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LINE × TESTER ANALYSIS FOR GRAIN YIELD AND GRAIN MOLD PARAMETERS IN *KHARIF* SORGHUM

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KEYWORDS

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ABSTRACT

Combining ability for grain yield and its components was studied using two male sterile lines and four testers. Mean squares due to lines, testers and line x tester were high and significant indicating the presence of high variability. The estimates of general combining ability (GCA) and specific combining ability (SCA) variances indicated presence of higher non- additive gene action for all the characters studied. The parents PMS 28 B, 6938 B, KR 192, C 43 and TC 43 were good general combiners and the crosses 6938A x C 43, PMS 28A x KR 192 were indentified with high SCA for grain yield. It was concluded from the present study that there is need to extensively use one line PMS 28B and two restores C43 and KR 192 which showed high GCA effects for grain yields, its contributing traits and most of the grain mold parameters in hybridization programme to develop high yielding hybrids in *kharif* sorghum.

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INTRODUCTION

Sorghum (*Sorghum bicolor* (L.) Moench) is the fourth most important cereal following rice, wheat and maize. It is a staple food in the semi-arid parts of the world and well recognized for its drought resistance and is the most suitable for dry region. With a shift in an approach from subsistence agriculture to quantum jump in production, it has become pertinent to stabilize yields of sorghum, through the utilization of high yielding hybrids and varieties. These hybrids though high yielding are coupled with few drawbacks such as susceptibility to pest and diseases.

Grain mold is complex disease causing enormous loss in rainy season sorghum in the years of prolonged rainfall at time of crop maturity. This is one of the major reasons for the replacement of the *kharif* sorghum with other crops. Information on genetics of grain mold resistance and mechanism is required to facilitate breeding of resistance cultivars. In the development of the high yielding hybrids, the identification of the potential parental lines is of prime importance. Selection of parents on the basis of phenotypic performance alone is not a sound procedure since phenotypically superior lines may yield poor recombination. It is therefore, essential that parents should be chosen on the basis of their genetic value (Krupakar *et al.*, 2013). Combining ability analysis in sorghum has been reported by several workers including Sheriff and Prasad (1994), Pillai *et al.*, (1995), Jain and Patel (2014) Prabhakar and (2015) Kalpande *et al.,* (2015) revealed that among the lines, AKRMS-47 A was the best general combiner for yield per plant along with other component characters i.e. plant height and thousand grain weight. Patil *et al.*, (2015) observed the presence of higher magnitude of non-additive gene action for most of the characters in the study on combing ability using three cytoplasmic male sterile lines and fifteen testers. Combining ability analysis is a useful tool to identify suitable parents. In addition to giving information regarding selection of parents. It also elucidate the nature and magnitude of different types of gene actions involved. This is important in formulation and execution of efficient breeding programme to accomplish maximum genetic upgrading with available resources in minimum time. The present study was undertaken with the objective to identify the promising parental lines for grain yield, its components and grain mold parameters using combining ability analysis. using combining ability analysis.

MATERIALS AND METHODS

Two male sterile lines (PMS 28A and 6938A) were crossed with four testers (KR 196, KR 192, C 43 and TC 43) in line x tester mating design to produce eight hybrids during summer season of 2008. The resulting eight hybrids along with their six parents and four checks *viz.* PVK 400, PVK 801, GMRP 9 and CSH 16 were sown during *kharif* 2008 at Sorghum research Station, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. The entries were planted in a randomized block design with three replications, each consisting two rows of 3 m length with 45 x 15 cm plant spacing. Observations were recorded on five randomly selected plants in each entry from each replication for days to 50% flowering, days to

maturity, plant height, panicle length, panicle girth, panicle weight, grain yield per plant, test weight, field grade score, grain hardness, seed density and germination percentage. The data was statically analyzed as described by Kempthorne (1950).

RESULTS AND DISCUSSION

The analysis of variance for line x tester design indicated significant differences due to the parents and crosses for most of the characters under study. High magnitude of variance due to lines and testers against line x tester for most of the characters indicated the presence of considerable variability among the female lines and testers (Table 1). These results are in agreement with those published earlier for days to 50% flowering and grain yield (Veerbadhiran *et al.,* 1995), test weight, panicle weight, panicle length, panicle girth and weight, (Pillai *et al.,* 1995) and days to 50% flowering, plant height, grain yield per plant, test weight and grain mold parameters *viz*. threshed grade scores and germination percentage (Vaidya, 2000 and Khapre *et al.,* 2003). The components of variance due to GCA and SCA revealed that variances due to SCA were larger than GCA for almost all the characters indicating the predominance of non-additive gene action. This was supported by the less than unity ratio of $ó^2$ GCA: $ó^2$SCA.

The estimates of GCA effects (Table 2) revealed that the parents PMS 28B, KR 192, TC 43 and C 43 were the best general combiners for grain yield, PMS 28B, KR 192 and KR 191 had recorded high GCA for panicle length, Panicle girth and panicle weight. Thus, it would be worthwhile to use above parents in breeding programme for exploitation of additive gene effects. Prabhakar and Raut, 2010 and Ghorade *et al.*, 2014 also reported the promising general combiners for yield and its components from their study. While 6938B and C43 had given GCA for earliness in flowering and maturity in positive direction. The parental lines PMS 28B, KR 191 and KR 192 showed high GCA effects for most of the grain mold parameters. In most of the parents higher GCA effects were associated with high *per se* means for yield and yield contributing characters. The results are in agreements with Khapre *et al.,* (2000) and Vaidya (2000).

The understanding of GCA effects together with *per se* performance of parents and crosses provide guidelines for their further use of generating useful breeding material. In general, good combiners for grain yield also had good or average combining ability for one or more of the yield components along with grain mold parameters.

The magnitude of SCA effects for yield and its components shown in Table 3 indicated the almost all the characters distinctly differed for both positive and negative directions, The Cross PMS 28A x KR 191, exhibited highest negative SCA effects. The estimates of SCA effects revealed that 4 out of 8 crosses were having significantly desirable SCA effects for increased yield. The best SCA effects and the highest *per se* performance were noted in the crosses 6938A x C43, MS 28A x C 43, PMS 28A x KR 192 and PMS 28A x C 43. The cross

Table 1: Analysis of varience (mean square) for different traits in sorghum

Charectres	Line x tester analysis				Estimation of variance componants			
	Lines	Testers	L xT	Error	Lines	Testers	GCA	SCA
Days to 50% flowering	161.10**	9.93	7.45**	2.06	7.68	0.24	0.28	27.29
Days to maturity	64.67**	18.10**	14.65**	0.65	3.13	0.35	0.15	15.65
Plant height (cm)	292500**	1692.00**	560.30**	4.19	118.20	113.20	8.89	816.32
Panicle length (cm)	41.61**	8.36	5.32**	1.53	2.27	0.30	0.11	8.19
Panicle girth (cm)	3.55**	4.99**	0.82**	0.70	0.17	0.42	0.027	1.15
Panicle weight (g)	35.19	282.70**	89.94**	0.24	-3.42	19.28	0.77	0.66
Grain yield per plant	180.20**	872.70**	256.90**	15.74	-3.83	61.37	2.36	198.28
Test weight (g)	275.80	31.78**	10.68	0.88	13.26	2.11	0.56	49.78
Field grade score	2.62	1.43	0.38	0.04	0.11	0.10	0.00	0.67
Threshed grade score	2.00	1.30	0.25	0.01	0.08	0.10	0.00	0.52
Grain hardness (kg/cm2)	5.02**	3.63**	2.85	0.11	0.10	0.07	0.00	1.81
Seed density (g/cm2)	30.00	0.001**	0.02**	0.0002	0.003	0.001	0.00	0.03
Germination(%)	431.80**	116.50**	80.26**	1.39	17.57	3.65	0.78	100.14

Table 2: general combining ability effect (GCA) for various characters.

Genotypes	Days to 50 % flowering	Days to maturity	Plant height	Panicle length	Panicle girth	Panicle weight	Grain yield per plant	Test weight	Field grade	Threshed grade	Grain hardness score	Seed density score	Germination (%)
Lines													
PMS 28B	-2.45**	0.73**	6.02**	1.55**	0.60**	1.73**	2.27**	2.52**	-0.40**	0.20**	0.63**	0.002**	7.10**
6938B	-0.95**	-1.95**	-7.99	1.30**	-0.43**	-0.50**	-1.89	-1.17	-0.13	-0.14**	-0.47**	0.006**	-4.15**
SE+	0.32	0.20	0.45	0.25	0.20	1.12	0.26	0.14	0.21	0.04	0.07	0.01	0.26
Testers													
KR 191	-0.15	2.31	-8.40**	1.11**	-0.15	3.26**	1.87	2.43**	0.08	-0.25**	0.36**	0.03**	-1.20**
KR 192	1.35**	-1.11**	2.69**	1.31**	1.62**	1.2**	4.36	-1.4	-0.19**	-0.97**	-0.50**	-0.06**	5.01**
TC 43	-0.85	1.48	9.48**	0.55	0.26	-6.12**	0.45	1.89**	-0.94**	-0.3	0.59**	0.08**	4.06**
C 43	-0.45	-1.18**	-4.03**	-1.20**	-0.48	-1.57**	1.02	-1.12	0.13	-0.10	-0.04	0.3**	-1.05
SE+	0.45	0.25	0.64	0.39	0.26	0.15	0.33	0.05	0.06	0.06	0.10	0.00	0.37

Table 3: Response of SCA effects for yield and yield components.

Characters	Negative	Total	Positive	Total	SE+
Days to 50% flowering	0.7-2.40	5	1.75-5.20	3	1.01
Days to maturity	1.94-3.71	3	0.68-5.62	5	0.78
Plant height (cm)	2.12-13.35	4	1.38-15.14	4	1.44
Panicle length (cm)	0.75-1.9	3	0.28-2.30	5	0.83
Panicle girth (cm)	0.21-0.99	5	0.21-1.47	3	1.23
Panicle weight (g)	1.81-4.76	3	3.88-10.64	5	0.49
Grain yield per plant	1.38-1.92	4	6.66-17.67	4	2.8
Test weight (g)	0.51-2.16	5	0.29-5.14	3	0.66
Field grade score	0.04-0.61	6	0.10-0.88	2	0.14
Threshed grade score	0.08-0.66	6	0.04-0.40	2	0.15
Grain hardness (kg/cm2)	0.45-1.042	2	0.34-3.54	6	0.22
Seed density (g/cm2)	0.01-0.08	5	0.02	3	0.02
Germination(%)	-1.29	1	0.20-7.61	7	0.83

PMS 28A x KR 192 had both parents showing high GCA effects. The same cross had desirable SCA effects for field grade score, grain hardness, threshed grade score and germination percentage. This cross could be shown in the areas where grain mold incidence is very high. Other crosses either involved poor x poor or good x poor gca combinations. This is in confirmatory with (Patel *et al.,* 1990, Khapre *et al.,* 2000 and vaidya, 2000).

Thus it was concluded from the present study that there is need to extensively use one line PMS 28B and two restores C43 and KR 192 which showed high GCA effects for grain yields, its contributing traits and most of the grain mold parameters in hybridization programme to develop high yielding hybrids in *kharif* sorghum.

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