ICS-70B	79.00	20.20	21.05	16.49	32.83	3.34	1.80	2.67	2.27	0.49	0.93	79.80 (63.25)	30.20 (35.01)
37.	ms-2219B	78.33	18.07	26.45	14.87	27.20	1.75	2.09	2.67	2.47	0.49	0.92	77.20 (61.50)	26.12 (31.52)
38.	AKms-17B	79.00	18.40	23.53	16.50	33.70	2.44	3.10	2.00	2.54	0.53	1.01	62.38 (52.17)	24.00 (29.40)
	SE (d) ±	1.930	1.019	1.328	1.275	1.836	0.146	0.198	0.578	0.157	0.025	0.025	2.192	2.625
	CD 5%	3.841	2.028	2.643	2.537	3.654	0.291	0.394	1.150	0.314	0.049	0.051	4.362	5.225
	CD 1%	5.103	2.694	3.511	3.371	4.855	0.387	0.526	1.537	0.417	0.066	0.068	5.796	6.982

Table.2 Estimates of Genotypic, Phenotypic Coefficient of Variation, Heritability and Expected Genetic Advance over Mean

Sr. No.	Characters	Mean	Range		GCV (%)	PCV (%)	h^2 (%)	EGA (%)
			Min	Max				
1.	Days to 50% flowering	78.368	67.67	90.67	6.22	6.91	80.90	9.03
2.	Plant height (cm)	19.231	15.60	22.93	8.03	10.33	60.50	2.48
3.	Panicle length (cm)	22.526	15.55	26.68	12.00	14.01	73.40	4.77
4.	Panicle breadth (cm)	15.446	12.23	19.00	8.56	13.25	41.80	1.76
5.	Yield/plant (g)	48.826	16.29	85.50	36.30	36.59	98.40	36.22
6.	100 seed weight (g)	2.323	1.12	3.41	24.78	25.95	91.10	1.13
7.	Number of eggs/plant	1.804	0.53	3.10	26.44	29.66	79.50	0.88
8.	Trichomes density/mm^2	4.789	2.00	8.67	34.88	37.88	84.80	3.17
9.	Chlorophyll content (mg/g)	2.095	1.75	2.69	9.91	13.54	53.50	0.31
10.	Reducing sugar (%)	0.364	0.22	0.53	23.04	24.53	88.30	0.16
11.	Total sugar (%)	0.832	0.68	1.01	10.47	11.14	88.40	0.17
12.	Recovery of infested plant (%)	88.21 (70.171)	62.38 (52.17)	98.94 (84.37)	9.14	9.90	85.10	12.18
13.	Dead heart counts (%)	18.91 (24.319)	10.10 (15.17)	32.97 (38.37)	21.34	25.10	72.30	9.09

GCV - Genotypic coefficient of variation
PCV - Phenotypic coefficient of variation
h^2 - Heritability estimates in broad sense
EGA - Expected genetic advance over mean

Expected Genetic Advance Over Mean

As regard the expected genetic advance, some shoot fly resistance traits and some yield contributing traits have recorded high values *viz.*, yield/plat (36.22%), followed by recovery of infested plant (12.18%), dead heart counts (9.09%), days to 50 per cent flowering (9.03%), panicle length (4.77%), trichomes density/mm^2 (3.17%), plant height (2.48%), panicle breadth (1.76%), 100 seed weight (1.13%), number of eggs/plant (0.88%), chlorophyll content (0.31%), total sugar (0.17%) and reducing sugar content (0.16%) indicating possible improvement in such desirable characters. However, its extent depend on upon selection pressure.

Borikar (1981) reported that high expected genetic advanced was recorded under optimum shoot fly population for both seedling mortality and oviposition.

In conclusion, on the basis of information obtained from mean value, genotypic coefficient of variation, phenotipic coefficient of variance, heritability estimate (%), expected genetic advance (%) and correlation. Following line of work can be suggested for the further utilization in breeding material under study.

It was observed from the mean values of AKENT lines and other check genotypes under study that most of the AKENT lines except few observed to be shoot fly resistant or tolerant as compared to susceptible checks AKms-14B, AKms-17B, ms-2219B, ICS-70B. These AKENT lines were exhibiting comparatively low chlorophyll content, low reducing sugar, low total sugar and less number of eggs per plant and more plant height in seedling stage, more trichomes density per mm^2, more recovery of infested plant and more yield per plant.

It was observed from the mean value of lines that, genotypes ICSV-705, IS-18551, IS-2205, AKENT-51, AKENT-24, AKENT-37, AKENT-38, AKENT-40, AKENT-42, AKENT-45, AKENT-50, AKENT-53 and AKENT-54 were found superior for low eggs laying per plant and low dead heart percentage. Most of the traits contributing to shoot fly resistance were present in the above lines.

It was also observed from mean value that, genotype AKENT-52 recorded more plant height at 21 days after sowing with better grain yield. Similarly other genotypes AKENT-34, AKENT-44, AKENT-50, AKENT-51, AKENT-53, AKET-54, AKENT-55, IS-18551 and IS-2205 also registered maximum plant growth with high yield, further, the presence of number of characters associated with shoot fly resistances were also recorded by these lines.

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