International Journal of Advanced Biochemistry Research 2024; SP-8(2): 601-604

International Journal of Advanced Biochemistry Research

**ISSN Print:** 2617-4693
**ISSN Online:** 2617-4707
IJABR 2024; SP-8(2): 601-604
www.biochemjournal.com
Received: 02-12-2023
Accepted: 07-01-2024

**VU Sonalkar**
Sorghum Research Unit,
Dr. Panjabrao Deshmukh
Krishi Vidyapeeth, Akoa,
Maharashtra, India

**RB Ghorade**
Sorghum Research Unit,
Dr. Panjabrao Deshmukh
Krishi Vidyapeeth, Akoa,
Maharashtra, India

**PK Rathod**
Sorghum Research Unit,
Dr. Panjabrao Deshmukh
Krishi Vidyapeeth, Akoa,
Maharashtra, India

**Corresponding Author:**
**VU Sonalkar**
Sorghum Research Unit,
Dr. Panjabrao Deshmukh
Krishi Vidyapeeth, Akoa,
Maharashtra, India

# Sorghum fodder line's reaction to shoot fly, *Atherigona soccata* and stem borer

**VU Sonalkar, RB Ghorade and PK Rathod**

**DOI:** https://doi.org/10.33545/26174693.2024.v8.i2Sh.656

**Abstract**
Sorghum single-cut hybrids and varietal fodder lines along with seven checks screening studies were evaluated for their reaction against insect pests at Akola in kharif 2022.The reaction of fodder sorghum single cut lines were observed against shoot fly, stem borer, aphid, Midge and shoot bug. Seedling glossiness recorded in scale 1.0 to 5.0; the score was minimum i.e. glossy seedlings for resistant checks IS 2205 and IS 18551 and in test line SPV2878. Shoot fly dead hearts 21 DAE within the sorghum entries were significant and least shoot fly damage was noted for resistant checks *viz*., IS 2205 (RC) and IS 18551 (RC) and among the test line SPV2878 (34.46%) had least damage. Maximum dead hearts were expressed by test line SPH2006. Dead hearts among the entries tested 28 days after emergence shoved significant differences. Shoot fly dead hearts were ranged between 25.64 and 90.74 percent, respectively observed in resistant check IS 2205 and in test line SPH2801. Resistant checks IS 2205 and IS 18551 expressed on par dead hearts and dead hearts in later were statistically equal with dead hearts in test entries test entries SPV2797, SPV2878, and CSV 30F; highest being noted in SPH2801. Correlation coefficients indicated that the glossy and vigorous seedlings had tolerant to shoot fly dead hearts and had no significant impact on stem borer.

**Keywords:** *Sorghum bicolor*, *Atherigona soccata*, hybrid, glossiness score, vigour

## Introduction
Sorghum (*Sorghum bicolor*), the most important cereal crops grown in Africa, Asia, United States of America, Australia and Latin America is widely grown for food, feed, fodder, forage and fuel in the semi-arid tropics (SAT) of Asia, Africa, the Americas and Australia. After wheat, maize, rice and barley, sorghum is important because of its good adaptation to a wide range of ecological conditions, low input cultivation and diverse uses. In the world, it is cultivated in 40.25 million ha with a production of 58.70 million tonnes and productivity of 1458 kg/ha (FAO, 2021) [2]. The USA, Sudan, Mexico, Nigeria, India, Niger, Ethiopia, Australia, Brazil and China are to ten producers contributing about 77% of world sorghum production (Aruna and Cheruku, 2019) [12]; and is the dietary staple in these regions for more than 200 million people and is a source of food and fodder, especially in the traditional, small-holder farming sector (Visarada and Aruna, 2019) [12]. Sorghum is considered as "healthy cereal" and is a good source of carbohydrates (68%), proteins (10%), micronutrients and phytochemicals with nutraceutical properties (Visarada and Aruna, 2019) [12]. Sorghum is a climate-smart $C_4$ crop with the ability to produce grain and fodder in harsh environments under low input conditions with high net returns (Hao *et al*., 2021 [3]. Sorghum, shoot fly (*Atherigona soccata* Rondani), most destructive insect pest causing huge economic losses. For its control, breeding for host plant resistance is the best and economically feasible strategy. Genetic correlation between dead hearts and leaf surface glossiness and with seedling height were negative (Madhusudhana and Padmaja 2023) [6]. In Maharashtra, pest causing dead hearts in early seedling stage, reducing plant population thereby causing heavy yield losses up to 75.60% in grain and 68.90% of fodder (Khandare *et al*. 2013) [4]. The shoot fly of sorghum effectively managed with seed treatments (Sonalkar *et al*, 2018) [9]. Some genotypes found tolerant / resistant to shoot fly on sorghum (Madavi and Sonalkar 2019; Sonalkar *et al* 2019) [5, 11]. Some characters of sorghum seedlings are associated with shoot fly resistance. Glossy leaves possibly affect the quality of light reflected from leaves and influence the orientation of shoot flies towards their host plant.

Shoot fly resistant lines have rapid plant growth, greater seedling height and hardness and have longer stems. Rapid growth of seedlings may retard the first instar larvae from reaching the growing tip. In contrast, slow growth due to poor seedling vigour, low fertility or environmental stress increases shoot fly incidence (Taneja and Leuschner 1985; Patel and Sukhani 1990) [10, 8]. For all time, early sowing is not feasible as the sowing window is short in rainfed situations and there exists a race with other crop for sowing. For shoot fly management, strategies such as agronomic practices, natural enemies, synthetic insecticides (Sonalkar *et al*, 2018) [9] and host plant resistance have been employed for minimizing the pest losses. Host plant resistance can play a most important role in hitting down the extent of losses and is friendly with other pest management tactics. It can be exploited as one of the most effective means of keeping insect pests below the economic threshold levels (Sharma 1985; Mohammed *et al*. 2015) [7]. AT Akola, several lines of single cut fodder lines were screened for their reaction against amjor insect pests particularly shoot fly.

## Materials and Methods

Sorghum single cut 18 fodder entries including seven checks were screened in field for their reaction against insect pests shoot fly. The sowing of the entries was done on July 21.7.2022 in randomized design with three replications. Plant population in each entry was counted at 12 days after emergence. The shoot fly eggs per five plants were recorded 14 days after emergence. The seedling glossiness score and seedling vigour was recorded at 12 days after emergence. Observations on dead hearts due to shoot fly were recorded by counting total plants and plant showing dead hearts due to shoot fly in each entry 21 and 28th days after emergence. Stem borer leaf injury rating in the scale 1 to 9 was recorded at 35 DAE. Stem borer dead hearts were counted 45 days after emergence for computing percent dead hearts in each entry. The midge damage, shoot bug damage and mite rating in the scale 1.0 to 9.0 were noted at maturity. The aphid leaf damage was assessed at milk stage in the scale 1.00 to 9.00

## Results and Discussion

### Seedling glossiness

Seedling glossiness in various entries the scale 1-5 scale in range was 1.673 to 4.33 (Table 1); lowest i.e. 1.67 score, glossy seedlings in resistant check IS 2205 followed with 2.00 in another resistant check IS 18551. Among the test lines, the lines SPV2878 (2.33) scored least glossiness score followed with 2.67 in SPV2797. Maximum score (4.33) i.e. less glossy seedlings in check CSH 40F and test line SPV2885. Seedling vigour expressed in scale 1-5 and range was 2.00 to 3.33 (Table 1); vigorous seedlings i. e. low score was for CSV 30F checks IS 18551 followed with 2.33 in another check IS2205, test lines SPV2797 and SPV2878. High score (3.33) was for CSH 40F. Sonalkar *et al* 2019 [11] noted least glossy seedling score in resistant checks and one test line. Sonalkar and Pagire (2018) [9] studied nine sorghum varieties along with ten checks and reported more than 3.0 glossiness score in test varieties. Also determined that glossy seedling expression could be used as a simple and reliable criterion for resistance, which supports the present findings.

### Shoot fly dead hearts

Shoot fly dead hearts within the sorghum entries were significant and were ranged from 21.78 to 80.49 percent 21 days after emergence (Table 1). Least shoot fly damage was noted for resistant checks *viz*., IS 2205 (RC) and IS 18551 (RC) with 21.78 and 28.66 percent dead hearts damage, respectively and on par to each other; however, dead hearts in later was on par to dead hearts in test entries SPV2797 (44.01%) and SPV2878 (34.46%) check CSV 30F (46.63%). Maximum dead hearts were expressed by test lineSPH2006 with 80.49 percent followed in test line SPV2884 (76.97%) and SPV2884 (76.48%). Dead hearts among the entries tested 28 days after emergence shoved significant differences (Table 1). Shoot fly dead hearts were ranged between 25.64 and 90.74 percent, respectively observed in resistant check IS 2205 and in test line SPH2801. Resistant checks IS 18551 (32.95%) expressed on par dead hearts to IS 2205 and dead hearts in former were statistically equal with dead hearts in test entries test entries SPV2797 (49.83%), SPV2878 (38.88%), and CSV 30F (51.72%). Highest dead hearts were noted in SPH2801 (90.74%) followed in CSH36F with 86.25% in check CSV 35F. Madavi and Sonalkar 2019 [5] noted amongst all entries, IS-18551 (15.69) was the most effective for shoot fly reaction 28 DAE and Swarna showed maximum dead hearts (65.97%) Sonalkar et. al. (2019) [11] also noted amongst all sorghum entries, the resistant check entries *viz*., IS 18551 and IS 2205 (RC) noted significantly lowest dead hearts supporting present study. Sonalkar and Pagire (2018) [9] observed less deadhearts not exceeding 5% on resistant checks under high pest pressure.


**Plate 1:** Shoot fly dead hearts

### Reaction to other insect pests

Stem borer leaf injury damage was expressed as damage score in the scale 1.00 to 9.00 (Table 2). The damage score was ranged between 2.00 and 3.67 within the entries. Least damage score i.e. 2.00 was expressed by check IS 2205 followed with 2.33 for test lines SPV2797, SPV2801, SPV2878 and SPV2884 and check CSV 35F. Maximum damage score i.e. 3.67 was recorded for CSV34 LC followed with 3.00 for SPH2006, SPV2880 and SPV2885. Stem borer dead hearts damage was recorded at 45 days after mergence (Table 2) and was non-significant. However, test line SPV2797, SPV2879 and SPV2884 tolerant with less than 5.00 dead hearts. The aphid damage was assessed in the damage scale 1.0 to 9.00 (Table 2). The aphid damage score was at low level ranging more than 1.67. The shoot damage was assessed in the damage rating scale 1.00 to 9.00 (Table 2); the range of damage score within entries was 1.33 to 3.00. The minimum damage score i.e. 1.33 was in test lines SPH1985, SPV2801and SPV2885 followed with 1.67 in test line SPH2006, SPV2879 and SPV2880. The high score was noted for test line SPV2878 and checks IS 2205 and IS 18551.

Correlation coefficients (Table 3) shows that the seedling vigour score i.e. higher the score less glossy seedlings and seedling vigour score i.e. higher the score less vigorous seedlings are highly significant shoot fly dead hearts indicating vigorous and glossy seedlings tolerating the shoot fly damage. And these coefficients are non-significant for stem borer dead hearts. Similar kinds of results were observed by Sonalkar *et al* (2019) [11] and Madavi and Sonalkar (2019) [5].

**Table 1:** Reaction of single cut sorghum varietal and hybrid lines to shoot fly kh 2022-23

| SR | Sorghum Entry | SGS (1-5) 12 DAE | SV (1-5) 12 DAE | SF-DH (%) 21 DAE | | SF-DH (%) 28 DAE | |
|---|---|---|---|---|---|---|---|
| | | | | OV | TV* | OV | TV* |
| 1 | SPH1985 | 3.67 | 2.67 | 75.66 | 60.99 | 84.39 | 67.45 |
| 2 | SPH2006 | 4.00 | 3.00 | 80.49 | 63.99 | 85.51 | 67.66 |
| 3 | SPV2797 | 2.67 | 2.33 | 44.01 | 41.38 | 49.83 | 44.86 |
| 4 | SPV2800 | 3.33 | 3.00 | 63.72 | 53.41 | 69.04 | 56.96 |
| 5 | SPV2801 | 4.00 | 3.00 | 73.15 | 58.87 | 90.74 | 75.48 |
| 6 | SPV2878 | 2.33 | 2.33 | 34.46 | 35.80 | 38.88 | 38.47 |
| 7 | SPV2879 | 3.67 | 2.67 | 71.98 | 58.17 | 80.11 | 63.65 |
| 8 | SPV2880 | 4.00 | 3.00 | 71.96 | 58.10 | 85.98 | 68.07 |
| 9 | SPV2881 | 3.67 | 2.67 | 73.81 | 59.25 | 84.13 | 66.73 |
| 10 | SPV2884 | 3.67 | 3.00 | 76.97 | 61.79 | 84.33 | 67.44 |
| 11 | SPV2885 | 4.33 | 2.67 | 76.48 | 61.21 | 86.65 | 68.71 |
| 12 | CSV 30F | 3.00 | 2.67 | 46.63 | 43.02 | 51.72 | 46.24 |
| 13 | CSV 35F | 3.67 | 3.00 | 74.73 | 59.84 | 86.25 | 68.56 |
| 14 | CSH 40F | 4.33 | 3.33 | 75.12 | 60.36 | 84.09 | 66.72 |
| 15 | CSV 34 LC | 3.33 | 3.00 | 63.01 | 52.79 | 71.13 | 58.24 |
| 16 | IS 2205 | 1.67 | 2.33 | 21.78 | 27.81 | 25.64 | 30.42 |
| 17 | IS 18551 | 2.00 | 2.00 | 28.66 | 32.34 | 32.95 | 35.01 |
| 18 | Swarna | 3.67 | 2.67 | 74.69 | 59.84 | 84.71 | 66.99 |
| | CD at 5% | | | | 10.80 | | 12.69 |
| | CV (%) | | | | 12.35 | | 13.02 |

**Note:** SGS, seedling glossiness score; SV, seedling vigour; SF-DH, shoot fly dead hearts; OV, original values; TV* arcsine transformed values.

**Table 2:** Stem borer damage, aphid damage and shoot bug damage score in AVHT-SC kh 2022.

| SR | Sorghum Entry | SBLIR (1-9) | SB-DH (%) 45 DAE | | Ah-DR (1-9) | ShB-DR (1-9) |
|---|---|---|---|---|---|---|
| | | | OV | TV* | | |
| 1 | SPH1985 | 2.67 | 8.73 | 3.01 | 1.33 | 1.33 |
| 2 | SPH2006 | 3.00 | 7.61 | 2.79 | 1.33 | 1.67 |
| 3 | SPV2797 | 2.33 | 4.49 | 2.01 | 1.33 | 2.33 |
| 4 | SPV2800 | 2.67 | 6.70 | 2.67 | 1.00 | 2.33 |
| 5 | SPV2801 | 2.33 | 9.26 | 2.75 | 1.67 | 1.33 |
| 6 | SPV2878 | 2.33 | 8.84 | 3.05 | 1.33 | 3.00 |
| 7 | SPV2879 | 2.67 | 4.63 | 2.05 | 1.00 | 1.67 |
| 8 | SPV2880 | 3.00 | 8.47 | 2.65 | 1.00 | 1.67 |
| 9 | SPV2881 | 2.67 | 10.32 | 3.24 | 1.67 | 2.00 |
| 10 | SPV2884 | 2.33 | 3.55 | 1.84 | 1.33 | 2.00 |
| 11 | SPV2885 | 3.00 | 8.66 | 2.89 | 1.33 | 1.33 |
| 12 | CSV 30F | 2.67 | 3.61 | 1.86 | 1.00 | 2.33 |
| 13 | CSV 35F | 2.33 | 8.49 | 2.97 | 1.33 | 1.67 |
| 14 | CSH 40F | 2.67 | 3.42 | 1.82 | 1.00 | 2.00 |
| 15 | CSV 34 LC | 3.67 | 6.27 | 2.58 | 1.00 | 2.00 |
| 16 | IS 2205 | 2.00 | 5.05 | 2.34 | 1.00 | 3.00 |
| 17 | IS 18551 | 3.00 | 5.68 | 2.46 | 1.00 | 3.00 |
| 18 | Swarna | 2.67 | 3.51 | 1.84 | 1.00 | 1.67 |
| | CD at 5% | | | - | | |
| | CV (%) | | | 39.08 | | |

**Note:** SBLIR, stem borer leaf injury rating; SB-DH, stem borer dead hearts; OV-Original values, TV*, x+0.5 square root transformed values; Ah-DR- Aphid-plant damage rating; ShB, shoot bug plant damage rating; FAW-DR-Fall army worm damage rating.

**Table 3:** Correlation coefficients for shoot fly dead hearts and stem borer dead hearts.

| Plant charachter | Shoot fly dead hearts (%) 21DAE | Shoot fly dead hearts (%) 28 DAE | Stem borer dead hearts (%) 45 DAE |
|---|---|---|---|
| Seedling glossiness score | 0.959** | 0.963** | 0.213 |
| Seedling Vigor | 0.774** | 0.771** | 0.036 |

Correlation coefficient values, n-2=16, r: 0.497 (0.05), 0.623 (0.01)

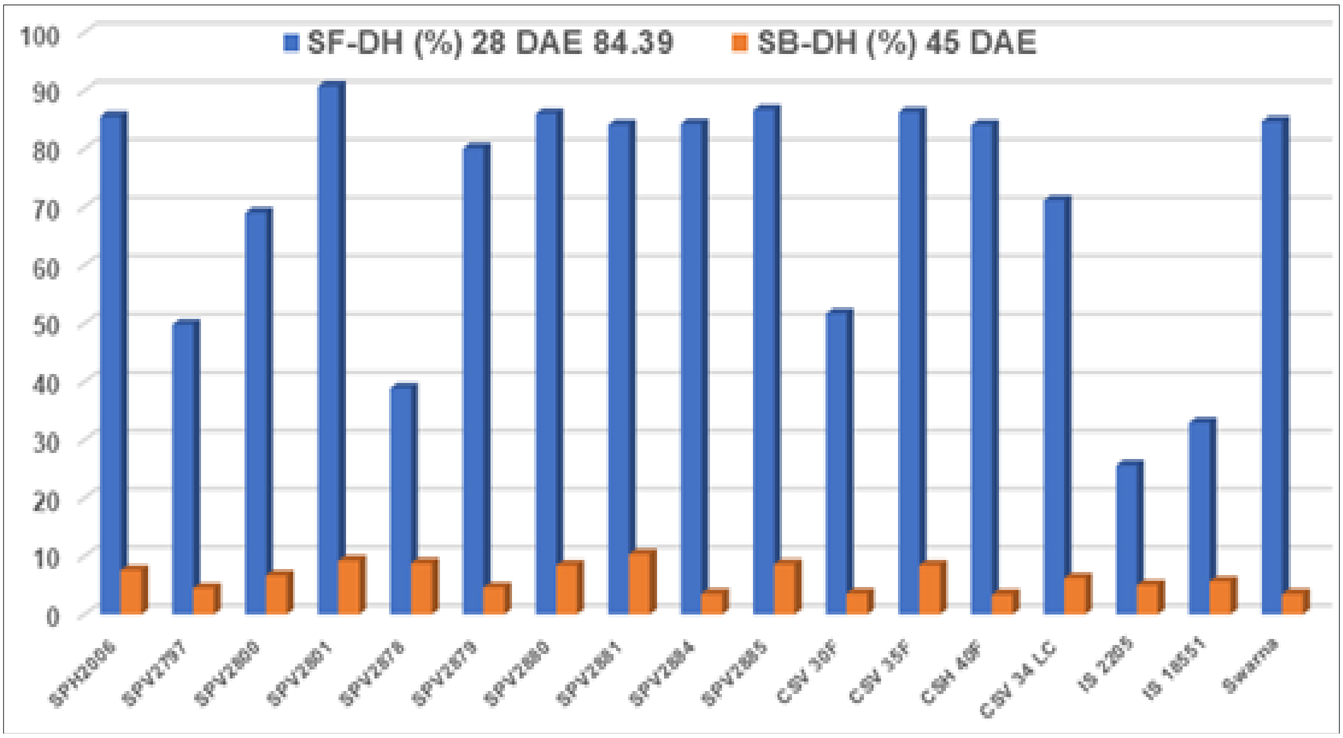


**Fig 1:** Shoot fly and stem borer dead hearts in single cut lines

## Conclusion

In conclusion, sorghum entries exhibited varying seedling glossiness, vigour, and susceptibility to shoot fly damage. Resistant checks demonstrated lower damage, highlighting the importance of selecting resistant varieties for pest management in sorghum cultivation.

## References

1. Aruna C, Audilakshmi S. A strategy to identify potential germplasm for improving yield attributes using diversity analysis in sorghum. Plant Genet Resour Characterization Util. 2008;6(3):87-194. DOI: 10.1017/S1479262108994144.
2. FAO. Food and Agriculture Organization of the United Nations [Internet]. 2021 [cited 2022 July 30]. Available from: http://www.fao.org/faostat/en/#data/QC.
3. Hao H, Li Z, Leng C, Lu C, Luo H, Liu Y, *et al.* Sorghum breeding in the genomic era: opportunities and challenges. Theor Appl Genet. 2021;134:1899-1924. doi: 10.1007/s00122-021-03789-z.
4. Khandare RP, Patil SP, Burghate SK, Kalpana Kurhade. Screening of advanced breeding material of sorghum against shoot fly (*Atherigona soccata*, Rondani). Scholarly J Agric Sci. 2013;3(8):305-307.
5. Madavi MG, Sonalkar VU. Evaluation of sorghum genotypes for their resistance to shoot fly *Atherigona soccata*. Indian J Entomol. 2019;81(3):558-563. doi: 10.5958/0974-8172.2019.00118.4.
6. Madhusudhana R, Padmaja PG. Multi-trait stability index for the identification of shoot fly (*Atherigona soccata*) resistant sorghum lines from a mini core collection. Pest Manag Sci. 2023. doi: 10.1002/ps.7629.
7. Mohammed RD, Munghate RS, Are AK, Reddy BVS, Sharma HC. Components of resistance to sorghum shoot fly, *Atherigona soccata*. Euphytica. 2016;207:419-438.
8. Patel GM, Sukhani TR. Screening of sorghum genotypes for resistance to shoot fly, Atherigona soccata Rondani. Indian J Entomol. 1990;52(1):1-8.
9. Sonalkar VU, Pagire KS, Gulhane AR, Ghorade RB. Management of Shoot Fly, *Atherigona soccata* (Diptera: Muscidae) in Kharif Sorghum in Vidarbha. Int. J Curr Microbiol. Appl. Sci. 2018;7(06).
10. Taneja SL, Leuschner K. Resistance screening and mechanisms of resistance in sorghum to shoot fly. In: Proc Int Sorghum Entomol Workshop. 1985. p. 15-188.
11. Sonalkar VU, Shilpa Khambalkar, Ghorade RB. Screening of multi-cut sorghum hybrids for their reaction to major insect pests in kharif. Multilogic Sci. 2019;VIII(Special Issue B).
12. Visarada KBRS, Aruna C. Sorghum: A bundle of opportunities in the 21st century. In: Breeding sorghum for diverse end uses. 1st Edn. Aruna C, Visarada KBRS, Bhat BV, Tonapi VA, editors. Sawston, UK: Woodhead Publishing; c2019. p. 1-14. Doi: 10.1016/B978-0-08-101879-8.00001-2.