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Short Communication

Combining ability analysis over the environments for harvest index and its components in sorghum [*Sorghum bicolor* (L.) Moench]

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Harvest index measures the physiological efficiency of the plants [1]. Breeders have recognized the importance of a favourable harvest index in terms of partitioning of photosynthates to economically important plant parts. Improvement in sorghum have been concentrated primarily on those traits, which have direct bearing on grain yield, eventhough harvest index in local and hybrids of sorghum has been reported up-to 29 and 50 per cent, respectively [2, 3]. Thus, there is a greater need for genetic manipulations to increasing the harvest index in sorghum. The present investigation was an attempt to obtain information on combining ability of harvest index, grain yield and related characters over the environments in sorghum by taking seven grain sorghum genotypes representing fairly wide range of genetic diversity were crossed in diallel fashion (without reciprocals). Twenty-eight genotypes including parents and their crosses were evaluated in a randomized block design with three replications in four environments, which were created by growing these genotypes in two successive seasons *viz.*, *kharif* 2001 and *kharif* 2002 along with two fertilizers doses *viz.*, recommended dose of fertilizers i.e. 80 kg N: 40 kg P_2O_5/ha and half of the recommended dose of fertilizers *i.e.* 40 kg N: 20 kg P_2O_5/ha. Each genotype was planted in single row of 3-meter length with 45 cm × 15 cm plant geometry. The data were recorded on nine quantitative characters (Table 1) on a sample of 10 randomly selected plants/replication/environment in each genotype. The pooled combining ability analysis was done following [4-6].

Pooled analysis of variance revealed significant variation among genotypes for all the traits indicating adequate genetic variability among all the genotypes used in present study. Pooled analysis of variance for combining ability revealed that *gca* and *sca* variances were significant for all the characters except plant height for *gca* indicating the importance of both additive and non-additive genetic variances in the inheritance of these traits. Wide differences between environments were revealed from the significant mean squares due to environments for all the traits under study. Both *gca* and *sca* showed significant interaction with environments for most of the characters indicated that the estimates of both additive as well as non-additive gene effects were prone to change with the environment

SPV 1134 is identified as good general combiner for harvest index, plant height grain, yield and biological yield as it showed significant and positive *gca* effect for harvest index on pooled analysis. Further, SPV 1333 was good general combiner for grain yield, test weight, green fodder yield, dry fodder yield and biological yield as these traits showed significant and positive pooled *gca* effects, while line ICSV 272 and GM 973445 identified as good general combiner for earliness (Table 1). Pooled effects of specific combining ability revealed that two crosses *viz.*, SPV 1134 × GM 973445 and SPV 1333 × ICSV 272 were identified as most superior cross combinations for harvest index, grain yield, green fodder yield, dry fodder yield, biological yield and test weight as these crosses showed significant *sca* effects of these characters. Cross combinations SPV 1134 × SPV 1329 and SPV 1329 × SPV 1201 exhibited significant *sca* effects in positive direction for harvest index along with number of leaves, grain yield, dry fodder yield and biological yield indicating their superiority for these characters. Significant *sca* effects in negative direction were also observed for days to 50% flowering in these four crosses. Majority of these cross combinations involved either good × good or good × poor general combining ability parents hence these crosses would give good transgressive segregants in segregating generations.

The conclusion that can be reached from present results is that cross combinations *viz.*, SPV 1134 × GM 973445, SPV 1134 × SPV 1329, SPV 1333 × ICSV 272 and SPV 1329 × SPV 1201 were found

Table 1. Pooled estimates of general combining ability and specific combining ability effects for various characters in sorghum over four environments

Genotypes	Days to 50% flowering	Plant height (cm)	Number of leaves/ plant	Grain yield/plant (g)	Test weight (g)	Green fodder yield/plant (g)	Dry fodder yield/plant (g)	Biological yield/plant (g)	Harvest index (%)
SPV 1134	0.28*	5.54*	–120.07	3.47**	0.19	0.19	–0.15	3.61**	0.82*
SPV 1333	0.53**	0.44	93.08	3.78**	1.23**	1.23**	5.87**	10.85**	–0.14
ICSV 298	0.39**	0.12	14.84	–4.99*	–0.26*	–0.26*	–3.98*	–9.79*	–0.68*
SPV 1329	0.58**	–1.53	130.15	–0.29	0.68**	0.68**	3.73**	2.75*	–0.57
SPV 1201	0.04	–3.61	5.86	–2.36*	0.48*	0.48*	2.31*	–4.74*	0.34
ICSV 272	–0.36*	–3.54	–50.19	1.00	–1.14*	–1.14*	4.18*	–4.32*	0.17
GM 973445	1.46*	2.58	61.95	1.40*	0.23	4.23	1.02	1.65	0.07
SPV 1134 × SPV 1333	0.20	6.64	337.47	0.94	0.55	0.55	11.34**	10.77**	–3.42**
SPV 1134 × ICSV 298	–1.23**	7.62	509.80*	3.67*	0.38	0.38	8.92**	12.06**	0.29
SPV 1134 × SPV 1329	1.25**	2.10	837.36**	16.46**	1.00**	1.00**	11.96**	28.52**	2.30*
SPV 1134 × SPV 1201	–1.55**	–8.06	118.38	0.13	2.46	2.46**	0.42	2.50	–0.79
SPV 1134 × ICSV 272	–0.31	11.12	352.43	13.26**	0.05	0.05	18.56**	31.69**	1.51
SPV 1134 × GM 973445	–1.88**	–7.67	47.00	36.61**	1.11**	1.11**	1.73	42.26**	7.47**
SPV 1333 × ICSV 298	–0.73*	3.53	228.23	–0.31	0.96*	0.96*	2.60	2.44	–0.10
SPV 1333 × SPV 1329	–1.33**	3.79	364.82	8.52**	3.66**	3.66**	3.17	–4.33	2.18*
SPV 1333 × SPV 1201	–1.38**	–1.79	264.23	3.39*	0.05	0.05	10.03**	18.98**	–0.52
SPV 1333 × ICSV 272	0.98**	–2.19	2850.12**	44.86**	1.17**	1.17**	30.22**	77.80**	4.37**
SPV 1 333 × GM 973445	–1.30**	1.93	286.30	11.21**	0.22	0.22	17.89**	24.95**	0.00
ICSV 298 × SPV 1329	–1.53**	7.94	248.47	3.34*	0.60	0.60	–0.38	4.25	0.62
ICSV 298 × SPV 1201	0.07	4.44	833.65**	14.00**	0.03	–0.03	18.86**	33.77**	0.44
ICSV 298 × ICSV 272	–0.09	4.79	398.55	–7.53**	0.33	0.33	0.73	–8.37*	–1.54
ICSV 298 × GM 973445	0.18	6.58	1580.82**	0.09	2.50**	2.50**	5.48*	5.74	–1.41
SPV 1329 × SPV 1201	0.41	10.09	675.83**	23.71**	0.68	–0.68	25.76**	48.17**	2.02*
SPV 1329 × ICSV 272	–2.61**	22.10**	724.80**	2.77	0.16	–0.16	5.42*	–2.05	2.79**
SPV 1329 × GM 973445	–1.59**	15.14*	673.24**	4.12**	0.01	0.01	8.47**	11.08**	1.19
SPV 1201× ICSV 272	0.76*	22.27**	85.40	–11.74**	1.38**	1.38**	–2.54	16.97**	2.95**
SPV 1201 × GM 973445	0.44	–5.44	353.70	8.53**	0.30	0.30	0.45	8.25*	4.00**
ICSV 272 × GM 973445	0.59	–5.76	–814.48**	–8.58**	–0.23	–0.23	–0.16	–9.40**	-1.18

*,**Significant at 5% and 1% level, respectively

most superior cross combinations for harvest index, grain yield and some of its component characters. These cross combinations were involved either good × good or good × poor general combiner parents for these traits. Hence, present results signifying the importance of exploitation of both additive and non-additive type of gene effects for attaining improvement in yield without affecting harvest index and also suggest that diverse good combiners should be used in hybridization and the resultant material should be exposed to different environments for identifying the stable high yielding genotypes.

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