SYNOPSIS

The objective of the work reported in this thesis was to study (i) the mode of inheritance of available characters of black gram (Phaseolus mungo L.), (ii) the mutagenic effect of the two radiations viz. X-rays and neutrons, and (iii) the cytogenetical behaviour of the induced mutants.

From the genetical studies, six pairs of genes were found to be responsible for the expression of qualitative characters, viz. growth habit, fruit surface, fruit colour, seed surface and seed colour. Linkage has been found between the genes responsible for (a) fruit colour and mosaic pattern on the seed, and (b) between seed colour and seed surface. Compared to the small number of characters studied, the presence of two linkage groups is conspicuous. It was seen from the wide collection of different varieties of black gram that the number of contrasting characters in them was quite small. This is so because, the selection in this crop is usually done for seed characters and other variants have not been well preserved.

In order to increase the variability in this crop an attempt was made to produce mutations by ionizing radiations. A short duration day-neutral variety T.9 was chosen and dry seeds were irradiated with X-rays and with neutrons at various doses. With X-rays, a dose of 60,000 r was found to be sub-lethal which gave maximum number of mutations. The tolerance of black gram

seed to X-radiation appeared to be much higher as compared to other seed legumes such as peas, beans and soybeans. With neutrons a dose of $4x10^{12}$np/cm^2 was found to be sublethal, and complete lethality was obtained at $8x10^{12}$np/cm^2. In the R_1 generation, morphological abnormalities, reduction in pollen fertility and reduction in fruit production, were found to be the pronounced effect of radiation. No conspicuous difference was observed between the two radiations in R_1 generation, but in general the neutrons showed more uniform and drastic effect than that of X-rays.

The very low rate of spontaneous mutation was accelerated considerably by X-rays and neutrons. The different mutants recovered in R_2 generation have been classified into three groups (a) Chlorophyll mutants, (b) Sterile mutants, and (c) Vital mutants.

The chlorophyll deficient group included albino, xantha, chlorina, virescent, variegated, chloroxantha, chlorodiv and viridis types. Of these the first three types were recovered both after X-ray and neutron irradiation. Virescent and variegated types were obtained only after X-ray treatment and, chloroxantha, chlorodiv and viridis were recovered after neutron irradiation. Albinos were found to be most frequent and xantha the least. The frequency of chlorophyll mutation was higher with neutrons than with X-rays.

Among the sterile mutants obtained after X-irradiation, three mutants, viz. unifoliate, ray-leaflet and small-leaf were conspicuous due to drastic morphological changes mostly in their

leaves, and absence of any reproductive organs. Other mutants of this group that did not show any morphological changes but were functionally sterile included a female-sterile mutant, three asynaptic mutants and a bud mutant. The female-sterile mutant showed degeneration in the megagametogenesis; the asynaptic mutants showed absence of pairing at meiosis; and the bud mutant was characterised by the absence of any open flower.

Eight sterile aberrant types were obtained after neutron irradiation. One of them was associated with long narrow leaves and in another two types the flower parts were deformed, the common characteristic being the rolling of the standard petal. Five others did not show any morphological abnormalities.

Those mutants that were capable of producing fruits and seeds even after enduring drastic morphological changes were grouped as 'vitals'. Some of these were distinctly associated with morphological abnormalities and others appeared to be the result of only physiological changes. Five X-ray induced mutants, viz. tall, keel, malformed flower, narrow-leaf, and basal-branch, were distinctly associated with morphological abnormalities and in most of them the flower characters showed minor to drastic changes. Fruit production was quite low in these mutants except in tall and keel mutants which produced equal number of fruits as normal. Two mutants showed change in growth habit, one of which was distinctly tall, and other spreading with large number of branches. The mutants conditioned by physiological changes

included early-flowering, many-fruited, and delayed-flowering mutant. In the R_2 generation after neutron irradiation, a good number of vital aberrant types were obtained which showed a syndrome effect mostly with distinct changes in the leaf size and shape.

The appearance of more than one mutation from the same X_1 plant was noticed in two cases. In one case a chlorina and a malformed flower mutant appeared in the same X_2 family which in the later generation occurred separately. The second set involved three X_2 mutants from the same X_1 plant of which the unifoliate and asynaptic mutant appeared jointly and the third mutant, a semi-sterile one, occurred independently in X_3 generation. Appearance of more than one aberrant type from the same R_1 plant after neutron irradiation was noted in three cases.

The mutation spectra of X-rays and thermal neutrons showed differences. The number of chlorophyll deficient types recovered after neutron irradiation was more than that of X-rays. Among the mutants showing morphological abnormalities X-irradiation affected mainly the flower and neutron affected the leaf characters.

The appearance of the chlorophyll deficient mutants was mostly due to the effect of a single recessive gene except in case of a chlorina mutant. The low frequency of chlorina mutant in the segregating generation may be due to minute chromosomal deletion. All the sterile X-ray mutants which did not show morphological abnormalities were found to be conditioned by a single recessive

gene. Other sterile mutants with drastic morphological changes segregated in considerably low frequency suggesting that their occurrence might be due to chromosomal aberration. The vital mutants were mostly conditioned by a single recessive gene.

A marked stability in the mutant characters was noticed. In a few mutants the fertility was regained in the subsequent generation. Some of the aberrant types like branchless, dwarfs, and others, however, failed to express themselves in later generation. The pleiotropic effect of the mutant gene was noted in some cases.

It is seen from the above studies that both X-ray and neutron irradiation gave rise to a number of mutations and helped considerably in increasing the variability. These variants have been found to be useful for the better understanding of cytogenetics of black gram. The appearance of economic mutants viz. many-fruited, tall and early-maturing types also proved the value of the irradiation experiment in producing mutants which have desirable agricultural qualities.