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IDENTIFICATION OF RESISTANT GENOTYPES OF SORGHUM TO SHOOT FLY [ATHERIGONA SOCCATA (RONDANI)] AND SPOTED STEM BORER [CHILO PARTELLUS (SWINHOE)]

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SUMMARY

Forty six sorghum genotypes along with resistant, susceptible and local checks were screened for resistance against shoot fly and spotted stem borer at Forage section, Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar during *Kharif*, 2019. Per cent dead hearts caused by shoot fly and Stem borer were recorded at 28 and 45 days after emergence respectively, under natural field conditions. Nine genotypes namely, CSH 40F, CSV 21F, SPV 2704, SPV 2591, SPV 2582, SPV 2587, SPV 2581, SPV 2584 and SPV 2593 showed resistant in terms of minimum per cent dead hearts caused by *Atherigona soccata* and *Chilo partellus*.

Key words : Sorghum, screening, insect-pest resistance, dead heart, stem borer stalk tunneling

Among coarse cereals sorghum [(*Sorghum bicolor* (L.) (Moench)] is one of the most important crops in the semi-arid tropics. It stands on fifth position in the world cereals. In India, a total of 3.47 million tons of sorghum grains were produced over the acreage of 4.09 million hectares during 2019 (FAO, 2020). The productivity of sorghum in India is 781.91 kg/ha, is well below the world's average (1427.94 kg/ha). In north Indian states, this crop is also cultivated for the purpose of fodder during April to October, which adds further significance of the crop in animal feed.

The penalties from sorghum crop starting from seedling stage to harvest by nearly 150 insect pests. Which are major factors in reducing yield? Among these, shoot fly *Atherigona soccata* (Rondani) (Diptera: Muscidae) and spotted stem borer, *Chilo partellus* (Swinhoe) (Lepidoptera: Crambidae) are major pests on sorghum which affect the quality and quantity of this fodder crop. In India, *A. soccata* alone is reported to cause grain yield losses to the tune of 80-90 per cent and up to 68 per cent loss of fodder yield (Balikai and Bhagwat, 2009; Kahate *et al*., 2014). The losses caused by *C. partellus* in maize and sorghum ranged from 18-25 per cent in Asia (Dhaliwal *et al.,* 2015). The host-plant resistance, if available is one of the most effective means of managing insect pests. This technique is environment-friendly, compatible with other methods of pest management, does not involve any extra cost of cultivation and has often been used for the successful management of several insect pests in sorghum (Huang, *et al.,* 2013). Therefore, the present study was undertaken to screen sorghum genotypes for resistance against *A. soccata* and *C. partellus* under All India Coordinated Research Project (AICRP) trials namely, Advanced Varietal and Hybrid Trial-Single Cut (AVHT-SC) and Initial Varietal and Hybrid Trial-Single Cut (IVHT-SC) during *Kharif,* 2019 under natural field conditions.

MATERIALS AND METHODS

Trials were carried out at Forage Section Research Farm, Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar (29°10'N, 75°46'E and 215.2 m above mean sea level) during *Kharif,* 2019 under natural field conditions. Weekly weather parameters recorded during crop season are given in Fig. 1. Under each trial, two rows of two meters length of each genotype including checks were sown in three replications under randomized complete block design (RBD) on 18 July, 2019. In order to maintain optimum plant population, the thinning was done at 12 days after emergence. Forty six sorghum genotypes including two resistance (IS 18551 and IS 2205) and two susceptible (DJ 6514 and Swarna) were evaluated for resistance to shoot fly, *A. soccata* and *C. partellus*.

Observations on shoot fly and stem borer dead heart were recorded at 28 and 45 days after emergence, respectively. The total number of plants and total number of dead hearts were counted from each plot, which were later used for calculating the dead heart with a formula as given below:

$$\text{Dead heart caused (\%)} = \frac{\text{No. of plant showing dead heart}}{\text{Total number of plants in the plot}} \times 100$$

The data was analyzed as per the methods suggested by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Forty six sorghum genotypes were screened for their resistance against shoot fly and stem borer at Hisar. Dead heart has been reported as a stable parameter to ascertain resistance against these pests (Singh *et al.*, 1968). Data on dead hearts were considered for screening genotypes which is recorded at peak activities of the shoot fly (28 DAE) and stem borer (45 DAE). The genotypes showing less than 45 and 15% dead hearts caused by shoot fly and stem borer were considered as resistant against *A. soccata* and *C. parellus*, respectively (Anonymous 2018). Perusal of data in terms of per cent dead hearts revealed that the shoot fly infestation varied from 18.7 to 53.9% in IS 8551 and Swarna respectively in AVHT - SC trial (Table 1). Genotypes SPV 2582, SPV 2591, SPV 2581, SPV 2584, SPV 2593, CSV- 21 F and HC-136 (LC) were statistically at par with resistant check (IS 18551).Genotype SPH 1890 was found to be susceptible to shoot fly.

The dead heart formation by stem borer is a consequence of damage to the apical meristem after successful establishment of larvae on young sorghum plant and leads to losses in plant stand. The mean dead heart in AVHT – SC Trial was 9.2 % was recorded. Maximum dead heart caused by stem borer 16.9 % and minimum 2.9 % were recorded in genotype SPH 1891 and in resistant check IS 2205, respectively. The genotype SPV 2581, SPV 2582, SPV 2584, SPV 2587, SPV 2593 and HC -136 (LC) were on par with resistant check IS 2205. Genotypes SPH 1891, SPH 1918 and CSH 13 showed susceptibility to stem borer and per cent dead heart were at par with susceptible check (14.8 %). In AVHT –SC trial the genotypes SPV2581, SPV 2582, SPV 2584, SPV 2591, SPV 2593 and HC - 136 (LC) showed resistant against both the pests shoot

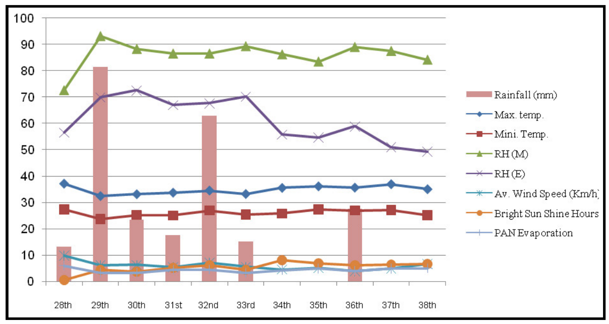

Fig. 1. Weekly weather parameters recorded during the crop duration *kharif* 2019.

TABLE 1

Screening of genotypes for insect pest resistance under AVHT-SC during *Kharif* 2019

S. No.	Genotypes	Pedigree	Shoot fly dead hearts (%) at 28 DAE	Stem borer dead hearts (%) at 45 DAE	Stem tunneling (SBST%) at Harvest
1.	SPH1890	-	46.0	12	12.7
2.	SPH1891	(2219A x ICSB 467) x Pant Chari 6	36.8	16.9	19.2
3.	SPH1917	465A x HC 308	31.0	10.8	16.3
4.	SPH1918	ICSA469 x Pant Chari 6	30.4	16.8	13.8
5.	SPH1919	(ICSA467 x 104B) x Pant Chari 6	31.5	13.6	12.7
6.	SPV2581	NSS1006 x Selection from HC 308 (composite of 5 lines)	17.4	5.5	12.9
7.	SPV2582	Selection from (SRT-18 x MR 836)-1-3	13.1	4.9	16.1
8.	SPV2584	(SRF-144 x GFS 4)-7-1-1	18.4	5.0	12.9
9.	SPV2587	Parbhani Moti x T-1000	22.0	4.8	20.0
10.	SPV2589	PC23x (SDSL92101 x UPFS23)-1	44.5	10.6	30.8
11.	SPV2591	Selection from cross SGL 87 x HJ 513-15-10-11-4	17.0	3.3	13.7
12.	SPV2593	ICSV93046 x UK-81)-1-2-1-1	19.6	5.1	21.4
13.	CSH 13	-	44.9	16.1	18.5
14.	CSV 30F	-	21.2	10.2	15.3
15.	CSV 21F	-	14.0	7.7	10.9
16.	Local Check	HC-136	20.6	4.8	12.4
17.	IS 18551	Resistant check	12.7	4.9	16.3
18.	IS 2205	Resistant check	13.1	2.9	15.9
19.	DJ 6514	Susceptible eheck	51.5	14.1	17.3
20.	Swarna	Susceptible eheck	53.9	14.8	25.6
	Mean		28.0	9.2	16.7
	C.D. (5%)		8.2	3.5	13.0
	C.V. (%)		21.3	22.8	47.2

fly and stem borer (Table 1). The stem tunneling due to borer was expressed as proportion of stem tunneled by the larvae. It ranged from 10.9 to 30.8 % and mean tunneling being 24.8%. There were significant differences in tunneling of stem in various genotypes. Low tunneling suggests that the larvae either took more time to enter inside the stem of these genotypes or fewer larvae survived on these genotypes. Extent of stem tunneling is influenced by antibiosis and has been used to measure genotypic susceptibility to *C. partellus* (Alghali, 1987).

The results of IVHT – SC trials indicate there was significant variation in shoot fly and stem borer dead heart in different genotypes condition (Table 2). The maximum dead heart caused by shoot fly and stem borer in Swarna, while minimum in IS 2205 (RC) which were recorded as 54.1 & 24.8, and 23.3 & 4.0%, respectively.

The 28 days seedlings of SPV 2710, CSV 35 F, CSH 40F, SPV 2704, CSV 21 F SPH 1958 and SPH 1961 were found resistant to shoot fly similar to resistance check IS 2205 and IS 18551.The genotypes HC -136 (LC), SPH 1962, SPV 2703, SPV 2707 SPV 2708 and SPV 2709 were more susceptible to shoot fly and at par with Swarna (SC).

At 45 days after emergence the stem borer infestation was 6.0, 6.1, 8.3 and 8.6 % dead heart in genotypes SPV 2706, CSH - 40 F, SPV 2705 and CSV 21 F respectively, being at par with resistant check IS 2205 (4.0 %).The genotypes SPV 2711, SPV - 2704, SPV 2710, CSV 30 F, SPH 1962, SPV 2703, HC 136 (LC), SPV 2702, CSV35 F and SPH 1959 showed moderately level- of resistance to stem borer (Table 2). Genotype SPH 1960 was susceptible as the Swarna (SC). The stem tunneling in IVHT – SC trial ranged between 9.1 to 34.5 % with mean tunneling being 21.3 %.

The genotypes CSV -21 F, CSH-40 F and SPV 2704 showed multiple resistances against shoot fly and stem borer. These finding are in line with the results of Anonymous (2018). Resistance to shoot fly is a cumulative effects of non preference and antibiosis (Raina *et al*., 1981), Antibiosis to shoot fly has been reported by Jotwani & Srivastva (1970), Sharma *et*

TABLE 2
Screening of genotypes for insect pest resistance under IVHT-SC during *Kharif* 2019

S. No.	Genotypes	Pedigree	Shoot fly dead hearts (%) at 28 DAE	Stem borer dead hearts (%) at 45 DAE	Stem tunneling (SBST%) at Harvest
1.	SPH1958	185A × RSSV 466-1-1-2-1	32.1	15.8	21.6
2.	SPH1959	-	38.8	14.7	17.5
3.	SPH1960	ICSA 693 × ICSB 467	44.5	20.6	27.9
4.	SPH1961	104A × ICSB 467	33.5	15.1	15.2
5.	SPH1962	Foragen	41.2	12.5	13.6
6.	SPV2701	UPMC 503 × SSV-84-6-1	37.4	16.1	17.5
7.	SPV2702	SPV1686 × SPV1526-7-3	38.2	14.5	16.4
8.	SPV2703	SPV1686 × SPV1526-3-1	41.9	13.7	13.3
9.	SPV2704	Composite of 6 lines	30.5	10.5	16.5
10.	SPV2705	G71 × SSG59-3-3-14-11-6	36.7	8.3	12.2
11.	SPV2706	Piper-60 × CoFS-29-9-1-3-2-4-1-4-1	40.4	6.0	23.2
12.	SPV2707	[SSV 84 x (SPV 462 x IS 21891)-3-1-1]-3-3-1	46.0	15.3	26.7
13.	SPV2708	Sel (426 B × ICSR 89058)-5-3	41.8	16.6	20.1
14.	SPV2709	(SPV 1616 × ICSR 89028)-30-1-2	45.2	18.6	20.8
15.	SPV2710	Sel. from Udgir Local	27.3	10.7	34.5
16.	SPV2711	PVR 904 × PVR 802	36.4	9.6	29.5
17.	CSH 13	-	38.4	16.8	22.6
18.	CSV 30F	-	35.0	11.3	20.2
19.	CSV 35F	-	29.4	14.4	23.1
20.	CSH 40F	-	30.7	6.1	19.0
21.	CSV 21F	-	30.1	8.6	19.7
22.	Local Check	HC-136	44.6	12.6	17.5
23.	IS 18551	Resistant check	24.6	5.8	10.7
24.	IS 2205	Resistant check	23.3	4.0	9.1
25.	DJ 6514	Susceptible check	53.7	20.6	45.5
26.	Swarna	Susceptible check	54.1	24.8	39.7
	Loc. Mean		37.5	13.2	21.3
	C.D. (5%)		15.0	4.6	17.7
	C.V. (%)		24.4	21.2	50.6

Local Check: HC- 136, RC: Resistant Check: SC: Susceptible Check.

al. (1977) and Dillon *et al.* (2005). Dead heart parameter was reported to the most stable parameters for differentiating degree of resistance with respect to borer (Singh *et al.* 1968). Several workers have used dead heart as a criterion for stem borer resistance (Singh and Rana 1989:, Prasad *et al.,* 2015 and Kumar *et al*., 2019). Some bio-chemicals such as malic acid, phenolic compounds, cellulose, hemi cellulose, lignin, free amino acids etc of crops could be responsible for resistance to insect pests (Jakhar *et al.,* 2018).

CONCLUSION

Nine genotypes namely, CSH 40F, CSV 21F, SPV 2704, SPV 2591, SPV 2582, SPV 2587, SPV 2581, SPV 2584 and SPV 2593 were found to be resistant against shoot fly and stem borer. These genotypes can be employed in sorghum breeding improvement program.

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