Indian Journal of Applied Entomology **29**(2) : 123–126 (2015)

SCREENING SORGHUM GENOTYPES AGAINST SHOOT PESTS (*ATHERIGONA SOCCATA* RONDANI AND *PEREGRINUS MAIDIS* ASHMEAD)

NAVEEN GAUTAM, KAN SINGH, RAJENDRA NAGAR AND T. HUSSAIN

Department of Entomology, Rajasthan College of Agriculture, Udaipur 313001
Corresponding author: rajendranagar86@gmail.com

ABSTRACT

Twenty sorghum genotypes from ICRISAT, Hyderabad were screened for their preference/ tolerance to shoot fly *(Atherigona soccata Rondani)* during *kharif,* 2013 at RCA, MPUA&T, Udaipur. Genotypes were screened on the basis of number of plants with eggs and percent dead hearts at 14th, 21st and 28th days after emergence with one resistant check (IS 18551) and one susceptible check (SWARNA). Of the twenty sorghum genotypes evaluated against shoot fly, the genotypes IS 2146, ICSV 700, IS 2123, ICSV 705 and IS 40615 were significantly less preferred for oviposition as observed on the 14th and 21st day after germination with a mean oviposition of 23.85, 26.07, 28.78, 30.29 and 30.99 per cent, respectively. The resistant check (IS 18551) had the lowest oviposition (18.43%) and also exhibited minimum average percentage of dead hearts (12.29%) on 28th day after emergence. Similarly, susceptibility to shoot bugs was assessed, by scoring number of both nymphs and adult shoot bug (*Peregrinus maidis* Ashmead) per plant at 45 days after emergence of the crop when the population was at its peak. The genotypes ICSV 705, IS 40615 and ICSV 700 harboured less than 2 shoot bugs per plant, indicating their less preference for shoot bug.

Key words: *Atherigona soccata* Rondani, *Peregrinus maidis* Ashmead, sorghum genotypes

INTRODUCTION

Sorghum [*Sorghum bicolor* (L.) Moench], an important food and fodder crop in the semi-arid tropics is infested by many insect pests from seedling stage to harvest. Grain yields in farmers' fields in Asia and Africa are generally low (500 to 800 kg ha^{-1}) mainly due to insect pest damage. Nearly 150 insect species have been reported as pests on sorghum (Jotwani et al. 1980, Sharma 1993), of which sorghum shoot fly (*Atherigona soccata*), stem borers (*Chilo partellus*, *Busseola fusca*, *Eldana saccharina*, and *Diatraea* spp), armyworms (*Mythimna separata*, *Spodoptera frugiperda* and *S. exempta*), shoot bug (*Peregrinus maidis*), aphids (*Schizaphis graminum* and *Melanaphis sacchari*), spider mites (*Oligonychus* spp), grasshoppers and locusts (*Hieroglyphus*, *Oedaleus*, *Aiolopus*, *Schistocerca* and *Locusta*), sorghum midge (*Stenodiplosis sorghicola*), earhead bugs (*Calocoris angustatus* and *Eurystylus oldi*), and head caterpillars (*Helicoverpa*, *Eublemma*, *Cryptoblabes*, *Pyroderces* and *Nola*) are the major pests worldwide. The sorghum shoot fly (*Atherigona soccata* Rondani) is a major pest in Asia, Africa and Mediterranean Europe (Dhillon *et al*., 2005 and Subbarayudu and Indira, 2007) and its damage results in yield losses up to 90 per cent (Jotwani and Srivastava, 1970). Of late, the shoot bug or plant hopper (*Peregrinus maidis* Ashmead) (Delphacidae: Homoptera) has attained serious pest status due to the introduction of hybrids that mature at different times in certain parts of Andhra Pradesh, Karnataka and Tamil Nadu. Severe infestation at the boot stage results in the twisting of top leaves and preventing the emergence of panicles resulting in losses up to 41 per cent in India (Subbarayudu *et al*., 2002).

MATERIALS AND METHODS

The present investigation was carried out at the Instructional Farm, Rajasthan College of Agriculture, Udaipur during *kharif* 2013 in a Randomized Block Design with 3 replications. Sowing was done in six rows of 4.0m length in plots of size 4.0m x 2.7m (10.80 m^2). The row to row distance was maintained at 45 cm while plant to plant at 15 cm. 20 sorghum genotypes (ICRISAT) were tested under natural conditions of shoot fly and shoot bug infestation with one resistant and one susceptible check.

The twenty sorghum genotypes screened were ICSB 411, ICSB 413, ICSB 435, ICSB 444, ICSB 445, ICSV 700, ICSV 705, ICSV 12001, ICSV 12002, ICSV 12003, ICSV 12004, ICSV 25019, ICSV 25022, ICSV 25026, ICSV 93046, IS 2123, IS 2146, IS 40615, IS 18551 (resistant check) SWARNA (susceptible check) obtained from ICRISAT, Hyderabad.

Observations were recorded for egg-laying by shoot fly on the 14th and 21st day after germination, while that for dead heart formation on 28th day after germination.

Oviposition: The total count of plants with shoot fly eggs from 10 tagged plants from each genotype were recorded on 14th and 21st day after germination.

$$\text{Oviposition (\%)} = \frac{\text{Number of plants with eggs}}{\text{Total number of plants observed}} \times 100$$

Dead hearts: Dead hearts formed due to shoot fly infestation was recorded on 10 tagged plants on 28th day after germination and the data were expressed as per cent dead hearts.

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

Observations for shoot-bug infestation: Observations for the shoot-bug were taken visually counting the nymphs and adults from the central whorl (length *ca*. 20cm) from 5-tagged plants 45 days after germination.

Statistical Analysis: The data on the percent oviposition and dead heart formation were analyzed in ANOVA by transforming the data to arcsine values.

RESULTS AND DISCUSSION

To evaluate the relative preference of sorghum genotypes by the sorghum shoot fly (*Atherigona soccata* Rondani), twenty experimental genotypes including two National Checks *viz.*, IS 18551 (Resistant Check) and SWARNA (Susceptible Check) were screened under late planting conditions, ensuring maximum shoot fly infestation, on the basis of preference for egg laying (percentage of plants with eggs) and inflicting damage (per cent dead hearts) to plants.

Oviposition

(a) 14th day after germination. It is evident from Table 1 that the maximum oviposition was recorded in the susceptible check SWARNA (63.43%); whereas, the

Table 1. Preference of sorghum genotypes for egg laying and resultant infestation during *kharif,* 2013

S.No.	Sorghum Genotypes	Egg laying (%)		Dead Hearts (%)
		14 DAG	21 DAG	28 DAG
1	ICSB 411	52.77 (63.39)^{efghi}	56.99 (70.32)^{gh}	48.84 (56.68)^{fghij}
2	ICSB 413	54.77 (66.73)^{fghi}	54.77 (66.73)^{fgh}	52.77 (63.39)^{hij}
3	ICSB 435	56.99 (70.32)^{ghi}	61.21 (76.81)^{h}	59.21 (73.79)^{ij}
4	ICSB 444	59.21 (73.39)^{hi}	63.43 (79.99)^{h}	56.99 (70.32)^{ij}
5	ICSB 445	54.98 (67.07)^{f}	50.85 (60.13)^{efg}	50.85 (60.13)^{fghij}
6	ICSV 700	26.07 (19.31)^{a}	39.15 (39.85)^{bc}	28.07 (22.15)^{bc}
7	ICSV 705	30.29 (25.44)^{b}	35.22 (33.25)^{b}	30.99 (26.52)^{bcd}
8	ICSV 12001	43.08 (46.65)^{d}	41.18 (43.36)^{bcd}	39.15 (39.85)^{cdef}
9	ICSV 12002	41.04 (43.10)^{cd}	46.92 (53.35)^{cdef}	46.92 (53.35)^{fghi}
10	ICSV 12003	42.99 (46.49)^{de}	48.84 (56.68)^{defg}	41.15 (43.31)^{defg}
11	ICSV 12004	44.91 (49.84)^{def}	46.92 (53.35)^{cdef}	43.07 (46.64)^{efgh}
12	ICSV 25019	48.84 (56.68)^{def}	50.85 (60.13)^{efg}	48.84 (56.68)^{fghij}
13	ICSV 25022	46.92 (53.34)^{defg}	50.76 (59.99)^{efg}	45.00 (49.99)^{fgh}
14	ICSV 25026	48.93 (56.83)^{defg}	45.00 (49.99)^{cde}	39.15 (39.85)^{cdef}
15	ICSV 93046	50.76 (59.99)^{defgh}	46.92 (53.35)^{cdef}	41.15 (43.31)^{defg}
16	IS 2123	28.78 (23.17)^{b}	41.15 (43.31)^{bcd}	30.99 (26.52)^{bcd}
17	IS 2146	23.85 (16.35)^{ab}	37.22 (36.59)^{b}	26.07 (19.31)^{b}
18	IS 18551	18.43 (9.99)^{a}	21.14 (13.01)^{a}	12.29 (4.53)^{a}
19	IS 40615	30.99 (26.52)^{bc}	39.15 (39.85)^{bc}	33.00 (29.66)^{bcde}
20	SWARNA	63.43 (79.99)^{i}	81.14 (97.63)^{i}	72.29 (90.74)^{k}
	S. Em. $\pm$	3.56	3.13	3.91
	C. D. (5%)	10.25	8.95	11.18

Figures in parentheses are retransformed per cent values; figures with similar letters are statistically at par

minimum was recorded in the resistant check IS 18551 (18.43%). The mean per cent oviposition by shoot fly on the 20 genotypes evaluated ranged from 23.85 (IS 2146) to 59.21 (ICSB 444). Among the test entries, IS 2146 and ICSV 700 were better as they happened to be less preferred for egg laying and were at par with resistant check IS 18551. The genotype ICSB 444 had maximum oviposition followed by ICSB 435, ICSB 445, ICSB 413 and ICSB 411, which had significantly more oviposition than the remaining genotypes. IS 2123, ICSV 705 and IS 40615 were identified as the less susceptible genotypes among the rest of the genotypes. Genotypes, ICSV 12001, ICSV 12002, ICSV 12003, ICSV 12004 and ICSV 25019 were found significantly better over SWARNA. Non-preference for egg-laying is considered to be a primary mechanism of resistance to shoot fly in sorghum (Blum, 1967; Singh and Narayana, 1978; Maiti and Bidinger, 1979; Singh and Jotwani, 1980; Taneja and Leuschner, 1985).

(b) 21st day after germination. The data recorded on 21st day after germination revealed that the maximum oviposition was observed in the susceptible check SWARNA (81.14%), while the minimum was recorded in the resistant check IS 18551 (21.14%). Among the test entries, ICSV 705 and IS 2146 were less preferred for oviposition. The genotype ICSB 444 had significantly more oviposition followed by ICSB 435 and ICSB 411 indicating its susceptibility towards shoot fly infestation.

Dead hearts at 28th day after germination. The data on dead heart formation revealed that the maximum percentage of dead hearts was recorded in the susceptible check SWARNA (72.29); whereas, the minimum was recorded in the resistant check IS 18551 (12.29). The dead heart formation in all the tested genotypes was significantly lower than the susceptible check (Table 1). Damage to sorghum in terms of dead heart percentage ranged from 26.07 (IS 2146) to 59.21 (ICSB 435). Physico-chemical traits such as leaf glossiness, trichome density and plumule and leaf sheath pigmentation were found to be associated with resistance, and chlorophyll content, leaf surface wetness, seedling vigor, and waxy bloom with susceptibility to shoot fly and explained 88.5 per cent of the total variation in dead hearts. Leaf glossiness of ICSV 705, ICSV 700, was comparable to the resistant check, IS 18551, while susceptible check Swarna was non-glossy and non-trichomed. (Dhillon *et al.,* 2005)

Screening of genotypes for shoot bug resistance. The relative incidence of the Shoot bug (*Peregrinus maidis* Ashmead) expressed as numbers of shoot bugs per plant (both nymph as well as adult). The results of screening of sorghum genotypes against shoot bug have been furnished in the Table 2. The shoot bug incidence per plant at 45 DAE ranged from 1.40 (ICSV 705) to 11.87 (ICSB 444). The remaining genotypes had a population range of shoot bug from 1.80 (IS 40615) to 10.40 (IS 2123). Sorghum lines ICSV 705, IS 40615 and ICSV 700 harboured less than 2 shoot bugs per plant, which reasonably indicated their less preference by shoot bug.

Table 2. Relative population of shoot-bug on different sorghum genotypes during *kharif,* 2013

S.No.	Sorghum Entries	Mean/ plant
1	ICSB 411	9.67
2	ICSB 413	9.40
3	ICSB 435	9.60
4	ICSB 444	11.87
5	ICSB 445	9.27
6	ICSV 700	1.93
7	ICSV 705	1.40
8	ICSV 12001	5.93
9	ICSV 12002	5.60
10	ICSV 12003	7.60
11	ICSV 12004	7.33
12	ICSV 25019	6.40
13	ICSV 25022	7.07
14	ICSV 25026	6.80
15	ICSV 93046	6.93
16	IS 2123	10.40
17	IS 2146	7.40
18	IS 18551	5.07
19	IS 40615	1.80
20	SWARNA	9.27
	S. Em. $\pm$	0.29
	C. D. (5%)	0.85

REFERENCES

Blum, A. 1967. Varietal resistance of sorghum to the sorghum shoots fly (*Atherigona soccata*). *Crop Science,* **7:** 461–462.

Dhillon, M.K., Sharma, H.C., Ram Singh and Naresh, J.S. 2005. Mechanism of resistance to shoot fly, *Atherigona soccata* (Rondani) in sorghum. *Euphytica,* **44**: 301-312.

Jotwani, M. G. and Srivastava, K. P. 1970. Studies on sorghum lines resistant against shoot fly (Atherigona soccata, Rondani**).** *Indian Journal of Entomology,* **32**:1-3.

Jotwani, M.G., Young, W.R., and Teetes, G.L. 1980. Elements of integrated control of sorghum pests. FAO Plant Production and Protection Paper. Rome, Italy: Food and Agriculture Organization of the United Nations, PP 159**.**

Maiti, R. K. and Bidinger, F. R. 1979. A simple approach to the identification of shoot fly tolerance in sorghum. *Indian Journal of Plant Protection,* **7:** 135-140.

Sharma, H.C. 1993. Host Plant resistance to insects in sorghum and its role in integrated pest management**.** *Crop Protection,* **12:** 11-34.

Singh, S. P. and Jotwani, M. G. 1980. Mechanisms of resistance in sorghum to shoot fly. Role of morphological characters of seedlings. *Indian Journal of Entomology,* **42**: 806-808.

Singh, R. and Narayana, K. L. 1978. Influence of different varieties of sorghum on the biology of sorghum shoot fly. *Indian Journal of Agricultural Sciences,* **48:** 8–12.

Subbarayudu, B., Indira, S. and Rana, B.S. 2002. Effect of integrated pest management modules on the incidence of sorghum shoot fly. *Journal of Research Acharya N.G.Ranga Agricultural University*, **30**: 22-29.

Subbarayudu, B. and Indira, S., 2007. Integrated pest management for the shoot fly (*Atherigona soccata*) in sorghum in Andhra Pradesh. *Indian Journal of Agricultural Sciences,* **77:**51-54.

Taneja, S. L. and Leuschner, K. 1985. Resistance screening and mechanisms of resistance in sorghum to shoot fly. In: Proceedings of the International Sorghum Entomology Workshop, 15–21 July,1984, Texas A&M University, College Station, Texas, USA, pp. 115–129. International Crops Research Institute for the Semi-Arid Tropics, Patancheru 502324, Andhra Pradesh, India.