



Evaluation the reaction and susceptibility of sorghum (*Sorghum bicolor*) genotypes for insect pests in timely sown crop

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Abstract: A field experiment was conducted during *Kharif* 2013 under the All India Co-ordinated Sorghum Improvement Project (AICSIP) at College of Agriculture, Indore, R.V.S.K.V.V. (M.P.). The experiment was carried out in Randomized Block Design (RBD) with three replications, in this experiment Seventy one (64 genotypes + 7 Checks) recently developed sorghum genotypes were evaluated along with three susceptible checks (DJ 6514, ICSV 745 & Swarna) and three resistant checks (IS 2205 & IS 18551) and two local checks (JJ 1041 & CSH 18). The result showing that lowest pest incidence was reported in both resistance entry (IS 18551 & IS 2205), while maximum incidence reported in all susceptible entries (DJ 6514, swarna and ICSV 745). Minimum ear head pests (bug and worm) were counted in SPH 1733 & SPV 2110 (2). Plant population at 15 DAS ranged was from 25.33-31.67 plants plot⁻¹, days to 50% flowering from 92.67-112.33 days, days to 50% maturity from 107.33-126.00 days and plant height was from 130.00-202.33 cm. The number of grain ear head⁻¹ ranged was 484.33 - 2507.6, while stover yield was 1.217-2.922 kg. The maximum yield (kg/plot and 5 plant⁻¹) was obtained in SPV 2165, CSV 27, SPV 2170, SPV 2174 and SPV 2114 (2).

Keywords: Sorghum, Ear head bug, Ear head worm, Reaction, Susceptibility

Introduction

Sorghum [*Sorghum bicolor* (L.) Moench] is an important staple food crop of the world and 5th most important cereal crop after wheat, rice, maize and barley. Sorghum is traditionally being used in food, feed, fodder, and fuel. The stem and foliage are used as green fodder, hay silage and pasture apart from using as fuel and building material. Sweet sorghum is one such alternative source which has very good potential as a feedstock for ethanol production and has emerged as a supplementary crop to sugarcane (Reddy *et al.*, 2005). Sorghum is grown in an area of 61.80 million hectares with a production of 52.80 million metric tonnes and productivity of 8544 hectogram/hectare in India (Anonymous, 2013-14). In Madhya Pradesh, sorghum crop is grown mainly in *Kharif* season and covers an area of 307.5 ha. and production 542.9 tonnes with productivity of 1809 kg ha⁻¹ respectively (Anonymous, 2009-10) and Sorghum mainly cultivated in Malwa followed by Jhabua, Nimar, Gird and Satpura plateau of Madhya Pradesh.

Numerous insects attack sorghum worldwide, more than 150 insect species are considered pests of sorghum and about 20 of them can cause severe economic damage to the crop (Sharma, 1993). Insect pests usually attack certain parts of sorghum plants (Teetes and Pendleton, 2000). In different parts of India, avoidable losses of 7-84% due to head bugs have been estimated, under experimental conditions, 55-84% losses have been recorded in

the commercial cultivars CSH5, ICSV1 and CSH1 (Sharma and Lopez, 1989). Among the biotic factors, arthropods constitute a major constraint to increase the sorghum production. About 150 insect species have been reported to damage sorghum in different agro-ecosystem (Jotwani *et al.*, 1980). Among them, ear head bug (*Calocoris angustatus* Leth.) and ear head worm (*Cryptoblabes gnidiella* Mab.) are also important insect pests appearing at different stages of the crop growth. Borad and Mittal (1983). Several sources of resistance have been Identified against head bugs in sorghum (Sharma *et al.*, 1988 a,b, Kumari *et al.*, 2000 ; Huang, 2004, 2011), only a few of them are being deployed in the development of insect-resistant varieties, as it takes a long time and needs a great deal of expertise and resources. Selection of resistant or tolerant varieties is a very important factor the diversity and intensity of pests in a particular place. Plants have their own sophisticated mechanisms to protect from the pest attack. Majority of the traditional varieties are resistant to many pests. Use of insect-resistant genotype is economically, ecologically, and environmentally advantageous. Economic benefits occur because crop yields are saved from loss to insect pests and money is saved by not applying insecticides that would have been applied to susceptible varieties. Considering in the light of above facts the following objectives of study have been under taken to confirm the resistance and susceptibility of Sorghum genotypes for insect pests in Malwa plateau region of Madhya Pradesh.

Material and Methods

This presented field experiment was conducted during *kharif* 2013 at All India Co-ordinated Sorghum Improvement Project (AICSIP), College of Agriculture, Indore, R.V.S.K.V.V. (M.P.). The soil of experiment field is medium black, geographical parameters at Indore: Latitude of 22°43'N, Longitude of 75°56'E, Altitude of 555.7 meters above the mean sea level. The climate of this region is semi-arid, sub-tropical having mid-winter and summer with uncertain winter rains. The rainfall occurs mostly from mid-June to the end of September. The experiment was carried out in Randomized Block Design (RBD) with three replications. In this experiment 71 (64 genotypes+ 7 Checks) newly developed sorghum genotypes were evaluated along with three susceptible checks (DJ 6514, ICSV 745 & Swarna) and three resistant checks (IS 2205 & IS 18551) and two local checks (JJ 1041 & CSH 18). All the data obtained with regard to the reaction and susceptibility of Sorghum (*Sorghum bicolor*) genotypes for insect pests *viz.*, Ear head bug (*Calocoris angustatus* Leth.), its population was counted on three ear heads of each treatment randomly selected at milky stage of crop and ear head worm (*Cryptoblabes gnidiella* Mab.) population was counted on three ear heads of each treatment randomly selected at milky stage of crop. Then the average numbers of ear head worm per three ear head was calculated ($AP_o = \frac{NPR}{OP} \times 100$, Where, AP_o - Average population, NPR -No. of received pest, OP - Total observed plants) and subjected to statistical analysis after making suitable transformation. Among the growth parameters *viz.*, plant population, plant height, and days to 50% flowering and days to 50% maturity and yield attributing characters *i.e.* types of panicle, grain yield per five plants, grain yield plot⁻¹, stover yield and grain yield hec^{-1} have been considered for observation. Statistically analysis using the analysis of variance of Fisher (1958) and Fisher and Yates (1963) at P=0.05 level of probability.

Results and Discussion

Reaction of sorghum genotypes for Ear head bug (*Calocoris angustatus*) and Ear head worm (*Cryptoblabus sp.*): The numbers of ear head bugs were significantly different in different entries (Table-1 and Fig: 1, 2). It was observed that the lowest ear head bug was recorded in IS 18551 (4.41 Bug plant⁻¹) followed by SPH 1733 (4.67 Bug plant⁻¹), IS 2205 (4.90 Bug plant⁻¹), SPV 2110 (2) (5.00 Bug plant⁻¹) and SPV 2183 (5.00 Bug plant⁻¹), However maximum numbers of bug were counted in all susceptible entry Swarna, ICSV 745 and DJ 6514 with 14.00, 13.67 and 13.33 ear head plant⁻¹. The maximum number of bug was received in SPH 1629(2) (11.00). These findings are supported by Sekhar (1997) who found the sorghum ear head bug incidence was high in May-August planted crops. Mote and Kadam (1984) found that, 24 genotypes none was free from damage, but SPV 472, Swarna, SPH 196, CSH 1, CSH 6 and CSH 9 were moderately resistant (score 1.1 to 2.0). The findings are also supported by Hiremath (1986), and Choudhary and Garg (2004).

The lowest ear head worm was recorded in IS 18551 (2.44 worm plant⁻¹). Among the test entry SPH 1733 (2.56 worm plant⁻¹) was found less incidence, which was at par with SPV 1822 (2) (2.56 worm plant⁻¹), SPV 2110 (2) (2.56 worm plant⁻¹) and SPV



Fig. 1: Ear head Worm (*Cryptoblabes gnidiella*) on sorghum ears



Fig. 2: Infested ear head due to Ear head bug

Table-1: Reaction of sorghum genotypes against Ear Head bugs and Ear head worm

S.N.	Entry	Population of ear head pest per three panicle			
		Ear head bug		Ear head worm	
		OV	TV	OV	TV
1	SPH 1733	4.67	2.27	2.56	1.75
2	SPH 1724	10.33	3.29	4.11	2.15
3	SPH 1736	7	2.74	3.33	1.96
4	SPH 1702 (2)	9	3.08	3.89	2.09
5	SPH 1703 (2)	9.33	3.13	3.67	2.04
6	SPH 1705 (2)	7.67	2.86	3.22	1.93
7	SPH 1737	7	2.74	3.33	1.96
8	CSH 25	8.33	2.97	3.44	1.99
9	SPH 1731	7.67	2.86	3.22	1.93
10	SPH 1730	8	2.91	3.33	1.96
11	CSH 23	8.33	2.97	3.44	1.99
12	CSH 30	9.33	3.13	3.78	2.07
13	CSH 16	9.33	3.13	3.78	2.07
14	SPV 1822 (2)	5.67	2.48	2.56	1.75
15	SPV 2175	6	2.55	2.67	1.78
16	SPV 2178	7	2.74	3.22	1.93
17	CSV 20	6.33	2.61	3.11	1.9
18	SPV 2110 (2)	5	2.34	2.56	1.75
19	SPV 2165	8	2.91	3.11	1.9
20	CSV 27	6.33	2.61	2.78	1.81
21	SPV 2179	6.67	2.68	3.22	1.93
22	SPV 2181	7.33	2.8	3.44	1.99
23	SPV 2122 (2)	7.33	2.8	3.33	1.96
24	SPV 2172	8	2.91	3.44	1.99
25	SPV 2164	6.67	2.68	3	1.87
26	SPV 2184	6	2.54	2.89	1.84
27	SPV 2183	5	2.34	2.67	1.78
28	SPV 2114 (2)	8.33	2.97	3.22	1.93
29	SPV 2174	8.33	2.97	3.44	1.99
30	SPV 2170	7	2.73	2.89	1.84
31	CSV 23	7	2.73	3	1.87
32	CSV 17	5.67	2.48	2.89	1.84
33	SPV 2182	8.33	2.97	3.44	1.99
34	SPH 1751	9	3.08	3.67	2.04
35	CSH 25	8.33	2.97	3.44	1.99
36	CSH 16	6.33	2.61	3	1.87
37	SPH 1749	7.67	2.85	3.44	1.99
38	CSH 23	7.33	2.8	3.44	1.99
39	SPH 1750	7.67	2.85	3.22	1.93
40	SPH 1748	7.33	2.8	3.33	1.95
41	CSH 30	7.67	2.85	3.56	2.01
42	SPV 2247	10.33	3.29	4	2.11
43	SPV 2249	13	3.67	4.78	2.3
44	SPV 2251	13.33	3.72	5.11	2.37
45	SPV 2256	8	2.91	3.55	2.01
46	SPV 2254	9.97	3.23	3.89	2.08
47	SPV 2243	12.43	3.59	4.66	2.27
48	SPV 2248	11	3.39	4.33	2.2
49	CSV 23	12	3.53	4.67	2.27
50	CSV 27	13.33	3.72	5.11	2.37
51	SPV 2253	11.33	3.44	4.44	2.22
52	SPV 2252	11.67	3.49	4.44	2.22
53	SPV 2242	9.2	3.11	3.78	2.07
54	SPV 2244	10.67	3.34	4.22	2.17

55	SPV 2246	9.67	3.19	3.89	2.09
56	CSV 17	12.33	3.58	4.44	2.22
57	SPV 2250	10.67	3.34	4.22	2.17
58	SPV 2255	13.6	3.75	5	2.34
59	SPV 2245	12	3.53	4.33	2.2
60	CSV 20	10	3.24	4	2.12
61	ICSV 12001	7.33	2.78	3.22	1.92
62	ICSV 12002	7.33	2.8	3.33	1.96
63	ICSV 705	7.33	2.8	3.22	1.92
64	ICSV 700	7.33	2.8	3.33	1.96
65	CSH-18 (LC)	8.17	2.94	3.33	1.95
66	DJ6514 (SC)	13.33	3.72	3.78	2.07
67	ICSV745 (SC)	13.67	3.76	4	2.12
68	IS 18551(RC)	4.41	2.21	2.44	1.71
69	IS2205 (RC)	4.9	2.32	2.67	1.78
70	JJ1041 (LC)	9.43	3.15	3.78	2.07
71	Swarna (SC)	14	3.81	4.11	2.14
SEm ±			0.09		0.05
CD (P = 0.05)			0.25		0.15

DAE= Days after Emergence, SFDH %= Shoot fly dead hearts per cent, SBDH %=Stem borer dead hearts per cent, SBLI %=Stem borer leaf injury per cent, SBSL %=Stem borer stem tunneling per cent, OV=Observation Value, TV=Transformation Value (arc sine transformation), RC = Resistant Check, SC= Susceptible Check, LC= Local Check

2175 (2.66 worm plant⁻¹), The maximum ear head worm population was observed in CSV 27 (5.11 worm plant⁻¹) which was at par with SPV 2251 (5.10 worm plant⁻¹) and SPV 2255 (5.00 worm plant⁻¹). They reported lowest number of ear head worm (3.09 per three plants) has been received in SPH 1675, SPV 2113, and SPV 2124.

Expression of growth parameters in sorghum genotype:

Among the growth parameters (Table-2) viz., plant population, plant height, days to 50% flowering and days to 50% maturity was considered for observation. There were significant differences observed among all the entries at all growth parameters. Plant population at 15 DAS ranged from 25.33 (SPH 1730) to 31.67 (SPV 2251) plants plot⁻¹. The mean population has been observed 28.7 plants per genotype. Further Kumar *et al.* (2000 b) reported that Genotypes IS 18551, ICSV 700 and ICSV 705, with longer roots and shoots contributed significantly to conferring resistance. The lowest days to 50% flowering was observed in SPH 1705 (2) (92.67 days) followed by SPV 2183 and CSH 16 (93.33 days), however maximum days to 50% flowering was observed in SPV 2251 (112.33 days). The mean days to 50% flowering were observed as 101.3 days. The maximum days to 50% maturity was observed in ICSV 705 (126.00 days) followed by ICSV 700 (125.00 days), however lowest days to 50% maturity were observed in CSV 17 and SPH 1749 with similar (107.33 day) days to 50% maturity. The mean days to 50% maturity were observed as 118.7 days. Present finding are partially supported by funding report of Rao *et al.* (2000) they reported that shoot fly incidence was positively correlated with days to flowering and days to maturity.

The maximum plant height recorded in SPV 2179 was (202.3 cm.) followed by CSV 20 (198.33 cm.) and CSV 17 (191.0 cm.). The lowest plant was noticed in SPH 1749 (130.0 cm.). Rao *et al.* (2000) reported that the taller varieties with increased leaf number appeared desirable for minimizing shoot fly incidence. Ameta

Table- 2: Level of growth parameters in different Sorghum genotypes

S.N.	Entry	Plant population	Days to 50% flowering	Days to 50% maturity	Plant height (cm)
1	SPH 1733	29.33	100	121.67	150
2	SPH 1724	30.33	94.67	113.33	144.33
3	SPH 1736	28.67	97.67	116.67	163
4	SPH 1702 (2)	29.67	100.67	119.67	150.33
5	SPH 1703 (2)	29.67	100	112.67	145
6	SPH 1705 (2)	30	92.67	114.67	151.67
7	SPH 1737	29.33	102.67	117.33	145.33
8	CSH 25	28.67	98.33	123.67	170
9	SPH 1731	28	105.33	117.33	137.67
10	SPH 1730	25.33	99.67	118.33	162.33
11	CSH 23	26	97.33	111.67	163.67
12	CSH 30	28.67	96.33	122.33	151
13	CSH 16	26.67	100	114.33	156
14	SPV 1822 (2)	30.67	100	120	154.67
15	SPV 2175	26.33	105.67	118.67	160.33
16	SPV 2178	27.67	100	120.33	163.33
17	CSV 20	30.67	104.33	120.33	175.33
18	SPV 2110 (2)	27	110	118.67	153.67
19	SPV 2165	30.33	104.33	119	151.67
20	CSV 27	28.33	104	122	152.67
21	SPV 2179	28	105	120.67	202.33
22	SPV 2181	30	98.67	120	159.67
23	SPV 2122 (2)	30.33	104	118	165.33
24	SPV 2172	28.33	103.33	121.33	158.67
25	SPV 2164	28	100.33	117.33	133.67
26	SPV 2184	29.33	97	120.33	169.33
27	SPV 2183	27.67	93.33	117.33	188.67
28	SPV 2114 (2)	29	102.33	118.67	146.67
29	SPV 2174	26	98.33	116.67	143.67
30	SPV 2170	28.33	103.67	123	170.67
31	CSV 23	27.67	98	121	164.33
32	CSV 17	29.67	100.33	107.33	130
33	SPV 2182	26.67	96	119.33	146.67
34	SPH 1751	29.67	100.33	116.67	162.33
35	CSH 25	29	98.33	122.67	166.33
36	CSH 16	28.33	93.33	114.33	167
37	SPH 1749	27.67	100.33	107.33	130
38	CSH 23	30	96.67	111.67	181.67
39	SPH 1750	29.67	97	117.33	176
40	SPH 1748	26.67	102.33	115	188.67
41	CSH 30	27	101.67	111.33	156.67
42	SPV 2247	27.67	102	122.33	178.33
43	SPV 2249	28.33	98	121.67	186
44	SPV 2251	31.67	112.33	119.67	171
45	SPV 2256	28	96.67	121	186.67
46	SPV 2254	27.67	105.33	120.33	177.67
47	SPV 2243	30.33	110.67	120	177
48	SPV 2248	30	99.67	119.33	149.67
49	CSV 23	30.67	108.33	123.33	175
50	CSV 27	29.67	103.33	123.33	144.33
51	SPV 2253	28.67	101.67	118	143.33
52	SPV 2252	29	110	118	156.33
53	SPV 2242	29.33	105.33	119.67	169
54	SPV 2244	27.67	103.67	120.67	141.67
55	SPV 2246	29.33	100	121	169.33

56	CSV 17	27.67	98.67	107.33	191
57	SPV 2250	30.33	100	119.67	165.33
58	SPV 2255	27.67	105	115.33	155
59	SPV 2245	28.33	101.33	120	174
60	CSV 20	29.67	94.67	119.33	198.33
61	ICSV 12001	28	106	124.33	161.89
62	ICSV 12002	28.33	106.67	124.67	150.33
63	ICSV 705	29	106	126	154.22
64	ICSV 700	29	107	125	184.78
65	CSH-18 (LC)	29.33	102.33	119.67	153.17
66	DJ6514 (SC)	29.92	100.33	118.67	165.58
67	ICSV745 (SC)	29	104.67	122.67	146.92
68	IS 18551(RC)	28.25	99.33	119.33	173.08
69	IS2205 (RC)	28.83	100.33	118.33	167.42
70	JJ1041 (LC)	28.17	99.33	120	161.83
71	Swarna (SC)	29.17	101.67	119.67	169.17
SEm ±		0.59	1.03	0.83	3.31
CD (P = 0.05)		1.66	2.87	2.33	9.28

and Sumeria (2004) reported that shoot fly, stem borer and midge increased and it adversely affected the plant height, weight and length of ear head. Reddy *et al.* (1993) reported that the height genes did not affect the susceptibility to the borer. The above referred findings are also in agreement with present investigation.

Expression of yield parameters in sorghum genotype: Three panicle types were found in all genotype (Table-3) *i.e.*, Compact (3 entry), Semi-compact (27 entry) and open types (41 entry). The number of grain ear head⁻¹ range was 484.33 (SPV 2252) to 2507.67 (SPV 2174). The mean number of grain head⁻¹ was 1290.5. The maximum yield (kg/plot and per 5 plants) was obtained in SPV 2165 (0.662 and 0.226 kg), CSV 27 (0.656 and 0.174 kg), SPV 2170 (0.648 and 0.207 kg), SPV 2174 (0.642 kg and 0.193), SPV 2114 (2) (0.639 and 0.187kg), the plot yield was converted into kg/ha. Badgujar *et al.* (2006), Gite *et al.* (2006), Kumar *et al.* (2008), Ogola and Kamau (2008) reported significant and positive correlation between sorghum insect pest and grain yield, these above referred findings are also in agreement with present study. The maximum stover yield plot⁻¹ was observed in SPH 1736 (2.922 kg) followed by SPV 2178 (2.889 kg), while minimum stover yield plot⁻¹ was recorded in CSV 17 (1.217 kg), the mean stover yield was 2.275 kg plot⁻¹.

The finding concluded that minimum pest incidence was reported in IS 18551 and IS 2205), while maximum incidence reported in DJ 6514, Swarna and ICSV 745. Minimum ear head pests were counted in SPH 1733 and SPV 2110 (2). Plant population at 15 DAS range from 25.33 to 31.67 plants per plot. Days to 50% flowering were from 92.67 to 112.33 days, while days to 50% maturity was between 107.33 and 126.00 days. Plant height was from 130.00 to 202.33 cm. The number of grain head⁻¹ ranged was 484.33 to 2507.67. Stover yield was between 1.217 and 2.922 kg. The maximum yield was obtained in SPV 2165, CSV 27, SPV 2170, SPV 2174 and SPV 2114 (2).

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Table-3: Yield attributing characters of different Sorghum genotypes

S.N.	Entry	Panicles Types	Grain yield (kg.) at harvest			Stover yield Kg/ plot	No. of grain /ear head
			Per 5 Plant	Per plot	ha ⁻¹		
1	SPH 1733	Semi-compact, curved(symmetrical)	0.157	0.600	3333.6	1.755	1822.67
2	SPH 1724	Semi-compact , erect(broad at base)	0.129	0.520	2891.2	2.217	1733.67
3	SPH 1736	Open, erect(symmetrical)	0.125	0.392	2175.6	2.922	1201.33
4	SPH 1702 (2)	Compact, erect(broad at base)	0.119	0.402	2231.9	2.253	2142.67
5	SPH 1703 (2)	Semi-compact, erect(broad at base)	0.132	0.425	2362.0	2.050	1664.33
6	SPH 1705 (2)	Open, erect(broad at base panicle)	0.125	0.392	2175.9	2.168	1184.00
7	SPH 1737	Open, erect(broad at base panicle)	0.124	0.456	2532.0	2.001	1199.33
8	CSH 25	Open, erect(broad at base panicle)	0.142	0.480	2668.0	2.276	1233.67
9	SPH 1731	Semi-compact, erect(broad at base)	0.127	0.501	2782.6	2.443	1727.67
10	SPH 1730	Open, erect(broad at base panicle)	0.156	0.522	2901.9	2.272	1322.33
11	CSH 23	Open ,erect(broad at base panicle)	0.111	0.375	2082.8	2.089	876.00
12	CSH 30	Semi-compact, curved(broad at base)	0.118	0.396	2199.3	2.064	1648.33
13	CSH 16	Open , erect(broad at base panicle)	0.061	0.213	1184.8	2.328	618.33
14	SPV 1822 (2)	Open, erect(broad at base panicle)	0.166	0.616	3421.3	2.525	1416.00
15	SPV 2175	Open, erect(broad at base panicle)	0.178	0.635	3527.0	2.207	1126.67
16	SPV 2178	Open, erect(broad at base panicle)	0.107	0.535	2974.9	2.889	750.00
17	CSV 20	Open , erect(broad at base panicle)	0.132	0.612	3399.7	2.242	1231.67
18	SPV 2110 (2)	Open, erect(symmetrical)	0.152	0.608	3376.3	2.622	1311.00
19	SPV 2165	Semi-compact, curved(broad at base)	0.226	0.662	3677.8	2.439	1973.00
20	CSV 27	Open ,erect(broad at base panicle)	0.174	0.656	3644.4	2.410	991.00
21	SPV 2179	Open, erect(broad at base panicle)	0.109	0.534	2964.3	2.221	853.33
22	SPV 2181	Compact, erect(broad at base)	0.112	0.440	2444.5	2.572	2300.67
23	SPV 2122 (2)	Open, erect(broad at base panicle)	0.127	0.558	3099.2	2.750	1184.67
24	SPV 2172	Semi-compact, erect(broad at base)	0.128	0.495	2752.3	2.826	1730.33
25	SPV 2164	Open, erect(pyramidal)	0.119	0.577	3208.1	2.231	1119.00
26	SPV 2184	Semi-compact, curved(broad at base)	0.136	0.562	3122.4	2.754	1757.33
27	SPV 2183	Semi-compact , erect(broad at base)	0.133	0.540	2998.6	2.081	1749.33
28	SPV 2114 (2)	Semi-compact, erect(broad at base)	0.187	0.639	3550.0	2.543	2076.33
29	SPV 2174	compact, erect(symmetrical)	0.193	0.642	3566.7	2.208	2507.67
30	SPV 2170	Semi-compact, erect(symmetrical)	0.207	0.648	3600.0	2.581	1929.33
31	CSV 23	Semi-compact, curved(broad at base)	0.150	0.611	3394.7	2.384	1772.00
32	CSV 17	Semi-compact, erect(broad at base)	0.108	0.494	2745.4	1.217	1606.33
33	SPV 2182	Open, erect(broad at base panicle)	0.148	0.623	3463.0	2.646	1245.00
34	SPH 1751	Open, erect(broad at base panicle)	0.145	0.575	3193.8	2.586	1240.00
35	CSH 25	Semi-compact, erect(pyramidal)	0.064	0.303	1685.4	1.817	1424.33
36	CSH 16	Semi-compact, erect(broad at base)	0.066	0.293	1625.2	1.808	1430.00
37	SPH 1749	Open, erect(broad at base panicle)	0.080	0.370	2053.9	2.067	714.67
38	CSH 23	Semi-compact, erect(symmetrical)	0.126	0.490	2722.9	1.487	1722.33
39	SPH 1750	Semi-compact, erect(broad at base)	0.058	0.310	1719.6	2.376	1410.33
40	SPH 1748	Semi-compact, curved(symmetrical)	0.059	0.289	1604.1	2.800	1441.00
41	CSH 30	Open, curved(broad at base panicle)	0.112	0.463	2573.7	1.622	953.33
42	SPV 2247	Open, erect(broad at base panicle)	0.107	0.398	2212.0	2.501	772.67
43	SPV 2249	Open, erect(broad at base panicle)	0.111	0.497	2761.9	2.725	883.33
44	SPV 2251	Open, erect(broad at base panicle)	0.156	0.571	3174.1	2.256	1322.67
45	SPV 2256	Open, erect(broad at base panicle)	0.164	0.638	3546.3	1.954	1388.00
46	SPV 2254	Semi-compact, erect(broad at base)	0.120	0.451	2502.9	2.030	1684.67
47	SPV 2243	Semi-compact, erect(broad at base)	0.158	0.619	3440.4	2.222	1848.33
48	SPV 2248	Open, erect(broad at base panicle)	0.070	0.315	1747.4	2.232	683.00
49	CSV 23	Open, erect(symmetrical)	0.086	0.320	1775.6	2.498	732.33
50	CSV 27	Open, erect(broad at base panicle)	0.046	0.252	1402.6	2.538	506.33
51	SPV 2253	Open, erect(broad at base panicle)	0.101	0.447	2480.6	2.147	743.33
52	SPV 2252	Open, erect(symmetrical)	0.044	0.198	1098.1	1.747	484.33
53	SPV 2242	Semi-compact, erect(symmetrical)	0.066	0.342	1897.2	2.488	1463.67
54	SPV 2244	Open, erect(symmetrical)	0.089	0.427	2373.5	2.202	738.33
55	SPV 2246	Open, erect(symmetrical)	0.049	0.242	1344.9	2.502	540.33
56	CSV 17	Semi-compact, curved(broad at base)	0.058	0.266	1475.6	1.331	1402.33

57	SPV 2250	Open, erect(broad at base panicle)	0.079	0.358	1989.5	2.544	706.67
58	SPV 2255	Open, erect(broad at base panicle)	0.064	0.279	1549.8	2.263	641.67
59	SPV 2245	Open, erect(symmetrical)	0.159	0.605	3361.1	2.261	1387.67
60	CSV 20	Open, erect(broad at base panicle)	0.101	0.438	2435.6	2.594	768.00
61	ICSV 12001	Open, erect(broad at base panicle)	0.067	0.471	2619.1	2.538	645.67
62	ICSV 12002	Open, erect(broad at base panicle)	0.116	0.490	2722.2	2.081	1045.67
63	ICSV 705	Open, erect(broad at base panicle)	0.130	0.333	1851.9	1.747	1211.33
64	ICSV 700	Open, erect(broad at base panicle)	0.069	0.330	1833.3	2.488	655.33
65	CSH-18 (LC)	Semi-compact, erect(symmetrical)	0.068	0.284	1577.8	1.857	1467.00
66	DJ6514 (SC)	Semi-compact, erect(broad at base)	0.056	0.271	1504.8	2.067	1328.67
67	ICSV745 (SC)	Semi-compact, curved(broad at base)	0.094	0.401	2225.6	1.487	1508.67
68	IS 18551 (RC)	Open, erect(broad at base panicle)	0.156	0.595	3308.0	2.509	1380.00
69	IS2205 (RC)	Open, erect(broad at base panicle)	0.155	0.576	3202.0	2.800	1286.00
70	JJ1041 (LC)	Semi-compact, curved(broad at base)	0.108	0.480	2666.9	2.331	1576.00
71	Swarna (SC)	Semi-compact, erect(symmetrical)	0.077	0.337	1874.0	2.833	1482.67
SEm ±			0.01	0.03		0.09	132.48
CD (P=0.05)			0.03	0.10		0.25	370.96

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