Forage Res., **47** (3) : pp. 355-358 (2021) **http://forageresearch.in**

RESPONSE OF SORGHUM GERMPLASM ENTRIES TO SHOOT FLY [*ATHERIGONA SOCCATA* (ROND)] AT LUDHIANA AND HISAR UNDER NATURAL CONDITIONS

HARPREET KAUR CHEEMA[1]*, BAJRANG LAL SHARMA[2], G. SHYAM PRASAD[3] AND NARESH KUMAR[4]

[1]Forage, Millets and Nutrition Section, Department of Plant Breeding and Genetics, Punjab Agricultural University, Ludhiana-141004 (Punjab), India
[2]Forage Section, Department of Genetics and Plant Breeding, CCS HAU, Hisar-125004 (Haryana), India
[3]ICAR- Indian Institute of Millets Research, Hyderabad-500030 (Telangana), India
[4]Department of Agricultural Meteorology CCS HAU, Hisar-125004 (Haryana), India
(e-mail : hkcheema@pau.edu)
(Received : 01 December 2021; Accepted : 18 December 2021)

SUMMARY

Shoot fly is a major insect pest of sorghum and screening for identifying resistant sources against it is a step towards managing it effectively. A total of forty germplasm lines of sorghum were evaluated along with resistant checks (IS 2312, IS 18551 and IS 2205) and susceptible checks (Swarna and DG 6514) during *kharif* 2020 at Ludhiana and Hisar. Twenty entries were found promising with less than 45% mean dead hearts inflicted by shoot fly. Entry EC- 13 had the lowest mean dead hearts incidence (22.9%) which was comparable to resistant checks. Entries EC-13, E-73, POP- 52 and E-173 had higher leaf glossiness (2.0 to 2.3) along with lesser mean shoot fly infestation (≤ 30.2% dead hearts). Entries GGUB-34, E-173, E-73, SEB- 12010, ELG-2, EC-12, EC-13, SEVS-2, SEVS-8 and EG- 2 with shoot fly dead hearts less than 45% (17.7- 44.2% dead hearts) were found promising at both the locations.

Key words : Sorghum, germplasm, screening, resistance, shoot fly

Sorghum [*Sorghum bicolor* (L.) Moench] plays an important role as fodder, in the health and nutrition of a large livestock population in India, having 20 % livestock population of the world (Sharda and Juyal, 2006). In Punjab, it is grown mainly as fodder crop in area of 2.71 lakh ha (Anonymous, 2021). The yield potential of sorghum is much higher than other forage crops but the production is low (Singh *et al.*, 2016). In spite of its resilience, insect pests are the major biotic constraints in the increasing production of quality fodder. In India, yield losses due to attack of shoot fly, *Atherigona soccata* (Rondani) (Diptera: Muscidae) and spotted stem borer *Chilo partellus* (Swinhoe) (Lepidoptera: Crambidae) vary from 50 to 90% (Pawar *et al.* 1984; Dhaliwal *et al.*, 2015). Maggots of shoot fly attack the crop one to four weeks after seedling emergence. There is withering of central shoot causing deadheart symptom (Subbarayadu and Rana, 2002). Being a fodder crop, the use of chemicals for management of insect pests in sorghum is not desirable. Host plant resistance is one of the most important means of insect control. Even genotypes with moderate resistance to major insect pests can be of much use in the integrated management strategies. Keeping this in view, the present study was undertaken to screen sorghum germplasm for resistance against *Atherigona soccata* under All India Co-ordinated Research Project (AICRP) on Sorghum.

MATERIALS AND METHODS

The experiments were conducted at two locations, *viz*., Ludhiana, Punjab (30°56'N latitude and 75°52'E longitude with an elevation of 247 m above mean sea level) and Hisar, Haryana (29°10'N latitude and 75°46'E longitude with an elevation of 215 m above mean sea level) during *Kharif* 2020 for the evaluation of different germplasm lines against major insect-pests under natural conditions.. The climate of Ludhiana is sub-tropical and semi-arid with very hot to dry and humid summer, while Hisar is hot and dry. At Ludhiana, the monthly mean maximum temperature, minimum temperature, minimum relative humidity, maximum relative humidity and sunshine

hours varied from 34.1 to 35.6°C, 13.3 to 25.6°C, 22 to 66%, 84 to 91%, 6.1 to 8.5 h during the cropping period. There were 27 rainy days. During cropping period at Hisar (the standard weeks 28 to 33), the mean maximum and minimum temperatures varied 35.1 to 36.5, and 26.2 to 27.5, respectively, while morning and evening relative humidity varied from 85 to 90, and 63 to 72 per cent, respectively. The mean sunshine hours ranged 6.5 to 7.9 h. The rain fall ranged from 0.0 to 105.7 mm.

A total of forty germplasm lines of sorghum were evaluated along with resistant checks (IS 2312, IS 18551 and IS 2205), susceptible checks (Swarna and DG 6514). The experiments were laid out in a Randomized Complete Block Design (RCBD) with three replications per entry with two rows of two meters length each. The crop was sown during mid July and thinning was done at 10 days after emergence to maintain the optimum plant stand. Crop was grown as per the respective recommended agronomic practices of both the states and kept free from insecticides. High incidence of shoot fly has been observed at both locations in the recent years. Furthermore, moist fish meal was also broadcasted evenly at 5 days after germination to ensure uniform infestation of sorghum shoot fly in the test material (Nwanze, 1997). Data on shoot fly infestation was recorded in terms of dead hearts at 28 days after emergence (DAE). The intensity of glossiness was recorded at 10 DAE during morning on a scale of 1–5, where 1, high intensity of glossiness and 5, non-glossy. All experimental data were subject to analysis of variance (ANOVA) as per Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Forty germplasm lines were screened for resistance against shoot fly at two locations, Ludhiana and Hisar. At 28 DAE when the shoot fly activity is at peak, the dead heart incidence was recorded and entries with less than 45 per cent incidence were identified as promising as per Anonymous (2020).

During *Kharif* 2020, a very high incidence of shoot fly was observed at Ludhiana with incidence reaching upto 61.9 % in susceptible check DJ 6514, while at Hisar it was as high as 49.5% (Table 1). The per cent dead hearts inflicted due to shoot fly damage across all germplasm and check entries during 2020 varied significantly from 17.8- 63.9 and 10.1- 80.4 per cent at Ludhiana and Hisar, respectively. Eighteen and nineteen entries at Ludhiana and Hisar, respectively had dead hearts incidence less than 45%. At Ludhiana, entry GGUB-27 had the least incidence of 8.0% dead hearts by shoot fly and seven entries were *on par* with it along with resistant check IS 2205. At Hisar, least incidence of 10.1% shoot fly deadhearts were recorded in the entry POP-52 and 17 entries were found promising and *on par* with it. The promising entries were *on par* with the resistant checks that had shoot fly dead hearts incidence of 10.7 – 12.5%. Entries GGUB-34, E-173, E-73, SEB- 12010, ELG-2, EC-12, EC-13, SEVS-2, SEVS-8 and EG- 2 with shoot fly dead hearts less than 45% (17.7- 44.2% dead hearts) were found promising at both the locations.

The pooled mean incidence of shoot fly ranged from 22.9 to 70.6% dead hearts. Twenty entries were found promising with less than 45% shoot fly inflicted dead hearts. Entry EC- 13 had the lowest incidence of dead hearts (22.9%) which was comparable to resistant checks IS 2205 and IS 18551. Higher leaf glossiness was recorded on the resistant checks IS 2312, IS 18551 and IS 2205 (1.3- 2.0) as compared to susceptible checks Swarna and DJ 6514 (4.0- 5.0). Entry EC- 13 having least mean shoot fly dead hearts (22.9%) was observed to have higher leaf glossiness (2.3). Other promising entries E-73, POP- 52 and E-173 with lesser dead hearts also had higher leaf glossiness (2.0) as compared to non- glossy checks that were susceptible to shoot fly. The results are in accordance with the findings of Sharma *et al*., (1997), Dhillon *et al*., (2005) and Mohammed *et al*., (2016) who reported that the intensity of leaf glossiness at the seedling stage is positively associated with the level of resistance to shoot fly and negatively correlated with dead heart formation. Sharma and Nwanze (1997) reported that leaf glossiness at seedling stage influences the oviposition behaviour of female shoot flies and thus resulting in lesser dead hearts. Gorthy *et al.* (2017) and Salama *et al.* (2020) also showed a negative reaction between percentage of dead hearts and leaf glossiness. In addition to shoot fly, stem borer, *C. partellus* incidence was also observed at Hisar, where it ranged from 5.4 to 18.1% dead hearts at 45 DAE, and entry POP- 52 had the least incidence. Kumar *et al.* (2019) and Prasad *et al*. (2015) also reported that some sorghum entries were found resistant to both shoot fly and stem borer using criteria of 45 and 15% dead hearts, respectively.

CONCLUSION

It is concluded from the study that twenty entries of the forty entries were found promising with

TABLE 1
Response of sorghum germplasm entries to shoot fly *Atherigona soccata*

S. No.	Entry	Shoot fly deadhearts (%) at 28 DAE						Seedling glossiness (1-5)
		Hisar	Ludhiana		Mean			
			R		R		R	
1.	GGUB-20	56.0	33	14.8	3	35.4	11	3.3
2.	GGUB-27	53.1	29	8.0	1	30.5	8	3.7
3.	GGUB-34	38.3	17	10.5	2	24.4	4	3.3
4.	GGUB-37	48.7	26	56.0	36	52.4	31	3.3
5.	GGUB-44	50.6	28	54.6	34	52.6	33	3.0
6.	GGUB-50	42.1	22	78.9	45	60.5	39	3.3
7.	GGUB-57	67.3	41	55.2	35	61.2	41	3.7
8.	GGUB-68	62.1	37	35.6	11	48.8	27	3.7
9.	E-58	31.3	11	77.3	44	54.3	36	3.0
10.	E-73	20.9	8	39.5	17	30.2	7	2.0
11.	E-77	59.2	35	45.9	23	52.5	32	4.0
12.	E-158	54.8	32	18.7	4	36.7	13	3.3
13.	E-173	17.7	7	41.1	19	29.4	6	2.0
14.	E-186	32.6	13	59.3	39	46.0	25	3.0
15.	E-203	13.5	6	49.2	29	31.3	10	2.0
16.	E-214	75.0	44	49.4	30	62.2	42	4.3
17.	E-223	57.4	34	48.8	28	53.1	35	3.7
18.	E-249	66.7	40	74.6	43	70.6	45	2.3
19.	POP-52	10.1	1	46.7	25	28.4	5	2.0
20.	ELG-2	41.1	19	31.5	7	36.3	12	3.0
21.	ELG-13	47.6	25	26.2	5	36.9	15	3.7
22.	EC-12	33.3	14	40.2	18	36.8	14	2.3
23.	EC-13	13.1	5	32.6	10	22.9	2	2.3
24.	EC-20	31.6	12	47.5	27	39.5	17	2.7
25.	EG- 2	41.7	21	44.2	21	42.9	23	3.3
26.	EG- 11	46.1	24	46.8	26	46.5	26	3.0
27.	EG- 20	27.2	9	56.3	37	41.8	21	3.0
28.	EG- 25	53.2	30	52.0	32	52.6	33	3.3
29.	EG- 35	70.8	43	58.4	38	64.6	44	3.7
30.	EG- 40	33.6	15	51.1	31	42.4	22	3.0
31.	SEB-11993	40.6	18	46.5	24	43.5	24	3.0
32.	SEB-11999	53.8	31	67.6	42	60.7	40	4.0
33.	SEB-12010	29.9	10	31.6	9	30.8	9	2.7
34.	SEB-12012	63.9	39	52.8	33	58.3	38	3.3
35.	SEB-12022	80.4	45	45.3	22	62.8	43	4.7
36.	EA-10	68.4	42	31.6	8	50.0	29	4.0
37.	EA-6	63.3	38	36.8	14	50.1	30	4.0
38.	SEVS-2	41.7	20	37.3	15	39.5	16	3.0
39.	SEVS-8	36.4	16	44.0	20	40.2	19	2.7
40.	SEVS-20	61.5	36	37.6	16	49.6	28	4.3
41.	IS 2312(RC)	12.5	4	67.2	41	39.9	18	2.0
42.	IS 18551(RC)	11.7	3	36.6	13	24.1	3	1.7
43.	IS 2205(RC)	10.7	2	27.5	6	19.1	1	1.3
44.	Swarna(SC)	45.0	23	35.7	12	40.4	20	4.0
45.	DJ 6514(SC)	49.5	27	61.9	40	55.7	37	5.0
	C.D. (5%)	31.8		27.0		NS		0.9
	C.V. (%)	22.3		17.4		19.73		17.8

R is ranking of the germplasm entry, RC - Resistant Check and SC - Susceptible Check.

less than 45% mean dead hearts inflicted by shoot fly. Entries GGUB-34, E-173, E-73, SEB- 12010, ELG-2, EC-12, EC-13, SEVS-2, SEVS-8 and EG- 2 with shoot fly dead hearts less than 45% were found promising at both the locations. Entry EC- 13 had the lowest mean dead hearts incidence (22.9%) which was comparable to resistant checks. Entries EC-13, E-73, POP- 52 and E-173 had higher leaf glossiness (2.0 to 2.3) along with lesser mean shoot fly infestation (≤ 30.2% dead hearts). The promising genotypes exhibiting resistance across locations can be effectively utilised in breeding program of forage sorghum.

ACKNOWLEDGEMENT

The authors thank Indian Council of Agricultural Research (ICAR) for its support in the form of germplasm and funds through AICRP on Sorghum for conducting of trials.

REFERENCES

Anonymous 2020 : Progress Report (Entomology) 2019-20, All India Coordinated Research Project on Sorghum. ICAR- Indian Institute of Millets Research, Hyderabad 500030. Telangana.

Anonymous 2021 : Package of Practices for crops of Punjab- *Kharif*. pp 1-173. Punjab Agricultural University, Ludhiana.

Dhaliwal, G. S., V. Jindal and B. Mohindru, 2015 : Crop losses due to insect pests: global and Indian scenario. *Indian Journal of Entomology,* **77** : 165-168.

Dhillon, M. K., H. C. Sharma, R. Singh and J. S. Naresh. 2005 : Mechanisms of resistance to shoot fly, *Atherigona soccata* in sorghum. *Euphytica,* **144** : 301- 312.

Gomez, K. A. and A. A. Gomez. 1984 : *Statistical Procedure for Agricultural Research*. John Wiley and Sons. New York. P 680.

Gorthy, S., L. Narasu, A. Gaddameedi, H.C. Sharma, A. Kotla, S. P. Deshpande and A. K. Are, 2017 : Introgression of shoot fly (*Atherigona soccata* L. Moench) resistance QTLs into elite post rainy season sorghum varieties using marker assisted backcrossing (MABC). *Frontiers in Plant Science,* **8** : 1494. https://doi.org/10.3389/fpls.2017.01494.

Kumar, H., Anil, P. Kumari, S. Arya and G. S. Prasad. 2019 : Evaluation of sorghum genotypes for multiple resistance against shoot fly [*Atherigona soccata* (Rondani)] and spotted stem borer [*Chilo partellus* (Swinhoe)]. *Forage Research,* **45** (1) : 38-42.

Mohammed R., R. S. Munghate, A. K. Are, K. Kishor, B. Polavarapu, Belum V. S. Reddy and Hari C. Sharma. 2016 : Components of resistance to sorghum shoot fly, *Atherigona soccata*. *Euphytica*, **207** : 419-438 DOI 10.1007/s10681-015-1566-1.

Nwanze, K. F., 1997 : Screening for resistance to sorghum shoot fly. In : *Plant resistance to insects in sorghum*, H. C. Sharma, F. Singh, K. F. Nwanze (eds.) pp. 35-37.

Pawar V. M., G. D. Jadhav and B. S. Kadam, 1984 : Compatibility of Incol 50 SP with different fungicides on sorghum (CS-3541) against shoot fly (*Atherigona soccata* Rondani). *Pesticides,* **18** : 9-10.

Prasad, G. Shyam, V. R. Bhagwat, K. Srinivasa Babu, A. Kalaisekar and B. Subbarayudu, 2015 : Identification of forage sorghum lines having multiple-resistance to sorghum shoot fly and spotted stem borer. *Range Management Agroforestry*. **36** : 164-169.

Salama, E. A., N. Kumaravadivel, S. Mohankumar and N. Muthukrishnan, 2020 : Correlation study of traits associated with shoot fly resistance in recombinant inbred lines (rils) population of sorghum [*Sorghum bicolor* (L.) Moench]. *Electronic J. Pl. Breed.* **11** : 110-115.

Sharda V. and G. P. Juyal, 2006 : Conservation Technologies for Sustaining Natural Resources In Hand Book of Agriculture, ICAR, New Delhi.

Sharma, H. C. and K. F. Nwanze, 1997 : Mechanisms of resistance to insects in sorghum and their usefulness in crop improvement. International Crops Research Institute for the Semi- Arid Tropics. Patancheru, AP, p 56.

Sharma, H.C., K.F. Nwanze and V. Subramanian, 1997 : Mechanisms of resistance to insects and their usefulness in sorghum improvement. In: *Plant Resistance to Insects in Sorghum,* H.C. Sharma, Faujdar Singh and K.F. Nwanze (eds.), International Crops Research Institute for the Semi-Arid Tropics, Patancheru 502324, Andhra Pradesh, India. pp. 81-100.

Singh, K. P., P. C. Chaplot, H. K. Sumeriya and G. L. Choudhary, 2016 : Performance of single cut forage sorghum genotypes to fertility levels. *Forage Research*, **42**(2) : 140-142.

Subbarayadu B. S. and B. S. Rana, 2002 : Effect of integrated pest management modules on the incidence of sorghum shoot fly. *J. Res. ANGRAU.,* **30** : 22-29.