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GENETICS OF CHARCOAL ROT RESISTANCE IN RABI SORGHUM

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ABSTRACT

Charcoal rot studies in a 10-parent diallel of sorghum revealed that two parents, E36-1 and M35-1, were resistant to the three charcoal rot related attributes, namely, lodging per cent, mean number of nodes crossed and mean length of spread. The combining ability analysis has shown that the gca effects for the resistant parents, E36-1, M35-1 and CSV-5, were negative (desirable direction) and significant, while the susceptible parents CSV-8R and SPV-232 had positive and significant gca effects. Out of the 45 crosses evaluated, significant sca effects in the desired direction were observed in seven crosses for lodging, in three crosses for mean number of nodes crossed, and in two crosses for mean length of spread. Three crosses, i.e. M35-1 x CSV-8R, M35-1 x E36-1, and CSV-8R x E36-1, appear to be promising in obtaining desirable segregates in subsequent generations.

Key words: Sorghum, charcoal rot, combining ability.

The low yields of rabi sorghum (*Sorghum bicolor* (L.) Moench) have been attributed to temperature sensitivity of the present varieties, receding moisture status of the soil during post-rainy season, and susceptibility of the high yielding varieties to charcoal rot caused by *Macrophomina phaseolina* (Tassi) Goid. Of late, charcoal rot disease has assumed greater importance, particularly with the introduction of the cultivars CSV-8R and CSH-8R [1]. This paper analyses the nature of gene action for attributes related to charcoal rot resistance.

MATERIALS AND METHODS

The diallel mating system of Griffing's Model I Method 2 [2] was used to study the nature of gene action, involving ten parents, viz. SPV-232, SPV-104, M35-1, 296B, 2219B, CSV-8R, 36B, D-71396, E36-1 and CSV-5. The experiment was laid in randomised block

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design with three replications in sandy loam soils of the College Farm, Andhra Pradesh Agricultural University, Hyderabad during rabi season. The row-to-row and plant-to-plant spacings were 45 cm and 15 cm, respectively. The field was uniformly fertilized with 40 kg N, 40 kg P_2O_5 and 30 kg K_2O/ha as basal dose and 40 kg N/ha as top dressing when the crop was about one month old. Irrigation was stopped after the boot-leaf stage so as to create moisture stress, which is helpful in creating charcoal rot infection.

Inoculum. The pathogen was cultured [3] on wooden tooth picks in honey-peptone medium (peptone 1 g, honey 5 ml, distilled water 94 ml), incubated at 39°C for 7 days, and then used for field inoculation. The plants were inoculated two weeks after 50% flowering. A fungus-infected tooth pick was inserted obliquely into a hole made with an iron needle into the second internode of each stalk from ground level. Ten plants of each population per replication were inoculated and observations recorded on three attributes which describe the extent of charcoal rot infection: lodging, mean number of nodes crossed, and mean length of spread.

RESULTS AND DISCUSSION

Absolute resistance was not observed. Quantitative analysis is considered appropriate to describe the genetic nature of this character. Rana et al. [4] also reported that the study of segregating and nonsegregating generations elucidates continuous variation, indicating quantitative nature of resistance. The analysis of variance and components of variance due to combining ability for the three attributes of charcoal rot are presented in Table 1, and the mean performance and general combing ability (gca) effects of parents in Table 2. The component due to entries was highly significant for all the three attributes. Lodging was high in SPV-232, CSV-8R and SPV-104 (above 50%), and low in E36- 1, M35-1 and CSV-5 (below 25%). Mean number of nodes crossed was lower in E36-1, M35-1, 2219B and 36B (below 2.0), and higher in

Table 1. Analysis of variance and components of variance due to combining ability for attributes of charcoal rot

Source	d.f.	Lodging %	No. of nodes crossed	Length of spread
Blocks	2	264.5	0.5	111.1
Entries	54	1321.7**	2.1**	83.8**
Error	108	172.9	0.5	25.8
	ANOVA for combining ability			
gca	9	1666.3**	2.4**	97.8**
sca	45	195.7**	0.3**	13.9**
Error	108	57.6	0.1	8.6
$2\hat{\sigma}^2 g$ / $2\hat{\sigma}^2 g + \hat{\sigma}^2 s$		0.64	0.63	1.13
Heritability (h^2)		0.56	0.49	0.50

** Significant at 1% level.

SPV-232, CSV-8R and 296 B (above 3.0). Mean length of spread was also less in E36-1 and M35-1 (below 15 cm), and more in CSV-8R, SPV-232, 296B and D-71396 (above 20 cm). It is thus clear that E36-1 and M35-1 are good sources of resistance in respect of all the three attributes of charcoal rot, while CSV-8R and SPV-232 are clearly susceptible parents.

Significant gca and sca variances for all the three attributes of charcoal rot resistance were observed (Table 1). The mean performance and desirable (negative) significant sca effects of F_1 hybrids are presented in Table 3.

Table 2. Mean performance and gca effects of parents for attributes of charcoal rot

Parent variety	Mean performance			General combining ability effects		
	lodging (%)	No. of nodes crossed	length of spread (cm)	lodging (%)	No. of nodes crossed	length of spread (cm)
SPV-232	96.7	4.2	27.5	19.4**	0.8**	3.6*
SPV-104	73.3	2.7	16.6	7.1**	0.1	–0.6
M35-1	18.9	1.3	14.2	–16.5**	–0.7**	–3.4**
296B	34.0	3.3	21.2	–2.1	0.1	0.04
2219B	46.7	1.7	17.6	–2.6	–0.2	–1.1
CSV-8R	89.2	3.6	32.8	16.9**	0.5**	5.2**
36B	43.3	1.8	19.3	0.3	–0.02	1.8*
D-71396	33.3	2.7	20.6	–0.2	0.2	0.3
E36-1	0.0	0.0	6.2	–11.7**	–0.6**	–3.3**
CSV-5	23.3	2.7	18.9	–10.8**	–0.2	–2.5**
SE	5.16	0.54	3.18	2.08	0.11	0.80

For the component, lodging %, the parents M35-1, E36-1 and CSV-5 recorded highly significant negative gca effects (less lodging), whereas SPV-232, CSV-8R and SPV-104 recorded highly significant positive gca effects (Table 2). Twenty-four F_1 recorded negative sca effects of which seven were significant. The highest negative sca effect was exhibited in the cross SPV-232 x M35-1, followed by CSV-8R x D-71396 and SPV-104 x CSV-5 (Table 3). Similarly for the attribute, mean number of nodes crossed, two parents M35-1 and E36-1 recorded highly significant negative gca effects, whereas two other parents, SPV-232 and CSV-8R, recorded highly significant positive gca effects (Table 2). Twenty-four F_1 showed negative sca effects, of which, only three i.e. SPV-232 x M35-1, SPV-232 x 2219B and SPV-232 x 296B, were significant (Table 3). For the third component studied, mean length of spread, three parents, M35-1, E36-1 and CSV-5, recorded highly significant negative gca effects, whereas the parents CSV-8R and SPV-232 recorded highly significant positive gca effects. The parent 36B also recorded significant positive gca effect (Table 2). Twenty-one F_1

recorded negative sca effects, of which only two, CSV-8R x D- 71396 and SPV-232 x M35-1, were significant (Table 3). Thus the only one cross SPV-232 x M35-1 showed negative significant sca effects for all the three attributes measuring charcoal rot.

As regards association of lodging with charcoal rot, the susceptible parents SPV-232 and CSV-8R had lodging above 89% against no lodging in E36-1 and 19% lodging in M35-1. Anahosur et al. [5] also reported that M35-1 was standing, while CSV-8R was completely lodged. Similar results were also reported by others [6, 7]. E36-1 was reported to be one of the most resistant sources [8, 9]. None of the crosses had lodging below 20%. However, crosses with the resistant parents E36-1 and M35-1 resulted in lower lodging (upto 25%), low mean number of nodes crossed (upto 1.3), and less mean length of spread (upto 15.0 cm).

Combining ability analysis showed that lodging per cent and mean number of nodes crossed had slightly higher sca variance compared to mean length of spread where gca variance was slightly high (Table 1). The parents M35-1, E36-1 and CSV-5 had desirable gca effects. Since additive variance is prevalent, selection is possible in the resistant x susceptible crosses. As reported by Indira et al. [10], no absolute resistance could be obtained in our study as well. Heritability of the three attributes was moderate (0.49 to 0.56). Hence continuous selection for gene-pyramiding will be helpful to attain a high degree of resistance. Three crosses, viz. M35-1 x CSV-8R, CSV-8R x E36-1 and M35-1 x E36-1, are considered useful in obtaining segregates combining yield with charcoal rot resistance, as one of the parents in these crosses is well adapted variety and the other a good source of resistance.

Table 3. Crosses showing desirable significant sca effects and their mean performance for attributes of charcoal rot

Cross	Mean performance	Sca effects
Lodging %		
SPV-232 x M35-1	21.8	-28.8**
SPV-232 x 296B	46.7	-18.4**
SPV-232 x 2219B	48.6	-16.0*
SPV-104 x CSV-8R	55.7	-16.1*
SPV-104 x E36	24.4	-18.8**
SPV-104 x CSV-5	24.5	-19.5**
CSV-8R x D-71396	43.3	-21.1**
Mean No. of nodes crossed		
SPV-232 x M35-1	1.3	-1.1**
SPV-232 x 296B	2.4	-0.8*
SPV-232 x 2219B	2.0	-0.9*
Mean length of spread (cm)		
SPV-232 x M35-1	15.0	-5.6*
CSV-8R x D-71396	19.7	-6.2*

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