

Screening of Sorghum Germplasm against Earhead Bugs with Morphological Characters

Dalip Kumar¹, SP Singh¹, Ramesh Kumar² and S Ranga³

¹ Department of Entomology, CCS HAU, Hisar-125004, India

² PPVFTA, NASC Complex, IARI Campus, New Delhi-110012, India

³ Germplasm Exchange Unit, NBPGR, New Delhi-110012, India

One hundred and fifty sorghum genotypes collected from different sources were screened for earhead bug infestation during 2001-2002 and 2002-2003 on the basis of their population buildup in panicle. The screened sorghum genotypes were then segregated into 5 groups on the basis of different morphological plant characteristics imparting resistance to sorghum panicle and it was found that grain weight, length and breadth of panicle was inter related with mean number of bugs present on panicle. The lowest test weight was observed in RSU 158 (7.80 g) and maximum in AKENT 16 (43.58 g) and showed positive correlation ($r = 0.290$) with earhead bug population. Least panicle length was observed in genotype SRF 2102 (10.34 cm) and it was maximum in early SDSL 92131 (14.90 cm) and shown positive correlation ($r = 0.123$) with pest incidence and least panicle breadth was observed in genotypes ISCU 708 (2.5 cm) and maximum in SDSL 92131 (22.5 cm) and shown positive correlation ($r = 0.465$) with pest build up. Thus, morphological characters could be one of the tool of selection while selecting sorghum genotypes for earhead bug resistance for improvement programme which need further confirmation to understand the resistance in sorghum against bugs.

Key Words: Sorghum, Earhead bug resistance, Germplasm screening

Introduction

The genus *Sorghum* belongs to the family Poaceae and includes both cultivated and wild species for grain, fodder, feed, syrup, commercial and other purposes. All the cultivated forms are grouped under single species *Sorghum bicolor* (L.) Moench. The crop originated in Eastern Africa, is presently grown in all six continents extending about 40° on either side of the equator.

Africa and Asia, which produce one third of the grain crop, insect, mites and other pests have taken their toll. Insect-pests continue to compete with human beings for the sorghum crop, and knowledge of both old and new pests has accumulated at a faster rate in the recent years as the crop has received increasing attention (Young and Teetes, 1977). In these areas the use of insecticides has generally not been found economically feasible, because of insecticides being costly for farmers with limited resources. There are over 150 insect species known to damage sorghum from germination to crop harvest (Seshu Reddy and Davies, 1979). *Calocoris angustatus* is most important species in India and *Eurystylus immaculatus* in West Africa. Damage results from bugs sucking juices from the immature developing grains, resulting in shrivelling of grain thereby affecting both yield and quality (Wood and Stark, 1972).

Compared to temperate zones, insect problem in the tropics are generally more severe and this is particularly

so in the case of sorghum, the world's fourth most important cereal. Recommendations for integrated pest management (IPM) in sorghum in different parts of the world involve cultural practices, natural enemies, host-plant resistance (HPR) and management through insecticides. The statement of Wilson and Huffakar (1976) reflects much of a paradigm upon which IPM is built "biological control, together with plant resistance are the core around which pest control in crops and forests should be built". In this context, HPR assume a central role in our efforts to increase production and productivity of sorghum.

HPR does not involve any direct costs to the farmers, it is environment friendly, and is compatible with other components of pest management. Insect resistant cultivars should yield more than the susceptible cultivars in the presence of pests (Doggett *et al.*, 1970).

Materials and Methods

For screening, one hundred and fifty sorghum genotypes having different plant characters and maturity period were procured from different sources and the trials were laid in 2001-2002 and 2002-2003 *kharif* season in forage research area with row to row and plant to plant spacings of 50 cm and 10-12 cm, respectively in Randomized Block Design in three replications and a plot size of 3 row length. Recommended agronomic practices were followed to raise the healthy crop except plant protection.

All these selected sorghum genotypes including IS 18551, DJ 6514 and IS 2205 as resistant check, while ICSV 1, CSH 5 and CSH 9 as susceptible checks were grown for screening against earhead bugs. For recording the incidence of the head bugs, fifteen plants, *i.e.*, 5 plants per replication from each genotype were selected. At initiation of 50 per cent flowering, number of head bugs present on each panicle were counted from 15 panicles at weekly intervals till the harvest of the crop.

For investigations on morphological characters associated with population buildup, one hundred and fifty sorghum genotypes screened and clustered into five groups on the basis of infestation by sorghum earhead bugs. Morphological characters observations were recorded at maturity and for recording the morphological parameters, in each genotype 5 plants were selected randomly per repeat. The size, *i.e.*, length and breadth of earhead of each individual sorghum genotype was measured with the help of half metre rod. To get the test weight of each sorghum genotype, the 1000-grains were counted manually and then their weight was recorded on electronic balance (AFCOSET FX-300: The Bombay Burmah Trading Corporation Ltd.).

Results and Discussion

Morphological characters, *viz.*, 1000-grain weight (test weight), length and breadth of panicles were categorized into different groups. The results on these parameters are presented below:

1000-Grain Weight (Test weight)

One hundred and fifty sorghum genotypes were categorized into 5 different groups on the basis of 1000-grain weight (Table 1). Category-1 comprised of only 2 sorghum entries, namely, RSU 158 and AKENT 14 and in these two sorghum genotypes mean grain weight was 7.80 g and 8.58 g, respectively. In category-II, there were forty sorghum genotypes, in which the mean grain weight varied from 12.10 g to 19.80 g with an overall mean of 17.07 g. The mean grain weight was maximum (19.80 g) in genotype BT 623 and the minimum (12.10) in genotype SPV 1567. Category-III comprised maximum (86) number of sorghum genotypes and these genotypes had average grain weight of 23.96 g and the mean number of bugs/ 5 panicles was 12.24. In this category least (20.11 g) test weight was recorded in genotype SRF 203 and maximum (29.68 g) 1000-grain weight was recorded in sorghum genotype RSE 9744. In Category-IV average 1000-grain weight was 34.01 g, and least (30.23 g) mean

Table 1. Sorghum genotypes categorized on the basis of 1000-grain weight

S. No.	Sorghum genotype	Grain weight* (g)	Mean no. of earhead* bugs/ 5 panicles
0.0-10.0 g – Grain weight			
1.	RSU 158	7.80	1.0
2.	AKENT 14	8.58	9.0
	Average	8.09	5.0
10.1-20.0 g – Grain weight			
3.	SPV 1567	12.10	12.3
4.	SU 699	12.92	1.2
5.	DSFR3	13.16	8.5
6.	DJ 6514	13.36	6.0
7.	DSFR 2	13.62	11.6
8.	SRF 2102	14.00	12.8
9.	SPV 1581	14.04	16.3
10.	RSU 202	14.71	5.3
11.	SPV 1576	15.08	8.4
12.	ICSV 711	15.88	5.2
13.	RSE 9728	16.23	23.1
14.	SPV 1570	16.26	9.3
15.	SPV 1579	16.33	15.4
16.	ICSV 714	16.72	5.4
17.	168-II-112	16.86	4.0
18.	GD 65174-1	17.08	0.0
19.	ICSV1	17.22	23.0
20.	IS 18551	17.30	3.7
21.	SPV 1577	17.34	11.1
22.	SR 770-2	17.68	23.2
23.	SPV 1568	17.72	19.1
24.	AKENT 8-3	17.80	3.8
25.	IS 2205	17.84	8.2
26.	SPV 1580	17.85	0.0
27.	CSH 7	17.89	26.9
28.	SR 2460-1	18.12	15.8
29.	GD 65195	18.26	7.6
30.	GMSB 69	18.43	8.1
31.	SRF 1665	18.68	15.5
32.	SR 1048-1	18.76	15.1
33.	CSH 5	18.83	23.7
34.	SU 700	19.02	11.4
35.	SPH 1355	19.18	19.8
36.	SPH 1280	19.20	8.4
37.	SPV 1574	19.44	6.7
38.	27 B	19.52	23.9
39.	CH 3	19.53	15.2
40.	AKENT 10-1	19.56	23.1
41.	SPH 1354	19.72	19.0
42.	BT X 623	19.80	11.8
	Average	17.07	10.42
20.1 – 30.0 g – Grain weight			
43.	SRF 203	20.11	19.0
44.	CSV 457	20.12	11.6
45.	AKMS 14-A	20.34	12.5
46.	DSFR5	20.52	25.6
47.	SPV 1573	20.56	0.0
48.	ICSV 708	20.76	17.2
49.	CSH 14	20.76	17.6
50.	SPV 1565	20.90	8.5
51.	CSH 17	20.94	19.5
52.	SFCR 1047	21.14	4.4
53.	RSV 204	21.16	15.1
54.	SR 2458	21.20	29.0
55.	SPH 1374	21.36	27.1

S. No.	Sorghum genotype	Grain weight* (g)	Mean no. of earhead* bugs/5 panicles	S. No.	Sorghum genotype	Grain weight* (g)	Mean no. of earhead* bugs/ 5 panicles
56.	GMSB 4	21.45	7.9	120.	296-A	28.16	26.5
57.	SPV 1571	21.46	19.9	121.	SFCR 1111	28.28	30.9
58.	SPH 1375	21.48	4.6	122.	SPH 1335	28.30	16.0
59.	GMSB 76	21.50	4.1	123.	463-A	28.76	3.9
60.	CSH 16	21.57	15.9	124.	SU 45	28.98	12.5
61.	CSV 15	21.71	16.3	125.	SPH 1352	29.16	6.1
62.	SPV 1575	21.72	16.5	126.	SRF 2549	29.43	25.7
63.	GMSB 5	21.76	8.2	127.	SU 52	29.58	12.0
64.	296 B	21.77	15.8	128.	RSE 9744	29.68	24.1
65.	SPV 1578	21.86	21.8		Average	23.96	12.24
66.	SPH 1350	21.88	8.6		30.1-40.0 g – Grain weight		
67.	GMSB 15	22.06	8.5	129.	RSE 9727	30.23	12.2
68.	CSH 9	22.28	24.0	130.	SPH 1372	30.32	12.7
69.	GD 65019	22.3	15.4	131.	SR 2460	30.34	12.1
70.	ICSV 700	22.42	3.9	132.	GD 65040	30.52	11.4
71.	168 UU 1006	22.44	4.4	133.	SR 2704	32.38	12.4
72.	SU 663	22.47	15.6	134.	AKENT 7-1-1	32.48	5.9
73.	ICSV 112	22.48	8.2	135.	GD 65004	32.58	15.2
74.	SR 1436	22.53	16.1	136.	SR 2459	32.90	26.7
75.	SFCR 1143	22.64	22.8	137.	ICSV 717	33.62	17.7
76.	IS 2312	22.79	22.4	138.	GD 65022	34.16	11.3
77.	200-1011	22.80	17.6	139.	ICSR 93034	34.58	17.5
78.	SDSL 92131	22.84	0.0	140.	SPH 1349	35.40	8.6
79.	SPV 1569	22.92	12.3	141.	S-35	35.48	15.5
80.	RSE 9715	22.92	3.8	142.	GD65006	36.64	15.3
81.	SR 833-2-3	22.96	19.2	143.	SPH 1376	37.16	11.8
82.	CSV 16	22.98	13.6	144.	SPH 1341	37.18	20.1
83.	200 IU 1005	22.98	19.1	145.	SPH 1347	37.64	20.1
84.	SPH 1353	23.03	18.0	146.	SPH 1329	38.70	13.8
85.	IS 22893	23.06	3.8		Average	34.01	14.46
86.	200 UU 1011	23.26	15.4		40.1-50.0 g – Grain weight		
87.	ICSV 745	23.44	9.1	147.	Amarnath	40.06	15.6
88.	IS 2269	23.48	4.0	148.	NT 52	40.72	17.1
89.	168-II-108	23.66	7.9	149.	Swati	43.26	17.0
90.	SPH 1183	23.78	4.1	150.	AKENT 16	43.58	8.2
91.	SFCR 1070	24.12	22.7		Average	41.90	14.47
92.	SPV 1562	24.18	16.0		S.E. \pm	2.28	
93.	Khwang Pahawang	24.24	0.0		*Grain weight and mean number of earhead bugs/ 5 panicles are mean of 3 replications		
94.	IS 6566	24.27	8.1		grain weight was observed in genotype RSE 9727 and the maximum (38.70 g) 1000-grain weight was recorded in genotype SPH 1329 with mean numbers of bugs per 5 earheads in this category were 12.46 bugs/ 5 panicle. Category-V consisted of only four genotypes, <i>i.e.</i> , Amarnath, NT 52, Swati and AKENT 16 with mean 1000-grain weight 40.06, 40.72, 43.23 and 43.58 g, respectively and the average mean grain weight of 41.90 g and the mean number of bugs/ 5 panicles varied from 8.2 (AKENT 16) to 17.1 (NT 52). The correlation ($r = 0.290$) between mean number of bugs/ 5 panicles and 1000-grain weight was positive.		
95.	GSSV 312	24.34	7.5		Length of Panicle (cm)		
96.	SPH 1334	24.62	11.0		On the basis of panicle length (cm), one hundred and fifty sorghum genotypes were categorized into 5 groups with		
97.	IS 25596	24.82	0.0				
98.	ICSV 93046	24.98	7.5				
99.	168-IU-1021	25.02	13.9				
100.	168-II-122	25.07	7.8				
101.	SPV 1605	25.08	4.3				
102.	AKENT 10-2	25.24	4.4				
103.	SPV 1563	25.26	16.6				
104.	GMSB 131	25.44	8.0				
105.	IS 20016	25.66	0.0				
106.	IS 2123	25.74	7.7				
107.	IS 11119	25.74	7.6				
108.	RSU 283	25.82	3.8				
109.	IS 112	25.82	18.6				
110.	168 UU 1022	26.02	7.7				
111.	IS 1044	26.46	11.5				
112.	IS 4663	26.51	8.4				
113.	IS 2122	26.52	9.9				
114.	AKENT 15	26.56	3.8				
115.	ICSV 705	27.05	4.0				
116.	GD 65055	27.16	10.0				
117.	RSE 9741	27.18	6.5				
118.	SFCR 1105	27.48	23.1				
119.	RSE 9745	27.58	9.2				

length ranging from 0.0 to 10.0, 10.1 to 15.0, 15.1 to 20.0, 20.1 to 25.0 and 25.1 to 30.0 cm into group 1, 2, 3, 4 and 5, respectively (Table 2). In Category-I, *i.e.*, (0.0 to 10.0 cm length), no sorghum entry was included. While Category-II included twenty, Category-III included sixty two, Category-IV included fifty three and Category-V included fifteen sorghum genotypes (Table 2). In Category-II, the least (10.34 cm) panicle length was observed in genotype SRF 2102, it was maximum (14.90 cm) in entry SPV 1568.

In Category-III, genotypes AKENT 15, had the least (15.11 cm) panicle length and it was maximum (19.91 cm) in entry 168-II-108. In Category-IV, entry SPV 1580 had the least (20.10 cm) panicle length and it was maximum (24.88 cm) in genotype GD 65004. In Category-V, genotype 296-A had the smallest panicle length (25.22 cm) and entry SDSL 92131 had maximum (28.96 cm). The average panicle length in Category-I, II, III, IV and V was 13.63, 17.21, 22.11 and 27.06 cm with mean number of bugs/5 panicles was 10.26, 12.69, 13.21 and 11.87, respectively. Length of panicles showed a positive correlation ($r = 0.123$) with pest incidence.

Breadth of Panicle (cm)

One hundred and fifty sorghum genotypes were categorized on the basis of breadth of panicle into 5

Table 2 . Sorghum genotypes categorized on the basis of length of panicle

S. No.	Sorghum genotype	Panicle length* (cm)	Mean no. of earhead* bugs/ 5 panicles
0.0-10.0 cm – Panicle length			
NIL			
10.1 -15.0 cm - Panicle length			
1	SRF 2102	10.34	12.8
2	SRF 1665	12.00	15.5
3	SU 45	12.29	12.5
4	BT X 623	12.47	11.8
5	GSSV 312	12.56	7.5
6	ICSV 717	13.39	17.7
7	RSE 9715	13.67	3.8
8	DSFR2	13.72	11.6
9	AKENT 8-3	13.78	3.8
10	ICSV 708	13.85	17.2
11	RSU 158	13.92	1.0
12	AKMS 14-A	14.16	12.5
13	IS 2205	14.30	8.2
14	SR 2460-1	14.35	15.8
15	SPV 1605	14.36	4.3
16	SPV 1579	14.50	15.4
17	ICSV 714	14.50	5.4
18	RSU 202	14.77	5.3
19	IS 2269	14.84	4.0
20	SPV 1568	14.90	19.1
Average		13.63	10.26

S. No.	Sorghum genotype	Panicle length* (cm)	Mean no. of earhead* bugs/ 5 panicles
15.1-20.0 cm – Panicle length			
21	AKENT 15	15.11	3.8
22	200 IU 1005	15.33	19.1
23	SRF 2549	15.34	25.7
24	IS 2122	15.51	9.9
25	RSE 9727	15.53	12.2
26	AKENT 10-1	15.79	23.1
27	DSFR 5	15.83	25.6
28	SPV 1562	16.20	16.0
29	ICSV 705	16.33	4.0
30	IS 112	16.40	18.6
31	SU 700	16.67	11.4
32	SR 2458	16.76	29.0
33	GMSB 69	16.81	8.1
34	SRF 203	16.83	19.0
35	SPH 1183	16.70	4.1
36	SR 2460	17.11	12.1
37	SPV 1563	17.20	16.6
38	SPH 1352	17.33	6.1
39	DSFR-3	17.35	8.5
40	SR 770-2	17.36	23.2
41	SU 699	17.43	1.2
42	IS 18551	17.52	3.7
43	RSV 204	17.66	15.1
44	463-A	17.67	3.9
45	GMSB 76	17.69	4.1
46	CSV 457	17.77	11.6
47	SPH 1280	17.90	8.4
48	AKENT 10-2	18.00	4.4
49	ICSV 93046	18.10	7.5
50	SFCR 1047	18.24	4.4
51	SPV 1576	18.30	8.4
52	RSE 9744	18.33	24.1
53	GMSB 5	18.33	8.2
54	IS 22893	18.36	3.8
55	ICSV 700	18.39	3.9
56	IS 6566	18.48	8.1
57	CSH 9	18.50	24.0
58	SPH 1349	18.52	8.6
59	27 B	18.55	23.9
60	DJ 6514	18.60	6.0
61	CSV 16	18.65	13.6
62	SPH 1350	18.66	8.6
63	SR 1048-1	18.66	15.1
64	ICSV 745	18.70	9.1
65	SFCR 1143	18.72	22.8
66	CSH 14	18.73	17.6
67	ICSV 711	19.17	5.2
68	IS 2312	19.20	22.4
69	SR 1436	19.23	16.1
70	IS 11119	19.28	7.6
71	168 UU 1006	19.31	4.4
72	SPV 1571	19.40	19.9
73	CSH 17	19.47	19.5
74	GD 65055	19.47	10.0
75	200 UU 1011	19.47	15.4
76	CSV 15	19.60	16.3
77	RSE 9728	19.62	23.1
78	ICSV 112	19.63	8.2
79	CSH 7	19.66	26.9
80	AKENT 14	19.77	9.0
81	GMSB 15	19.80	8.5
82	168-II-108	19.91	7.9
Average		17.96	12.69

S. No.	Sorghum genotype	Panicle length* (cm)	Mean no. of earhead* bugs/ 5 panicles
20.1-25.0 cm – Panicle length			
83	SPV 1580	20.10	0.0
84	GD 65019	20.23	15.4
85	SR 833-2-3	20.33	19.2
86	SU 663	20.37	15.6
87	168-II-112	20.38	4.0
88	SPV 1569	20.40	12.3
89	GMSB 4	20.45	7.9
90	GD 65195	20.49	7.6
91	SPH 1375	20.50	4.6
92	SPH 1334	20.50	11.0
93	SFCR 1070	20.53	22.7
94	SPH 1329	20.66	13.8
95	168 IU 1021	20.69	13.9
96	RSE 9745	20.73	9.2
97	SPV 1574	20.80	6.7
98	SR 2704	20.81	12.4
99	GMSB 131	20.83	8.0
100	SPV 1567	20.90	12.3
101	SFCR 1105	20.93	23.1
102	SPV 1565	21.10	8.5
103	IS 4663	21.36	8.4
104	SU 52	21.47	12.0
105	SPH 1374	21.50	27.1
106	SFCR 1111	21.63	30.9
107	SPV 1581	21.66	16.3
108	SPH 1335	21.83	16.0
109	RSU 283	21.84	3.8
110	200-1011	21.90	17.6
111	SPV 1570	22.30	9.3
112	168 UU 1022	22.53	7.7
113	IS 2123	22.54	7.7
114	GD 65174-1	22.54	0.0
115	SPV 1575	22.60	16.5
116	IS 1044	22.70	11.5
117	168 II 122	22.73	7.8
118	SPV 1577	22.90	11.1
119	CH 3	23.12	15.2
120	SPH 1354	23.33	19.0
121	CSH 16	23.35	15.9
122	GD 65040	23.40	11.4
123	296-B	23.48	15.8
124	SPH 1355	23.50	19.8
125	SPH 1376	23.66	11.8
126	ICSR 93034	23.78	17.5
127	SPH 1353	23.83	18.0
128	SPV 1578	24.00	21.8
129.	S 35	24.13	15.5
130.	CSH 5	24.16	23.7
131.	SPV 1573	24.20	0.0
132.	SR 2459	24.32	26.7
133.	GD 65006	24.57	15.3
134.	AKENT 7-1-1	24.88	5.9
135.	GD 65004	24.88	15.2
	Average	22.11	13.21

25.1-30.0 cm – Panicle length

136.	296-A	25.22	26.5
137.	SPH 1347	25.50	20.1
138.	GD 65022	25.51	11.3
139.	Swati	25.91	17.0
140.	SPH 1341	26.5	20.1
141.	Amarnath	26.52	15.6
142.	SPH 1372	26.66	12.7
143.	NT 52	26.82	17.1

S. No.	Sorghum genotype	Panicle length* (cm)	Mean no. of earhead* bugs/ 5 panicles
144.	ICSV-1	27.16	23.0
145.	AKENT 16	27.55	8.2
146.	RSE 9741	28.13	6.5
147.	IS 25596	28.24	0.0
148.	Khawang Pahwang	28.39	0.0
149.	IS 20016	28.91	0.0
150.	SDSL 92131	28.96	0.0
	Average	27.06	11.87
	S.E. ±	1.42	

*Panicle length and mean number of earhead bugs / 5 panicles are mean of 3 replications

different categories (Table 3). Category-I included seventy six entries and the average breadth of these genotypes was 4.17 cm and mean number of bugs/ 5 panicles were 7.23 bugs. Least (2.5 cm) panicle breadth was observed in genotype ICSV 708 and maximum (5.0 cm) panicle breadth was observed in genotype SFCR 1047. In Category-II, a total of seventy sorghum genotypes were included and the least (5.1 cm) panicle breadth was observed in genotypes IS 2123, SPV 1578, CSH 17 and SFCR 1070 and maximum (9.6 cm) panicle breadth was observed in entry SPH 1329, having mean panicle breadth of 6.42 cm and the mean number of bugs/5 panicles was 13.85 bugs. In Category-III, only 2 genotypes SPV 1573 and GD 65174-1 were included with panicle breadth of 11.4 and 14.7 cm, respectively. In this category the mean panicle breadth was 13.05 cm and with no bugs/ population. Category-V also included two entries, Khawang Pahawang and SDSL 92131 with panicle breadth of 20.1 and 22.5 cm, respectively, having mean panicle breadth of 21.3 cm with no bugs presence. No sorghum genotype was included in Category-IV. It is concluded that as the breadth of panicle increases from a certain level, either there was a reduction in bug population or it was negligible. Breadth of panicle and the mean number of bugs/ 5 panicles exhibited a positive correlation ($r = 0.465$).

The grain weight, length and breadth of panicle and mean number of bugs present on panicle seems to be inter-related with each other. Similar results have earlier been reported by Sharma (1985), who observed that small grains covered by hairy glumes hindered oviposition by females in comparison to those which had bigger size grain. He also observed that lesser the 1000-grain weight, smaller will be the grain size and lesser will be the population of earhead bugs. As for length and breadth of panicle are concerned, it is already well established by many workers that size of panicle matters in deciding the number of head bugs as in case of *C. angustatus*, Sharma

Table 3. Sorghum genotypes categorized on the basis of breadth of panicle

S. No.	Sorghum genotype	Panicle breadth* (cm)	Mean no. of earhead* bugs/ 5 panicles
0.0 – 5.0 cm – Panicle breadth			
1	ICSV 708	2.5	17.2
2	ICSV 714	2.6	5.4
3	AKENT 8-3	2.8	3.8
4	SRF 2102	2.9	12.8
5	SPV 1605	3.2	4.3
6	DSFR2	3.3	11.6
7	AKMS 14-A	3.4	12.5
8	IS 22893	3.5	3.8
9	SPV 1576	3.5	8.4
10	IS 6566	3.5	8.1
11	IS 112	3.5	18.6
12	27-B	3.5	23.9
13	RSU 202	3.6	5.3
14	ICSV 112	3.6	8.2
15	296-B	3.6	15.8
16	SR 2458	3.6	29.0
17	IS 11119	3.8	7.6
18	SPV 1579	3.8	15.4
19	SU 700	3.8	11.4
20	RSE 9727	3.8	12.2
21	ICSV 745	3.9	9.1
22	ICSV 93046	3.9	7.5
23	GMSB 5	3.9	8.2
24	SPV 1562	3.9	16.0
25	SR 1436	3.9	16.1
26	GD 65019	4.0	15.4
27	AKENT 10-1	4.0	23.1
28	SRF 1665	4.0	15.5
29	RSU 283	4.1	3.8
30	168-UU-1006	4.1	4.4
31	GMSB 131	4.1	8.0
32	SU 52	4.1	12.0
33	AKENT 15	4.2	3.8
34	463-A	4.2	3.9
35	168-II-112	4.2	4.0
36	GMSB 76	4.2	4.1
37	IS 4663	4.2	8.4
38	GD 65195	4.2	7.6
39	SU 663	4.2	15.6
40	CSV 457	4.2	11.6
41	SR 770-2	4.2	23.2
42	CSH 7	4.2	26.9
43	SDH 1352	4.3	6.1
44	SU 699	4.3	1.2
45	RSE 9745	4.3	9.2
46	SR 2460-1	4.3	15.8
47	CSH 3	4.3	15.2
48	168-IU-1021	4.3	13.9
49	SR 2460	4.4	12.1
50	IS 1044	4.4	11.5
51	RSE 9715	4.5	3.8
52	168-II-108	4.6	7.9
53	RSU 158	4.7	1.0
54	ICSV 700	4.9	3.9
55	SPH 1280	4.7	8.4
56	SR 1048-1	4.7	15.1
57	CSH 14	4.7	17.6
58	SPV 1567	4.7	12.3

S. No.	Sorghum genotype	Panicle breadth* (cm)	Mean no. of earhead* bugs/5 panicles
59	SPV 1571	4.7	19.9
60	GSSV 312	4.8	7.5
61	GD 65055	4.8	10.0
62	GMSB 4	4.8	7.9
63	SPV 1575	4.8	16.5
64	SPV 1577	4.8	11.1
65	CSV 16	4.8	13.6
66	SPV 1568	4.8	19.1
67	SRF 203	4.8	19.0
68	168-II-122	4.9	7.8
69	CSH 16	4.9	15.9
70	SR 2704	4.9	12.4
71	296-A	4.9	26.5
72	RSE 9728	5.0	23.1
73	ICSR 93034	5.0	17.5
74	168-UU-1022	5.0	7.7
75	GMSB 69	5.0	8.1
76	SFCR 1047	5.0	4.4
	Average	4.17	7.23
5.1 – 10.0 cm – Panicle breadth			
77	IS 2123	5.1	7.7
78	SPV 1578	5.1	21.8
79	CSH 17	5.1	19.5
80	SFCR 1070	5.1	22.7
81	SPV 1574	5.2	6.7
82	SPH 1375	5.2	4.6
83	ICSV 705	5.2	4.0
84	SU 45	5.2	12.5
85	AKENT 10-2	5.3	4.4
86	ICSV 711	5.3	5.2
87	DSFR3	5.3	8.5
88	200-UU-1011	5.3	15.4
89	SPH 1183	5.4	4.1
90	AKENT 14	5.4	9.0
91	GD 65006	5.4	15.3
92	SPV 1570	5.6	9.3
93	CSV 15	5.6	16.3
94	GD 65004	5.6	15.2
95	SR 2459	5.6	26.7
96	DJ 6514	5.7	6.0
97	SPH 1334	5.7	11.0
98	GD 65040	5.7	11.4
99	AKENT 7-1-1	5.8	5.9
100	SPV 1565	5.8	8.5
101	SPV 1569	6.0	12.3
102	200-1011	6.0	17.6
103	GD 65022	6.0	11.3
104	SR 833-2-3	6.0	19.2
105	AKENT 16	6.1	8.2
106	GMSB 15	6.1	8.5
107	IS 18551	6.2	3.7
108	IS 2269	6.2	4.0
109	SPH 1349	6.2	8.6
110	S-35	6.2	15.5
111	SPH 1350	6.3	8.6
112	SPV 1563	6.3	16.6
113	SPH 1335	6.3	16.0
114	SPH 1376	6.3	11.8
115	SPH 1341	6.3	20.1
116	SRF 2549	6.4	25.7
117	SPH 1374	6.4	27.1

S. No.	Sorghum genotype	Panicle breadth* (cm)	Mean no. of earhead* bugs/ 5 panicles
118	NT 52	6.5	17.1
119	SFCR 1143	6.6	22.8
120	Amarnath	6.7	15.6
121	SPH 1354	6.7	19.0
122	SPH 1347	6.7	20.1
123	Swati	6.8	17.0
124	SPH 1355	6.8	19.8
125	SFCR 1105	6.8	23.1
126	RSE 9741	6.9	6.5
127	SFCR 1111	6.9	30.9
128	200-IU-1005	7.0	19.1
129	CSH 9	7.0	24.0
130	SPH 1353	7.1	18.0
131	SPH 1372	7.2	12.7
132	RSE 9744	7.2	24.1
133	SPV 1580	7.2	0.0
134	RSV 204	7.3	15.1
135	ICSV 717	7.3	17.7
136	CSH 5	7.3	23.7
137	IS 2205	7.6	8.2
138	DSFR 5	7.7	25.6
139	ICSV-1	7.8	23.0
140	BT X 623	7.9	11.8
141	IS 2312	8.0	22.4
142	IS 2122	8.2	9.9
143	SPV 1581	8.7	16.3
144	IS 20016	8.7	0.0
145	IS 25596	8.7	0.0
146	SPH 1329	9.6	13.8
	Average	6.42	13.85
10.1 – 15.0 cm – Panicle breadth			
147	SPV 1573	11.4	0.0
148	GD 65174-1	14.7	0.0
	Average	13.05	–
15.1 – 20.0 cm – Panicle breadth NIL			
20.1 – 25.0 cm – Panicle breadth			
149	Khawang Pahawang	20.1	0.0
150	SDSL 92131	22.5	0.0
	Average	21.30	–
	S.E. ±	0.937	

* Panicle breadth and mean number of earhead bugs/ 5 panicles are mean of 3 replications

and Lopez (1994a) recorded that the number of *C. angustatus* increased with increase in size of panicle in susceptible cultivars. They also observed more panicle breadth in loose type of earheads resulting in lesser population of bugs.

References

- Doggett H, KJ Starks and SA Eberhart (1970) Breeding for resistance to the sorghum shootfly. *Crop Sci.* **10**: 528-531.
- Seshu Reddy KV and JC Davies (1979) Pests of sorghum and pearl millet, and their parasites and predators, recorded at ICRISAT Center, India, upto August, 1979. Cereal Entomology Progress Report No.2. Patancheru, Andhra Pradesh-502324, India: International Crop Research Institute for the Semi-Arid Tropics. 23 p.
- Sharma HC (1985) Screening for host-plant resistance to mirid head bugs in sorghum. In: *Proceedings of the Intl. Sorghum Ent. Workshop*, 15-21 July, 1984, College Station, Texas, USA, Patancheru, A.P. 502 324, India: International Crops Research Institute for the Semi-Arid Tropics p. 317-335.
- Sharma HC and Lopez VF (1994a) Interactions between panicle size, insect density and environment for genotypic resistance in sorghum to head bug, *Calocoris angustatus*. *Entomologia Exp. Appl.* **71**: 101-109.
- Wilson F and CB Huffakar (1976) The philosophy, scope and importance of biological control. In: CB Huffakar and PS Messenger (eds.) *Theory and Practice of Biol. Control*, Academic Press, New York, pp 3-15.
- Wood EA Jr. and KJ Starks (1972) Effect of temperature and host plant interaction on the biology of three biotypes of the greenbug. *Environ. Ent.* **1**: 230-234.
- Young WR and GL Teetes (1977) Sorghum Entomology. *Ann. Rev. Ent.* **22**: 193-218.