Studies on the Effect of Irradiation on the Performance of Chrysanthemum Cultivars

ABSTRACT

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ABSTRACT

Chrysanthemum (*chryos* = golden; *anthos* = flower) is popular flower crop of commercial importance, it is commonly known as the "Queen of the East", *Guldaudi* or Autumn Queen. It belongs to the family Asteraceae and is a native of northern hemisphere. Among the cut flower crops in the international market, cut chrysanthemum ranks next to rose and is the number one dollar earning flower crop in the United States. In India, it occupies a place of pride both as a commercial flower crop and as a popular exhibition flower. Many cultivars which exhibit variation in respect of photoperiod, growth, size, colour and shape of blooms make chrysanthemum suitable for varied purposes and has increased immensely its potential as a commercial crop, which can be grown round the year. However, maintaining quality and longevity of cut flowers is one of the critical issues in the floriculture industry.

Mutation breeding is an alternative breeding method for production of genetically modified cultivars and classical breeding methods as it is safe and easily affordable. Gamma rays are the most energetic form of electromagnetic radiation and are considered the most penetrating physical mutagenic agent as compared to other radiation sources, which interact with atoms or molecules to produce free radicals in cells. These radicals can induce higher mutation in plants because they produce serious cell damage or affectations in plant cells components modifying only some important traits without disturbing the whole genotype but these changes are induced at a very low rate. Gamma ray induced cultivars also increased vase life of flowers. Mutation as a method of breeding new cultivars in chrysanthemum is preferred because chrysanthemum is a hexaploid perennial plant and vegetatively propagated, which makes this difficult for conducting hybridization programs. For inducing mutations for developing novel mutants as well as variation in flower characters.

In the present study rooted cuttings of chrysanthemum cv. Little Pink, Vasantika and Maghi were subjected to gamma radiation (0, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5 kR) with the following objectives:

1. To study the effect of gamma radiation on vegetative parameters of chrysanthemum cultivars.
2. To assess the effect of gamma radiation on floral parameters of chrysanthemum cultivars.
3. To study the effect of gamma radiation on cytological changes in the chrysanthemum cultivars.
4. To estimate the effect of gamma radiation on yield of chrysanthemum cultivars under study as potential cut flower.
5. To determine the effect of gamma radiation on vase life of chrysanthemum cultivars under study as potential cut flower.

The field experiment was laid out in Split Plot Design (SPD) and laboratory experiment was laid out in Complete Randomized Design (CRD) with nine treatments replicated three times.

The experimental findings obtained from this investigation have been summarized here:

1. Lower irradiation doses 1.0 and 1.5 kR increased number of branching and leaves, however, higher irradiation doses (3.5, 4 and 4.5 kR) were incrementally decreased vegetative growth parameters viz., plant height, survival percent, and number of branches, suckers and leaves in chrysanthemum cultivars under study *viz.*, Little Pink, Vasantika and Maghi.

2. Maximum number of abnormal leaves and plants were observed with 4.0 and 4.5 kR gamma irradiation dose in all three chrysanthemum cultivars viz, Little Pink, Vasantika and Maghi , over control.

3. Maximum days taken to bud formation, days to first color shown and days to full bloom with higher irradiation doses (2.5 and 3 kR). Lower irradiation doses viz., 1.0 and 1.5 kR induced earliness in flowering and flowering duration in all chrysanthemum cultivars viz., Little Pink, Vasantika and Maghi as compare to control.

4. Maximum flower abnormalities were observed with higher irradiation doses (2.5 and 3kR) in all cultivars viz., Little Pink, Vasantika and Maghi as compare to control.

5. Lower irradiation doses 1.5 kR increased number of ray floret in Little Pink and 1 kR in Maghi as compare to Vasantika and other treatments, whereas higher irradiation doses (2, 2.5, 3 kR) decreased number of ray florets in all chrysanthemum cultivars viz., Little Pink, Vasantika and Maghi.

6. Highest floret ratio were observed in Little Pink (V_1) with higher gamma irradiation treatments (3kR) in all chrysanthemum cultivars viz., Little Pink, Vasantika and Maghi along with control.

7. Lower irradiation doses (1 and 1.5 kR) increased weight of flower in all three chrysanthemum cultivars viz., Little Pink, Vasantika and Maghi among all gamma radiation treatment, while higher irradiation doses (2.5 and 3 kR) decreased flower weight in all three chrysanthemum cultivars viz., Little Pink, Vasantika and Maghi.

8. Maximum flowers yield were observed in control (untreated) among all treatment (1 to 4.5 kR) and Little Pink among all the cultivars. Treatments of gamma irradiation incrementally decreased yield (kg) of flowers (in M_1 generation).

9. Maximum chimeric plants were observed in Little Pink with 1.5kR gamma irradiation treatment. Among the treatments 1.0, 1.5 and 2.0 kR were induced flower colour

in form of chimera in Little Pink, however foliage variegation were observed in Maghi with lower irradiation doses (1.0, 1.5 and 2.0 kR).

10. Vase life of cut flower and foliage of chrysanthemum cultivars at lower doses (1 and 1.5 kR) of irradiation treatments of gamma ray and their interaction with cultivars significantly increased vase life of flower and foliage in all three chrysanthemum cultivars viz., Little Pink, Vasantika and Maghi.

11. Among the cultivars maximum cytological aberrations were observed in root mitosis of V_1 (Little Pink), whereas among the treatments 2.5kRads showed highest cytological aberrations.

12. Among all mutants Mutant 2 was screened as a superior Mutant which had highest plant height, number of suckers, branches and leaves, however lowest highest plant height, number of suckers, branches and leaves were observed in Mutant 3 over control and Mutant one.

13. Maximum number of flower, yield of flowers, florets per flower, diameter of flower, size of florets, and earliness were observed in Mutant 2 over Mutant 1. Mutant 3 (Dwarf mutant) produced minimum number of flowers per plant, number of floret per flowers, yield of flowers, floret diameter of flower, size of florets and late flowering were observed. It is ideal for pot culture, hanging baskets, and decoration at multistory buildings.

14. Maximum cytological abnormalities were observed in Mutant 3 whereas minimum in control (parent plant).

15. For novelty testing, anatomical and cytological study were done and results revealed that Mutant 3 had maximum anatomical and cytological aberration viz., size of stomata (size of pore and guard cell), stomatal density, abnormal chromosomes, bridges, laggards, clumped chromosomes followed by Mutant 2 and Mutant 1 while minimum in parent plant.

Conclusion

The quantitative and qualitative characters studied revealed earliness in the flowering, flowering duration, significant change in color and shape of flowers in plants treated with

1.0- 2.0 Kr gamma radiation over control. Maximum number of branches, diameter of flower, weight of flower and size of stomata along with minimum number of days taken to bud initiation, first color shown and full bloom was recorded for the lower radiation doses (1.0 and 1.5 Kr). Higher radiation doses of 2.5 to 4.5 Kr were ineffective since they adversely affected the plant performance in terms of its survival, vegetative as well as flower growth and chromosomal aberration. Chimeric plants were produced in M_1 generation which could be multiplied and obtained mutants in pure form through the screening of vegetative and floral characters, yield and vase life parameters, cytological as well as anatomical characters.

On the basis of experimental findings summarized above it may be concluded that lower to medium doses of gamma ray viz., 1.0, 1.5 and 2.0 kR to be applied in chrysanthemum cultivars for improvement in vase life, yield and floral traits. Three pure mutants were isolated from purple blooming chrysanthemum cultivar Little Pink cultivar as:

Mutant-1 It was isolated as a size mutant from 1.0 kR gamma rays treatment is a high yielding early blooming mutant.

Mutant-2 This was isolated as a colour (Light Pink) and size mutant from 1.5 kR treatment and is a attractive early blooming mutant having good vase life.

Mutant-3 Dark red coloured dwarf mutant which is suitable for hanging baskets and landscaping of houses and multistory building, isolated from 2 kR gamma irradiation.

Gamma irradiation doses of 1.0 kR and 1.5 and 2.0 kR found beneficial for various growth, flowering and post-harvest traits in chrysanthemum cultivars. Among chrysanthemum cultivars cv Little Pink responded well at different gamma ray doses and may be used for improvement cultivars through mutation breeding.