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Heterotic Patterns Among Ten Pearl Millet Populations

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Abstract: Ten pearl millet [*Pennisetum glaucum* (L.) R.BR. Emend Stuntz] populations were evaluated following diallel mating design (excluding reciprocals) for determining the heterotic patterns among the ten populations and their crosses, and partitioning of heterosis into average heterosis, variety heterosis, specific heterosis, and further to identify base populations for intra- and inter-population improvement programme. In heterotic patterns, average heterosis is more important for characters, namely, grain yield and day to 50% flowering, and specific heterosis has a major role in 1000-grain weight. In the present investigation, the heterotic patterns indicated that the populations RVPT 93 (102) and crosses HTP88 x HMP9102 x RVPT93 (102), RVPT93(102) x ICMV94774 and HP8601 x ICMV95778 can be successfully exploited as base material for development of inbred lines for hybrids and to develop improved population varieties.

Key words: Pearl millet, diallel mating, population improvement, heterosis.

Pearl millet forms the staple food for nillions of people and provides good quality odder for cattle in the arid and semi-arid egions of the world. An approach towards he genetic improvement in pearl millet s directed towards development of high ielding varieties and hybrids with wider daptability. Plant breeders are faced with he task of identifying parents that, when rossed, will express maximum heterosis. opulation cross diallel amongst set of ivergent populations is quite useful in ategorizing the performance of populations nd to establish useful heterotic patterns. eterosis effects and combining ability rve as a guide for choice of parents for tra- and inter-population improvement ogrammes. The objectives of the present periment were to determine the heterotic tterns among the populations and their osses, and to identify the base population r intra- and inter-population improvement ogrammes.

Materials and Methods

Ten populations, namely HTP88, HMP9002, HMP9102, ICMV91450, HP8601, RVPT93(102), RVPT93(115), ICMV 95501, ICMV 95778 and ICMV 94774, were used in the study. These populations were crossed in all possible combinations, excluding reciprocals, during *kharif*, 1996, at Department of Plant Breeding, CCS Haryana Agricultural University, Hisar. These ten populations and their 45 crosses were grown in randomized block design with six replications. Each population and cross had two rows of 4 m length. Plant to plant and row to row distances were maintained at 15 cm and 45 cm, respectively. All the recommended cultural practices were followed before and after sowing. Grain yield and 50% flowering were recorded on plot basis.

Table 1. Mean squares from analysis of variance for population cross diallel analysis II of Gardner and Eberhart (1966)

Source	d.f.	50% flowering (Days)	100-grain weight (gm)	Grain yield per plot (gm)
Among diallel entries	54	3.86**	0.19**	5933.74**
Population effect (V_i)	9	3.74**	0.20**	11287.80**
Heterosis (hij)	45	3.88**	0.18**	4862.93**
Average heterosis ($\bar{h}$)	1	5.26**	0.03**	28241.84**
Populations heterosis (hi)	9	3.13**	0.15**	2157.72**
Specific heterosis (sij)	35	4.04**	0.20**	4890.58**
Error	270	0.51	0.05	937.52

** Significant at 1% level.

Genetic effects were evaluated as per analysis II of Gardner and Eberhart model (1966) and details of calculations given by Singh (1978) were followed.

Results and Discussion

Analysis of variance for randomized block design showed that all the ten populations were significantly different from each other. Significant differences were observed among entries of diallel in the analysis II of Gardner and Eberhart (1966). Both V_i and hij variances were significant for all the traits, indicating the importance of both additive and non-additive gene effects in their expression. A further partitioning of heterosis variation revealed that h, h_i and sij were significant for all the traits studied. The analysis of variance of diallel crosses revealed the major contribution of population effects (V_i) for grain yield. Heterosis (hij) ranged from 30.11% (grain yield) to 50.92% (days to 50% flowering). This perhaps showed the major contributions of additive and epistatic gene effects for grain yield.

Table 2. Estimates of population effects (Vi) and population heterosis (hi) for different characters in pearl millet

Population	Grain yield per plot (g)		50% flowering (days)		1000-grain weight (g)	
	V_i	h_i	V_i	h_i	V_i	h_i
HTP 88	-74.00*	28.74	-1.88*	-0.12	0.04	-0.13
HMP 9002	21.83	-12.30	0.45	0.19	-0.11	0.02
HMP 9102	-45.67*	-38.92	2.45*	-2.18*	0.14	-0.19
ICMV 91450	-15.17	5.59	-0.72	0.19	0.62	-0.27
HP 8601	-11.33	-3.33	-1.88*	1.75	0.15	-0.26
RVPT 93(102)	66.83*	39.84*	-1.05	1.15	-0.43	0.30
RVPT 93(115)	-85.50*	-26.30	3.62*	-1.02	-0.83*	0.41
ICMV 95501	19.50	29.03	-0.05	0.11	0.65*	-0.08
ICMV 95778	17.33	2.80	-1.05	0.32	-0.43	0.19
ICMV 94774	14.83	-33.14	0.12	-0.39	0.21	0.11

* Greater than 2 x SE.

Table 3. Best crosses selected on the basis of heterotic effects

Characters	Crosses	
	Heterosis effect (hij)	Specific heterosis (sij)
50% flowering (days)	HMP 9102 x ICMV 95501	HMP 9102 x ICMV 95501
	RVPT 93(102) x RVPT 99(115)	RVPT 93(102) x RVPT 93(115)
	HMP 9102 x RVPT 93(115)	ICMV 91450 x RVPT 93(102)
	HTP88 x RVPT 93(115)	
1000-grain weight (g)	RVPT 93(115) x ICMV 94774	RVPT 93(115) x ICMV 94774
	HMP 9002 x RVPT 93(102)	HMP 9002 x HMP 9102
	HMP 9102 x ICMV 95778	HMP 9102 x ICMV 95778
		ICMV 91450 x RVPT 93(115)
Grain yield per plot (g)	HP 8601 x ICMV 95778	HMP 9002 x RVPT 93(102)
	HMP 9002 x RVPT 93(102)	RVPT 93(102) x ICMV 94774
	HTP 88 x HMP 9002	HTP 88 x HMP 9102
		HP 8601 x ICMV 95778

From Table 3, it is inferred that none of the populations excelled in the V_i effects for all the traits, (i.e., for every trait), suggesting the use of multiple crosses alone to effect substantial improvement in grain yield. Similar results were also obtained by Sinha and Misra (1997) in maize. Population RVPT 93(102) showed highest V_i for grain yield (Table 2). It can be attributed to high additive gene effects. Population RVPT 93 (102) was also involved in several good hybrids, which might be due to its positive and significant population (h_i) effect. Population HTP88 showed significant and negative population effects and low population heterosis for grain yield, but this population is early in days to 50% flowering. Therefore, this population can be a good source for breeding early maturing varieties. The crosses HTP88 x HMP9102, HP8601 x ICMV95778, HMP9002 x RVPT93 (102), HTP88 x HMP9002 and RVPT93(102) x ICMV 94774 were found to express better heterosis and specific heterosis for grain yield. Out of these, two crosses, HMP9002 x RVPT93 (102) and RVPT93 (102) x ICMV 94774, were highest in grain yield. Therefore, these crosses can be used in reciprocal recurrent selection for development of inbreds for high grain yield. Further, the parent RVPT 93 (102) is common in both these crosses and this parent also possessed highest V_i effect. Therefore, this population can be used for inter-population improvement programme. The cross RVPT93 (115) x ICMV 94774 was the best in heterosis and specific heterosis effects for the 100-grain weight. Hence, can be used for development of high grain weight inbreds through reciprocal recurrent selection.

The results of this study showed the existence of useful heterotic patterns among populations with high grain yield. Population RVPT 93(102) and above population crosses can successfully be exploited as base material for development of inbred lines for hybrids as well as to develop improved population varieties.

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