6. Summary and Conclusion

 Nearly 95% of the world production of groundnut comes from developing countries where it is seen as high energy value crop rich in nutrients, oil and protein. In India, the production of groundnut no doubt has seen a significant improvement over the years, the pressure to raise it further is high on the agenda of the plant breeders due to an ever increasing domestic demand and to tap its export potential to support the country’s economy. However, the crop is highly vulnerable to post harvest losses and aflatoxin contamination. High temperature and RH during storage cause a significant loss of seed quality and viability. Ionizing radiations have a role not only in crop improvement but also in reducing the post-harvest losses in perishable crops. Very low doses of irradiation have been reported to cause stimulatory and hormosis effect on plants. Differences in sensitivity to ionizing radiations have been reported across plant species. Ionizing radiation can help to increase crop yields by aiding in the production of new varieties of plants through mutation breeding or by direct stimulation of plant growth. The present study was executed to assess the variation in radiosensitivity across the two cultivars of groundnut viz., TG-37A and B-95 that differed in terms of their developmental approach. TG-37A had been developed through radiation induced genetic changes while cultivar B-95 was the product of conventional breeding. Further, the radiation protection of groundnut seed quality and viability during storage under condition of accelerated aging (Temperature and RH) was also investigated in the radiomutant cultivar TG-37A and B-95 which were irradiated at 0, 5, 25, 100, 500 and 1000 Gy across the two independent experiments. The results obtained during this investigation are summarized below:

- Gamma irradiation of seeds in general improved the seed germination and seedling vigor index-I and II particularly at low dose radiation up to 25 Gy followed by a significant decline at 500 Gy.
- LD<sub>50</sub> for the two groundnut cultivars in response to the radiation treatment was beyond 100 Gy.
- Gamma irradiation improved the root characteristics and root-shoot ratio of the two experimental cultivars at low dose of radiation. Improved root growth is likely to improve
crop establishment and survival under suboptimal conditions of nutrients and other resources.

- Gas exchange characteristics such as photosynthetic rate, transpiration rate and stomatal conductance exhibited radiation stability up to 100 Gy followed by a decline in both the cultivars, however, a genotypic variation was evident.

- Gamma irradiation treatment did not significantly alter rubisco activity up to 100 Gy but caused only 25 % inhibition at 500 Gy. On the other hand, the NR activity was either stimulated or was affected significantly by gamma irradiation across the cultivars. Relatively higher irradiation insensitivity was measured across the crop species for different gas exchange attributes and for the activity of enzymes involved in C and N metabolism.

- Radiation did not significantly affect the specific leaf weight (SLW) except at 500 Gy where an increase in SLW was observed which could be due to an inhibited loading and translocation of photosynthates from the leaf to the developing sinks.

- Mineral nutrients accumulation profile under the radiation treatment varied in the two experimental groundnut cultivars and did not follow any dose effect relationship.

- The nutritional quality of the harvested seeds of irradiated and unirradiated plants revealed a higher seed Fe, Zn, K and P particularly at lower doses in the radiomutant cultivar TG-37A. An efficient translocation of nutrients from the root to shoot to the grain coupled with a higher seed sink demand might have led to the observed nutrient enrichment in the harvested seed.

- An increase in APX and SOD activities with no change in CAT activity was measured in response to radiation across the cultivars. Further, an increase in total antioxidant activity was also measured in radiation treatments.

- Gamma irradiation treatment improves the level of most of the plant hormones with a dose dependent rise in GA, IAA and Kinetin at low doses, up to high GA level together with increase amylase activity in the radiated seed might has triggered an early germination and the resultant higher initial seedling vigor. It is postulated that radiation induced growth stimulation is a consequence of favourable hormonal changes and an increase in the antioxidative capacity in the irradiated cells/tissue.
- Irradiated seeds of groundnut cultivar TG-37A performed better in terms of seed viability and quality when stored under condition of accelerated aging, however, the effect was radiation dose dependent.
- Lose of seed vigor was evident beyond 25 Gy radiation treatment and 5 days of storage under aging and could be related to hormonal imbalance and loss of seed membrane integrity.
- Gamma irradiated seeds in general imbibed lesser water and showed a lower water activity and seed mass increment when compared with the unirradiated control over increasing storage duration under high temperature and high RH condition.
- A significant radiation protection towards biochemical and metabolic characteristics of seeds under aging was recorded.
- Gamma irradiation of seeds protected against peroxidation of fatty acid under aging and thus, facilitated a reduced rate of oil degradation with a reduction in the ratio of unsaturated to saturated fatty acids compared to the storage duration dependent variation in oil characteristic of unirradiated control seeds of cultivar TG-37A stored under accelerated aging condition.

In conclusion, the present study provides evidence for the cultivar independent hormosis effect of gamma irradiation in groundnut with the measured LD-50 value of >50 Gy. Further, this study proves the radiation protection advantage for viability and qualities of groundnut seeds stored under accelerated aging condition and elucidate the underlying physiological and biochemical mechanism in groundnut cultivar TG-37A. Since the experimental comparison of radiosensitivity between the radiomutant TG-37A and conventionally bred cultivar B-95 revealed a higher hormosis effect in TG-37A, it is probable that the radiation protection during storage under accelerated aging conditions is also contributed in parts by the acquired inherent genetic constitution of the radiomutant cultivar, thus suggesting a need to verify the radiation advantage, under adverse storage condition across the other groundnut cultivar to rule out its genetic dependence.