RESEARCH ARTICLE

SCREENING OF DIFFERENT ENTRIES AGAINST SHOOT FLIES AND STEM BORER TOLERANCE IN LARGE SCALE VARIETAL TRIAL OF GRAIN SORGHUM

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Abstract: Sorghum (*Sorghum bicolor* L.) is one of the main staples for the world's poorest and most food-secure people commonly known as *jowar* in the Indian sub-continent, it grows well in both summer and winter, and is thus both a *rabi* and *kharif* crop. In this experiment, 21 entries including two checks were evaluated for pest resistance at three different centre/locations of Gujarat *viz*., Dediapada, Deesa and Surat. In pooled analysis, shoot fly dead heart per cent at 14 DAE over three location, resistant check IS 18551 (5.56%) was recorded significantly lowest damaged. The shoot fly dead heart per cent at 28 DAE was found significantly lower in resistant check is 18551 (14.75) whereas, for stem borer damaged per cent at 45 DAE over three location, significantly lowest damaged was found in resistant check. Considering performance at locations, the entry SR 2879 gave significantly lowest damaged by stem borer.

Keywords: Deadheart, Screening, Shoot fly, Sorghum, *Sorghum bicolor*, Stem borer

INTRODUCTION

Sorghum bicolor (L.) Moench, the grain sorghum, ranks fifth in acreage and production among the world's major cereal crops, following wheat, rice, corn, and barley (Young and Teetes, 1977). It is grown worldwide and is one of the major cereal crops in India, with an area of 16 million ha and a total production of 11 million tonnes (Gahukar and Jotwani, 1980). Sorghum is one of the main staples for the world's poorest and most food-insecure people. Sorghum is the third largest crop to be grown in India after wheat and rice. More commonly known as jowar in the Indian sub-continent, it grows well in both summer and winter, and is thus both a *rabi* and *kharif* crop. 75% of the cultivated area is devoted to the production of sorghum. Maharashtra, Karnataka, Andhra Pradesh and Madhya Pradesh are some of the regions where sorghum is grown on a massive scale. The crop is genetically suited to hot and dry agroecologies where it is difficult to grow other food grains. These are also areas subject to frequent drought.

Grain yields on farmers' fields in Asia and Africa are generally low (500−800 kg ha-1) mainly due to insect pest damage. Nearly 150 insect species have been reported as pests on sorghum (Sharma, 1993) of which, sorghum shoot fly (*Atherigona soccata*) and stem borers (*Chilo partellus, Busseola fusca, Eldana saccharina* and *Diatraea* spp.) and others are the major pests worldwide. Other insects reported to be damaging sorghum are of regional/local importance. Annual losses due to insect pests differ in magnitude on a regional basis. They have been estimated to be $1,089 million in the semi-arid tropics (SAT), $250 million in United States, and $80 million in Australia (ICRISAT 1992). In India, nearly 32% of sorghum crop is lost due to insect pests (Borad and Mittal 1983). Shoot fly (*Atherigona soccata* Rondani) is an important pest of sorghum in Asia, Mediterranean Europe, and Africa, but is absent in the Americas and Australia. It attacks the sorghum from 1 to 4 weeks after seedling emergence. White, elongated, cigar-shaped eggs are laid singly on the under surface of the leaves parallel to the midrib. The larva after hatching crawls along the leaf sheath and moves upward to reach the plant whorl. From there it moves downwards between the fifth and sixth leaf till it reaches the growing point, and cuts around it, causing drying of the central leaf and the typical "deadheart" symptom. The shoot fly completes its life cycle (from egg to adult) within 17 to 21 days (Kundu and Kishore, 1970). The fly population varies across seasons and years, depending upon environmental factors and cropping systems. The first report on sorghum varieties resistant to shoot fly was given by Ponnaiya (1951 a), who screened 212 genotypes and found 15 less damaged. Jowar stem borer, also known as the spotted stem borer. It is a major pest of sorghum in India, Pakistan, and East Africa, and also occurs in other areas, including Malawi, Botswana and South Africa, and southeast Asia. Young larvae generally feed initially in leaf whorls of growing plants, producing characteristic repetitive patterns of small holes and "window-paning" where they have eaten through or partly through the rolled leaves. Later they tunnel into the stems and may kill the central leaves and growing point, producing "deadhearts," a symptom that may also result from attack by the sorghum shoot fly,

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Atherigona soccata Rondani. Deadheart formation is the most important criterion for differentiating degrees of resistance, and is directly related to loss in grain yield. Considering the economic losses in this present investigation attempts were therefore made to ascertain the spectrum of above pests in sorghum crop.

MATERIAL AND METHOD

Experimental details

1	State Trial No.	**LSVT**
2	Name of Trial	Screening for shoot fly and stem borer tolerance entry in Large scale varietal trial of grain sorghum
	Objective	To find out the promising resistant source for shoot fly and stems borer
3	Location	Surat-II, Deesa-V and Dediapada-II
4	Year of commencement	*Kharif* 2014
5	**Technical information**	
a	Treatment	21
b	Design	RBD
c	Replication	(3) Three
d	Plot size in m	2.00 x 0.90
e	Spacing cm	45 x 15
f	Fertilizer NPK kg/ha	80:40:00
g	Date of sowing	16/07/2014
h	Previous crop	Sun hemp

The observation will be recorded as per the standard methodology for all shoot fly and stem borer. The observations on shoot fly dead heart incidence were recorded at 14 and 28 days after germination. Stem borer dead heart infestations was recorded at 45 days after germination. The shoot fly and stem borer dead heart per cent will be calculate by counting total plant and dead heart plant in test entries as per the standard methodology given by Indian Institute of Millet Research (IIMR), Hyderabad.

RESULT AND DISCUSSION

In large scale varietal trial (LSVT), 21 entries including two checks were evaluated for pest resistance at three different centre/locations of Gujarat *viz.,* Dediapada, Deesa and Surat. In pooled analysis of shoot fly dead heart per cent at 14 DAE over three location, resistant check IS 18551 (5.56%) was recorded significantly lowest damaged and at par with SR 2879 (6.98%), SR 2917 (8.86%) and SR 2823 (9.45%) (Table: 1). The shoot fly dead heart per cent at 28 DAE was found significantly lower in resistant check IS 18551 (14.75) and it was at par with genotype SR 2879 (17.74%) (Table: 2). For stem borer, damaged per cent at 45 DAE over three location, significantly lowest damaged was found in resistant check but it was at par with genotype SR 2879 (12.92%). Considering performance at locations, the entry SR 2879 gave significantly lowest damaged by stem borer and comparable with resistant check IS 18551 (Table: 3).

Overall losses may be of the order of 5 to 10% in many sorghum growing areas, especially where early attack causes loss of stand and avoidable grain losses on the hybrid sorghum CSH 1 and on the variety Swarna have been estimated in India to be about 55 to 83% (Jotwani *et al*., 1971 and Jotwani 1972). Kumar and Asino, 1994 who studied the difference between susceptible and resistant genotypes in terms of stem damage and found that susceptible genotypes were distinctly more damaged than the resistant ones in Maize crop. 22 genotypes were tested for resistance to the damage caused by the sorghum stem borer *Chilo partellus* (Swinhoe) under infested field condition and found that genotype SSV-7073 was the most resistant against stem borer in the Dharwad region of Northern Karnataka (Marulasiddesha *et al*.,

2007). Saxena (1990) reported the genotype IS-18363 to be highly susceptible, IS-18463 and IS-2146 to be moderately susceptible, IS-4660 and IS-2205 to be moderately resistant, and IS-1044 to be highly resistant.

Table 1. Statement showing the shoot fly incidence at 14 DAE in lines of sorghum

Sr. No.	Entry	Dediapada	Deesa	Surat	Pooled
		SFDH (%)	SFDH (%)	SFDH (%)	SFDH (%)
1	SR 1904	15.89 (8.19)	33.15(30.00)	20.15 (12.16)	23.06 (16.78)
2	SR 2706	16.82 (8.77)	31.22(27.21)	21.87 (14.14)	23.30 (16.71)
3	SR 2805	10.93 (3.84)	26.92(21.58)	17.24 (8.94)	18.36 (11.45)
4	SR 2812	19.55 11.55)	29.19(24.03)	23.63 (16.37)	24.14 (17.32)
5	SR 2819	12.71 (5.59)	25.39(18.57)	17.98 (9.83)	18.70 (11.33)
6	SR 2823	11.32 (3.95)	23.07(16.41)	15.74 (7.99)	16.31 (9.45)
7	SR 2847	21.56 14.11)	37.35(37.10)	26.03 (19.57)	28.31 (23.59)
8	SR 2859	15.26 (7.28)	31.07(27.56)	20.92 (12.90)	22.42 (15.91)
9	SR 2860	13.72 (5.96)	23.91(16.76)	18.45 (10.51)	18.69 (11.08)
10	SR 2872	14.99 (7.22)	32.15(28.89)	21.51 (13.53)	22.88 (16.55)
11	SR 2873	19.19 11.42)	30.15(26.84)	20.21 (13.29)	23.18 (17.18)
12	SR 2879	7.20 (2.34)	18.47(10.42)	16.40 (8.18)	14.03 (6.98)
13	SR 2897	13.99 (6.30)	23.64(16.46)	16.41 (8.21)	18.01 (10.32)
14	SR 2914	16.72 (8.58)	26.54(20.39)	20.84 (12.73)	21.37 (13.90)
15	SR 2917	5.49 (2.50)	23.45(16.60)	15.42 (7.48)	14.79 (8.86)
16	SPV 1700	14.22 (6.23)	27.29(21.79)	19.04 (10.70)	20.18 (12.91)
17	GJ 38	16.87 (8.57)	21.33(13.68)	17.32 (9.09)	18.51 (10.44)
18	GJ 42	21.45 14.38)	31.00(27.94)	24.96 (18.37)	25.81 (20.23)
19	CSV -15	16.83 (9.39)	32.55(29.56)	17.88 (9.49)	22.42 (16.15)
20	IS 18551 (RC)	9.86 (3.03)	17.85 (9.97)	10.92 (3.68)	12.88 (5.56)
21	Swarna (RC)	23.26(16.08)	35.38(33.64)	22.43 (15.63)	27.02 (21.78)
	S.Em.	2.80	4.11	2.58	1.74
	C.D.@5%	8.01	NS	7.37	4.82
	Y x T				
	S.Em.	-	-	-	3.23
	C.D.@5%	-	-	-	NS
	C.V.%	32.09	25.72	23.12	27.06

* Figure in parenthesis is original values while those outside are arc sign transformed value.

Table 2. Statement showing the shoot fly incidence at 28 DAE in lines of sorghum

Sr. No.	Entry	Dediapada	Deesa	Surat	Pooled
		SFDH (%)	SFDH (%)	SFDH (%)	SFDH (%)
1	SR 1904	24.81(35.09)	51.10(60.56)	36.28 (17.88)	37.40 (37.84)

2	SR 2706	25.25(39.18)	45.92(51.62)	38.69 (18.37)	36.62 (36.39)
3	SR 2805	21.20(33.18)	44.60(49.01)	35.13 (13.15)	33.65 (31.78)
4	SR 2812	27.42(40.85)	40.42(42.11)	39.68 (21.39)	35.84 (34.78)
5	SR 2819	22.81(32.95)	40.42(42.12)	35.00 (15.27)	32.75 (30.12)
6	SR 2823	21.45(34.05)	41.64(44.26)	35.61 (13.40)	32.90 (30.57)
7	SR 2847	29.15(45.58)	52.88(63.12)	42.43 (24.02)	41.48 (44.24)
8	SR 2859	24.20(39.05)	47.46(53.67)	38.65 (16.96)	36.77 (36.56)
9	SR 2860	22.77(39.09)	39.90(41.20)	38.65 (15.07)	33.77 (31.79)
10	SR 2872	23.17(40.42)	48.42(55.74)	39.45 (15.74)	37.01 (37.30)
11	SR 2873	26.48(37.22)	46.48(52.28)	37.42 (20.13)	36.79 (36.54)
12	SR 2879	20.10(16.83)	29.63(24.53)	24.17 (11.87)	24.63 (17.74)
13	SR 2897	23.08(31.84)	39.40(40.38)	34.33 (15.55)	32.27 (29.26)
14	SR 2914	24.86(35.62)	37.97(38.10)	36.63 (17.83)	33.15 (30.51)
15	SR 2917	20.37(32.04)	41.57(44.22)	34.40 (12.34)	32.11 (29.53)
16	SPV 1700	23.11(33.83)	41.63(44.64)	35.55 (15.52)	33.43 (31.33)
17	GJ 38	24.95(32.53)	33.62(30.81)	34.76 (17.87)	31.11 (27.07)
18	GJ 42	29.08(41.83)	41.81(45.00)	40.25 (24.06)	37.05 (36.97)
19	CSV -15	24.78(33.49)	47.16(53.70)	35.33 (17.96)	35.76 (35.05)
20	IS 18551 (RC)	20.28 (7.39)	29.67(24.79)	15.91 (12.06)	21.89 (14.75)
21	Swarna (RC)	29.47(40.57)	46.93(53.38)	39.46 (24.48)	38.62 (39.48)
S.Em.		1.92	4.49	1.99	1.80
C.D.@5%		5.49	12.84	5.67	4.99
Y X T					
S.Em.		-	-	-	3.05
C.D.@5%		-	-	-	NS
C.V.%		13.74	18.39	9.66	15.49

* Figure in parenthesis is original values while those outside are arc sign transformed value.

Table 3. Statement showing the stem borer incidence at 45 DAE in lines of sorghum

Sr. No.	**Entry**	**Dediapada**	**Deesa**	**Surat**	**Pooled**
		SBDH (%)	**SBDH (%)**	**SBDH (%)**	**SBDH (%)**
1	SR 1904	22.90(30.50)	44.03(48.33)	33.47 (15.46)	33.47 (31.43)
2	SR 2706	23.40(34.17)	40.23(41.85)	35.70 (15.97)	33.11 (30.66)
3	SR 2805	19.13(28.33)	37.76(38.04)	32.12 (10.82)	29.67 (25.73)
4	SR 2812	25.64(35.95)	36.12(34.88)	36.78 (18.93)	32.85 (29.92)
5	SR 2819	20.75(28.33)	34.82(32.70)	32.12 (12.85)	29.23 (24.63)
6	SR 2823	19.36(28.84)	34.92(33.12)	32.37 (11.04)	28.88 (24.33)
7	SR 2847	27.41(40.38)	46.53(52.71)	39.39 (21.54)	37.78 (38.21)

8	SR 2859	22.27(33.82)	40.97(43.22)	35.54 (14.54)	32.92 (30.53)
9	SR 2860	20.86(33.38)	34.04(31.42)	35.22 (12.79)	30.04 (25.86)
10	SR 2872	21.40(35.04)	42.07(45.00)	36.27 (13.61)	33.25 (31.22)
11	SR 2873	24.84(32.43)	40.27(42.11)	34.46 (17.95)	33.19 (30.83)
12	SR 2879	17.86(11.46)	24.92(17.82)	19.66 (9.49)	20.81 (12.92)
13	SR 2897	21.15(27.12)	33.62(30.81)	31.36 (13.24)	28.71 (23.72)
14	SR 2914	23.06(31.04)	33.64(31.02)	33.84 (15.52)	30.18 (25.86)
15	SR 2917	18.05(27.13)	34.94(33.17)	31.29 (9.88)	28.10 (23.39)
16	SPV 1700	21.20(29.20)	36.15(35.50)	32.69 (13.19)	30.01 (25.97)
17	GJ 38	23.15(27.84)	29.16(23.96)	31.83 (15.55)	28.05 (22.45)
18	GJ 42	27.36(37.14)	37.61(38.17)	37.47 (21.64)	34.15 (32.32)
19	CSV -15	23.06(28.69)	41.51(44.05)	32.36 (15.82)	32.31 (29.52)
20	IS 18551 (RC)	18.21(7.39)	23.46(15.90)	15.27 (9.80)	18.98 (11.03)
21	Swarna (RC)	28.01(35.58)	36.12(35.27)	36.45 (22.38)	33.53 (31.08)
	S.Em.	2.02	4.06	2.08	1.68
	C.D.@5%	5.78	11.61	5.94	4.65
	Y X T				
	S.Em.	-	-	-	2.88
	C.D.@5%	-	-	-	NS
	C.V.%	15.68	19.37	11.03	16.40

* Figure in parenthesis is original values while those outside are arc sign transformed value.

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