SUMMARY

Gamma radiation induced polygenic variation and the nature of its gene effects in the inheritance of quantitative characters have been investigated in diverse homozygous parents and their cross combinations. It has also been ascertained if the variability released by irradiation is cumulative with that created by hybridization. A study of expected and realized selection response was also taken up.

The \( F_1 \) harvested seeds of three diverse crosses, \( \text{IP 824 x C 273 (Indian x Indian), K 227 x C 273 (Indian x Mexican)} \) and \( S 354 x K 227 (Mexican x Mexican) \) along with their parents were irradiated with 10 Kr, 20 Kr and 30 Kr doses of gamma rays from \( \text{Co}_60 \) source at the Indian Agricultural Research Institute, New Delhi. The irradiated and non-irradiated populations were studied for days to earing, plant height, spike number, spike length, spikelet number, grain number, 100-grain weight and grain yield in the \( R_1 \) and \( R_2 \) generations and selected populations in the \( R_3 \) generation, which otherwise were normal \( F_2 \), \( F_3 \) and \( F_4 \) generations.
The immediate effect of irradiation in R₁ was decrease in mean for grain yield, 100-grain weight, grain number, spikelet number and spike number. The mean for plant height also decreased. On the other hand, the increase in mean was observed in NP 624 x C 273 hybrid population for spike length, in parent S 354 for spike number, and for 100-grain weight in the S 354 x K 227 hybrid population. Delay in days to earing, in general, was observed in all the genotypes. Different genotypes responded differently to various doses. The irradiation widened range and consequently increased coefficients of variation in most of the cases.

In the R₂, the analysis of variance revealed that different doses of irradiation were effective for different characters in different genotypes. Generally a higher dose of 30 Kr was more effective in the hybrid populations. The variances between progenies within the treatments generally increased as compared to the respective controls. The irradiation induced variation was not cumulative with that of hybridization. The mean values in R₂ generation generally did not change from the control but if there was a shift it was generally on the lower side except for days to earing which was delayed.

A skewed bias towards lower side was also observed in the frequency distributions. The coefficients of variation generally increased after irradiation, but the extent varied with the genotype and the character. For characters like, days to earing, plant
height, and 100-grain weight in the cross, NP 824 x C 273 and for
days to earing in the cross, K 227 x C 273 no dose could increase
variability over the control which showed that these populations
required still higher dose of irradiation for these characters.

The heritability estimates in the broad sense revealed a similar
trend. In general, heritability was low for grain yield and spike
number compared to other characters in all the populations but
expected genetic advance for grain yield was higher than for the
other characters. The expected genetic advance in the parental
populations was of low magnitude.

Variance within R₂ progenies increased after irradiation
for most of characters. The range of individual plant values
and the magnitude of induced genetic variances within progenies
revealed that selections on single plant basis within progenies
could be useful. The variances within R₂ progenies in the
homozygous genotypes increased in more cases than in the hybrid
populations.

The partitioning of variance into additive and non-additive
components revealed that both types of variances were induced by
irradiation. In the parental populations 30 Kr dose primarily
induced additive gene effects. The additive gene effects were
more pronounced for days to earing, spike number, spike length
and spikelet number while for grain yield both types of gene
effects were important. In the NP 824 x C 273, irradiation induced
more of additive effects for grain yield and non-additive effects
for days to earing and spikelet number. In the second cross, K 227 x C 273, induced variation was additive for days to earing and plant height while it was non-additive for grain number, 100-grain weight and grain yield. In the third cross, S 354 x K 227, irradiation generally induced non-additive effects which were more pronounced in the normal hybrid populations as well.

The average degree of dominance was of different magnitude with different doses in different genotypes. In the parental populations complete to over dominance was observed for plant height, spike number, grain number, 100-grain weight and grain yield but its degree was partial for days to earing, spike length and spikelet number. In the first two crosses, UP 824 x C 273 and K 227 x C 273, the degree of dominance was nearly complete to overdominance while in the cross S 354 x K 227, it was mostly overdominance for various characters. The estimates of heritability both in broad and narrow sense were more in irradiated populations than in the untreated ones. The heritability estimates from inter-generation relationship also showed increases after irradiation.

The selection in R2 was done for grain yield. The realized genetic advance for grain yield was higher than expected. Moreover, selection for grain yield seemed to influence the other characters as well but the correlated response varied with the genotype.

In R3, the values of range, frequency curves, coefficients of variation, heritability and the expected genetic advance showed that enough variability was still present for some characters and
it was more so in the hybrid populations, thus revealing further scope of selection.

The present investigations provide useful information concerning the inheritance of quantitative characters in the irradiated pure varieties and their hybrids. The results reveal that the extent and nature of induced variation varies with the genetic constitution of the population treated. The irradiated hybrids, generally, show greater variability and more scope of improvement than the untreated hybrids or their treated parents. It can be concluded that for affecting improvement in agronomic characters, irradiation as a supplement to hybridization, offers a greater possibility of opening new vistas in plant improvement as a result of induced variability, especially of additive type.