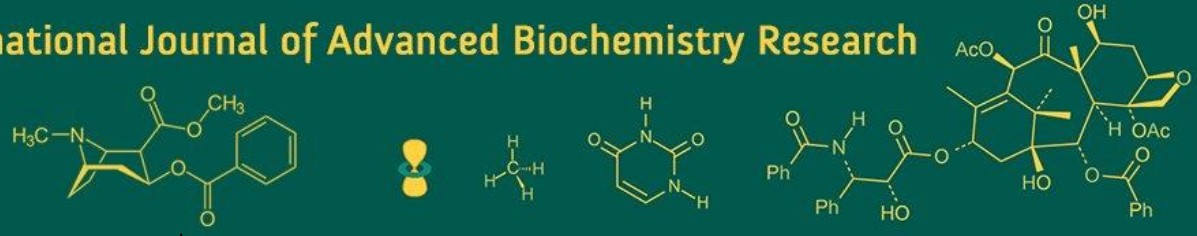
International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; SP-8(7): 596-598
www.biochemjournal.com
Received: 04-04-2024
Accepted: 10-05-2024

Akshay A Thakare
Horticulture Section,
College of Agriculture,
Nagpur, Dr. PDKV, Akola,
Maharashtra, India

Dr. Megha H Dahale
Associate Professor,
Horticulture Section,
College of Agriculture,
Nagpur, Dr. PDKV, Akola,
Maharashtra, India

Dr. VU Raut
Head and Professor,
Horticulture Section,
College of Agriculture,
Nagpur, Dr. PDKV, Akola,
Maharashtra, India

Snehal V Deshmukh
Horticulture Section,
College of Agriculture,
Nagpur, Dr. PDKV, Akola,
Maharashtra, India

Corresponding Author:
Akshay A Thakare
Horticulture Section,
College of Agriculture,
Nagpur, Dr. PDKV, Akola,
Maharashtra, India

Effect of gamma rays and EMS on germination and survival percentage of annual chrysanthemum

Akshay A Thakare, Dr. Megha H Dahale, Dr. VU Raut and Snehal V Deshmukh

DOI: https://doi.org/10.33545/26174693.2024.v8.i7Sh.1594

Abstract
An experiment entitled "Mutation studies in annual chrysanthemum" was carried out during *rabi* season of the year 2021- 2023 at the farm of Horticulture Section, College of Agriculture, Nagpur. The experiment of M_1 generation was laid out in randomized block design with three replications and eight treatments. However, the experiment of M_2 generation was laid out in progeny rows with eight treatments consists of Control, 100 Gy, 200 Gy, 300 Gy, 400 Gy, 0.1% EMS, 0.2% EMS, 0.3% EMS.
The different treated seeds of annual chrysanthemum with gamma rays and EMS had significantly influenced the vegetative characters and also created the variability. Significantly reduced the germination percentage of plants and survival percentage of plants in M_1 and M_2 generation of annual chrysanthemum.

Keywords: Mutation, gamma rays, EMS, germination, survival, annual chrysanthemum

Introduction
Annual chrysanthemum (*Chrysanthemum coronarium* L.) is one among important commercially cultivated flower crops grown in India. It is a winter season annual, native to Mediterranean region distributed throughout Europe, Northern Africa and Asia and propagated by seeds producing daisy like, golden yellow to white flowers. It is different from florist chrysanthemum in many aspects. The crop is relatively short durated and less photosensitive thus capable of coming up throughout the year. It is hardier, vigorous and grows taller. Its flowers are in various shades of yellow white, having single or double forms. Mutation breeding is one of the established methods by which one can induce variability in vegetatively propagated crops and it also offers advantage over conventional breeding for the improvement of one or more traits within a short span of time. Mutation derived varieties have had a significant impact on the array and choiced of genetic resources available in modern agriculture. Spontaneous mutation or bud sports have played an important role in the evolution of many garden chrysanthemums. In addition to spontaneous mutation, another type of mutation that have a high potential for bringing about the further genetic improvement, is induced mutation through physical and chemical mutagens. The introduction of induced mutation has also attracted considerable attention in chrysanthemums due to the fact that any mutation in dominant genes is easily expressed in the first generation and thus the selection of mutations of directly perceptible characters like flower colour, shape, size *etc*. is generally very easy and directly be put in commercial use.
EMS is a chemical mutagen of the alkylating group and has been widely used in plants because it causes high frequency of gene mutations and low frequency of chromosome aberrations. This mutagen has been used to treat seeds and recently to treat in vitro explants of many species. In India the crop has been naturalized and locally called 'Bijli' in Nagpur (Meshram *et al.* 2008) [10], 'Baboona' in Haryana (Mishra *et al*. 2002) [11] 'Guldhak' in Punjab, 'Market' in Delhi and 'Gendi' in Uttar Pradesh. The major flower growing states in India are Tamil Nadu, Andhra Pradesh, Karnataka (Banglore, Dharwad, Belgaum, Hosur), Maharashtra (Ahmadnagar and Pune), West Bengal, Uttar Pradesh, Haryana, Gujarat and Delhi. The important flowers having more demand are Flowers are sold in market loose as well as cut flowers. Among the flowers used for domestic market, annual chrysanthemum is considered as one of the important commercial loose flower.

There is a great scope of increasing area under this crop. Increasing flower yield with quality flowers, extending the duration of flower production are the prime importance in the cultivation of annual chrysanthemum. This can be achieved by proper dose of nutrients.

Materials and Methods

The investigation entitled, "Mutation studies in annual chrysanthemum" was carried out at the field of college garden, Horticulture Section, College of Agriculture, Nagpur during rabi season of the year 2021-22 and 2022-23. The best quality seeds of annual chrysanthemum variety "PDKV Bijli Super" were obtained from, Horticulture Section, College of Agriculture, Nagpur (M.S). The 100 seeds were sown on nursery beds. The seeds of annual chrysanthemum variety PDKV Bijli Super was irradiated with four doses of gamma rays (100 gy, 200 gy, 300 gy and 400 gy) at chemistry lab of Rashtra sant tukdogi maharaj Nagpur university. The seeds of annual chrysanthemum variety PDKV Bijli Super were selected for treatment. The seeds were treated with different Ethyl methane sulphonate (EMS) concentrations immersed in Ethyl methane sulphonate (EMS) solution for 2 hours. In control, the seeds were immersed in distilled water for 2 hours. After the treatments, the seeds were dipped in STS (sodium thiosulphate) solution (0.3%) for 15 minutes to remove the stresses of the solution on seed.

Uniform and healthy seedlings were selected for transplanting. The gamma rays treated seedlings transplanted on 7th November, 2021. The chemical treated seedlings and untreated seedlings (control) were planted. These seedlings were planted at 45 X 30 cm distance on the experimental field in Randomized Block Design (RBD) of three replications with eight treatments. All the standard cultural practices were followed, except pinching and disbudding operations.

The plants that had showed variation were isolated from the population of the M_1 generation and of these variants were transplanted as per induced mutagenic treatments and non-treated control separately on 15 November 2022 as progeny rows to raise the M_2 population. Collect seeds from each variant separately, ensuring proper storage conditions to maintain seed viability. Document the seed collection process, including the quantity and quality of seeds obtained from each variant. Establish a systematic timeline for data collection and observations. Regularly record data points such as plant height, leaf morphology, flowering time, and any other relevant traits to track the development of the M_2 population.

Results and Discussion

1. Germination (%)

M_1 generation

The perusal of data presented in Table 1 clearly indicated that germination percentage was decreased due to gamma rays and EMS treated population of annual chrysanthemum over control T_1 (89.67%) during M_1 generation. Among the induced mutagen maximum germination percentage (87.95%) was recorded at (0.1%) EMS treatment T_6 which was at par with the treatment T_7 (84.93%) and treatment T_2 (83.15%) respectively and minimum (65.60%) in gamma rays (400 Gy) T_5.

Table 1: Effect of induced mutagens on germination percentage of annual chrysanthemum in M_1 and M_2 generation

Treatment Details	Germination percentage in M1 generation (%)	Germination percentage in M2 generation (%)
T – Control 1	89.67 (71.25)	89.05 (70.67)
T - Gamma rays 100 Gy 2	83.15 (65.76)	83.09 (65.71)
T - Gamma rays 200 Gy 3	79.30 (62.93)	79.20 (62.86)
T - Gamma rays 300 Gy 4	73.34 (58.91)	72.68 (58.48)
T - Gamma rays 400 Gy 5	65.60 (54.08)	63.57 (52.87)
T - EMS @ 0.1% 6	87.95 (69.68)	87.67 (69.44)
T - EMS @ 0.2% 7	84.93 (66.63)	84.91 (67.14)
T - EMS @ 0.3% 8	79.15 (62.83)	79.12 (62.81)
'F' test S.E (m) ± CD at 5%	Sig. 1.59 4.82	Sig. 1.66 5.03

Figures in parentheses are arc sine transformed values

M2 generation

The data presented in Table 1 indicated that germination percentage was also decreased due to the gamma rays and EMS treated population of annual chrysanthemum over control T_1 (89.05%) during M_2 generation. Among the induced mutagen maximum germination percentage (87.67%) was recorded at (EMS @ 0.1 %) treatment T_6 which was at par with the treatment T_7 (84.91 %) and treatment T_2 (83.09%) respectively and minimum (63.57%) in gamma rays (400 Gy) T_5.

Data revealed that gamma rays (100 Gy, 200 Gy, 300 Gy & 400 Gy) and EMS (0.1 %, 0.2 % & 0.3%) treatments had reduced the germination percentage in both generations over control. It was also cleared from the data that, in M_1 generation. Similarly, the germination was more in M_1 generation as compared to M_2 generation. The decrease in germination after exposure of the seeds of chrysanthemum to the gamma rays were a form of ionizing radiation that disrupts the structure of atoms and molecules within the seed. This might due to directly damage DNA, enzymes, and other cellular components crucial for germination and EMS is a chemical mutagen that alters the DNA structure within the seed. Similar to gamma radiation, these mutations can interfere with the complex processes needed for germination, resulted to failure of germination. (Gunckel and Sparrow, 1961) [6]. The results are in closed conformity with the findings of Vaidya *et al.* (2016) [9] in chrysanthemum who had observed the significant reduction in germination. when treated with gamma rays and EMS. Datta *et al.* (1985b) [3], Banerji and Datta (1992a, 2002) [1, 2], Fu *et al.* (1995) [5], Datta *et al.* (2003), Gupta *et al.* (2003) and Kapadiya *et al.* (2014) [8] also have same opinion.

2. Survival (%)

M_1 generation

The perusal of data presented in Table 4.2 clearly indicated that survival percentage was decreased due to gamma rays and EMS treated population of annual chrysanthemum over control T_1 (90.16%) during M_1 generation. Among the induced mutagen maximum survival percentage (87.10%) was recorded at (EMS @ 0.1%) T_6 Which was at par with the treatment T_7 (83.49%) and treatment T_2 (82.86%) respectively and minimum (58.33%) in gamma rays (400 Gy) T_5.

Table 2: Effect of induced mutagens on survival percentage of annual chrysanthemum in M_1 and M_2 generation

Treatment Details	Survival percentage in M_1 generation (%)	Survival percentage in M_2 generation (%)
T_1 – Control	90.16 (71.71)	88.23 (69.93)
T_2 - Gamma rays 100 Gy	82.86 (65.54)	81.57 (64.57)
T_3 - Gamma rays 200 Gy	78.52 (62.38)	77.88 (61.94)
T_4 - Gamma rays 300 Gy	70.37 (57.02)	69.99 (56.78)
T_5 - Gamma rays 400 Gy	58.33 (49.79)	53.96 (47.27)
T_6 - EMS @ 0.1%	87.10 (68.95)	86.73 (68.63)
T_7 - EMS @ 0.2%	83.49 (66.02)	82.96 (65.61)
T_8 - EMS @ 0.3%	78.15 (62.13)	72.01 (58.05)
'F' test S.E (m) ± CD at 5%	Sig. 1.52 4.59	Sig. 1.86 5.62

Figures in parentheses are arc sine transformed values

M_2 generation

The data presented in Table 2 indicated that survival percentage was also decreased due to the gamma rays and EMS treated population of annual chrysanthemum over control T_1 (88.23%) during M_2 generation. Among the induced mutagen maximum survival percentage (86.73%) was recorded at (EMS @ 0.1%) treatment T_6 which was at par with the treatment T_7 (82.96%) and treatment T_2 (81.57%) respectively and minimum (53.96%) in gamma rays (400 Gy) T_5.

The data revealed that gamma rays (100 Gy, 200 Gy, 300 Gy & 400 Gy) and EMS (0.1 %, 0.2 % & 0.3 %) treatments had reduced the survival percentage in both generations over control. It is also cleared from the data that, in M_1 generation. Similarly, the plant survival was more in M_1 generation as compared to M_2 generation. The decrease in plant survival after exposure of the seeds of annual chrysanthemum to the gamma rays and EMS has been due to disturbances of auxin synthesis and chromosomal aberrations (Gunckel and Sparrow, 1961) [6]. The results are in closed conformity with the findings of Vaidya *et al.* (2016) [9] in chrysanthemum who had observed the significant reduction in plant survival when treated with gamma rays and EMS. Datta *et al.* (1985b) [3], Banerji and Datta (1992a, 2002) [1, 2], Fu *et al.* (1995) [5], Gupta *et al.* (2003) [7] and Kapadiya *et al.* (2014) [8] also have same opinion.

Conclusion

The findings from this study underscore the significant impact of gamma rays and EMS treatments on germination and survival percentages in annual chrysanthemum across M1 and M2 generations. Both mutagens induced a notable decrease in these vital parameters compared to the control, with gamma rays (400 Gy) consistently exhibiting the most severe effects. The observed reductions in germination and survival can be attributed to DNA damage and chromosomal aberrations caused by gamma rays and EMS, disrupting crucial cellular processes necessary for seed viability and plant survival. These results align closely with previous research, emphasizing the reproducibility of mutagenic effects in chrysanthemum, as documented by several authors. Further investigations could explore mitigation strategies to enhance seed quality and plant survival post-mutagenesis.

Reference

1. Banerji BK, Datta SK. Gamma ray induced flower shape mutation in chrysanthemum cv. 'Jaya'. Journal of Nuclear Agriculture and Biology. 1992;21(2):73-79.
2. Banerji BK, Datta SK. Induction and analysis of gamma ray induced flower head shape mutation in 'Lalima' chrysanthemum (Chrysanthemum morifolium). The Indian Journal of Agricultural Sciences. 2002;72(1):6-10.
3. Datta SK. Gamma ray induced mutant of chrysanthemum. Journal of Nuclear Agriculture and Biology. 1985;14:131-133.
4. Datta SK, Gupta MN. 'Hemanti' - A new chrysanthemum cultivar evolved by gamma irradiation. The Progressive Horticulture. 1982;14(1):33-7.
5. Fu R, Andersen RL, Cheng Z, Liu ZR. Studies on Induced Mutation of Fruit Trees in Vitro. Acta Horticulture. 1995;403(2):56-61. DOI: 10.17660/ActaHortic.1995.403.2.
6. Gunckel JE, Sparrow AH. Ionization radiations: Biochemical, physiological and morphological aspects and their effects on plants. Encyclopedia of Plant Physics. 1961;16:555-611.
7. Gupta YC, Dilta BS, Bhalla R, Sharma BP. Effect of gamma rays on vegetative and flowering parameters of chrysanthemum. Journal of Ornamental Horticulture (New Series). 2003;6(4):328-34.
8. Kapadiya DB, Chawla SL, Patel AI, Ahlawat TR. Exploitation of variability through mutagenesis in chrysanthemum (Chrysanthemum morifolium Ramat) var Maghi. The Bioscan. 2014;9(4):1799-1804.
9. Vaidya PP, Dalal SR, Mahadik MK. Vegetative Mutagenesis Studies in Chrysanthemum. Advances in Life Sciences. 2016;5(12):4831-4835.
10. Meshram M, Kulkarni A, Jayaraman VK, Kulkarni BD, Lele SS. Optimal xylanase production using Penicilium janthinellum NCIM 1169: A model based approach. Biochemical Engineering Journal. 2008 Jun 1;40(2):348-356.
11. Mishra SK, Tripp J, Winkelhaus S, Tschiersch B, Theres K, Nover L, *et al*. In the complex family of heat stress transcription factors, HsfA1 has a unique role as master regulator of thermotolerance in tomato. Genes & development. 2002 Jun 15;16(12):1555-1567.