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COMBINING ABILITY ANALYSIS OF GRAIN YIELD AND ITS COMPONENT CHARACTERS IN PEARL MILLET [*Pennisetum Glaucum* (L.) R. BR.]

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ABSTRACT

Combining ability study was made in pearl millet using diallel analysis involving 10 diverse inbred. Analysis of variance revealed the significant difference for all the characters. Preponderance of additive gene action was found for the traits like plant height, ear head length, ear head girth and 1000 grain weight, while for the remaining traits including grain yield per plant, the non-additive gene action was found important. Among the parents viz., RHRBI-458, J-2442, IPC-1518 and D-23 were emerged good combiners for grain yield and some other important contributing traits. The hybrids viz., RHRBI-458 x D-23, RHRBI-458 x IPC-1518, RHRBI-458 x J2429, J-2429 x IPC-1518 and J- 2442 x IPC-1518 exhibited high SCA effects and involved the parents with high GCA effects.

Key words : *Combining ability, pearl millet, diallel analysis.*

Yield is a complex character involving number of components traits each of which is polygenically controlled and sensitive to environmental fluctuations. Thus, selection of parents for hybridization is, therefore, a complex problem (1). In such a situation, combining ability is useful technique to assess the nicking ability of the parents in both self and cross pollinated crops. It helps in identifying the best combiner to exploit heterosis or to link up fixable favourale gene that may lead for the development of superior genotypes. The grain yield is the main component for the cultivation of pearl millet in India and other countries. The nutritive value of pearl millet grain is fairly high and used for human consumption. It contains protein (9 to 15%), fat (5%) and mineral matters (2 to 7%) and is also rich in vitamin-A and B, thiamin and riboflavin provide the substantial energy to the body with easy digestibility (2). Apart from grain, the forage and stover at harvest is an important secondary product in low resource agriculture for animal feed and fuel. Thus, looking to the important of this crop, the present investigations were, planned.

MATERIALS AND METHODS

Ten genetically diverse genotype of pearl millet viz., J-2340, J-2296, RIB-3135-18, RHRBI-458, H-77/ 833-2, J-2442, J-2459, IPC-1518, D-23 and J-2290 were crossed in all possible combinations during summer 2006. Fifty five entries, comprising 10 parents and their 45F_1 hybrids, were planted in a Randomized Block Design with three replication at the Main Millet Research Station, JAU, Jamnagar during khrif 2011. Each entry was sown in a single row of 4.0 m length with row-to-row and plant-to-plant distance of 60 cm and 15 cm, respectively. All recommended agronomic practices were followed to raise the good and healthy crop. Observations were recorded from five randomly selected plants from each genotype per replication for all the characters except days to flowering and days to maturity, which were recorded on plot basis. Replicated mean data were subjected to combining ability analysis according to the method suggested by (3) which is related to design II in terms of covariance of half sibs and full sibs (4).

RESULTS AND DISCUSSION

The variances due to both GCA and SCA were highly significant for all the characters indicating important of both the additive and non-additive gene effects. The ratio GCA: SCA variance suggested predominant role of additive gene action for plant height, ear head length, ear head girth and 1000-grain weight while, non additive gene action for ear head weight, fodder yield and grain yield per plant. Incase of days to flowering, days to maturity and effective tillers per plant both gene actions were equally important. The present study confirmed the finding of (5, 6).

None of the parents was found to be good general combiner for all the characters (Table 2) and the parent J-2442 ranked first as, it was thee best general for

Table-1: Analysis of variance for combining ability for 11 characters in pearl millet.

Source	S^2gca	S^2sca	Error	General predictability ratio
d.f.	9	44	108	-
Days to flowering	2.482	4.691	0.414	0.51
Days to maturity	1.734	2.963	0.213	0.54
Plant height (cm)	146.899	118.700	5.081	0.71
No. of effective tillers per plant	0.138	0.277	0.039	0.50
Ear head length (cm)	3.413	2.185	0.188	0.76
Ear head girth (cm)	0.829	0.264	0.103	0.86
1000-grain weight (g)	1.562	0.635	0.015	0.83
Ear head weight (g)	6768.835	22028.746	172.050	0.38
Compactness	4.140	3.457	0.560	0.71
Fodder yield per plant (g)	61.142	199.992	4.791	0.38
Grain yield per plant (g)	38.830	107.275	1.707	0.42

Table-2: Estimates of general combining ability effects of parents or 11 characters in pearl millet.

Parents	Days to flowering	Days to maturity	Plant height (cm)	No. of effective tillers/ plant	Ear head length (cm)	Ear head girth (cm)	1000-seed weight (g)	Ear head weight (g)	Compa-ctness	Fodder yield/ plant (g)	Grain yield / plant (g)
J-2340	-0.25	-0.98**	-11.93**	0.41**	-3.09**	-0.88**	-0.40**	-73.03**	-0.25	-13.96**	-5.40**
J-2296	0.47*	0.74**	-0.90	-0.14*	-0.54**	-0.23*	-0.09*	-52.70**	1.67**	0.01	-3.28**
RIB-3135-18	-2.56**	-1.76**	-22.87**	0.18**	-2.30**	-0.37**	-1.65**	-122.59**	1.11**	-11.96**	-9.73**
RHRBI-458	0.14	0.83**	12.54**	0.11	1.16**	1.35**	2.20**	70.88**	-3.69**	7.43**	5.11**
H-77/833-2	-2.22**	-1.06**	-5.82**	0.01	-1.46**	-1.38**	-2.08**	-94.01**	3.50**	-5.02**	-6.96**
J-2442	0.64**	-0.09	10.79**	-0.23**	1.14**	0.73**	0.94**	96.44**	-0.67**	6.12**	6.70**
J-2459	-0.75**	0.11	-0.59	0.62**	1.35**	-0.82**	-0.48**	19.69**	1.08**	4.48**	2.14**
IPC-1518	1.11**	0.30*	-5.54**	-0.44**	1.79**	0.71**	0.73**	37.72**	-2.31**	1.84*	2.48**
D-23	0.58**	-0.95**	15.46**	0.08	2.37**	-0.13	0.50**	113.08**	-0.58*	7.76**	9.20**
J-2290	2.83**	2.86**	8.85**	-0.61**	-0.41**	1.02**	0.32**	4.52	0.14	3.29**	-0.26
SE (gi)	0.176	0.126	0.617	0.055	0.119	0.088	0.033	3.592	0.205	0.600	0.358
CD at 5%	0.40	0.29	1.40	0.12	0.27	0.20	0.07	8.13	0.46	1.36	0.81
in0CD at 1%	0.57	0.41	2.01	0.18	0.39	0.29	0.11	11.67	0.67	1.95	1.16

*, ** significant at 5 and 1 per cent levels, respectively.

grain yield per plant, plant height, ear head length, ear head girth, 1000-grain weight, ear head weight and fodder yield. The parent J-2459 was good general combiner for days to flowering, number of effective tillers per plant, ear head length, ear head weight, compactness, fodder yield and grain yield per plant while, the parent IPC-1518 was good general combiner for ear head length, ear head girth, 1000-grain weight, dry fodder yield and grain yield per plant. The parent D-23 was good general combiner for days to maturity, plant height, ear head length, 1000-grain weight, ear head weight, dry fodder yield and grain yield per plant. The parent J-2340 was a good general combiner for days to maturity and effective tillers per plant. While J-2296 was good general combiner for compactness only. The parent RIB-3135-18 was good general combiner for days to flowering, days to maturity, number of effective tillers per plant and compactness while, RHRBI-458 was good general combiner for plant height, ear head length, ear head girth. 1000-grain weight, ear head weight, fodder yield and grain yield per plant, and H-77/833-2 for days to flowering, days to maturity and compactness. Thus, parents like RHRBI-458, J-2442,

Table-3: Best performing hybrids based on specific combining ability effects for 11 characters in pearl millet.

Character	Cross	SCA status	GCA status of parent
Days to flowering	RIB-3135-18 x RHRBI-458	-5.49**	Good x Average
	RIB-3135-18 x H-77/833-2	-4.13**	Good x Good
	RIB-3135-18 x J-2459	-3.94**	Good x Good
	J-2340 x RIB-3135-18	-3.44**	Average x Good
	J-2340 x H-77/833-2	-3.44**	Average x Good
Days to maturity	RHRBI-458 x H-77/833-2	-5.20**	Good x Poor
	RIB-3135-18 x J-2290	-3.20**	Good x Poor
	J-2340 x RIB-3135-18	-3.06**	Good x Good
	J-2296 x H-77/833-2	-2.78**	Poor x Good
	J-2340 x RIB-3135-18	-2.70**	Good x poor
Plant height	J-2442 x J-2290	28.49**	Good x Good
	RHRBI-458 x H-77/833-2	21.08**	Good x Poor
	J-2340 x D-23	19.27**	Poor x Good
	RHRBI-458 x IPC-1518	18.47**	Good x poor
	J-2340 x IPC-1518	17.94**	Poor x Poor
Number of effective tiller/plant	RHRBI-458 x D-23	1.42**	Good x Average
	J-2340 x IPC-1518	1.23**	Poor x Good
	RHRBI-458 x J-2459	1.15**	Good x Good
Ear head length	RHRBI-458 X D-23	3.23**	Average x Average
	J-2340 x D-23	2.87**	Good x Average
	RHRBI-458 x H-77/833-2	2.12**	Good x Poor
	RIB-3135-18 X RHRBI-458	2.03**	Poor x Good
Ear head girth	J-2442 x IPC 1518	1.29**	Good x Good
	RHRBI-458 x J-2290	0.84**	Good x Good
	RHRBI-458 x D-23	0.83**	Good x Average
Test weight	RHRBI-458 x D-23	2.08**	Good x Average
	J-2340 x J-2459	1.74**	Poor x Poor
	J-2459 x IPC-1518	1.61**	Poor x Good
	RHRBI-458 x J-2290	1.27**	Good x Good
	J-2442 x IPC-1518	1.22**	Good x Good
	J-2442 x J-2290	1.04**	Good x Good
Ear head weight	RHRBI-458 X J-2459	307.79**	Good x Good
	J-2340 x IPC-1518	298.67**	Poor x Poor
	RHRBI-458 x IPC-1518	296.09**	Good x Poor
	RHRBI-458 x D-23	261.06**	Good x Poor
	J-2442 x J-2290	249.06**	Poor x Average
Compactness	H-77/833-2 x J-2459	4.23**	Good x Good
	H-77/833-2 x J-2442	2.65**	Good x Poor
	J-2340 x J-2290	2.60**	Average x Average
	H-77/833-2 x J-2290	2.51**	Good x Average
	J-2340 x RHRBI-458	2.43**	Average x Good
Fodder yield/plant	J-2459 x IPC-1518	37.71**	Good x Good
	J-2442 x J-2290	31.30**	Good x Good
	D-23 x J-2290	25.33**	Good x Good
	J-2340 x IPC-1518	20.83**	Poor x Good
	J-2442 x IPC-1518	20.74**	Good x Good
Grain yield/plant	RHRBI-458 x IPC-1518	21.81**	Good x Good
	J-2340 x IPC-1518	21.25**	Poor x Good
	RHRBI-458 x J-2459	19.75**	Good x Good
	RHRBI-458 x D-23	19.22**	Good x Good
	J-2442 x J-2290	17.83**	Good x Average

* ,** significant at 5 and 1 per cent levels, respectively.

J-2459, IPC-1518 and D-23 could be used in hybridizing pragramme to exploit their GCA effects for grain yield and some important yield contributing traits in pearl millet.

The SCA effect depicted that no parent had consistently high SCA effect for all the characters (Table 3) as out of 45 crosses only five cross showed significant positive SCA effect for grain yield per plant. The cross combination RHRBI-458 x IPC-1518 showed the highest significant positive SCA effect for grain yield per plant and other hybrids exhibiting higher were J-2340 x IPC-1518, RHRBI-458 x J-2459, RHRBI-458 x D-23 and J-2242 x J-2290. These crosses involved parents with good x good, poor x good and good x average GCA effects. Beside these, crosses also expressed desirable and significant SCA effects for some yield component traits (Table 3). These types of crosses could yield desirable and better transgressive segregants in further generation.

For days to flowering, 14 crosses showed negative significant SCA effects and among them cross RIB-3135-18 x RHRBI-458 displayed the highest negative significant. This cross involved good x average GCA effects and it might be give desirable transgressive segregants. For days to maturity, significant and negative SCA effects were observed in 17 hybrids and among them the cross RHRBI-458 x H-77 / 833-2 ranked top and was resulted from poor x good GCA parents.

Twenty one hybrids depicted positive and significant SCA effect for plant height with higher magnitude in the cross J-2242 x J-2290, was resulted from parents of good x good GCA effects. Such combination may give desirable transgressive segregants. For number effective tillers per plant, significant positive SCA effects were exhibited by nine crosses with hybrid J-2340 x IPC-1518 showing the highest significant positive effect. This cross was involved from the parents of good x good GCA effects.

Incase of ear length, 20 hybrids showed positive significant SCA effects and among them RHRBI-458 x H-77 / 833-2 ranked top and was resulted from good x good GCA parents. Six hybrids manifested positive significant SCA effects for ear head girth, thus they were good specific combination among them and the cross J-2442 x IPC-1518 displayed the highest positive SCA effects for ear head girth and was involved from the parents of good x good GCA effects.

For ear weight and compactness, the highest SCA effect was exhibited by the cross combinations RHRBI-458 x J-2459 and H-77 / 833-2 x J-2459, respectively. These crosses involved parents with good x good GCA effects.

Twenty crosses exhibited significant positive SCA effects for test weight with higher magnitude in the cross RHRBI-458 x D-23, was resulted from parents of good x average GCA effects.

Regarding fodder yield, 21 hybrids displayed significant positive SCA effect among and them the highest estimate of SCA was observed in J-2459 x IPC-1518 and was involved from the parents of good x good GCA effects.

The hybrids exhibited high SCA status indicated that substantial role was played by dominance and epistatis interaction. Such crosses have potential to throw the desirable transgresants in segregating material, which the breeder can handle through pedigree method for the development of high yielding inbred lines.

REFERENCES

1. Gauri Shankar, V., Ganesh, M., Regananth, A. R. G., Suman, A. and Shridhar, V. (2007). Combining ability studies in diverse source in sunflower (*Helianthus annuus* L.). *Indian J. agric. Sci., 14:* 171-176.
2. Pal, M., Deka,J. and Rai , R. K. (1996). Fundamentals of cereals crop production. Tata McGraw Hill Publishing Company Limited, New Delhi.
3. Kempthrone, O. (1957). An Introduction to Genetic Statistics. *John Willey & Sons, Inc.,* New York.
4. Comstock, R. E. and Robinson, H. F. (1948). The components of genetic variance in populations of biparental progenies and their use in estimating the average degree of dominance. *Biometrics, 4:* 254-266.
5. Dangaria C. J., Chotalia J. M., Savaliya J. J. Davda B. K. and Pansuriya A.G. (2009). Combining ability analysis in pearl millet (*Pennisetvum galacum* (L.) R. Br.). *Agric Sci. Digest, 29:* 287-290.
6. Chauhan G.P., Chovatiya V.P., Savaliya J. J., Mehta D. R. and Pansuriya A.G. (2010). Genetic architecture of grain yield and yield attributing traits in pearl millet (*Pennisetvum galacum* (L.) R.Br.). *Res. on crops, 11:* 77-81.

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