CHAPTER 7

SUMMARY

AND

CONCLUSION
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Coriandrum sativum Linn. (2n = 22) var CS – 287 belongs to family Apiaceae. This plant is named after koris, the Greek word for bug, as the unripe fruits have a smell that has been compared to that of bedbugs. It is commonly known as Coriander. Coriander is native to Mediterranean region. It is an annual, soft, hairless plant growing up to 25 to 35 cm. in height. The leaves are variable in shape, broadly lobed at the base, slender at the above and feathery on the stem. The flowers are borne in small umbels, white or pale pink in colour, with the petals pointing away from the center of the umbel, longer about 5–6 in mm. The fruit is a globular, dry, schizocarp and about 3–5 mm. in diameter. Fruit has delicious fragrance and seeds are pale white to light brown in colour.

In American culinary usage, the fruits ("seeds") are generally referred to as Coriander, the leaves as cilantro. Coriander is a very common green spice used in every part of India popularly known as Dhania. In Maharashtra, it is pronounced as Kothembiri. Coriander seeds and leaves are used as common food flavoring agent in preparation of various recipes. It has great economic and nutritional value in Indian agriculture.

Major producers of Coriander are Morocco, Canada, India, Pakistan and Romania. Other Producers include Iran, Egypt and Israel, China, Burma and Thailand in Asia, and Poland, Bulgaria, Hungary, France and the Netherlands in Europe. In India Rajasthan, Madhya Pradesh, Gujarat, Maharashtra, West Bengal, Bihar, U.P., A.P., Karnataka, and Tamil Nadu are the major producers.

Apart from all uses it is well known medicine in traditional medicinal system like Ayurveda. This plant due to its uses and economic value has been undertaken in mutational studies with respect to its productivity and chemical constituents in leaves and seed as parts of the plants. Essential oil is main chemical constituents. The seeds have a lemony citrus flavor when crushed, due to terpenes, linalool and pinene.

Coriander is also contains antioxidants like other spices. Coriander seeds are used in traditional Indian medicine as a diuretic by boiling equal parts of seeds of Coriander and cumin, then cooling and consuming the resulting liquid. In holistic and traditional medicine, it is used as a carminative and digestive. Coriander has been reported as a traditional treatment for diabetes patients. Coriander juice (mixed with
turmeric powder or mint juice) is used as a treatment for acne and applied to the face in the form of toner.

Research and development in the area of mutation breeding is undertaken through “Induction of mutation in *Coriandrum sativum* Linn.” Induced mutagenesis may bring about changes in the overall morphology and physiology of the plants. In present studies, biochemical investigations like essential oil, protein, carbohydrates and minerals. Research and development in this area of investigation is necessary for the improvement with increased nutritive and medicinal values in Coriander.

The seed material of *Coriandrum sativum* Linn. var. CS-287 was treated with chemical mutagen like Ethyl Methane Sulphonate (EMS) at the concentration of 0.050%, 0.075%, 0.10%, 0.125% and physical mutagen like Gamma rays at the doses of 10kR, 20kR, 30kR, 40kR respectively. The seed material of each treatment along with control (untreated seeds) was sown in research field by Complete Randomized Block Design (CRBD) with three replications. The statistical analysis was done with help of SPSS and Excel software.

For the present mutation breeding programme, study was spread over three generations. Studies in the M₁ generation included collection of data on M₁ biological parameters like seed germination percentage, seedling height and seedling injury, survival of plants at maturity and pollen sterility. Results indicated that the EMS and Gamma rays showed an inhibitory effect on seed germination. Seedling height was decreases with increase in concentration/doses of EMS and Gamma rays. EMS and Gamma rays individually showed increase in survival percentage with increase in concentration/dose. In Gamma rays at 40kR treatment was highest survival rate as compare to other treatments. In individual treatment of EMS and Gamma rays, the pollen sterility increases as the concentration/dose of mutagen increased. However, in Gamma rays treatment the percentage of pollen sterility was more as compared to EMS treatments. It is observed that the induced mutagenic sterility in the present investigation could be due to chromosomal aberrations.

The seeds of M₁ generation were used to raise the M₂ progenies. Plants of M₂ generation were assessed for chlorophyll mutations. These mutations were recorded after 15-20 days at seedling stage immediately after the germination of seeds. The different chlorophyll mutations like *xantha*, *viridis* and *chlorina* were recorded and studied. The maximum frequency of such chlorophyll mutation carrying plants was in
high doses of Gamma rays treatment. Many researchers found that the chlorophyll mutants are not heritable.

Data on biological damage in M₁ generation, the relative effectiveness and efficiency of the mutagenic treatments was assessed. The values for each mutagen varied according to the M₁ parameters taken for calculation. Induced mutation through chemical and physical mutagens is very effective tool for plants improvement. The usefulness of induced mutations in plant improvement depends on increasing the efficiency of mutation induction and its proper selection. The choice of proper mutagens and appropriate treatment conditions are important in obtaining the desired efficiency and mutation rate. Mutagens can induce different genetical variations.

The mutagenic effectiveness and efficiency increased with increase in the concentration/dose of mutagens. The intermediate concentrations/doses were found to be more effective. EMS mutagens were found to be more superior than Gamma rays treatment. EMS was found to be most effective mutagen in Coriander as compared to Gamma rays treatment. The order of effectiveness and efficiency of the mutagens were EMS > GR. The increase in effectiveness with increasing concentrations/dose of mutagens up to certain level could be attributed to the biological damage like lethality and pollen sterility, which increased with increase in concentration/dose at faster rate than the mutation.

The mutation rate was calculated by used the mean values of efficiency for each treatment. This provides an idea of the average rate of mutation induced as per mutagen. It could be noted that when the mutation rates based on efficiency was considered the order of mutagens have varied values in relation to lethality and pollen sterility. For lethality in M₂ generation of Withania the order of mutagens could be framed as GR > EMS. For pollen sterility the order of mutagens in the increasing direction was GR > EMS.

In M₂ and M₃ generations, differential viable mutations like plant type, flower colour and fruit colour mutations A broad range of viable mutants has been observed in M₂ generation of Coriander. The different viable mutants obtained were of the following type: 1) Tall mutant 2) Dwarf mutant 3) Dark green leaves mutant 4) Early flowering mutant 5) Late flowering mutant 6) Luxuriant mutant 7) Flower colour mutant 8) Fruit colour mutant and 9) Fruit shape mutant. In M₂ generation, the frequency of viable mutations increased with the increased concentration/dose in
individual treatments. Tall, dark green leaves and luxuriant mutants have shown better yield contributing parameters and even more total essential oil content as compare to control. These mutants can be incorporated in the conventional breeding programme. Such mutants could be promoted for cultivation after successful completion of seed certification procedure. Data of quantitative character plant height, number of branches per plant, number of umbellete per umbel, number of umbel per plant, days to flower, number of fruit per umbel, number of fruits per plant, days to maturity, size (diameter) of fruit, weight of 100 fruits were recorded and statistically analyzed to understand the effect of mutagens in shifting the mean and variance in either direction. The mean, variance and coefficient of variance were computed. It was seen that the quantitative parameters were succeeded in showing a significant positive shift in mean values. Quantitative characters are supposed to be controlled by polygene and exhibit a feature of continuous distribution. In addition, the expression of some quantitative characters is subjected to strong environmental influences. Thus, in crop plants the assessment of the practical role of induced mutations in crop improvement is based on quantitatively inherited characters which have been subjected to statistical analysis.

The improvement of cultivated plants largely depends on the genetic variability occurred within the species. The mutagenesis can help to enhance the natural mutational rate and to enlarge the genetic variability. The induction of micro mutations in polygenic system controlling the quantitative characters is important for crop improvement. The major objective of employing induced mutations is to increase variability within shortest possible period and to develop useful genotypes carrying a range of beneficial attributes of high economic values.

Statistical analysis of phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV), heritability ($h^2$) and genetic advance (GA) for quantitative character like plant height, number of branches per plant, number of umbellete per umbel, number of umbel per plant, days to flower, number of fruit per umbel, number of fruits per plant, days to maturity, size (diameter) of fruit, weight of 100 fruits was carried out. Estimates of heritability and genetic advance for different traits were carried out to enable selection of desired genotypes. Induced variability was calculated in EMS and Gamma rays treatments for ten different yield-contributing traits of Coriander in the M2 generation.

The higher heritability coupled with high genetic advance for quantitative
traits like plant height, number of branches per plant, number of umbellate per umbel, number of umbel per plant, days to flower, number of fruit per umbel, number of fruits per plant, days to maturity, size (diameter) of fruit, weight of 100 fruits was observed in Coriander. In modern plant breeding one of the major trends has been supporting the traditional methods by biochemical studies so as to obtain a better value of a progeny in breeding. The economic importance of different plants is not only restricted to the number and weight of seeds product but also several specific substances stored in the vegetative organs such as carbohydrates, proteins, essential oils, minerals etc. in sufficient amount. The content of fruit with respect to total essential oil content has shown significant enhancement in case of mutants as compared to control. Protein content in the present investigation has revealed an enhancement in majority of mutants in the M₃ generation which was induced through the EMS and Gamma rays treatments.

Dark green leaves and luxuriant mutants showed increasing values as compared to control. Dwarf and fruit shape mutants induced by various mutagenic treatments showed the slight decline in values of total protein and carbohydrate content than against control. The Dark green leaves mutant showed relatively higher total essential oil percentage among the different mutant types. Tall mutant and early flowering mutant showed slightly high essential oil content.

**Significant findings**

1. From the above observations, it can be demonstrated that the EMS and Gamma rays mutagenic treatments employed in the present investigation which succeeded in inducing genetic variability.
2. In present investigation, six different morphological mutants were observed and recorded.
3. The Luxuriant mutant and Dark green leaves mutant were the high yielding in biochemical content.
4. These mutants are the biochemical and economically superior.
5. Statistical analysis of phenotypic and genotypic coefficient of variation (PCV and GCV) of all quantitative characters studied in M₂ and M₃ generation revealed that there was difference between two parameters indicated that the characters are controlled by genetic and environmental factors.
6. The high heritability and genetical advance of these medicinal traits suggested that...
they can be transferred to other plants through breeding programme for genetic improvement in Coriander.

**Conclusion**

From the observations of present study it may be concluded that a considerable and usable variation has been created in this crop by the employed mutagens. It is also clear that micro mutational changes may be effectively induced for yield and other related characters using EMS and Gamma rays.

Over all, study of induced morphological mutant in M₃ generation in concern with behavior performance and their biochemical value will be considered for genetic improvement in plants. Mutation breeding programme can be employed to induce a number of desirable traits in Coriander, which has been selection of novel mutants making a great contribution to mutation breeding. In the future, the chemical mutagen like EMS and physical mutagen like Gamma rays used to induce desirable genes at different developmental stages of the plant. Thus, mutation breeding is effective and valid medicinal plant through breeding method of improvement in Coriander. In mutation breeding, the researcher can use experimental mutagenesis for creation of new varieties of medicinal plants and to obtain higher genetic diversity.

The present investigation, clearly demonstrated that induced mutation can be successfully utilized to create genetic variability when it is desired to improve specific traits in plants. It can be said that various chemical and physical mutagenic treatments employed in the present research work have been succeeded in inducing superior genotypes with significant alterations in growth and metabolism of the plant body. The mutagens successfully induced genetic variability and different mutants of agronomic traits. The results obtained are quite encouraging to utilize the mutants recovered for obtaining better biochemical content in case of Coriander. Eight different types of morphological mutants were recorded in the present studies like Tall, Dwarf, Dark green, Early flowering, Late flowering, Luxuriant, Flower colour and Fruit shape mutant in M₂ and M₃ generations. These mutants are showing better yield contributing parameters and even more essential oil content as compare to control. Such mutants could be promoted for cultivation after obtaining seed certification from concern agency.