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Reaction of sorghum [*Sorghum bicoior* (L) Moench] varieties against major insect pests

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ABSTRACT
Sorghum is well documented for more potential drought tolerance and water use efficiency as compared to other cereals. An experimental field was carried out to screening of sorghum varieties against major insect pests at Research Farm of College of Agriculture, Gwalior (M.P.) during kharif season in the year 2011-12. The total 50 genotypes including cultivated varieties were tested against the major insect pests of sorghum. The plot size was kept 4m x 0.45m and replicated twice following the randomized block design. Results revealed that the genotype significant differences were observed in per cent dead heart caused by shoot fly in different genotypes at 14, 21 and 28 days after emergenec. The per cent dead heart in different genotypes ranged from 2.00 to 10.40%. Genotype Gird 7 was found less susceptible to shoot fly followed by Gird 4, Gird 47, Gird 45 and Gird 40. Whereas, genotype Gird 5 was found higher to shoot fly followed by Gird 8. Per cent plant infestation caused by stem borer was significantly differed among different genotypes at 30 and 45 days after sowing. It ranged from 14.8 in Gird 44 to 21.2 in Gird 11. Significant differences were also observed in per cent dead heart caused by stem borer in different genotypes. It ranged from 3.25 in Gird 44 to 7.55 percent in Gird 13. Stem tunneling in different genotypes ranged from 5.25 in Gird 18 to 21.85 per cent in Gird 47 with significant differences among them. However, the ear head bug population ranged from 0.05 to 0.95 and worm population ranged from 0.05 to 0.60 per ear head. Whereas, ear head pests of sorghum were recorded minor in Gwalior region.
Key words: *sorghum, dead heart, stemfly, shoot fly, earhead pests,*

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INTRODUCTION

Sorghum [*Sorghum bicolor* (L.) Moench] is one of the main staple food for the world's poorest and most food insecure people across the semiarid tropics. India contributes about 16% of the world's sorghum production. Sorghum is well known for drought tolerance, water use efficiency of sorghum is more than other cereals. Hence, sorghum is most suitable cereal crop for rainfed farming. The total cultivable area in india is 6.18 million hectares, which produces 5.28 million tonnes grain. The average productivity of sorghum in the country is 850 kg/ha (1). In Madhya Pradesh, it is grown as a rainfed crop and is cultivated on nearly 205 thousand hectares of land with an annual production of 400 thousand tones. The average yield in Madhya Pradesh is 1951 kg/ha (2). Sorghum grain yield on farmer's field in M.P. is low mainly due to insects, diseases, weeds, and drought. Nearly 150 insect species have been reported as pest of sorghum (3). However, only nine are considered as potential pests of economic importance in India. The major being shoot fly, stem borer and panicle insects as the most important ones in sorghum growing areas of Madhya Pradesh. Recommendation for the integrated management of the insect pest in sorghum involves cultural practices, and use of insecticides. Cultural practices are effective against certain insect species. Chemical control is expensive and numerous applications may be required. This is often beyond the reach of most farmers. Host plant resistance can be used as a principal component of pest control.

MATERIAL AND METHODS

An experimental field was carried out at Research Farm of College of Agriculture, Gwalior (M.P.) during kharif season in the year 2011-12. The total 50 genotypes including cultivated varieties ere tested against

the major insect pests of sorghum. The plot size was kept 4m x 0.45m and replicated twice and randomized block design. Shoot fly (*Atherigona soccata* Rondani) Observation on total number of plants and dead heart caused by shoot fly were recorded in each plot at 14 and 28 days after sowing of the crop.Stem borer (*Chilo partellus* Swinhoe) During growth period two types of observations viz., leaf injured plants and dead heart formation were recorded at 30 and 45 days after sowing to work out the per cent plant infestation and per cent dead heart caused by stem borer. At harvest 5 (five) plants were selected randomly to record the stem length and stem tunneling. On the basis of observed data, per cent stem tunneling was calculated and therefore, subjected to arc sign transformation. Ear head bug (*Calocoris angustatus* Leth.) Insect population (nymph and adults) was counted on 3 ear heads of each genotype randomly at milky stage. Ear head worms Larval population counted was counted on three ear heads of each genotype at milky stage and average larvae/ear head was worked out. The data obtained from a set of observations for each character were tabulated and analyzed by the method of "Analysis of variance" (4)

RESULTS

A. Reaction of genotypes against shoot fly

Observation on per cent dead heart caused by shoot fly were recorded at 14, 21 and 28 days after emergence (DAE) (Table1). Observation recorded on per cent dead heart caused by shoot fly at 14 days after emergence showed significant differences among different genotypes. Per cent dead heart in genotype Gird 7 was significantly less (1.15) than rest of the genotypes except Gird 1, Gird 4, Gird 15, Gird 21, SPV 1962, Gird 39, Gird 40, Gird 41, Gird 45 and Gird 47. On the other hand, significantly higher dead heart (9.55) was recorded in Gird 5 than rest of the genotypes except Gird 3, Gird 6, Gird 8, Gird 13, Gird 16, Gird 18, ERS 29, ERS 19, Gird 25, Gird 30, JJ 1022, Gird 36, Gird 37 and Gird 44. At 21 days after emergence significant differences were recorded among different genotypes with regard to per cent dead heart caused by shoot fly. Minimum dead heart (1.40) was recorded in genotype Gird 7, which found significantly less than the dead heart in rest of the genotypes but was at par to Gird 1, Gird 4, SPV 1962, Gird 39, Gird 40, Gird 41, Gird 45 and Gird 47. Whereas, maximum dead heart (9.80) was recorded in Gird 5 and was found to be significantly higher than rest of the genotypes except Gird 3, Gird 6, Gird 8, Gird 16, Gird 18, ERS 29, ERS 19, Gird 25, Gird 30, JJ 1022, Gird 36, Gird 37, Gird 44 and JJ 938. At 21 days after emergence significant differences were recorded among different genotypes with regards to per cent dead heart caused by shoot fly. Minimum dead heart (8.10) was recorded in genotype Gird 7, which was significantly less than the dead heart in rest of the genotypes but was at par to Gird 1, Gird 4, Gird 7, GJrd 15, SPV 1962, Gird 39, Gird 40, Gird 41, Gird 45 and Gird 47. Whereas, maximum dead heart (10.40) was recorded in Gird 5 which was significantly higher than rest of the genotypes except Gird 3, Gird 6, Gird 8, Gird 17, Gird 18, ERS 29, ERS 19, Gird 25, Gird 30, JJ 1022, Gird 36 and Gird 37.

B. Reaction of genotypes against stem borer

Observation on per cent plant infested and dead heart caused by stem borer were recorded at 30 and 45 days after emergence (Table 2 and 3).

(i) Per cent plant infested

Data recorded on per cent plant infested by stem borer at 30 days after emergence showed significant differences among different genotypes (Table 2). Significantly less plant infestation (10.6%) was recorded in genotype Gird 44 than rest of the genotypes but it was at par to Gird 2, Gird 4, Gird 5, Gird 6, Gird 7, Gird 8, Gird 12, Gird 14, Gird 15, Gird 16, Gird 19, Gird 20, ERS 29, EJN 33, Gird 25, Gird 27, Gird 30, Gird 32, Gird 34, Gird 36, Gird 37, Gird 38, Gird 39 and Gird 43. Whereas, significantly higher plant infestation (17.2%) was recorded in JJ-1022 than all the tested genotypes. Data recorded at 45 days after emergence showed significant differences among different genotypes with regard to plant infestation. Minimum infestation (14.8%) was recorded in genotype Gird 44 which was significantly less than rest of the genotypes except but it was at par to Gird 2, Gird 4, Gird 5, Gird 6, Gird 7, Gird 8, Gird 12, Gird 14, Gird 15, Gird 16, Gird 19, Gird 20, ERS 29, EJN 33, Gird 25, Gird 27, Gird 30, Gird 32, Gird 34, Gird 36, Gird 37, Gird 38, Gird 39 and Gird 43. Whereas, maximum and significantly higher infestation (21.2%) was recorded in Gird 11 as compared to all the tested genotypes.

(ii) Per cent dead heart

Observations recorded on per cent dead heart caused by stem borer at 30 days after emergence indicate significant differences among different genotypes (Table 3). Minimum dead heart (1.30%) was recorded in genotype Gird 44, which was significantly less than the genotypes Gird 1, Gird 3, Gird 5, Gird 9, Gird 11, Gird 13, Gird 18, ERS 19, SPV 1962, Gird 28, Gird 33, Gird 40, Gird 41, Gird 42, JJ 938, Gird 49 and Gird 50 but was at par to rest of the genotypes. On the other hand maximum dead heart (5.60%) was recorded in Gird 13, which was significantly higher than rest of the genotypes was at par to Gird 18, Gird 28, Gird 33, JJ 938 and Gird 49, and than rest of the genotypes. Observations recorded on per cent dead heart caused

by stem borer at 45 days after emergence indicate significant differences among different genotypes (Table 3). Minimum dead heart (3.25%) was recorded in genotype Gird 44, which was significantly less than the genotypes Gird 1, Gird 3, Gird 9, Gird 11, Gird 13, Gird 18, ERS 19, SPV 1962, Gird 28, Gird 33, Gird 40, Gird 41, Gird 42, JJ 938, Gird 49 and Gird 50 but was at par to rest of the genotypes. On the other hand maximum dead heart (7.55%) was recorded in Gird 13, which was significantly higher than rest of the genotypes was at par to Gird 9, Gird 11, Gird 18, Gird 28, Gird 33, Gird 40, JJ 938 and Gird 49, and than rest of the genotypes.

(iii) Stem tunneling by stem borer

Data recorded at harvest on stem tunneling caused by stem borer showed significant differences in different genotypes (Table 4). Minimum stem tunneling (5.25%) was recorded in genotype Gird 18, which was significantly less than the tunneling in rest of the genotypes except Gird 1, Gird 2, Gird 3, Gird 9, Gird 15, Gird 16, Gird 19, Gird 20, SPV 1962, Gird 27, Gird 29, Gird 30, JJ 1022, Gird 33, Gird 35, JJ 938 and Gird 49. Whereas, maximum and significantly higher stem tunneling (21.85%) was recorded in Gird 47 than all the tested genotypes.

C. Reaction of genotypes against ear head pests

Observation recorded on number of ear head worms showed no significant difference among different genotypes. However, ear head worms population ranged from 0.05 to 0.60 worms/ ear head (Table 5). Data recorded on number of ear head bugs indicate no significant difference among different genotypes (Table 5). However, ear head bugs population ranged from 0.05 to 0.95 per ear head.

DISSCUSSION

A. Reaction of genotypes against shoot fly

Significant differences were observed in per cent dead heart caused by shoot fly among different genotypes at 14, 21 and 28 days after emergence. At 28 days after emergence, per cent dead heart ranged from 2.00 to 10.40% in different genotypes with significant differences among them. Minimum dead heart formation in genotypes Gird 7 showed their less susceptibility to shoot fly than rest of the genotypes. Whereas, maximum dead heart formation recorded in Gird 5 indicate their higher susceptibility to shoot fly followed by Gird 8. Similar findings were by earlier co workers on genotype IS 2312 which was exhibited highly promising source of resistance to shoot fly (4),(5) and reported 8.5 to 76.5% dead hearts caused by shoot fly (6). Whereas Tomar has recorded 14.37 to 53.3% dead heart due to shoot fly. The variation in per cent dead heart formation may be due to genotypes/cultivars tested by different workers and variation in climatic conditions of the tested stations. The shoot fly infestation in different genotypes might be associated with high silica content, colour and glossiness of leaves and antibiosis mechanism of resistance (7). Resistance to sorghum shoot fly might be due to antibiosis which results maggots could not feed fully and also could not survive on shoot (8).

B. Reaction of genotypes against stem borer

Significant differences were recorded in per cent plant infested by stem borer among different genotypes at 30 and 45 days after emergence. The per cent plant infestation in different genotypes at 45 days after emergence ranged from 14.8 to 21.2. Minimum plant infestation in Gird 44 showed their resistance to stem borer than rest of the genotypes. Whereas, maximum infestation in Gird 11 showed their higher susceptibility than rest of the tested genotypes. The per cent dead heart formed by stem borer was also significantly differing among different genotypes at 30 and 45 days after sowing. At 45 days after emergence per cent dead heart caused by stem borer ranged from 3.25 to 7.55%. Minimum dead heart in Gird 44 showed their resistance to stem borer followed by EJN 33 and ERS 29. Whereas, maximum dead heart in Gird 13 indicates their higher susceptibility to stem borer followed by Gird 18 and Gird 49. The incidence of shoot fly was assessed in the form of dead hearts symptoms observed on 28th days after emergence. At this stage dead hearts was at high level i.e. up to 93.67 percent. Under such high population pressure; resistant check entries expressed resistance with least dead hearts. The resistant check, IS 18551 and IS 2205 had 5.04 and 4.89 percent dead hearts, respectively and rest of the entries had more than 59 percent dead hearts except entry SPV 2296. The highest dead hearts were in susceptible check Swarna (93.67%) lines followed with 92.07, 90.55 and 88.80 per cent in susceptible checks ICSV 745, SPV 669 and DJ 6514, respectively (9). Similar results had also found in the test entries viz., SPV 2294 (59.94%), SPV 2293 (60.58 %), SPV 2308 (60.76%), SPV 2298 (60.87%), SPV 2250 (61.24%) and SPV 2307 (63.78%) has caused significantly least dead hearts than susceptible checks(10). Among screening of 32 sorghum lines 16 lines were observed at par against shoot fly dead hearts where resistance performed cumulative/combine effect as non - preference and antibiosis(11). Similar report was also obtained against sorghum shoot fly on different cultivars (19.99 to 84.78% dead heart)(12).

Stem tunneling by stem borer in different genotypes also differed significantly. Stem tunneling in different genotypes ranged from 4.1 to 38.2%. Minimum stem tunneling in genotype IS 2312 showed their less susceptibility to stem borer followed by SPV 1826, 1821 and SPV 1824. Whereas, maximum tunneling in DJ 6514 indicates their higher susceptibility to stem borer. The present findings were corroborated with earlier researchers who has reported reported 0.51 to 12.71% stem tunneling among different varieties. The stem tunneling might be associated with the presence of silica content and stem hardening in the genotypes(13). Whereas also reported genotype CSV 15 to be less susceptible against stem borer on the basis of plant infestation, and stem tunneling caused by stem borer(14). Whereas, CSV 15 found to be highly susceptible against stem borer(15).

C. Reaction of genotypes against ear head pests

During present investigation the population of ear head pests on different genotypes was very less with no-significant differences among them. However, ear head bugs and ear head worms population ranged from 0.05 to 0.95 and 0.05 to 0.60 per ear head, respectively. The reaction of genotypes could not be assessed due to very less infestation of ear head pests. The varieties in level of infestation may be due to climate conditions of test station. Present findings were also supported with the result of Gagre who has recorded the incidence of ear head bug on sorghum varieties varied from 0.74 to 1.03 per cob. agreement with recorded incidence of ear head bug on sorghum varieties in the range of 0.74 to 1.03 per cob(16).

CONCLUSION

In the present investigation twenty one genotypes were screened to find out the less susceptible genotype against shoot fly, stem borer and ear head pests. Significant differences were observed in per cent dead heart caused by shoot fly in different genotypes at 14, 21 and 28 days after emergenec. The per cent dead heart in different genotypes which was ranged from 2.00 to 10.40%. less susceptible to shoot fly was found to genotype Gird 7 followed by Gird 4, Gird 47, Gird 45 and Gird 40. Whereas, genotype Gird 5 was found highly suceptible to shoot fly followed by Gird 8. Per cent plant infestation caused by stem borer was significantly differed among different genotypes at 30 and 45 days after sowing. It ranged from 14.8 in Gird 44 to 21.2 in Gird 11. Significant differences were also observed in per cent dead heart caused by stem borer in different genotypes. It ranged from 3.25 in Gird 44 to 7.55 percent in Gird 13. Stem tunneling in different genotypes ranged from 5.25 in Gird 18 to 21.85 per cent in Gird 47 with significant differences among them. There were no significant differences in ear head bugs and worms population recorded on different genotypes. However, the ear head bug population ranged from 0.05 to 0.95 and worm population ranged from 0.05 to 0.60 per ear head.

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Table 1 : Dead heart (%)caused by shoot fly in different genotypes of sorphum.

S.No.	Genotypes	Per cent dead heart at		
		14 DAE	**21 DAE**	**28 DAE**
1	Gird-1	2.20 (8.34)	2.45 (8.86)	3.05 (9.96)
2	Gird-2	3.55(10.68)	3.80(11.07)	4.40(11.97)
3	Gird-3	7.40(15.94)	7.65(15.92)	8.25(16.57)
4	Gird-4	1.35(6.52)	1.60(7.13)	2.20 (8.45)
5	Gird-5	9.55 (17.99)	9.80(18.23)	10.40(18.80)
6	Gird-6	8.75(17.19)	9.00(17.44)	9.60(18.03)
7	Gird-7	1.15(6.08)	1.40(6.75)	2.00 (8.10)
8	Gird-8	9.40(17.84)	9.65 (18.09)	10.25(18.66)
9	Gird-9	4.10(11.60)	4.35(11.96)	4.95 (12.79)
10	Gird-10	4.10(11.65)	4.35(12.01)	4.95(13.83)
11	Gird-11	5.15(13.07)	5.40(13.39)	6.00(14.13)
12	Gird-12	5.20(12.93)	5.45(13.23)	6.05(14.05)
13	Gird-13	4.90(17.78)	5.15(13.11)	5.75(13.87)
14	Gird-14	3.60 (10.88)	3.85(11.26)	4.45(13.13)
15	Gird-15	3.25(10.36)	3.50(10.76)	4.10(11.66)
16	Gird-16	6.10(14.24)	6.35(14.53)	6.95(15.23)
17	Gird-17	4.95(12.85)	5.20(13.17)	5.80(13.93)
18	Gird-18	8.50 (16.94)	8.75(17.19)	9.35(17.79)
19	Gird-19	4.20(11.80)	4.45(12.16)	5.05(12.97)
20	Gird-20	5.80(13.90)	6.05(14.21)	6.65(14.91)
21	Gird-21	3.40(10.39)	3.65(10.79)	4.25(11.72)
22	ERS-29	6.60(14.64)	6.85(14.93)	7.45(15.62)
23	ERS-19	6.60(14.83)	6.85(15.11)	7.45(15.79)
24	EJN-33	5.45(13.49)	5.70(13.80)	6.30(14.53)
25	Gird-25	8.10(16.46)	8.35(16.73)	8.95(17.35)
26	SPV-1962	3.00(9.83)	3.25(10.27)	3.85(11.24)
27	Gird-27	3.60(10.90)	3.85(11.27)	4.45(12.14)
28	Gird-28	3.75(10.84)	4.00(11.23)	4.60(12.14)
29	Gird-29	3.85(11.11)	4.10 (11.48)	4.70(12.36)
30	Gird-30	8.90(17.34)	9.15(17.59)	9.75(18.17)
31	JJ-1022	6.95(15.22)	7.20(15.50)	7.80(16.16)
32	Gird-32	5.45(13.49)	5.70(13.80)	6.30(14.53)
33	Gird-33	5.45(13.49)	5.70(13.80)	6.30(14.53)
34	Gird-34	4.85(12.67)	5.10(13.00)	5.70(13.76)
35	Gird-35	5.10(12.97)	5.35(13.31)	5.95(14.06)
36	Gird-36	6.95(15.26)	7.20(15.54)	7.80(16.20)
37	Gird-37	6.35(14.51)	6.60(14.80)	7.20(15.49)
38	Gird-38	4.60(12.29)	4.85(12.63)	5.45(13.42)
39	Gird-39	2.80 (9.53)	3.05 (9.96)	3.65(10.94)
40	Gird-40	2.15(8.10)	2.40(8.61)	3.00 (9.76)
41	Gird-41	2.55(9.13)	2.80J9.57)	3.40(10.58)
42	Gird-42	3.90(11.34)	4.15(11.70)	4.75(12.54)
43	Gird-43	5.70(13.78)	5.95(14.09)	6.55(14.80)
44	Gird-44	6.05(14.22)	6.30 (14.52)	6.90(15.21)
45	Gird-45	2.00 (7.85)	2.25 (8.37)	2.85 (9.55)
46	JJ-938	5.85(13.96)	6.10(14.55)	6.70(14.96)
47	Gird-47	1.50(6.93)	1.75(7.50)	2.35 (8.75)
48	Gird-48	4.00(11.53)	4.25(11.89)	4.85(12.72)
49	Gird-49	4.50(12.07)	4.75(12.42)	5.35(13.23)
50	Gird-50	3.50(10.52)	3.75(10.95)	4.35(11.86)
	SE(m)± **CD at 5%**	**(1.39)** **(3.95)**	**(1.34)** **(3.83)**	**(1.25)** **(3.58)**

DAE - Days after emergence Figures in parenthesis are arc sign values

Table 2: Plant infested(%) by stem borer in different genotypes of sorghum

S.No.	Genotypes	Per cent plant infested at	
		30 DAE	**45 DAE**
1	Gird-1	14.2(21.19)	18.6(25.57)
2	Gird-2	13.2(20.33)	17.6(24.83)
3	Gird-3	14.2(21.33)	18.8(25.68)
4	Gird-4	11.1 (20.29)	17.6(24.78)
5	Gird-5	14.2(20.28)	17.6(24.81)
6	Gird-6	10.2(19.44)	16.6 (24.05)
7	Gird-7	11.2(17.98)	15.5(22.88)
8	Gird-8	9.2(18.51)	15.6(23.27)
9	Gird-9	13.1 (21.99)	19.6(26.25)
10	Gird-10	11.2(20.33)	17.6(24.82)
11	Gird-11	18.2(23.27)	21.2(27.41)
12	Gird-12	11.6(18.68)	15.8(23.44)
13	Gird-13	16.2(23.25)	21.1 (27.37)
14	Gird-14	10.5(18.17)	15.3(23.02)
15	Gird-15	11.2(20.75)	18.1 (25.18)
16	Gird-16	8.5(18.15)	15.3(22.99)
17	Gird-17	12.5(20.91)	18.3(25.31)
18	Gird-18	10.2(21.09)	18.6(25.49)
19	Gird-19	13.4(20.41)	17.7(24.90)
20	Gird-20	11.2(18.99)	16.1 (23.68)
21	Gird-21	12.2(20.78)	18.1 (25.20)
22	ERS-29	11.2(18.99)	16.1 (23.68)
23	ERS-19	14.2(21.19)	18.6(25.57)
24	EJN-33	10.2(18.99)	16.1 (23.68)
25	Gird-25	13.2(19.91)	17.2(24.48)
26	SPV-1962	14.2(22.45)	20.1 (26.66)
27	Gird-27	11.2(20.33)	17.6(24.82)
28	Gird-28	11.2(21.16)	18.6(25.53)
29	Gird-29	12.2(19.90)	17.1 (24.45)
30	Gird-30	9.2 (17.94)	15.0(22.81)
31	JJ-1022	17.2(27.38)	20.1 (26.63)
32	Gird-32	12.4(19.99)	17.2(24.53)
33	Gird-33	15.6(22.19)	19.8(26.44)
34	Gird-34	10.2(19.87)	17.1 (24.42)
35	Gird-35	12.4(21.69)	19.2(25.99)
36	Gird-36	9.1 (18.08)	15.2(22.93)
37	Gird-37	10.7(19.67)	16.9(24.25)
38	Gird-38	13.2(20.46)	17.8(24.94)
39	Gird-39	12.3(19.94)	17.2(24.49)
40	Gird-40	15.2(22.03)	19.6(26.30)
41	Gird-41	12.3(22.05)	19.7(26.30)
42	Gird-42	14.3 (20.79)	18.2(25.23)
43	Gird-43	11.3(19.03)	16.2(23.72)
44	Gird-44	10.6(17.71)	14.8 (22.65)
45	Gird-45	13.2(20.33)	17.6 (24.83)
46	JJ-938	14.9(21.48)	19.0(25.82)
47	Gird-47	12.4(19.03)	16.2(23.75)
48	Gird-48	12.3(19.94)	17.2(24.49)
49	Gird-49	17.2 (23.63)	21.6(27.72)
50	Gird-50	14.2(21.19)	18.6(25.57)
	SE(m)± **CD at 5%**	**(1.07)** **(3.06)**	**(0.92)** **(2.63)**

DAE **- Days after emergence** *** Figures for parenthesis are arc sign values**

Table 3: Dead (%) heart caused by stem borer in different genotypes of sorghum.

S.No.	Genotypes	Per cent dead heart at	
		30 DAE	45 **DAE**
1	Gird-1	3.10 (9.97)	5.05(12.95)
2	Gird-2	2.65(9.31)	4.60(12.38)
3	Gird-3	3.25(10.27)	5.20(13.16)
4	Gird-4	2.55(9.15)	4.50(12.18)
5	Gird-5	3.00(9.96)	4.95(12.85)
6	Gird-6	1.60(7.21)	3.55(10.78)
7	Gird-7	2.60 (9.25)	4.55(12.26)
8	Gird-8	1.60(7.21)	3.55(10.78)
9	Gird-9	3.55(10.83)	5.50(13.51)
10	Gird-10	2.60 (9.25)	4.55(12.26)
11	Gird-11	4.20(11.74)	6.15(14.34)
12	Gird-12	2.80 (9.62)	4.75(12.55)
13	Gird-13	5.60(13.67)	7.55(15.92)
14	Gird-14	1.75(7.58)	3.70(11.02)
15	Gird-15	2.60 (9.25)	4.50(12.19)
16	Gird-16	2.75 (9.45)	4.70(12.51)
17	Gird-17	2.75 (9.53)	4.70(12.48)
18	Gird-18	4.60(12.37)	6.55(14.79)
19	Gird-19	2.70 (9.37)	4.65(12.44)
20	Gird-20	2.10(8.13)	3.90(11.25)
21	Gird-21	2.60 (9.25)	4.50(12.18)
22	ERS-29	1.60(7.21)	3.50(10.69)
23	ERS-19	3.10(9.97)	5.10(13.02)
24	EJN-33	1.60(7.21)	3.40(10.51)
25	Gird-25	2.65(9.31)	4.55(12.31)
26	SPV-1962	3.10(10.13)	5.15(13.11)
27	Gird-27	2.10(8.13)	4.15(11.62)
28	Gird-28	4.10(11.61)	6.35(14.53)
29	Gird-29	1.60(7.13)	3.55(10.85)
30	Gird-30	2.50 (9.08)	4.45(12.13)
31	JJ-1022	3.00 (9.83)	4.95(12.83)
32	Gird-32	1.95(7.97)	3.90(11.38)
33	Gird-33	3.80(11.17)	5.75(13.86)
34	Gird-34	2.10(8.13)	4.25(11.78)
35	Gird-35	2.70 (9.44)	4.65(12.41)
36	Gird-36	1.65(7.31)	3.60(10.93)
37	Gird-37	1.85(7.81)	3.80(11.20)
38	Gird-38	2.75 (9.51)	4.70(12.52)
39	Gird-39	1.65(7.23)	3.60(10.93)
40	Gird-40	3.60(10.90)	5.55(13.62)
41	Gird-41	3.15(10.13)	4.95(12.76)
42	Gird-42	3.15(10.04)	5.05(12.95)
43	Gird-43	2.15(8.26)	3.95(11.34)
44	Gird-44	1.30(6.50)	3.25(10.38)
45	Gird-45	2.60(9.21)	4.55(12.31)
46	JJ-938	3.85(11.21)	5.80(13.92)
47	Gird-47	2.20 (8.52)	4.10(11.67)
48	Gird-48	1.65(7.23)	3.60(10.93)
49	Gird-49	4.60(12.35)	6.45 (14.70)
50	Gird-50	3.10(9.97)	5.10(13.02)
	SE(m)± **CD at 5%**	(1.16) (3.32)	**(0.87)** **(2.48)**

DAE - **Days after emergence** *** Figures in parenthesis are arc sign values**

Table 4: Stem tunneling by stem borer in different genotypes of sorghum

S.No.	Genotypes	Stem tunneling by stem borer at harvest
1	Gird-1	9.90(18.33)
2	Gird-2	9.55(17.98)
3	Gird-3	12.15(20.34)
4	Gird-4	15.55(23.20)
5	Gird-5	31.15(33.90)
6	Gird-6	15.00(22.70)
7	Gird-7	11.90(20.14)
8	Gird-8	15.20(22.82)
9	Gird-9	12.65(20.81)
10	Gird-10	14.40(22.29)
11	Gird-11	18.30(25.32)
12	Gird-12	16.20(23.67)
13	Gird-13	15.50(23.18)
14	Gird-14	18.50(25.46)
15	Gird-15	10.65(18.86)
16	Gird-16	11.90(20.17)
17	Gird-17	16.10(23.64)
18	Gird-18	5.25(13.15)
19	Gird-19	10.75(19.12)
20	Gird-20	12.14(20.38)
21	Gird-21	13.89(21.87)
22	ERS-29	17.79(24.93)
23	ERS-19	15.69(23.29)
24	EJN-33	14.99(22.77)
25	Gird-25	17.99(25.07)
26	SPV-1962	10.14(18.29)
27	Gird-27	11.39(19.71)
28	Gird-28	15.59(23.24)
29	Gird-29	5.75(13.84)
30	Gird-30	10.24(18.63)
31	JJ-1022	11.63(19.93)
32	Gird-32	13.38(21.43)
33	Gird-33	11.95(20.08)
34	Gird-34	19.45(26.13)
35	Gird-35	11.45(19.67)
36	Gird-36	21.35(23.80)
37	Gird-37	14.30(22.16)
38	Gird-38	14.04(21.90)
39	Gird-39	17.84(24.84)
40	Gird-40	14.44(22.31)
41	Gird-41	16.83(24.20)
42	Gird-42	17.04(24.36)
43	Gird-43	19.09(25.89)
44	Gird-44	13.84(21.53)
45	Gird-45	20.99 (27.25)
46	JJ-938	10.09(18.49)
47	Gird-47	21.85(27.84)
48	Gird-48	13.69(21.62)
49	Gird-49	9.81 (18.19)
50	Gird-50	16.07(23.57)
	SE(m)± **CD at 5%**	**(2.72)** **(7.75)**

DAE - Days after emergence *Figures in parenthesis are arc sign values

Table 5: Number of ear head bugs and ear head worm on different genotypes of sorghum

S.No.	Genotypes	Number of worm ear head/cob	Number of ear head bug/cob
1	Gird-1	0.25 (0.86)	0.55(1.02)
2	Gird-2	0.20 (0.84)	0.50 (0.99)
3	Gircl-3	0.50 (0.97)	1.10(1.17)
4	Gird-4	0.30 (0.89)	0.95(1.20)
5	Gird-5	0.20 (0.84)	0.90(1.17)
6	Gird-6	0.20 (0.83)	0.30 (0.89)
7	Gird-7	0.05 (0.74)	0.20 (0.84)
8	Gird-8	0.30 (0.89)	0.85(1.15)
9	Gird-9	0.10 (0.77)	0.30 (0.89)
10	Gird-10	0.20 (0.84)	0.35(0.91)
11	Gird-11	0.15 (0.80)	0.50 (0.99)
12	Gird-12	0.15 (0.80)	0.95(1.20)
13	Gird-13	0.10 (0.77)	0.90(1.17)
14	Gird-14	0.25 (0.86)	0.20 (0.83)
15	Gird-15	0.20 (0.84)	0.70(1.10)
16	Gird-16	0.15 (0.80)	0.30 (0.89)
17	Gird-17	0.15(0.80)	0.15(0.80)
18	Gird-18	0.15 (0.80)	0.25 (0.86)
19	Gird-19	0.15 (0.80)	0.40 (0.95)
20	Gird-20	0.25 (0.86)	0.45 (0.95)
21	Gird-21	0.15 (0.80)	0.25 (0.86)
22	ERS-29	0.20 (0.84)	0.40 (0.95)
23	ERS-19	0.30 (0.89)	0.60(1.05)
24	EJN-33	0.10 (0.77)	0.40 (0.95)
25	Gird-25	0.25 (0.86)	0.70(1.10)
26	SPV-1962	0.15 (0.80)	0.30 (0.89)
27	Gird-27	0.30 (0.89)	0.15(0.80)
28	Gird-28	0.10 (0.77)	0.55(1.01)
29	Gird-29	0.15 (0.80)	0.60 (1.05)
30	Gird-30	0.20 (0.84)	0.30 (0.89)
31	JJ-1022	0.30 (0.89)	0.70(1.10)
32	Gird-32	0.10 (0.77)	0.05 (0.74)
33	Gird-33	0.20 (0.83)	0.40 (0.93)
34	Gird-34	0.30 (0.89)	0.30 (0.89)
35	Gird-35	0.20 (0.83)	0.30 (0.89)
36	Gird-36	0.35 (0.92)	0.40 (0.94)
37	Gird-37	0.25 (0.86)	0.15(0.80)
38	Gird-38	0.15 (0.80)	0.75(1.11)
39	Gird-39	0.50 (0.99)	0.45 (0.97)
40	Gird-40	0.20 (0.83)	0.25 (0.86)
41	Gird-41	0.25 (0.86)	0.25 (0.86)
42	Gird-42	0.50 (0.97)	0.25 (0.86)
43	Gird-43	0.25 (0.86)	0.25 (0.86)
44	Gird-44	0.20 (0.84)	0.30 (0.88)
45	Gird-45	0.25 (0.86)	0.20 (0.84)
46	JJ-938	0.20 (0.83)	0.35(0.91)
47	Gird-47	0.60(1.03)	0.40 (0.94)
48	Gird-48	0.20 (0.84)	0.25 (0.86)
49	Gird-49	0.15 (0.80)	0.40 (0.93)
50	Gird-50	0.25 (0.86)	0.25 (0.86)
	SE(m)± **CD at 5%**	**(1.16)** **(3.32)**	**(0.87)** **(2.48)**

Figures in parenthesis are $\sqrt{n+0.5}$ values

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