grain yield in 732A also appeared to show high combining ability effects in one or other characters such as number of tillers. number of grains.

The estimates of sea effects presented in Table 3 for those crosses only which showed significant effects. A perusal of this table revealed that only seven crosses exhibited high sea effects for grain yield. The number of crosses showing high sea effects were ten for number of grains, four for 100 grain weight and one each for panicle length and number of tillers.

The predominance of non-additive gene action for grain yield was evident from the greater value of SCA variance than GCA variance (0.35:1). This situation was reported earlier by Mithila (1987), Vijayalakshmi (1990) and Kandasamy (1992).

The present investigation has helped in identification of parents of pearl millet for exploitation through heterosis breeding.

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HETEROSIS FOR GRAIN YIELD IN PEARL MILLET

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ABSTRACT

Pronounced heterosis in grain yield with different degree and magnitude was expressed in various individual crosses under varied environments. Environment-specific as well as widely adaptable hybrids and parents were identified. The hybrid 732 A X PT 1650 was versatile for providing heterotic hybrid in individual as well as a cross the environments. Differential behaviour of heterosis under varying environments and breeding value are discussed.

KEY WORDS : Heterosis, Pearl millet, Grain Yield

Pearl millet *(Pennisetum glaucum)* is the most important food and fodder crop of dry land agriculture in India. In order to realise substantial production and improvement in this allogamous crop, studies on heterosis deserve special consideration. The scope for exploitation of hybrid vigour depends on the direction and magnitude of heterosis in the crosses of newly developed parents. The present report describes the extent and nature of heterosis in hybrids of such parents for grain yield under three environments.

MATERIALS AND METHODS

The research material comprised five male sterile lines (732 A, 861A, ICMA1, 862A, 302A) used as females, 3 inbred lines used as males and their 15 F_1 hybrids. These 23 entries were sown in randomised block design with two replications. The experimental material was sown in three environments with a spacing of 45 cm along with hybrid check. X5.

Each entry was sown in a single row plot (4m) The sowing was done by dibbling the seeds at 15 cm. Nonexperimental rows were planted all around the experiment to eliminate the border effects. All agronomic operations were carried out as per norms. After sun drying, the ears of five random plants were hand threshed and grain yield per plant recorded.

The degree of heterosis in F_1 over midparent, female parent, male parent and standard heterosis were calculated for individual environment as well as over the three environments (pooled) and expressed in per cent (Turner, 1953).

Table 1. Analysis of variance (MSS) for grain yield under different environments.

Source	df	Location 1	Location 2	Location 3
Replication	1	0.2092	6.3532	1.5135
Parents	7	81.0908**	64.1932**	93.9440**
Females	4	83.1859**	68.8103**	77.3127**
Males	2	107.9817**	75.4615**	173.0869**
Female x Males	1	18.9287	23.1884	2.1845
Hybrids	14	68.3184**	30.2123**	37.5566**
Parents Vs hybrid	1	225.8652**	309.4648**	85.1279**
Error	22	10.2448	9.6152	3.0514

* Significant at P = 0.05 ** Significant at P = 0.01

RESULTS AND DISCUSSION

The analysis of variance for grain yield indicated significant differences among the genotypes in all environments (Table 1). Further differences amongst parents and parents vs hybrids were also singificant. This revealed the existence of significant variability in the material. Comparison of parents with hybrids was significant in all environments, which indicated presence of heterosis.

In environment 1, eleven hybrids showed significant positive relative heterosis ranging from 10.90 to 90.52 per cent . The hybrid ICMA1 X PT 1650 had recorded the highest relative heterosis (di) followed by 732 A X PT 1650. Eight hybrids showed significant positive heterosis over female parent di (f) ranging from 28.36 to 124.23 per cent (ICMA1 X PT811/9), while ten hybrids recorded significant positive heterosis over male parent dii (m) from 12.66 to 133.59 per cent (732A X PT 1650). All the fifteen hybrid ICMA1 X PT 811/9 had the highest standard heterosis followed by 732 A X PT 1650, 302A x PT 2086. The hybrid 732A X PT 1650 recorded the highest heterotic value for grain yield in all types of heterosis.

In environment 2, the range of relative heterosis varied from - 12.93 to 67.44 per cent. Thirteen hybrids displayed positive and one hybrid significant negative heterosis. The top ranking hybrid was 302A X PT 1650 followed by 732 AX PT1650. Eleven hybrids exhibited positive significant heterosis over female parent and male parent each, the maximum heterosis was recorded by the hybrid ICMA1 X PT 2086, over female parent and 732A X PT 1650 over male parent. All the 15 hybrids showed significant positive standard heterosis. The hybrid 861A x PT 1650 displayed the highest positive and significant heterosis of 130.26 per cent over male parent.

In environment 3, the range of relative heterosis was -20.66 to 72.77 per cent. Nine hybrids manifested positive and three hybrids significant negative heterosis. Ten hybrids showed positive significant heterosis over female parent, six hybrid over male parent. Eleven hybrids displayed positive and one hybrid negative significant standard heterosis. The top ranking hybrids were 732A x PT 1650, ICMA 1 X PT 811/9 and 862A X PT 1650.

The pooled analysis indicated that twelve hybrids showed significant positive relative heterosis ranging from 4.47 to 73.06 per cent. The hybrid 732A X PT 1650 recorded the highest relative heterosis followed by 302A X PT 811/9 with 61.19 per cent. Nine hybrids showed significant positive heterosis over female parent ranging from 1.47 to 76.81 per cent (ICMA1 X PT 811/9), While eight hybrids recorded significant positive heterosis over male parent from 0.90 to 127.25 per cent (732 A X PT 1650). All the 15 hybrids possessed significant and positive standard heterosis. The hybrid 732A X PT 1650 had the highest standard heterosis of 69.57 per cent followed by 732A X PT 811/9 (59.46). The hybrid 732A X PT 1650 recorded the highest heterotic value for grain yield in all types of heterosis.

In this study, many hybrids displayed conspicuous heterosis for grain yield. The direction and magnitude of different heterosis varied from cross to cross. This indicates that the mechanism of expression of heterosis was different in various croses under different environment (Table 2). High

Table 2. Expression of heterosis as percentage over environments.

Hybrid	E1				E2				E3				Over environments			
	di	dii(f)	dii(m)	diii	di	dii(f)	dii(m)	diii	di	dii(f)	dii(m)	diii	di	dii(f)	dii(m)	diii
732A x PT 811/9	34.86**	35.71**	34.02**	78.45**	33.73**	31.37**	36.18**	55.45**	13.94**	27.10**	3.24**	48.84**	27.13**	31.40**	23.14**	59.46**
732A x PT 1650	83.14**	50.63**	133.55**	98.07**	63.64**	30.59**	119.09**	54.52**	72.77**	38.66**	129.17**	60.19**	73.06**	39.74**	127.25**	69.57**
732A x PT2086	13.67**	28.36**	2.00	68.78**	23.64**	26.67**	20.75**	49.88**	3.80**	20.59**	-8.89**	39.32**	13.52**	25.24**	3.80	52.99**
861A x PT 811/9	12.65**	-2.29	32.99**	77.07**	21.69**	9.21**	37.40**	56.84**	-6.69**	-12.54**	0.0	42.43**	8.59**	-2.16	21.99**	57.97**
861A x PT 1650	10.90**	-18.60**	73.94**	47.51**	51.68**	13.09**	130.26**	62.41**	23.17**	-11.94**	104.86**	43.20**	28.27**	-6.22**	102.89**	51.39**
861A x PT 2086	-37.85**	-40.55**	-34.89**	7.73*	5.55**	-1.62	13.83**	41.30**	-0.46	-3.43	2.70	57.03**	-11.24**	-16.37**	-6.69*	36.60**
ICMA$_1$ x PT 811/9	80.94**	124.23**	51.66**	101.93**	28.36**	61.04**	6.71*	21.81**	7.56**	46.47**	-15.02**	20.87**	37.46**	76.81**	12.44**	45.57**
ICMA$_1$ x PT 1650	90.52**	85.97**	96.42**	66.57**	42.22**	37.42**	47.37**	3.94	21.02**	11.76**	31.94**	-7.77**	51.35**	44.25**	59.18**	18.77**
ICMA$_1$ x PT 2086	20.86**	71.47**	-6.68*	54.42**	27.06**	67.79**	2.24	26.91**	-2.06	39.71**	-24.60**	15.29**	14.73**	59.38**	-10.37	31.23**
862A x PT 811/9	-0.09	-10.25**	12.66**	50.00**	-5.14	-12.26**	3.25	17.86**	-11.05**	-11.36**	-10.75**	26.94**	-5.58**	-11.27**	0.90	30.63**
862A x PT 1650	23.03**	-7.27**	82.74**	54.97**	21.63**	-7.25**	76.64**	24.59**	59.91**	18.98**	143.75**	70.39**	34.58**	1.47	100.22**	49.40**
862A x PT 2086	-20.10**	-20.50*	-19.70**	32.87**	-12.93	-16.23	-9.35**	12.53**	-20.66**	-17.97**	-23.17**	17.47**	-18.03**	-18.26**	-17.80**	20.37**
302A x PT 811/9	-29.99**	-29.47**	-30.50**	-7.46**	16.97**	24.94**	9.96**	25.52**	24.06**	33.73**	15.70**	64.56**	4.47**	9.82**	-0.38	28.98**
302A x PT 1650	77.49**	46.11**	126.06**	91.71**	67.44**	42.49**	102.96**	43.31**	39.37**	9.27**	92.36**	34.46**	61.19**	31.80**	107.45**	54.78**
302A x PT 2086	32.40**	49.68**	18.78**	96.41**	19.83**	33.95**	8.41*	34.57**	-0.79	11.24**	-10.48**	36.89**	16.70**	31.10**	5.16	53.98**

di = Relative heterosis, dii(f) = Heterosis over female parent, dii(m) = Heterosis over male parent, diii = Standard heterosis.

positive heterosis was also reported by earlier workers Vaidya *et al.* (1983) and Pethani and Kapoor (1984) Pethani and Dave (1992), suggesting useful exploitation of such potential parents for effective breeding programme. There was differential behaviour of various hybrids to environments for the expression of heterosis. This indicates environmental specificity in the expression of hybrid vigour. However, the study was carried out over three environments and it was remarkable that 732A X PT 1650 maintained its consistent superior performance under all environments. This indicates high stability of heterosis of the hybrid under varying environments, which can be exploited over wide areas.

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GENETIC DIVERGENCE IN SESAME *(Sesamum indicum)*

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ABSTRACT

Mahalanobis D^2 analysis was employed to study the genetic diversity of 50 sesame geno types at the Regional Research Station, Vridhachalam during *kharif* 1992. A wide genetic diversity was observed among the 50 genotypes tested. Based on D^2 analysis of Mahalanobis, the genotypes were grouped into four clusters. The clustering patten indicated that the geographic diversity need not necessarily be related to the genetic diversity. This could be evidenced from the study that genotypes from the same eco- geographic region did scatter in four clusters. Similarly, genotypes from different eco-geographic regions were identified in one cluster. The inter- cluster distance study revealed that cluster IV followed by cluster III were found to be highly divergent from the other two clusters. The genotypes in these two clusters may possibly be utilized for hybridization programme through suitable breeding programmes for the successful exploitation of heterosis in sesame.

KEY WORDS : Sesame, Genetic, Divergence

Sesame *(Sesamum indicum)* has more genetic variability than most of the other self-pollinated crops. A wide range of genetic diversity among parents is an essential feature in any hybridisation programme. Hence, plant breeders are interested to estimate the range of genetic diversity among different genotypes which will help the plant breeders to select parents in the hybridisation programme to achieve the set goals. Mahalanobis D^2 analysis provides a mean to quantitatively estimate the same among crop plants and an attempt of this kind was made in sesame and the results were discussed.

MATERIALS AND METHODS

Fifty eco-geographically different genotypes of sesame (*S. indicum*) were taken for the study from the germplasm bank maintained at the Regional Research Station, Vridhachalam. The genotypes were raised in randomized block design with three replications in the Research Station during *kharif*, 1992 season. Observations on plant height, number of branches per plant, number of capsules on main stem, number of capsules on branches, total number of capsules per plant, capsule length, number of seeds per capsule and seed yield per plant were recorded in five randomly selected plants of each genotype in each replication.

The data were subjected to multivariate analysis (Rao, 1952). The original mean values were transformed to normalised variables and all possible D^2 values were calculated. For determining group constellations or clusters, a relatively simple criterion suggested by Rao (1952)