SUMMARY

1. Complete diallel ($F_1$ and $F_2$) and partial diallel ($F_1$, five sets) crosses among 17 diverse and elite inbreds of pearl millet were studied for characterising the nature and magnitude of genetic variance, combining ability, heterosis and efficiency of sampling the diallel crosses with varying number of crosses per parent for identifying suitable parents from a large number of inbreds. The characters studied were days to 50 percent flowering, plant height, number of effective tillers per plant, grain yield per plant, main ear length, main ear girth, ear compactness and test weight.

2. The 156 diallel progenies of each of the $F_1$ and $F_2$ generations along with the parents and a check variety (HB-3) were raised adjacent in randomised blocks with three replications at the Research Farm, Institute of Advanced Studies, Meerut University, Meerut, during the year 1972.

3. The statistical techniques for analysing the data were those proposed by Jinks and Hayman (1953), Hayman (1954a), Jinks (1954), Griffing (1956b) and Kempthorne and Curnow (1961).

4. The analysis of variance for the progenies and parents, carried out for all the eight characters in each generation as well as for all the sets of partial diallels in $F_1$ generation, showed that there were significant differences among the parental lines for all the characters.
5. The graphic analysis of the diallel crosses exhibited overdominance for days to 50 percent flowering and number of effective tillers per plant in both the generations; overdominance for plant height and grain yield per plant was also recorded in the F₁ analysis. The remaining characters showed partial dominance in both the generations. Epistatic control was exhibited for all the characters in both the generations. The distribution of the parents along the regression line suggested significant diversity among the parents. The array points were more scattered in the F₂ analysis than the F₁.

6. The components analysis revealed preponderance of non-additive gene effects for all the characters in both the generations, except main ear length. Both additive (D) and non-additive (H₁, H₂, h², etc.) components of variation, were significant for almost all the characters studied. The dominance components, particularly H₁ was found to be invariably higher in magnitude than the additive component for all the traits except main ear length. The estimates of component F were significant only for days to 50 percent flowering and ear length in the F₁ analysis and for plant height, main ear girth, ear compactness and test weight in the F₂ analysis, indicating that for these characters there was an excess of positive genes. The direction of dominance (h²) was positive for all the traits, except ear compactness in the F₁, while in the F₂ analysis it was negative for almost all the characters. The estimates of the ratio H₂/4H₁, in case of number of effective tillers, grain yield and main ear length, suggested that negative and positive homozygotes were in almost equal proportion among the 17 parents studied. The estimates
of the ratio \((4DH_1)^{3/2} + F/(4DH_1)^{3/2} - F\) suggested that there was an excess of dominant genes controlling most of the characters studied, except grain yield per plant \((F_1)\) and ear length \((F_2)\) for which excessive control of recessive genes was revealed. The estimates of correlation coefficient between parental order of dominance and parental measurement indicated that earliness, high number of effective tillers per plant, high grain yield, loose seed setting and high test weight were controlled by dominant genes. The estimates of heritability (narrow sense) were low for most of the characters, relatively higher estimates were obtained for ear compactness, ear length, plant height and test weight.

7. The combining ability analysis revealed that the GCA and SCA variances, both were highly significant for all the characters in both the generations. The estimates of GCA variances were higher than that of SCA variances for all the characters. The per se performance of the parents was associated with their GCA effects for all the eight characters. The parents \(P_6 (D_5)\) and \(P_2 (D_4)\) were the top general combiners for yield and number of effective tillers per plant. The other promising general combiners were \(P_17 (S_{13-6-24})\) for dwarfness and ear compactness and \(P_{10} (D_{54-5})\) for ear length and test weight. Usually the high \(X\) high cross combinations showed high SCA effects. Sometimes the high \(X\) low and low \(X\) low combinations also exhibited significant SCA effects. For most of the crosses, for majority of the characters, high correlation among the mean performance of the crosses, their SCA effect estimates and the estimates of heterosis was recorded.
8. Estimates of heterosis expressed as deviation of $F_1$ progenies from the mid-parent, better parent and the best local variety (HE-3), were found to be high and significant for a number of crosses for the different characters. In general, the estimates were higher in case of grain yield, number of effective tillers, ear girth and test weight. Negative heterosis was obtained for ear compactness. The estimates of heterosis for yield was relatively high than other characters.

9. The parameters estimated from the $F_1$ and $F_2$ data were almost parallel. This suggested that $F_2$ progenies can also be utilized reliably for getting informations about genetic architecture of the parental material. Rather, the GCA estimates were estimated with greater precision from the $F_2$ data.

10. Sampling the varying number of crosses per parent (5 4, 6, 8, 10 and 12) from the full diallel (3 16) it was found that six crosses per parent, which was about one-third of the full diallel crosses, may reliably detect the best general combiners from a large number of inbred lines. The predominance of non-additive gene action, as observed in the full diallel analysis, was also found for all the characters at all the levels of 3, except in case of effective tillers per plant, main ear girth and test weight at 3 4. The proportion of non-additive components increased considerably, as 3 was reduced to less than 3/3. Considering the GCA effects obtained by the full diallel analysis as true estimates, considerable changes were observed in the order and magnitude of the GCA effects of the parents in partial
diallel with $S = N/3$. The average S.E. increased substantially as $S$ was reduced. The change in $\log e \frac{\sigma^2_s}{\sigma^2_e}$ also supported the contention that $S = N/3$ is optimum, below that there is steep loss in precision of the estimates.

11. Based on the present study it may be concluded that for the genetic improvement in pearl millet breeding plan that may simultaneously exploit additive and non-additive gene effects should be adopted. A system of recurrent selection would be effective. Since heterosis breeding has proved highly remunerative in this crop, for maximising the effects imparting heterosis the 'B' and 'R' lines should be evolved in contrast to each other so that besides the concentration of additive genes, the allelic contrast is also maximised. Further, the most promising general combiners for different characters should be inter-crossed to develop synthetic and composite varieties.