Forage Res., **47** (3) : pp. 363-371 (2021) **http://forageresearch.in**

FIELD EVALUATION OF SORGHUM GENOTYPES AGAINST DISEASES AND INSECT-PESTS

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(Received : 11 September 2021; Accepted : 10 December 2021)

SUMMARY

Foliar diseases (anthracnose, grey leaf spot, zonate leaf spot) and insect-pests (sorghum shoot fly, stem borer) are major restraints in the cultivation of forage sorghum. Host plant resistance is one of the alternative components to manage sorghum shoot fly, stem borer and foliar diseases. In the present study, Forty three sorghum genotypes were screened for varied levels of resistance during *Kharif* 2018 and 2019. Eleven genotypes *viz*., SPH 1881, SPV 2564, SPH 1890, SPH 1891, SPV 2445, SPV 2451, SPH 1917, SPH 1918, SPV 2581, SPV 2591 and SPV 2593 showed highly resistant disease reaction against sorghum anthracnose. Entries SPH 1905, SPV 2587 and SPV 2451 with 17.8, 17.0 and 27.1 percent deadhearts caused by shoot fly (*Atherigona soccata*). The percent deadhearts caused by spotted stem borer *Chilo partellus* were ranged between 3.5- 7.8. Overall, SPV 2587 recorded lesser oviposition, least percent deadhearts, low seedling vigour and higher glossiness.

Key words : Sorghum, screening, resistance, shoot fly, foliar diseases

Sorghum (*Sorghum bicolor* L. Moench) is one of the most important annual cereal crops belongs to family Poaceae grown extensively in the arid, semiarid tropics and drought prone areas (Price *et al.*, 2005). Its fast growing ability, regeneration potential, high yield, better palatability and digestibility makes it a precious fodder for the farming community on which the livestock industry depends. In India, it is cultivated in an area of about 4.01 million ha with a production of 3.70 million metric tonnes and in Punjab it is grown in an area of 2.71 lakh ha (Anonymous, 2021). In spite of its diverse use and resilience, biotic and abiotic are major constraints in the increasing production of quality fodder and grain in sorghum and causing significant yield losses across all its growing areas (Tesso *et al.*, 2012). In fodder sorghum, foliar diseases like anthracnose, grey leaf spot, zonate leaf spot and insect-pests like shoot fly and spotted stem borer are the major biotic factors that affects fodder quality and production during the *Kharif* season crop (Aruna *et al.*, 2011).

Leaf diseases cause reduction in photosynthetic area of leaf that result in reduced accumulation of sugars and thereby affecting the in vitro dry matter digestibility and fodder quality (Rana *et al.*, 1999). Sorghum anthracnose, incited by *Colletotrichum sublineolum* Hann. Kabát et Bub. (syn. *C. graminicola* (Ces.) G.W. Wilson) is one of the key limiting factors in all sorghum growing areas (Valerio *et al.*, 2005). The pathogen infects all aboveground parts by forming elliptical or irregular reddish coloured lesions with greyish centers and thereby weakens the plant and severely reducing the fodder quality. Zonate leaf spot caused by *Gloeocercospora sorghi* D.C. Bain & Edgerton ex Deightonis widely distributed and one of the most damaging foliar pathogens of sorghum crop. The most conspicuous and diagnostic symptoms on leaves of sorghum appear as circular lesions which are reddish purple and tan colored alternating concentric zonate pattern. Similarly, another disease grey leaf spot caused by *Cercospora sorghi* Ellis and Everhart infecting sorghum plants show narrow rectangular lesions delimited by veins longitudinally and turn grey with age. The foliar diseases are known to cause significant fodder and grain losses upto 30 to 60% due to the reduction of the photosynthetic leaf area (Bergquist, 2000).

Sorghum shoot fly (*Atherigona soccata* (Rondani) that belongs to the order Diptera and family Muscidae and spotted stem borer [*Chilo partellus* (Swinhoe)] that belongs to order Lepidoptera and family Crambidae are major pests that adversely affects the fodder sorghum in terms of quality, production and productivity. In India, yield losses due to attack of shoot fly and stem borer varies from 50 to 90% (Kahate *et al.*, 2014; Dhaliwal *et al.*, 2015).

Shoot fly attacks sorghum 5–25 days after emergence. The larvae of shoot fly cut the growing tip, resulting in deadheart formation causing considerable damage to the crop. Spotted stem borer attacks the crop from two weeks after germination. The larva bores into the stem to reach the growing point, where it cuts the growing point resulting in "deadheart" symptom and later feed inside the stem, causing tunneling in stalks. The use of insecticides and fungicides to protect the sorghum against foliar diseases, shoot fly and stem borer poses risk to the environment, human and reduces the profit margin of producers. Moreover, pesticide use is least desired for fodder crop. Considering the ecological and economic consequences, utilization of host-plant resistance and development of genotypes with resistance to diseases and insect-pests is the only economical option of disease and pest management in fodder sorghum. To achieve this objective, the present study was undertaken to screen the sorghum genotypes for resistance against anthracnose, grey leaf spot, zonate leaf spot, shoot fly and spotted stem borer in different trials under AICRP on Sorghum during *Kharif* 2018 and 2019.

MATERIALS AND METHODS

Experimental details

The experiments were conducted at Ludhiana (Punjab) during *Kharif* season for the evaluation of different genotypes against foliar diseases and insect-pests as part of All India Coordinated Research Project (AICRP) on Sorghum. The experimental fields are situated at Ludhiana (30°56'N latitude and 75°52'E longitude with an elevation of 247 m above mean sea level) The climate of Ludhiana is sub-tropical and semi-arid with very hot to dry and humid summer. The average annual temperature during the period of study was 23.1°C to 42.1°C. The average annual rainfall was 705 mm. The field trials were conducted for two years during *Kharif* season in 2018 and 2019. There were six different trials, three for Entomology (IAVHT Multicut, AVHT Single cut in 2018 and AVHT Single cut in 2019) and three for Pathology (IAVHT Multicut, AVHT Single cut in 2018 and AVHT Single cut in 2019). A total of forty three genotypes of sorghum were evaluated along with national checks (CSH 13, CSV 30F, CSV 21F, CSV 32F, CSV 33MF & CSH 24 MF), resistant checks (IS 18551 & IS 2205), susceptible checks (Swarna and DG 6514) and local checks (PSC 4 (shoot fly and stem borer) and SL 44 (foliar diseases). The experiments were laid out in a Randomized Complete Block Design (RCBD) with three replications per genotype with two rows of two meters length each. The crop was sown during last week of June as per the recommended agronomic practices (Anonymous, 2019) and thinning was done at 10 days after emergence to maintain the optimum plant stand. The weather parameters prevailing during *Kharif* 2018 and 2019 were presented in Figure 1a and 1b.

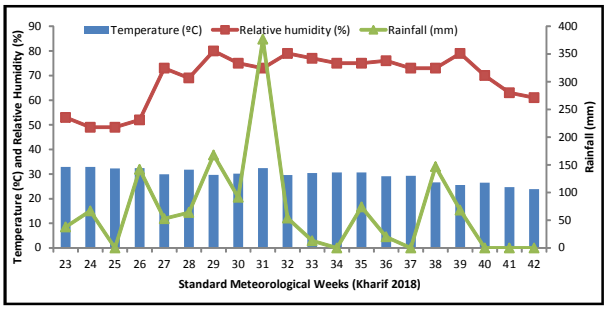

Fig. 1a. Weekly weather data prevailing during *Kharif* 2018.

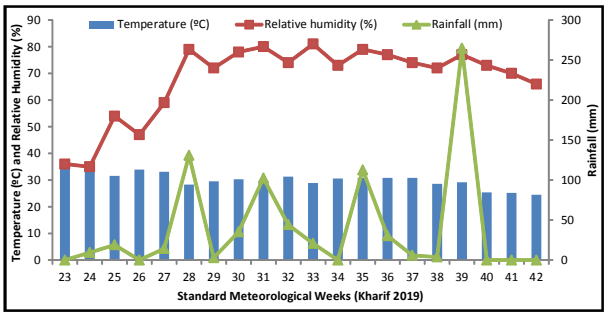

Fig. 1b. Weekly weather data prevailing during *Kharif* 2019.

Data recording

Foliar diseases

Disease severity was assessed at 40 and 70 days after emergence and the rating was based on visual estimate of percent leaf area infected with leaf spots. Disease severities of anthracnose, grey leaf spot and zonate leaf spot (percentage of leaf area covered by lesions) were recorded on a 1-to-9 rating scale (Xu *et al.*, 2017). Five classes of reaction were considered: HR = Highly resistant reaction, infection type 1; R = resistant reaction, including infection types as 2, 3, MR = moderately resistant reaction, including infection types 4, 5; S = susceptible reaction, including infection types 6 and 7; HS = highly susceptible reaction, including infection types 8 and 9.

Shoot fly and stem borer

Moist fish meal was broadcasted evenly at 5

days after germination to ensure uniform infestation of sorghum shoot fly in the test material (Nwanze, 1997). The intensity of glossiness was recorded at 10 DAE on a scale of 1–5, where 1, high intensity of glossiness and 5, non-glossy. Seedling vigour was scored at 10 DAE on a scale of 1–10, where 1, high vigour (plants showing maximum height, leaf expansion and robustness) and 10, low vigour (plants showing minimum growth, less leaf expansion and poor adaptation).The observations on shoot fly eggs (from 5 randomly selected plants) and per cent deadhearts were recorded from all the test entries at 2-3 weeks after germination (Prasad *et al*., 2015). In case of stem borer, the observations were recorded on plants with dead-hearts, leaf feeding and stem tunneling. Leaf feeding by *Chilo partellus* larvae was assessed, two to three weeks after artificial infestation on a 1–9 rating scale (Sharma *et al*., 1992). Leaf injury and deadhearts were recorded at 35-45 days after germination.

Data analysis

All experimental data were analyzed with SAS software (version 9.3). Analysis of variance (ANOVA) was used to assess effect of trial to determine the significant difference between the experimental repeats ($p \leq 0.05$). Fisher's Least Significance Difference (LSD) test ($\alpha \leq 0.05$) was used for computing treatment statistically significant means.

RESULTS AND DISCUSSION

Different genotypes were screened for disease and insect-pest resistance against anthracnose, grey leaf spot, zonate leaf spot, shoot fly and stem borer during *Kharif* 2018 under IAVHT Multicut and AVHT Single cut trials. Disease severities of anthracnose, grey leaf spot and zonate leaf spot were recorded under IAVHT Multicut trial (Table 1a & Fig. 2). Disease pressure of anthracnose on sorghum was moderate to high (5.7 to 6.3) followed by grey leaf spot that is moderate (>3.0) and low in case of zonate leaf spot. Entries, SPH 1881 and SPV 2564 showed highly resistant disease reaction to anthracnose followed by SPH 1879, SPH 1905, SPH 1907 and SPV 2563 which exhibited resistant disease reaction to anthracnose infecting forage sorghum. Rest of the entries were moderately resistant were at par with checks. The disease pressure of grey leaf spot was recorded low (3.0) in forage sorghum and all entries showed resistant disease reaction to grey leaf spot.

TABLE 1A
Evaluation of genotypes for shoot fly and diseases in IAVHT (Multi cut) trial during *Kharif* 2018

S. No	Entries	No. of shoot fly eggs/5 plants	Shoot fly dead hearts (%)	Seedling vigor (1-5)	Seedling glossiness (1-5)	Anthracnose (1-9)	Grey leaf spot (1-9)
1.	SPH 1840	6.33	63.9	3.7	3.0	4.7	1.0
2.	SPH 1877	9.00	54.6	3.0	2.7	4.0	2.0
3.	SPH 1879	5.00	31.1	2.0	2.0	1.7	3.0
4.	SPH 1881	4.33	35.0	2.0	2.3	1.3	1.7
5.	SPH1904	8.33	56.0	3.7	3.0	4.7	1.0
6.	SPH1905	4.00	17.8	1.7	2.0	1.7	2.3
7.	SPH1906	6.67	56.8	3.7	3.0	4.3	1.0
8.	SPH1907	5.33	60.9	4.0	3.3	3.0	3.0
9.	SPV2563	4.00	33.1	2.0	2.0	2.0	1.0
10.	SPV2564	3.67	29.9	1.7	1.7	1.0	3.3
11.	CSH 24MF	4.00	27.4	1.3	2.0	2.3	1.7
12.	SSG 59-3	2.00	28.4	1.7	2.0	4.0	1.0
13.	CSV 33MF	3.33	63.2	3.3	3.0	3.7	2.3
14.	Local Check	3.33	42.7	3.0	2.3	5.7	2.0
15.	IS 18551 (RC)	0.33	8.2	1.3	1.0	-	-
16.	IS 2205 (RC)	1.33	13.2	1.0	1.7	-	-
17.	DJ 6514 (SC)	3.67	75.3	3.3	3.0	-	-
18.	Swarna (SC)	5.33	70.3	3.3	3.0	-	-
19.	Pant Chari 5	-	-	-	-	6.3	2.7
20.	Kekri Local	-	-	-	-	5.7	1.0
	Mean	4.44	42.7	2.5	2.4	3.5	1.9
	LSD (5%)	4.46	20.2	1.1	0.9	2.0	2.1

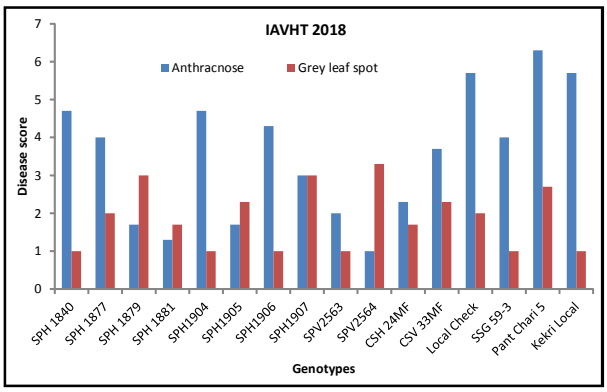

Fig. 2. Evaluation of genotypes for disease resistance in IAVHT (Multi cut) trial during *Kharif* 2018.

In case of shoot fly, the total number of eggs per 5 plants was in range of 2-9 in test entries as compared to 0.33-1.33 in resistant checks. The egg count per 5 plants was lesser in SSG 59-3 and SPH 1905 (Table 1a). In IAVHT Multicut trial, the per cent dead hearts inflicted due to shoot fly damage across all entries varied significantly from 17.8- 63.9 per cent with significantly less number of dead hearts observed in SPH 1905 and highest number of shoot fly dead hearts in SPH 1840. The seedling vigour and glossiness in test entries ranged from 17.0 to 4.0 and 1.7 to 3.3, respectively. There was very less damage of stem borer *Chilo partellus* in the form of dead hearts (3.1- 4.6) and stem tunneling (0.9- 12.6%) in various entries (Table 1b).

During *Kharif* 2018, a total of 13 genotypes were screened for diseases and insect-pest resistance in AVHT Single cut trial. Disease pressure of anthracnose was moderate to high (5.7). Entries SPH 1890, SPH 1891, SPV 2445, SPV 2451 showed resistant disease reaction to anthracnose (Table 2a & Fig. 3). Grey leaf spot was observed in moderate form and all entries showed resistant disease reaction as compared to checks. During this period, zonate leaf spot was also recorded in traces. However, due to low-moderate disease pressure, entries showed resistant disease reaction to leaf spot. The total number of shoot fly eggs per 5 plants was in range of 1.67-6.00 in test entries. The egg count per 5 plants was lowest in SPV 2451 and CSV 30 F. The per cent dead hearts inflicted due to shoot fly damage across all entries varied significantly from 27.1- 62.3 per cent with least dead hearts observed in SPV 2451 and highest in SPH 1891. Other data parameters *viz* seedling glossiness and seedling vigour were also recorded and result are shown in Table 2a. There was very less damage of stem borer *Chilo partellus* in the form of stem borer leaf injury score (1.7- 3.0), dead hearts

TABLE 1B

Evaluation of genotypes for stem borer in IAVHT (Multi cut) trial during *Kharif* 2018

S. No.	Entries	Stem borer leaf injury score (1-9)	Stem borer dead hearts (%)	Stem tunneling (%)	Plant Height (cm)	Days to 50% flowering
1.	SPH 1840	2.0	4.4	3.4	215.0	87.0
2.	SPH 1877	2.0	4.1	7.2	225.0	87.7
3.	SPH 1879	2.3	4.4	12.6	213.3	85.3
4.	SPH 1881	2.3	4.0	1.9	208.3	88.7
5.	SPH1904	2.3	4.3	4.4	218.3	89.3
6.	SPH1905	2.3	3.5	0.9	211.7	89.0
7.	SPH1906	2.7	4.6	4.1	238.3	84.7
8.	SPH1907	2.7	4.4	1.7	223.3	84.3
9.	SPV2563	2.0	3.4	0.9	180.0	90.3
10.	SPV2564	2.7	3.1	3.6	188.3	86.0
11.	CSH 24MF	1.7	3.8	3.4	250.0	84.3
12.	SSG 59-3	2.7	4.1	2.6	231.7	84.7
13.	CSV 33MF	2.0	4.1	5.7	178.3	91.7
14.	Local Check	2.0	3.8	4.6	176.7	87.7
15.	IS 18551 (RC)	1.3	3.0	5.8	230.0	91.7
16.	IS 2205 (RC)	1.7	2.8	11.4	190.0	88.7
17.	DJ 6514 (SC)	2.7	4.8	3.4	131.7	93.0
18.	Swarna (SC)	3.3	6.2	4.4	151.7	89.0
19.	Pant Chari 5	-	-	-	195.3	90.7
20.	Kekri Local	-	-	-	191.7	87.3
	Mean	2.3	4.0	4.4	202.4	88.1
	LSD (5%)	1.2	1.4	8.4	51.1	4.9

TABLE 2A
Evaluation of genotypes for shoot fly and diseases in AVHT (Single cut) trial during *Kharif* 2018

S. No	Entries	No. of shoot fly eggs/5 plants	Shoot fly dead hearts (%)	Seedling vigor (1-5)	Seedling glossiness (1-5)	Anthracnose (1-9)	Grey leaf spot (1-9)	Zonate leaf spot (1-9)
1.	SPH 1890	4.67	48.6	2.3	2.3	1.0	1.7	1.0
2.	SPH 1891	5.33	62.3	3.3	3.3	1.0	2.0	2.0
3.	SPV 2445	2.00	35.1	2.0	2.0	1.0	1.7	1.7
4.	SPV 2451	1.67	27.1	2.0	2.0	1.0	2.0	1.7
5.	CSH 13	4.67	33.5	2.3	2.3	1.0	1.7	1.0
6.	CSV 30F	1.67	37.2	2.3	2.3	5.3	1.0	1.0
7.	CSV 32F	6.00	45.0	2.3	2.7	2.0	2.3	1.7
8.	CSV 21F	2.33	33.1	2.3	2.0	2.0	2.3	1.0
9.	Local Check	4.33	26.1	2.7	2.3	6.0	1.0	1.0
10.	IS 18551 (RC)	0.83	17.2	1.3	1.0	-	-	-
11.	IS 2205 (RC)	1.00	16.6	1.0	1.3	-	-	-
12.	DJ 6514 (SC)	4.33	61.6	3.7	3.7	-	-	-
13.	Swarna (SC)	3.00	69.5	4.0	4.0	-	-	-
14.	Pant Chari 5	-	-	-	-	6.3	1.0	1.0
15.	Kekri Local	-	-	-	-	6.0	1.0	1.0
	Mean	3.22	39.4	2.4	2.4	3.0	1.6	1.3
	LSD (5%)	2.27	7.5	0.8	0.7	1.5	1.8	1.1

TABLE 2B
Evaluation of genotypes for stem borer in AVHT (Single cut) trial during *Kharif* 2018

S. No.	Entries	Stem borer leaf injury score (1-9)	Stem borer dead hearts (%)	Stem tunneling (%)	Plant Height (cm)	Days to 50% flowering
1.	SPH 1890	2.3	6.0	4.0	225.0	89.7
2.	SPH 1891	3.0	4.3	4.4	178.3	87.3
3.	SPV 2445	2.3	7.0	3.3	183.3	88.7
4.	SPV 2451	2.3	6.1	2.7	211.7	87.7
5.	CSH 13	2.0	5.6	3.0	170.0	89.7
6.	CSV 30F	1.7	7.8	11.0	121.7	92.3
7.	CSV 32F	2.3	4.0	6.3	181.7	89.3
8.	CSV 21F	1.7	3.5	2.6	218.3	93.3
9.	Local Check	2.0	4.4	4.6	176.7	87.7
10.	IS 18551 (RC)	1.3	3.5	5.8	230.0	91.7
11.	IS 2205 (RC)	1.3	2.8	11.4	190.0	88.7
12.	DJ 6514 (SC)	3.3	3.8	3.4	131.7	93.0
13.	Swarna (SC)	3.7	6.3	4.4	151.7	89.0
14.	Pant Chari 5	-	-	-	194.7	90.3
15.	Kekri Local	-	-	-	191.3	89.3
	Mean	2.3	5.0	4.8	183.7	89.8
	LSD (5%)	0.9	4.0	7.6	55.6	5.6

(3.5- 7.8%) and stem tunneling (2.6- 11.0%) (Table 2b).

During *Kharif* 2019, in AVHT Single cut trial, anthracnose pressure was high (6.3). Entries SPH 1890, SPH 1917, SPH 1918, SPV 2581, SPV 2591, SPV 2593 showed highly resistant disease reaction to anthracnose (Table 3a & Fig. 4). Whereas, genotypes SPH1891, SPV2589 and SPV 2587, SPV 2582, SPH 1919 exhibited resistant and moderately resistant disease reactions to anthracnose as compared to susceptible checks (Table 4). The disease pressure of grey leaf spot was recorded less in forage sorghum and all entries showed resistant disease reaction. In case of shoot fly, a total number of eggs per 5 plants were in the range of 3.7- 13.0 in test entries as compared to 1.3-2.3 in resistant checks and 8.7 in susceptible checks. The egg count per 5 plants was least in SPV 2582 and SPV 2587 (Table 3a). The per

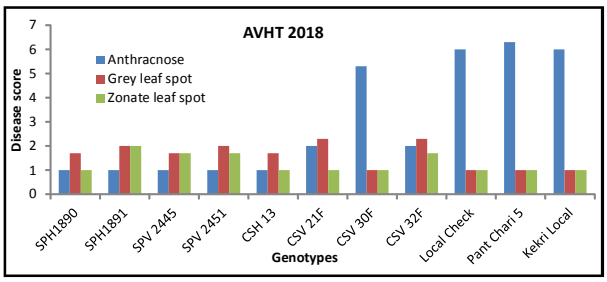

Fig. 3. Evaluation of genotypes for disease resistance in AVHT (Single cut) trial during *Kharif* 2018.

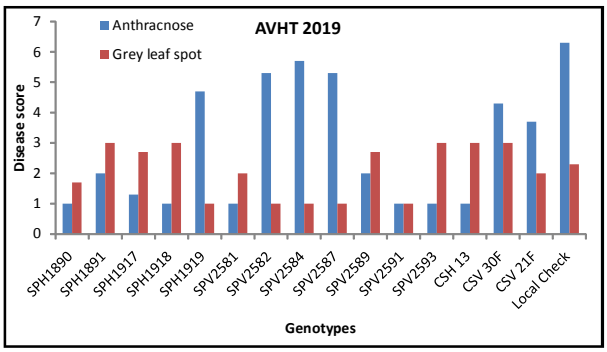

Fig. 4. Evaluation of genotypes for disease resistance in AVHT (Single cut) trial during *Kharif* 2019.

cent dead hearts inflicted due to shoot fly damage across all entries varied significantly from 18.2- 67.2 per cent with significantly less number of dead hearts observed in SPV 2587 and highest number of shoot fly dead hearts in SPH 1918. Entries SPV 2582 and SPV 2587 had seedling glossiness of 4.0, similar to resistant checks IS18551 and IS2205 (4.0) in comparison to susceptible checks (1.0 to 2.0).There was very less damage of stem borer *Chilo partellus* in the form of leaf injury score (1.0 – 2.0), dead hearts (0.0- 4.4) and stem tunneling (1.8- 18.4 %) (Table 3b). Overall, SPV 2587 recorded lesser oviposition, least percent dead hearts, low seedling vigour and higher glossiness.

All the entries showed variation in disease reactions towards foliar diseases infecting forage sorghum (Table 4) in the present study. These findings justify the findings of other researchers (Thakur *et al*., 2007; Cuevas *et al*., 2017; Anitha *et al*., 2020). A plenty of sorghum genetic diversity is available globally that has an utmost significance in sorghum breeding program aimed to improve resistance against diseases in sorghum (Upadhyaya *et al*., 2016; Cuevas *et al*., 2017; Mengistu *et al*., 2020). For the identification of novel sources of resistance within vast sorghum germplasm collection, various resistance-screening programs have identified several resistant genotypes which can be used in sorghum breeding. A total of 97 genotypes from Mali were evaluated for anthracnose

TABLE 3A

Evaluation of genotypes for shoot fly and diseases in AVHT (Single cut) trial during *Kharif* 2019

S. No	Entries	No. of shoot fly eggs/5 plants	Shoot fly dead hearts (%)	Seedling vigor (1-5)	Seedling glossiness (1-5)	Anthracnose (1-9)	Grey leaf spot (1-9)
1.	SPH 1890	11.3	58.3	3.0	2.0	1.0	1.7
2.	SPH 1891	11.0	43.4	2.0	3.0	2.0	3.0
3.	SPH 1917	8.3	47.6	2.0	3.0	1.3	2.7
4.	SPH 1918	13.0	67.2	3.0	2.0	1.0	3.0
5.	SPH 1919	6.0	49.5	2.0	2.0	4.7	1.0
6.	SPV 2581	6.0	18.2	1.0	3.0	1.0	2.0
7.	SPV 2582	1.7	37.5	2.0	4.0	5.3	1.0
8.	SPV 2584	7.0	52.9	2.0	3.0	5.7	1.0
9.	SPV 2587	1.7	17.0	1.0	4.0	5.3	1.0
10.	SPV 2589	4.3	47.7	2.0	2.0	2.0	2.7
11.	SPV 2591	6.3	25.6	2.0	3.0	1.0	1.0
12.	SPV 2593	3.7	20.3	1.0	3.0	1.0	3.0
13.	CSH 13	9.3	61.9	2.0	2.0	1.0	3.0
14.	CSV 30F	4.0	21.8	2.0	3.0	4.3	3.0
15.	CSV 21F	4.7	18.3	1.0	4.0	3.7	2.0
16.	Local Check	6.3	50.6	2.0	3.0	6.3	2.3
17.	IS 18551 (RC)	1.3	14.4	1.0	4.0	-	-
18.	IS 2205 (RC)	2.3	23.5	1.0	4.0	-	-
19.	DJ 6514 (SC)	12.7	69.7	3.0	1.0	-	-
20.	Swarna (SC)	11.0	70.2	3.0	2.0	-	-
	Mean	6.6	40.8	2.0	3.0	2.9	2.1
	LSD (5%)	4.8	15.1	1.0	1.0	2.01	1.10

TABLE 3B
Evaluation of genotypes for stem borer in AVHT (Single cut) trial during *Kharif* 2019

S. No.	Entries	Stem borer leaf injury score (1-9)	Stem borer dead hearts (%)	Stem tunneling (%)	Plant Height (cm)	Days to 50% flowering
1.	SPH 1890	1.3	0	5.0	211.7	91.7
2.	SPH 1891	1.3	3.0	10.8	203.3	94.0
3.	SPH 1917	1.3	4.2	7.0	246.7	92.3
4.	SPH 1918	1.3	3.2	6.7	206.7	96.0
5.	SPH 1919	1.0	0	4.2	235.0	96.0
6.	SPV 2581	1.3	2.2	1.8	253.3	96.3
7.	SPV 2582	1.3	2.2	6.4	191.7	94.3
8.	SPV 2584	1.7	2.8	7.0	273.3	95.3
9.	SPV 2587	2.0	2.5	18.4	216.7	95.0
10.	SPV 2589	1.7	2.9	9.8	180.0	94.3
11.	SPV 2591	1.0	0	2.3	231.7	94.0
12.	SPV 2593	1.7	4.4	9.3	205.0	92.3
13.	CSH 13	1.3	3.4	6.6	205.0	95.3
14.	CSV 30F	2.0	3.3	14.8	191.7	94.3
15.	CSV 21F	1.3	2.3	4.5	261.7	95.0
16.	Local Check	1.3	3.5	7.1	235.0	95.7
17.	IS 18551 (RC)	1.3	2.4	8.3	261.7	94.7
18.	IS 2205 (RC)	1.0	0	3.9	250.0	97.0
19.	DJ 6514 (SC)	2.0	0	2.8	171.7	98.0
20.	Swarna (SC)	2.0	2.0	3.1	233.3	96.0
	Mean	1.5	2.9	7.0	223.3	94.9
	LSD (5%)	0.8	8.1	10.4	63.2	NS

response and about 46% of genotypes exhibited resistant response to anthracnose infecting sorghum crop (Erpelding, 2010). Likewise, 68 accessions were screened against diseases in sorghum and nine showed variable disease reactions from highly resistant to resistant and 34 were found susceptible (Cuevas *et al*., 2014). Similarly, 167 accessions of sorghum were screened under field conditions during 2015 and 2016 and among them 27 and 38 accessions were showed highly resistant to resistant diseases reaction to anthracnose respectively (Xu *et al*., 2020).

Several researchers have screened large number of genotypes against *A. soccata* and *C. partellus* infesting fodder sorghum and found varies level of resistance against the test pests (Patil and Bagde 2017; Kumar *et al*., 2019). Our results are in conformity with Bhoge *et al*., (2017) who have screened twenty sorghum genotypes against shoot fly

TABLE 4
Disease reaction of different genotypes against anthracnose of sorghum in different trials

Severity rating	Genotypes			Disease reaction class
	IAVHT MC - 2018	AVHTSC - 2018	AVHTSC - 2019	
1	SPH 1881, SPV2564	SPH1890, SPH1891, SPV 2445, SPV 2451	SPH1890, SPH1917, SPH1918, SPV2581, SPV2591, SPV2593	Highly Resistant
2, 3	SPH 1879, SPH1905, SPH1907, SPV2563	-	SPH1891, SPV2589	Resistant
4, 5	SPH 1840, SPH 1877, SPH1904, SPH1906,	-	SPV2587, SPV2582, SPH1919	Moderately Resistant
6, 7	Pant Chari 5, Kekri Local, Local Check	Pant Chari 5, Kekri Local, Local Check	Local Check	Susceptible
8, 9	-	-	-	Highly Susceptible

and observed different levels of resistance which might be due to high seedling vigour and glossiness (Mohammed *et al*., 2018). Prasad *et al*., (2015) screened thirty two sweet sorghum genotypes against *A. soccata* and *C. partellus* and found that these parameters were the most authentic for discrimination of entries as resistance or susceptible. Similarly, thirty sorghum genotypes were evaluated against *A. soccatai* they found positive correlation between parameters like leaf glossiness, seedling vigour, trichome and shoot fly resistance in sorghum genotypes (Mohammed *et al*., 2016). Prasad *et al*. (2015) screened thirty two sweet sorghum genotypes against *A. soccata* and *C. partellus* and found that these parameters were the most authentic for discrimination of entries as resistance or susceptible.

CONCLUSION

It is concluded from the study that eleven genotypes *viz*., SPH 1881, SPV 2564, SPH 1890, SPH 1891, SPV 2445, SPV 2451, SPH 1917, SPH 1918, SPV 2581, SPV 2591 and SPV 2593 showed highly resistant disease reaction against sorghum anthracnose. Entries namely, SPH 1905, SPV 2587 and SPV 2451 showed 17.8, 17.0 and 27.1 percent dead hearts caused by shoot fly. The genotypes exhibiting resistance to shoot fly, stem borer and fungal diseases across seasons can be effectively utilised in breeding program of forage sorghum.

ACKNOWLEDGEMENT

The authors thank Indian Council of Agricultural Research (ICAR) for its support through AICRP on Sorghum.

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