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COMBINING ABILITY ANALYSIS OF HARVEST INDEX AND SOME COMPONENTS OF HARVEST INDEX IN SORGHUM

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ABSTRACT

Six genotypes of sorghum, selected on the basis of maturity duration, plant height, and grain yield, were crossed in half-diallel fashion. Combining ability analysis revealed that mean sum of squares of gca and sca were significant for days to 50% flowering, harvest index, dry wt. of leaves and stem, primary branches/panicle, and grains/primary branch. Varieties SPV 472 and SPV 475 were identified as desirable combiners for harvest index on the basis of their gca effects. Crosses SPV 472 × 2077 B and SPV 475 × 2219 B were superior combinations for this character on the basis of their sca effects.

Key words: Combining ability, harvest index, sorghum.

Sorghum genotypes manifest variability for dry matter accumulation [1–3]. Local varieties, which are usually late in maturity, produce more dry matter per plant. However, only 29% of dry matter is in the form of grains, as against 50% in the high yielding hybrids [3]. Efficient partitioning of dry matter into the components is an important attribute of high yielding cultivars. The present investigation aims to identify desirable parents for hybridization and superior cross combinations with respect to harvest index in sorghum.

MATERIALS AND METHODS

Six sorghum genotypes were selected on the basis of plant height, maturity duration, grain yield, etc. Gwalior 82, Vidisha 60-1 and SPV 472 are tall genotypes (more than 250 cm). However, the first two (local cultivars) are late maturing (135-140 days) and poor yielding (20-25 q/ha). SPV 475 has medium plant height (150–180 cm). SPV 475 and SPV 472 are medium maturity (110–115 days) and high yielding (30–35 q/ha) varieties. 2219 B is an early genotype (100-105 days). 2077 B is medium maturity (110–115 days). Both these genotypes have dwarf plant stature (plant ht. 110–120 cm).

These six genotypes were crossed in half-diallel fashion. The 15 F_1 and 6 parents were planted in randomized block design with two replications at the J.N.K.V.V. Research Farm, Indore, in single row plots of 3 m length at 45 cm spacing with 15 cm plant-to-plant distance.

The crop season was not normal: the first monsoon showers were received on 15 July 1985, and there was a dry spell of about 30 days after 20 August. This was critical because it coincided with stage GS_2 (floral primordial initiation to flowering stage) of early genotypes. However, rains were received after 19 September, which was beneficial, particularly to the late maturing varieties and their F_1 hybrids.

Observations were recorded on five competitive plants of each genotype in each replication on days to 50% flowering, dry weight of leaves and stem, number of primary branches per panicle, number of grains per primary branch, harvest index (HI) calculated from the total biological yield and grain yield recorded on plant basis in percentage. The individual HI values were transformed to angles as $O° = \text{Arcsin } \sqrt{\text{percentage}}$ before the data were subjected to analysis. For recording dry weight, the plants were sun dried in the field.

The data were subjected to combining ability analysis following Model I, Method 2 of Griffing [4].

RESULTS AND DISCUSSION

Large phytomass production coupled with high HI is likely to result in efficient grain production. As pointed out by Rao [5], the indigenous varieties of sorghum are tall, late maturing, locally adapted, and exhibit low HI (about 30%). However, these cultivars produce more phytomass.

The results of combining ability analysis revealed that mean sum of squares for both general combining ability (gca) and specific combining ability (sca) were significant for all characters, including HI. This indicates that additive as well as

Table 1. General (diagonal) and specific combining ability effects for days to 50% flowering and harvest index (transformed) in sorghum

Varieties	SPV 475	SPV 472	Gwalior 82	Vidisha 60-1	2219 B	2077 B
SPV 475	**0.88**	−4.56*	4.20*	−0.49	−1.62	−2.18
	2.39**	−0.71	−0.62	2.58	3.88*	1.78
SPV 472		**−0.25**	2.32	1.63	7.51*	2.95
		1.02*	1.39	−0.72	−1.45	5.19**
Gwalior 82			**−0.50**	−3.12	4.26*	2.20
			0.00	1.59	−4.79**	2.78
Vidisha 60-1				**4.69***	−1.93	−1.49
				−2.19**	−5.48**	−1.46
2219 B					**−5.19****	−3.12
					−0.79	−0.38
2077 B						**0.38**
						−0.42
	$SE_{gi} \pm 0.70$	$SE_{gi-gj} \pm 1.10$	$SE_{sij} \pm 1.92$	$SE_{sij-sik} \pm 2.86$	$SE_{sij-skl} \pm 2.65$
	± 0.45	± 0.77	± 1.36	± 2.03	± 1.88

*P = 0.05, **P = 0.01.

Note. Upper values are for the days to flowering and lower for harvest index.

nonadditive components of heritable variance were responsible for the variation observed for these traits. Such observations were reported for wheat [6].

Varieties SPV 475 and SPV 472 emerged as most desirable general combiners for HI by virtue of their significant and positive gca effects (2.39** and 1.82*, respectively). On the other hand, variety Vidisha 60-1 was identified as poor combiner (Table 1). This genotype was also poor combiner with respect to days for 50% flowering.

Table 2. General (diagonal) and specific combining ability effects for dry weight of leaves and stem in sorghum

Varieties	SPV 475	SPV 472	Gwalior 82	Vidisha 60-1	2219 B	2077 B
SPV 475	**−0.96**	−7.72	8.47	−4.64	12.22	−6.22
	−7.80**	3.79	29.41	−19.64	12.96	−7.04
SPV 472		**7.19***	−5.38	22.61*	1.77	16.44*
		21.63**	−19.63	102.40**	−14.76	−21.48
Gwalior 82			**−1.10**	3.10	3.46	4.32
			2.11	−25.48	27.46	43.65*
Vidisha 60-1				**12.02****	2.55	4.01
				53.56**	−23.61	32.58
2219 B					**−15.15****	2.77
					−47.45**	9.91
2077 B						**−2.01**
						−22.04**
	SE_{gi} ± 2.69	SE_{gi-gj} ± 4.05	SE_{sij} ± 7.18	$SE_{sij-skl}$ ± 10.71		$SE_{sij-skl}$ ± 9.92
	± 6.59	± 10.21	± 18.10	± 27.02		± 25.02

*P = 0.05, **P = 0.01.

Note. Upper values are for leaf and lower for dry stem weight.

Since the dry matter is mainly accumulated in stem and leaves, combining ability effects for these characters were also calculated. Varieties Vidisha 60-1 and SPV 472 appeared as desirable combiners for these traits (Table 2). Vidisha 60-1 was significantly superior for dry weight of stem. Genotypes 2219 B and 2077 B were identified as undesirable combiners for these attributes. Number of primary branches and grains/primary branch are important components of grain yield in sorghum. Vidisha 60-1 and Gwalior 82 recorded significant and positive gca effects for number of primary branches (Table 3), hence considered as superior combiners for this character. SPV 475 alone emerged as superior combiner for grains/primary branch. 2219 B is an undesirable combiner for both these traits. Gwalior 82 was a poor combiner for grains/primary branch.

On the basis of sca effects only two crosses were considered as desirable for HI: SPV 472 × 2077 B and SPV 475 × 2219 B (Table 1). Crosses Gwalior 82 × 2219 B and Vidisha 60-1 × 2219 B were undesirable as they showed significant negative sca effects. The sca effects for grains/primary branch were in desirable direction in crosses SPV 475 × 2219 B and SPV 472 × 2077 B (Table 3). For primary branches/panicle, four crosses (SPV 475 × Gwalior 82, SPV 472 × Vidisha 60-1, Gwalior 82 × 2219 B, and Vidisha 60-1 × 2219 B) were identified as desirable.

Table 3. General (diagonal) and specific combining ability effects for number of primary branches and number of grains/primary branch in sorghum

Varieties	SPV 475	SPV 472	Gwalior 82	Vidisha 60-1	2219 B	2077 B
SPV 475	**−0.59** **8.99****	1.26 −5.83	9.14** −15.02**	−2.63 4.22	−1.05 8.88*	−6.63* 1.73
SPV 472		**−2.13** **5.44**	1.78 7.44	15.51** −0.62	−0.21 7.36	−1.99 15.89**
Gwalior 82			**3.68**** **−3.78***	5.21 1.39	8.49** −6.95	3.21 0.21
Vidisha 60-1				**10.84**** **−2.62**	9.83** −2.31	−5.85 12.04
2219 B					**−11.54**** **−6.88****	5.93 0.21
2077 B						**−0.26** **−1.15**
	SE_{gi} ± 1.12 ± 1.49	SE_{gi-gj} ± 1.64 ± 2.31	SE_{sij} ± 2.91 ± 4.10	$SE_{sij-sik}$ ± 4.34 ± 6.12	$SE_{sij-skl}$ ± 4.02 ± 5.66	

*P = 0.05, **P = 0.01.

Note. Upper values are for No. of primary branches and lower for grains/primary branch.

Since male sterile counterparts of strains 2077 B and 2219 B are available, hybrids 2077 A × SPV 472 and 2219 A × SPV 475 could be used to exploit the gene action responsible for the characters investigated. However, recurrent selection, followed by pedigree method, could also be employed to exploit the nonadditive and additive gene actions for HI. The F_2 generation of two crosses, SPV 472 × 2077 B and SPV 475 × 2219 B, would be desirable for this purpose.

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