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SOME OF THE POTENTIAL DONORS FOR THE GRAIN MOLD RESISTANCE IN *KHARIF* SORGHUM

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Abstract

General combining ability analysis in ten parental lines of kharif sorghum revealed that among the ten parents, five parents *viz.*, IS 14384, GMPR 65, IS 14332, GM 9219 and SVD 9601 appeared to be potential donor parents for exploitation in grain mold resistance breeding because of the desirable and significant *gca* effects for germination percentage along with some other components in both F_1 and F_2 generations. Non additive type of gene action was noticed for almost all the characters in both F_1 and F_2 generations.

Key words : Combining ability, *gca*, germination, grain mold.

Introduction

Grain mold is one of the major diseases of kharif sorghum affecting both the yield as well as the quality of the produce. With the help of general combining ability analysis potential donor parents for the parameters associated with grain mold resistance can be identified and used further in the grain mold resistance breeding programme. The present study was undertaken to identify the potential parental lines exhibiting good general combining ability for the parameters associated with grain mold resistance in kharif sorghum.

Materials and Methods

The experimental material consisted of ten parents (SVD 9601, GM 9219, IS 14332, AKMS 14 B, IMS 9 B, MS 296 B, ICS 70 B, MS 27 B, IS 14384 and GMPR 65) the forty five F_1 crosses developed by crossing these ten parents in half-diallel (excluding reciprocals) fashion and forty five F_2 progenies obtained by selfing of the forty five F_1 crosses. The experiment was conducted during kharif 2007-08 at the Sorghum Research Unit, Dr. P.D.K.V., Akola (M.S.), India. The experiment was laid out in randomized block design with spacing of 45 × 15 cm. in three replications. Five spore inoculated plants were randomly selected from each entry in each replication for recording the observations and the observations were days to 50% flowering, grain yield (g), glume coverage (%), 100 seed weight (g), seed hardness (kg/cm^2), grain density (g/ml), water absorption capacity (g), electrical conductivity of grain leachates (ms/ppt), germination (%), fungal load of *Fusarium moniliforme* (%), fungal load of *Curvularia lunata* (%) and fungal load of other species (%). In case of F_2 progenies, all the observations as in F_1 crosses except fungal load of *Fusarium moniliforme* (%), fungal load of *Curvularia lunata* (%) and fungal load of other species (%) were recorded on the fifteen spore inoculated plants. Combining ability analysis was done using method II, model I of Griffing (1956 b).

Results and Discussion

Combining ability analysis was carried out for 12 characters in F_1 crosses and 9 characters in F_2 progenies. The variance existing due to treatments was further partitioned using appropriate expectations of the observed mean squares into components of variations attributable to general combining ability (*gca*) variance and specific combining ability (*sca*) variance (table 1).

Denis and Girad (1977) reported loss in viability to be very important part of the grain mold syndrome and recommended the germination test as part of the standard evaluation for identification of grain mold resistance. Accordingly, in this study also the superior parental lines

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Table-1:: Analysis of variance for combining ability of F_1 and F_2 crosses.

Source of variation	DF	Generation	Mean squares											
			DTF	**GY**	**GC**	**HSW**	**SH**	**GD**	**WAC**	**EC**	**GP**	**FL-F**	**FL-C**	**FL-O**
GCA	**9**	F_1	45.54**	391.99**	198.54**	0.32**	5.81**	0.01**	0.03**	0.50**	201.53**	112.89**	96.001**	71.08**
	9	F_2	35.70**	36.27**	168.84**	0.48**	2.95**	0.006**	0.07**	0.26**	135.67**	-	-	-
SCA	**45**	F_1	17.04**	125.28**	99.34**	0.16**	0.69**	0.01**	0.03**	0.09**	41.39**	36.36**	30.94**	39.56**
	45	F_2	25.03**	38.67**	108.30**	0.07**	0.29**	0.003**	0.03**	0.03**	22.63**	-	-	-
Error	**108**	F_1	2.96	2.61	1.02	0.02	0.03	0.0001	0.0001	0.0001	1.36	0.04	0.05	0.45
	108	F_2	5.18	11.67	1.37	0.01	0.05	0.0001	0.0001	0.0002	0.97	-	-	-
σ^2 gca		F_1	3.30	32.45	16.46	0.03	0.48	0.0001	0.003	0.04	16.68	9.40	8.00	5.89
		F_2	2.54	2.05	13.96	0.04	0.24	0.0001	0.01	0.02	11.23	-	-	-
σ^2 sca		F_1	14.08	122.67	98.32	0.14	0.66	0.01	0.03	0.09	40.03	36.32	30.89	39.11
		F_2	19.85	27.0	106.93	0.06	0.24	0.003	0.03	0.003	21.66	-	-	-
σ^2 sca/		F_1	0.23	0.26	0.17	0.18	0.73	0.10	0.10	0.49	0.42	0.26	0.26	0.15
σ^2 sca		F_2	0.13	0.08	0.13	0.69	1.004	0.19	0.21	0.64	0.52	-	-	-

*, ** = Significant at 5% and 1% levels, respectively

DF-Degrees of freedom, **DTF**-Days to 50 % flowering, **GY**- Grain yield (g), **GC**-Glume colour, **HSW**- 100 Seed weight, **SH**- seed hardness(kg/cm^2), **GD**-Gain density(g/ml), **WAC**-Water absorption capacity(g), **EC**- Electrical conductivity of grain leachates (ms/ ppt), **GP**-Germination(%), **FL-F**-Fungal load of *Fusarium moniliforme* (%), **FL-C**-Fungal load of *Curvularia lunata* (%), **FL-O**-Fungal load of other species (%).

(table 1) having significantly high general combining ability effects for germination percentage and its component traits have been identified.

It was observed form table 2 that none of the parents proved to be the best general combiner for all the traits under study. However, the parent IS 14384 was found to possess desirable *gca* for ten characters out of the twelve characters observed in F_1 and five out of nine characters studied in F_2 diallel progenies. Parent IS 14384 transmitted genes for minimum days to 50 per cent flowering, higher grain yield, higher 100 seed weight, higher grain density, lower water absorption capacity, lower electrical conductivity of grain leachates, higher germination percentage, minimum fungal load of *Fusarium moniliforme*, fungal load of *Curvularia lunata* and fungal load of other species in F_1 generation while in F_2 generation, it transmitted minimum days to 50 per cent flowering, higher 100 seed weight, lower water absorption capacity, lower electrical conductivity of grain leachates and higher germination percentage.

Second parent GMPR 65 was found to be good general combiner for nine characters like higher grain yield, higher 100 seed weight, more seed hardness, higher grain density, lower electrical conductivity of grain leachates, higher germination percentage, minimum fungal load of *Fusarium moniliforme*, fungal load of *Curvularia lunata* and fungal load of other species in F_1 generation while in F_2 generation it transmitted the seven characters like lower glume coverage, higher 100 seed weight, more seed hardness, high grain density, lower water absorption capacity, lower electrical conductivity of grain leachates and higher germination percentage.

Another potential parent for grain mold resistance IS 14332 was identified to contribute favourable genes for eight traits like minimum glume coverage, higher seed hardness, lower water absorption capacity, lower electrical conductivity, higher

Table 2 : Estimates of general combining ability effects of parents from F_1 crosses.

Characters →	Gener-ation	DTF	GY	GC	HSW	SH	GD	WAC	EC	GP	FL-F	FL-C	FL-O
Parents ↓													
SVD 9601	F_1	0.38	-0.99*	-2.92**	0.10*	1.13**	-0.04**	-0.02**	-0.14**	2.72**	0.73**	1.85**	5.23**
	F_2	0.02	-0.56	0.31	0.11**	0.84**	-0.03**	0.17**	-0.08**	3.08**			
GM 9219	F_1	2.16**	1.70**	-0.79**	0.18**	0.73**	-0.002	0.03**	-0.24**	3.93**	-1.19**	0.47**	0.06
	F_2	3.86**	-0.56	5.20**	0.14**	0.68**	-0.03**	-0.03**	-0.16**	4.32**			
IS 14332	F_1	0.40	-8.07**	-4.72**	-0.26**	0.41**	-0.04**	-0.09**	-0.27**	5.83**	-5.79**	-4.64**	-0.78**
	F_2	-1.09	2.39*	6.21**	-0.33**	0.08	-0.03**	-0.06**	-0.15**	3.08**			
14 B	F_1	-3.80**	-7.99**	-4.73**	0.04	-0.54**	-0.01**	-0.01**	-0.05**	-2.93**	2.35**	2.12**	1.79**
	F_2	-1.98**	-3.93**	-4.12**	-0.23**	-0.53**	-0.001	-0.10**	0.07**	-2.43**			
9 B	F_1	1.90**	-2.79**	3.46**	-0.10*	-0.18**	0.02**	0.01**	0.15**	-2.46**	3.33**	0.90**	1.47**
	F_2	1.63*	0.82	-2.43**	-0.13**	-0.34**	0.02**	0.04**	0.10**	-4.78**			
296 B	F_1	1.65**	0.71	1.82**	-0.28**	-1.10**	0.01**	0.01**	0.42**	-6.24**	2.06**	0.22**	0.05
	F_2	0.72	0.72	-2.46**	-0.20**	-0.58**	0.004	0.02**	0.32**	-3.73**			
70 B	F_1	0.23	-2.83**	1.80**	-0.02	-0.83**	0.01*	-0.01**	0.11**	-3.77**	2.83**	2.39**	-1.30**
	F_2	-0.92	0.67	-3.70**	0.20**	-0.18**	0.01**	0.04**	0.04**	-1.66**			
27 B	F_1	-2.05**	4.42**	5.95**	0.10*	0.04	0.02**	-0.06**	-0.05**	2.55**	-3.25**	-4.23**	-2.78**
	F_2	0.05	-1.39	0.06	0.06	-0.32**	0.04**	-0.03**	0.04**	-2.61**			
IS 14384	F_1	0.45	7.87**	4.61**	0.16**	0.37**	0.04**	0.04**	-0.01**	3.34**	-2.67**	-2.50**	-3.21**
	F_2	-1.42*	1.21	3.46**	0.16**	-0.06	0.001	-0.02**	-0.13**	1.80**			
GMPR 65	F_1	0.47	0.44	0.28	0.04	0.04	0.003	0.001	0.003	0.32	0.05	0.06	0.18
	F_2	-0.87	0.64	-2.54**	0.21**	0.41**	0.02**	-0.03**	-0.05**	2.94**			
SE (m) (gi)	F_1	0.93	0.88	0.55	0.08	0.09	0.01	0.003	0.01	0.63	0.11	0.12	0.36
	F_2	0.62	0.94	0.32	0.03	0.06	0.003	0.003	0.003	0.27			
CD 5% (gi)	F_1	0.93	0.88	0.55	0.08	0.09	0.01	0.003	0.01	0.63	0.11	0.12	0.36
	F_2	1.24	1.86	0.64	0.06	0.12	0.01	0.01	0.01	0.53			

Table 2 continued....

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CD 1% (gi)	F_1	1.24	1.16	0.73	0.11	0.12	0.01	0.004	0.01	0.84	0.14	0.15	0.48
	F_2	1.64	2.46	0.84	0.08	0.16	0.007	0.007	0.01	0.71			
SE (m) (gi-gj)	F_1	0.70	0.66	0.41	0.06	0.07	0.004	0.002	0.004	0.48	0.08	0.09	0.27
	F_2	0.93	1.40	0.48	0.04	0.09	0.004	0.004	0.01	0.40			
CD 5% (gi-gj)	F_1	1.39	1.31	0.82	0.12	0.13	0.07	0.004	0.01	0.94	0.16	0.17	0.54
	F_2	1.84	2.77	0.95	0.09	0.18	0.01	0.01	0.01	0.80			
CD 1% (gi-gj)	F_1	1.84	1.73	1.08	0.16	0.17	0.01	0.01	0.01	1.25	0.21	0.23	0.72
	F_2	2.44	3.66	1.25	0.12	0.23	0.01	0.01	0.01	1.05			

+ = Significant and desirable general combining ability estimates, - = Nonsignificant or undesirable general combining ability estimates
DF- Degrees of freedom, **DTF**- Days to 50 % flowering, **GY**- Grain yield (g), **GC**- Glume colour, **HSW**- 100 Seed weight, **SH**- seed hardness(kg/cm^2), **GD**- Gain density(g/ml), **WAC**- Water absorption capacity(g), **EC**- Electrical conductivity of grain leachates (ms/ ppt), **GP**- Germination (%), **FL-F**- Fungal load of *Fusarium moniliforme* (%), **FL-C**-Fungal load of *Curvularia lunata* (%), **FL-O**- Fungal load of other species (%).

germination percentage, lower fungal load of *Fusarium moniliforme*, fungal load of *Curvularia lunata* and fungal load of other species in F_1 generation and in F_2 diallel progenies four characters like higher grain yield, lower water absorption capacity, lower electrical conductivity and higher germination percentage.

Parent GM 9219 also showed desirable *gca* effects for seven important characters *viz.*, higher grain yield, lower glume coverage, higher 100 seed weight, more seed hardness, lower electrical conductivity, higher germination percentage and lower fungal load of *Fusarium moniliforme* in F_1 crosses. The same parent showed desirable *gca* effects for five important characters *viz.*, higher 100 seed weight, more seed hardness, lower water absorption capacity, lower electrical conductivity and higher germination percentage in F_2 progenies.

Parent SVD 9601 also showed desirable *gca* effects for six important traits like lower glume coverage, higher 100 seed weight, higher seed hardness, lower water absorption capacity, lower electrical conductivity and higher germination percentage in F_1 crosses. The same parent showed desirable *gca* effects for four important characters *viz.,* higher 100 seed weight, more seed hardness, lower electrical conductivity and higher germination percentage.

Rest of the parents did not exhibited significant *gca* for the important characters like germination percentage and other grain mold related traits. Ghorade *et al.* (1998) and Wadikar and Jagtap (2010) in their study also identified some of the parents showing high gca effects for the grain mold resistance parameters.

The general and specific combining ability variances for the traits studied indicated the gene action associated with them. From the plant breeding point of view, knowledge of type of gene action involved is useful in the choice of the most appropriate breeding procedure. Broadly general combining ability variances indicate additive gene action and additive × additive interaction effects, while specific combining ability effects corresponds with non-additive gene action like dominance and other epistatic interaction *viz*., additive × dominance and dominance × dominance (Griffing, 1956a). It was found in the present study that in F_1 generation non-additive type of gene action was observed for all the twelve characters while in F_2 generation non additive type of gene action was noticed for all the characters except for seed hardness for which additive as well as non additive type of gene action was found. Thus, improvement for grain mold and its associated traits would be possible by the heterosis breeding.

Thus, from the summery performance indicated above for the grain mold associated characters, the above mentioned five parents *viz.,* IS 14384, GMPR 65, IS 14332, GM 9219 and SVD 9601 could be identified as the potential donors for grain mold resistance in kharif sorghum. Since a high general combining ability corresponds with additive and additive × additive interaction (Griffing, 1956 b) and represents the fixable genetic component of variation, these parents appeared to be worthy of exploitation in recombination breeding programme for grain mold resistance breeding.

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