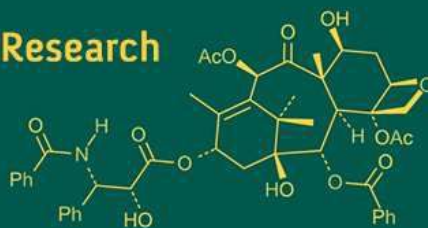
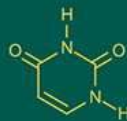


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Screening of sorghum genotypes/varieties against the stem borer

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Abstract

A study on “Screening of Stem Borer, *Chilo partellus* (Swinhoe), on Grain Sorghum (*Sorghum bicolor* L.)” was conducted at the Agronomy Instructional Farm, S.D. Agricultural University, Sardarkrushinagar, during the kharif seasons of 2021 and 2022. The trial included twenty five sorghum genotypes/varieties and weekly observations were taken to assess stem borer infestation by monitoring plants with dead hearts. Among the tested genotypes, IS 2205 (4.46%) and IS 1851 (5.98%) displayed the lowest infestation, indicating high resistance. On the other hand, DJ 6514 (29.16%), Swarna (28.05%), and DSF 231 (27.29%) showed the highest levels of infestation, reflecting greater susceptibility. These results suggest that IS 2205 and IS 1851 are promising resistant genotypes for developing sorghum varieties with improved tolerance to stem borer attacks.

Keywords: Screening, stem borer, *Chilo partellus*, grain sorghum, *Sorghum bicolor*, genotypes

Introduction

Sorghum is a unique crop among the major cereals and the staple food and fodder crop of the world's most food-insecure population. During 2022-23, world sorghum grain production was 55.09 million tonnes. India is the largest producer of sorghum in the world followed by Mexico and Nigeria. It is one of the major cereal crop consumed in India after rice and wheat. In *kharif* (2022-23), sorghum production was 1.69 million tonnes (1st advance estimates) in an area of 2.94 million hectares. (Anon., 2022) [1].

The spotted stem borer, belongs to the family *Crambidae* and order *Lepidoptera*. It primarily infests sorghum but also attacks maize, sugarcane, rice, finger millet, and wild grasses. The pest damages crop from the vegetative stage to maturity, causing significant economic losses. Its life cycle lasts 3–4 weeks, with five or more generations possible under favorable conditions. In regions with abundant water and host plants, it remains active year-round (Saranya and Samiayyan, 2017) [5].

Plant resistance is the most viable option to manage the pest. Several sorghum accessions have been screened for resistance to *C. partellus* and several sources of resistance identified, but the resistance levels range from low to moderate. Therefore, it is important to identify sorghum genotypes with higher levels of resistance with diverse mechanisms of resistance to diversify the bases of resistance to this pest.

Objective

1. Screening of sorghum genotypes/varieties against the stem borer

Methodology

The investigations on “Biology, population dynamic and management of stem borer, *Chilo partellus* (Swinhoe) on grain sorghum (*Sorghum bicolor* L.)” were carried out at Agronomy Instructional Farm, C. P. College of Agriculture, S. D. Agricultural University, Sardarkrushinagar during *kharif* seasons of year 2021 and 2022. The material used and methodology adopted during the course of investigation are described under here.

Experimental details

Location: Agronomy Instructional Farm, C. P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University Sardarkrushinagar.

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Season and year: *Kharif*, 2021 and 2022**Crop:** Sorghum**Replications:** 3 (Three)**Plot size:** 4.00 m × 1.35 m**Spacing:** 0.45 m × 0.15 m**Treatments:** 25 genotypes**Treatment details**

Sr. No.	Varieties/Genotypes	Sr. No.	Varieties/Genotypes
1.	SRF 332	14.	CSV 21 F
2.	GSF 19	15.	DS 318
3.	CVS 31	16.	SR 2980
4.	GY 43	17.	SSG S9 3
5.	GSF 211	18.	CSV 20
6.	SR 3048	19.	DS 226
7.	GFS 5	20.	DS 189
8.	Swarna	21.	DS 224
9.	DJ 6514	22.	DSF 213
10.	GFS 12	23.	GJ 43
11.	GNJ 1	24.	GFS 6
12.	GSF 218	25.	GFS 209
13.	IS 2205		

Method of recording observations

All the agronomical practices were followed and experimental plot was kept free from any application of plant protection measures.

To record the observations from each plot for plants with dead hearts were observed at weekly interval during morning hours starting from first week after sowing till the final harvest.

Observations of the infestation of stem borer were recorded from 50 plants of net plot by visual observing dead heart at weekly interval starting from the first week after sowing and per cent damage was worked out using following formula.

$$\text{Stem borer dead heart (\%)} = \frac{\text{Number of plants showing dead heart}}{\text{Total number of plants observed}} \times 100$$

Results and Discussion**Screening of sorghum genotypes/varieties against the stem borer *Kharif*, 2021****Vegetative stage**

The ascending trend of stemborer infestation on varieties/genotypes of sorghum recorded in terms of dead hearts during vegetative stage was (Table 1): IS 2205 (0.67) < GSF 209 (2.00) < IS 1851 (2.67) < GSF 218 (4.66) < SRF 332 (5.33) = SR 3048 (5.33) = GSF 12 (5.33) = DS 224 (5.33) < DS 318 (5.99) < DS 189 (6.65) < GSF 5 (6.66) = CSV 21 F (6.66) = SSG 593 (6.66) = GFS 6 (6.66) < DS 226 (6.67) < CSV 20 (7.33) < GJ 43 (7.98) < GFS 211 (7.99) = GNJ 1 (7.99) < GFS 19 (8.00) < SR 2980 (8.65) < CSV 31 (8.97) < DJ 6514 (9.78) < Swarna (10) = DSF 213 (10). Genotype, IS 2205 had minimum dead hearts which was at par with DJ 6514. While, significantly higher dead hearts were recorded in Swarna and DSF 213.

Ear-head stage

The chronological order of stemborer infestation on varieties/genotypes of sorghum recorded in terms of dead hearts during earhead stage was (Table 1): IS 1851 (4.00) < IS 2205 (4.67) < DS 318 (8.65) = DS 289 (8.65) = GFS 6 (8.65) = SR 3048 (8.67) < GSF 12 (9.31) < CVS 31 (9.99) < CSV 20 (9.98) < GSF 209 (10.01) < GFS 218 (10.65) < DS 226 (11.32) < GJ 43 (11.98) < SSG 593 (11.99) < GNJ 1 (12.67) < GSF 211 (13.30) < SR 2980 (13.31) < CSV 21 F (13.32) < GSF 19 (13.33) < GSF 5 (14.64) < DS 224 (15.98) < Swarna (16.09) < DSF 213 (17.97) < DJ 6514 (18.67). Significantly minimum dead hearts were recorded on genotype, IS 1851 and IS 1851. While, significantly higher dead hearts were recorded in DJ 6514 which was at par with GSF 5, DSF 213, Swarna and DS 224.

Table 1: Screening of sorghum varieties/ genotypes against stem borer (2021)

Sr. No.	Varieties/ Genotypes	Dead heart (%)	
		Vegetative stage	Ear head stage
1	SRF 332	13.34 ^{ef} (5.33)	20.24 ^{cdefg} (11.97)
2	GSF 19	16.43 ^{abcd} (8.00)	21.42 ^{bcd} (13.33)
3	CVS 31	17.43 ^{abc} (8.97)	18.42 ^g (9.99)
4	GSF 211	16.42 ^{abcd} (7.99)	21.39 ^{bcd} (13.30)
5	SR 3048	13.34 ^{ef} (5.33)	17.12 ^g (8.67)
6	GSF 5	14.96 ^{abcd} (6.66)	22.50 ^{abcde} (14.64)
7	Swarna	18.43 ^a (10.00)	23.65 ^{abc} (16.09)
8	DJ 6514	18.22 ^{ab} (9.78)	25.60 ^a (18.67)
9	GSF 12	13.34 ^{ef} (5.33)	17.77 ^{fg} (9.31)
10	GNJ 1	16.42 ^{abcd} (7.99)	20.85 ^{cdefg} (12.67)
11	GSF 218	12.46 ^f (4.66)	19.05 ^{efg} (10.65)
12	IS 2205	4.69 ^h (0.67)	12.47 ^h (4.67)
13	CSV 21 F	14.96 ^{cdef} (6.66)	21.41 ^{bcd} (13.32)
14	DS 318	14.17 ^{def} (5.99)	17.10 ^g (8.65)
15	SR 2980	17.10 ^{abc} (8.65)	21.39 ^{bcd} (13.31)
16	SSG 593	14.96 ^{cdef} (6.66)	20.26 ^{cdefg} (11.99)
17	CSV 20	15.71 ^{cdef} (7.33)	18.42 ^{fg} (9.98)
18	DS 226	14.96 ^{ef} (6.67)	19.67 ^{defg} (11.32)
19	DS 189	14.95 ^{cdef} (6.65)	17.10 ^g (8.65)
20	DS 224	13.34 ^{ef} (5.33)	23.56 ^{abcd} (15.98)
21	DSF 213	18.43 ^a (10.00)	25.08 ^{ab} (17.97)
22	GJ 43	16.41 ^{abcd} (7.98)	20.25 ^{cdefg} (11.98)
23	GFS 6	14.96 ^{cdef} (6.66)	17.10 ^g (8.65)
24	IS 1851	9.40 ^g (2.67)	11.53 ^h (4.00)
25	GFS 209	8.13 ^g (2.00)	18.44 ^{fg} (10.01)
S. Em. ±		0.77	1.18
C. D. at 5%		2.18	3.36
C.V. %		9.15	10.40

Kharif, 2022**Vegetative stage**

The observed chronological order stemborer infestation on varieties/genotypes of sorghum recorded in terms of dead hearts during vegetative stage was (Table 2): IS 2205 (0.33) < IS 1851 (1.34) < GFS 209 (2.00) < GSF 12 (4.01) < DS 318 (4.66) < SRF 332 (4.67) < GJ 43 (5.33) < CSV 21 F (5.33) < SR 3048 (5.65) < GSF 5 (6.00) = CSV 20 (6.00) < GSF 19 (6.40) < CSV 31 (6.65) < SSG 593 (6.66) = GSF 211 (6.66) < DS 224 (6.67) = GNJ 1 (6.67) = GFS 6 (6.67) < DS 189 (7.33) < DJ 6514 (7.99) < Swarna (10.45) < DSF 213 (10.67).

Significantly minimum dead hearts were recorded on genotype, IS 2205. While, significantly higher dead hearts were recorded in DSF 213.

Earhead stage

The ascending trend of stemborer infestation on varieties/genotypes of sorghum recorded in terms of dead hearts during earhead stage was (Table 2): IS 2205 (3.34) < IS 1851 (4.00) < GFS 6 (8.00) < SSG 593 (8.65) < SR 3048 (9.33) = DS 318 (9.33) < DS 189 (9.34) < GSF 218 (10.00) < GSF 19 (10.66) < GSF 12 (11.31) < SRF 332 (11.33) < DS 226 (11.34) < GJ 43 (11.90) < CSV 31 (11.98) < GNJ 1 (12.58) < CSV 21 F (12.64) < CSV 20 (12.66) < GSF 5 (13.87) < SR 2980 (14.65) < DS 224 (15.31) = GFS 209 (15.31) < DSF 213 (15.74) < Swarna (18.64) < DJ 6514 (21.49). Significantly minimum dead hearts were recorded on genotype, IS 2205. While, significantly higher dead hearts were recorded in DJ 6514 which was at par with Swarna.

Table 2: Screening of sorghum varieties/ genotypes against stem borer (2022)

Sr. No.	Varieties/ Genotypes	Dead heart (%)	
		Vegetative stage	Ear head stage
1	SRF 332	12.48 ^{ef} (4.67)	19.67 ^{cdef} (11.33)
2	GSF 19	14.68 ^{bcd} (6.42)	19.06 ^{cdef} (10.66)
3	CVS 31	14.95 ^{bcd} (6.65)	20.25 ^{bcd} (11.98)
4	GSF 211	14.96 ^{bcd} (6.66)	21.97 ^{bcd} (14.00)
5	SR 3048	13.75 ^{cde} (5.65)	17.78 ^{def} (9.33)
6	GSF 5	14.18 ^{bcd} (6.00)	21.87 ^{bcd} (13.87)
7	Swarna	18.86 ^a (10.45)	25.58 ^{ab} (18.64)
8	DJ 6514	16.42 ^b (7.99)	27.62 ^a (21.49)
9	GSF 12	11.55 ^f (4.01)	19.65 ^{cdef} (11.31)
10	GNJ 1	14.96 ^{bcd} (6.67)	20.77 ^{bcd} (12.58)
11	GSF 218	12.48 ^{ef} (4.67)	18.43 ^{cdef} (10.00)
12	IS 2205	3.29 ^h (0.33)	10.53 ^g (3.34)
13	CSV 21 F	13.35 ^{def} (5.33)	20.83 ^{bcd} (12.64)
14	DS 318	12.46 ^{ef} (4.66)	17.79 ^{cdef} (9.33)
15	SR 2980	13.36 ^{def} (5.34)	22.50 ^{def} (14.65)
16	SSG 593	14.95 ^{bcd} (6.66)	17.11 ^{abcd} (8.65)
17	CSV 20	14.18 ^{bcd} (6.00)	20.84 ^{bcd} (12.66)
18	DS 226	14.96 ^{bcd} (6.67)	19.68 ^{cdef} (11.34)
19	DS 189	15.71 ^{bc} (7.33)	17.79 ^{def} (9.34)
20	DS 224	14.96 ^{bcd} (6.67)	23.04 ^{abcd} (15.31)
21	DSF 213	19.06 ^a (10.67)	23.37 ^{abc} (15.74)
22	GJ 43	13.35 ^{def} (5.33)	20.18 ^{bcd} (11.90)
23	GFS 6	14.97 ^{bcd} (6.67)	16.43 ^f (8.00)
24	IS 1851	6.65 ^g (1.34)	11.53 ^g (4.00)
25	GFS 209	8.12 ^g (2.00)	23.04 ^{abcd} (15.31)
S. Em. ±		0.67	1.12
C. D. at 5%		1.89	3.18
C.V. %		8.50	9.75

Pooled (2021 and 2022)

The ascending trend of stemborer infestation on varieties/genotypes of sorghum recorded in terms of dead hearts was (Table 3): IS 2205 (4.46) < IS 1851 (5.98) < DS 318 (14.30) < SR 3028 (14.42) < GFS 209 (14.55) < GSF 12 (14.97) < GSF 218 (14.98) < GFS 6 (14.99) < DS 189 (15.97) < SRF 332 (16.46) < SSG 593 (16.94) < CSV 20 (17.83) < DS 226 (18.00) < GJ 43 (18.63) < CSV 21 F (18.97) < CSV 31 (18.98) < GSF 19 (20.98) < GNJ 1 (19.78) < GSF 5 (20.59) < SR 2980 (20.96) < GSF 211 (20.98) < DS 224 (21.65) < DSF 231 (27.29) < Swarna (28.05) < DJ 6514 (29.16).

It is clear from the pooled data of both year in terms of the dead hearts inflicted by the stem borer during entire crop period presented in table 3 that the genotypes, IS 2205 (4.46) and IS 1851 (5.98) had significantly lower infestation as compared to other varieties and genotypes. Conversely genotypes, DSF 213, DJ 6514 and variety Swarna had

highest dead hearts accounting 27.29, 28.05 and 29.16 per cent, respectively.

Thus, from the results it is clear that genotypes IS 1851, DSF 213 and IS 2205 are showing resistance to the stem borer infestation as they have suffered from least dead hearts during the vegetative and reproductive stage of the crop. While, DJ 6514, DS 224 and Swarna had suffered most showing susceptibility to the stem borer infestation. Earlier, at Navsari agricultural university Chavan (2006) [2] Found that the genotype DJ 6514 (Susceptible check) (40.30%) recorded with highest damage. While, the genotype IS 1851 (Resistant check) (9.10%) recorded with lowest damage due to *C. partellus*. Subbarayadu *et al.* (2011) also conducted an experiment at Hisar and observed that among all seven genotypes viz., SR 770-2, SR 970-2, SR 833, GFS 261, ICSV 745, IS 2312 and IS 2205 were found to be resistant while, 13 genotypes (SR12477, SR 2126, ICSV 705, SPV 839, SR 2315, RS 29, CSH 5, GSSV 251, NSS 103, SR 1115-1, CSH-6, CSH-9 and SPV 46 were

found as moderately resistant to stem borer (*C. partellus*). Similarly, the genotype, IS 2205 suffered least infestation. Patidar *et al.* (2019) [4] reported that the lowest damage of stem borer was recorded in resistant check IS 2205 (11.67%) which was at par with CSH 16 (15.00%), SPH 1776 (16.67%) and SPH 1810 (17.33%) followed by CSH 14 (17.67%) and SPH 1820 (19.90%). The present results are in conformity with the earlier findings by the researchers. SR 770-2, SR 970-2, SR 833, GFS 261, ICSV 745, IS 2312 and IS 2205 were found to be resistant while, 13 genotypes (SR12477, SR 2126, ICSV 705, SPV 839, SR

2315, RS 29, CSH 5, GSSV 251, NSS 103, SR 1115-1, CSH-6, CSH-9 and SPV 46 were found as moderately resistant to stem borer.

Similarly, the genotype, IS 2205 suffered least infestation. Patidar *et al.* (2019) [4] reported that the lowest damage of stem borer was recorded in resistant check IS 2205 (11.67%) which was at par with CSH 16 (15.00%), SPH 1776 (16.67%) and SPH 1810 (17.33%) followed by CSH 14 (17.67%) and SPH 1820 (19.90%). The present results are in conformity with the earlier findings by the researchers.

Table 3: Screening of sorghum varieties/genotypes against stem borer pooled: 2021 and 2022

Sr. No.	Varieties/ Genotypes	Dead heart (%)		
		2020-21	2021-22	Pooled over years
1	SRF 332	24.31 ^{defg} (16.95)	23.56 ^{cde} (15.98)	23.94 ^{cefg} (16.46)
2	GSF 19	27.42 ^{cde} (21.20)	24.60 ^{cde} (17.33)	26.01 ^{bcdefg} (19.23)
3	CVS 31	26.06 ^{defg} (19.30)	25.59 ^{cde} (18.66)	25.83 ^{bcdefg} (18.98)
4	GSF 211	27.49 ^{cde} (21.31)	27.04 ^{cd} (20.66)	27.26 ^{bc} (20.98)
5	SR 3048	21.85 ^{gh} (13.86)	22.77 ^{de} (14.98)	22.31 ^{hi} (14.42)
6	GSF 5	27.42 ^{cde} (21.21)	26.56 ^{cde} (19.99)	26.99 ^{bcde} (20.59)
7	Swarna	31.42 ^{abc} (27.18)	32.54 ^a (28.93)	31.98 ^a (28.05)
8	DJ 6514	32.35 ^a (28.63)	33.03 ^a (29.70)	32.69 ^a (29.16)
9	GSF 12	22.49 ^{fgh} (14.63)	23.03 ^{de} (15.31)	22.76 ^{ghi} (14.97)
10	GNJ 1	26.75 ^{def} (20.26)	26.06 ^{cde} (19.30)	26.41 ^{bcdef} (19.78)
11	GSF 218	23.04 ^{efgh} (15.32)	22.50 ^{de} (14.65)	22.77 ^{ghi} (14.98)
12	IS 2205	13.36 ⁱ (5.34)	11.04 ^f (3.67)	12.20 ^j (4.46)
13	CSV 21 F	26.55 ^{defg} (19.98)	25.08 ^{cde} (17.97)	25.82 ^{bcdefg} (18.97)
14	DS 318	22.47 ^{fgh} (14.61)	21.97 ^e (14.00)	22.22 ⁱ (14.30)
15	SR 2980	27.95 ^{bcd} (21.97)	26.55 ^{cde} (19.97)	27.25 ^{bcd} (20.96)
16	SSG 593	25.58 ^{defg} (18.64)	23.03 ^{de} (15.30)	24.30 ^{cdefghi} (16.94)
17	CSV 20	24.57 ^{defgh} (17.30)	25.38 ^{cde} (18.37)	24.98 ^{bcdefghi} (17.83)
18	DS 226	25.10 ^{defg} (18.00)	25.10 ^{cde} (18.00)	25.11 ^{bcdefghi} (18.00)
19	DS 189	23.03 ^{efgh} (15.30)	24.09 ^{cde} (16.66)	23.56 ^{fghi} (15.97)
20	DS 224	27.49 ^{cde} (21.31)	27.96 ^{bc} (21.99)	27.73 ^b (21.65)
21	DSF 213	31.90 ^{ab} (27.93)	31.08 ^{ab} (26.65)	31.49 ^a (27.29)
22	GJ 43	26.55 ^{defg} (19.99)	24.59 ^{cde} (17.31)	25.57 ^{bcdefgh} (18.63)
23	GFS 6	23.04 ^{efgh} (15.31)	22.52 ^{de} (14.67)	22.78 ^{ghi} (14.99)
24	IS 1851	14.95 ⁱ (6.66)	13.36 ^f (5.34)	14.16 ^j (5.98)
25	GFS 209	20.26 ^h (11.99)	24.59 ^{cde} (17.31)	22.42 ^{hi} (14.55)
S. Em. ±		T	0.50	0.98
		Y	0.14	0.27
		T × Y	--	1.38
C. D. at 5%		T	0.71	1.39
		T × Y	--	3.88
C.V. %		T	8.86	9.72

Conclusion

The study highlighted notable differences in susceptibility to stem borer (*Chilo partellus*) infestation among the tested sorghum genotypes, as assessed by the percentage of dead hearts during the vegetative and reproductive stages. Genotypes IS 2205 (4.46%) and IS 1851 (5.98%) exhibited significantly lower infestation levels, demonstrating strong resistance to stem borer attacks. Other genotypes such as DS 318, SR 3028, and GFS 209 also showed relatively lower infestation levels, indicating moderate resistance.

In contrast, genotypes DSF 231 (27.29%), DJ 6514 (29.16%), and the variety Swarna (28.05%) recorded the highest levels of dead hearts, reflecting their high susceptibility to the pest. Additionally, genotypes like DS 224, GSF 211, and SR 2980 also experienced substantial infestation, further confirming their vulnerability.

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