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STUDIES ON HARVEST INDEX IN SOYBEAN

According to **Vogel** *et al.* (1963) the right approach to increase the seed yield is the improvement in total biological yield and/or harvest index. Further, harvest index is a highly conservative and stable character (**Spaeth** *et al;* 1984, **Mercellos,** 1987) and accounts for 95% variation in seed yield alongwith growth rate (**Takeda** *et al.*, 1979). These factors emphasize the importance of harvest index in identifying the most efficient genotypes with superior biological and seed yielding abilities (**Sharma** *et al.*, 1987). But the study of genetic architecture of harvest index is essential before embarking upon selection based on it. In the present study heterosis, combining ability and gene effects for harvest index were investigated.

Twenty one F_1s and seven parents (Bragg, Hardee, Monetta, KHSb2, Local Black Soybean, DS-79-62 and SL-96) of a diallel set constituted the experimental material. The entries were evaluated in a randomized block design with three replications at College of Agriculture Farm, Dharwad (Karnataka). Pods were harvested when 95% of them had attained maturity. Air dried above ground plant weights were recorded for computing apparent harvest index.

$$\text{Harvest index} = \frac{\text{Seed weight}}{\text{Above grount mature plant weight including pods}}$$

The data were analyzed employing Mode-1, Method-2 of **Griffing** (1956). The analysis suggested by **Gardner** and **Eherbart** (1966) was also applied to obtain more information. Heterosis over mid parent (MP), better parent (BP) and best parent (BeP) was computed using the F_1 values averaged over replications following the methods of **Turner** (1953) and **Hays** *et al.* (1955).

Among the parents and crosses, the variation for harvest index was significant. The percent heterosis ranged from — 5.6 (Hardee×SL-96) to 21.4 (Monetta×LBS) over mid parental value, from—8.0 (KHSb-2×DS-74-62) to 20.0 (Monetta×LBS) over better parent and — 16.4 (KHSB-2×DS-74-62) to 7.3 (KHSb-2×SL-96) over best parent (Table 1). Only two crosses, KHSb-2×SL-96 and DS-74-62×SL-96 showed 7.3 percent heterosis each over the best parent (SL-96). The parents differed significantly for harvest index (Table 2). Both general and specific combining ability variances were highly significant. But variances due to sca was smaller than that of gca. However **Paschal** and **Wilcex** (1975) found only gca variance to be significant. Predominance of non-additive gene effects was noticed. The general predictability ratio (0.227) was not high and hence the performance of crosses cannot be predicted by gca alone.

In table 3 the harvest indices of parents and crosses alongwith their combining ability values are presented. The Monetta×LBS cross with highest mid parent heterosis (21.4%) and high sca value (0.039) involved parents with

Table 1. Heterosis for harvest index in soybean

Cross	% Heterosis over		
	Mid parent	Better parent	Best parent
Bragg × Hardee	10.7*	7.6*	3.6
Bragg × Monetta	15.8**	10.0*	0.0
Bragg × KHSb-2	14.0**	6.0*	—3.6
Bragg × LBS	4.3	—2.0	—10.9**
Bragg × DS-74-62	10.0**	10.0**	0.0
Bragg × SL-96	8.6**	3.6	3.6
Hardee × Monetta	14.3**	5.7*	1.8
Hardee × KHSb-2	8.3**	—1.9	—5.5*
Hardee × LBS	10.4**	0.0	—3.6
Hardee × DS-74-62	—2.9	—5.7	—9.1**
Hardee × SL-96	—5.6**	—7.3**	—7.3**
Monetta × KHSb-2	13.6**	11.1**	—9.1**
Monetta × LBS	21.4**	20.0**	1.8
Monetta × DS-62	15.8**	10.0**	0.0
Monetta × SL-96	12.0**	1.8	1.8
KHSb-2 × LBS	14.9**	13.6**	—9.1**
KHSb-2 × DS-74-62	—1.1	—8.0**	—16.4**
KHSb-2 × SL-96	20.4**	7.3**	7.3**
LBS × DS-74-62	8.5**	2.0	—7.3**
LBS × SL-96	7.1**	—3.6	—3.6
DS-74-62 × SL-96	12.4**	7.3**	7.3**
SE	0.009		
C.D. at 5%	0.022	0.025	0.025
C.D. at 1%	0.030	0.033	0.033
Best parent		SL-96 (0.55)	

*, **Significant at 5 percent and 1 percent, respectively.

Table 2. General ANOVA and ANOVA for combining ability for harvest index in soybean

Source	d.f.	Mean sum of squares
Replication	2	0.0003
Treatment	27	0.0055**
gca	6	0.00323**
sca	21	0.0014**
Error	54	0.00008
σ^2g		0.00020
σ^2s		0.00136
σ^2A		0.0004
σ^2D		0.00136
General predictability ratio		0.227

**Significant at 1 percent.

Table 3. gca diagonal and sca of parents and crosses for harvest index in soybean

	Bragg	Hardee	Monetta	KHSb-2	LBS	DS-74-62	SL-96
Bragg	—0.0110	0.028	0.022	0.024	—0.024	0.022	0.009
	(0.50)	(0.57)	(0.55)	(0.53)	(0.49)	(0.55)	(0.57)
Hardee		0.009	0.031	0.016	0.025	—0.026	—0.052
		(0.53)	(0.56)	(0.52)	(0.53)	(0.50)	(0.51)
Monetta			—0.002	—0.001	0.039	0.035	0.12
			(0.45)	(0.49)	(0.54)	(0.55)	(0.56)
KHSb-2				—0.024**	0.024	—0.040	0.061**
				(0.43)	(0.50)	(0.46)	(0.58)
LBS (Local Black Soybean)					—0.23*	0.012	0.003
					(0.44)	(0.51)	(0.53)
DS-74-62						—0.002	0.035
						(0.50)	(0.59)
SL-96							0.031
							(0.55)

*, **Significant at 5 percent and 1 percent and respectively.
(Values in parentheses indicate per se performance of parents and crosses).

relatively low harvest indices. On the other hand DS-74-64 × SL-96 cross exhibited highest harvest index (0.59) had the parents excelling in this character. But KHSb-2 × SL-96 cross involving parents with highest and lowest harvest index exhibited high harvest index (0.58).

The combining ability analysis (Griffing, 1956) beside giving the estimates of components of genetic variance, gives the estimates of combining ability effects, which help in selecting desirable parents and crosses for further exploitation. The analysis proposed by **Gardner** and **Eberhart** (1966) sub divides the variance due to sca in to different components viz. avarage heterosis (h), varietal heterosis (hi) and specific heterosis (sij) which provides information on the additive effects of varieties and their average and individual contributions to the heterosis in crosses.

The inferences from the analysis of **Gardner** and **Eberhart** (1966) are similar to those of **Griffing** (1956). The varietal effect (vi), which measures the differences between the value of a particular parent and the mean of all parents was highest for SL-96 and lowest for KHSb-2. This depends only on additive and additive × additive epistatic type of action, regardless of gene frequencies or correlation between loci. SL-96 also exhibited the highest gca value. The sca value of only KHSb-2 × SL-96 was significant and positive. Similary, the sca value of Hardee × SL-96 was negative and lowest as in Griffing's analysis. Of the sub-components of heterosis sij (which are equal to sca of griffing's method) variances due to average heterosis (h) and varietal heterosis (vi) were significant.

The crosses showing positive sca effects, combined with one good and one poor general combiners (e.g. KHSb-2×SL-96) could produce desirable transgressive segregants. Because of significance of non-additive variance, it would be desirable to enforce homozygosity before operating selection. This could be achieved by advancing such crosses through single seed descent method.

To improve the grain yield in soybean, the crosses involving parents with high gca for biomass and harvest index be pursued through selection based on harvest index. The parent KHSb-2 with high gca effect for biomass and SL-96 with high gca for harvest index hold promise. Thus the cross KHSb-2×SL-96 may provide the genotypes with greater biomass as well as harvest index resulting in high yielding ability. It is clear that this cross is also interesting when viewed from harvest index point alone, as it involves good and poor general combiners. The present study was limited to one season only and hence more information should be generated, on this aspect.

Department of Genetics and Plant Breeding,
University of Agricultural Sciences,
Dharwad-580005, Karnataka.

R.N. Gadag,
H.D. Upadhyaya*
and J.V. Goud

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*Present address : Plant Breeder (Groundnut), ICRISAT Centre, Patancheru P.O., Andhra Pradesh 502 324, India.