Original Research Article

Effect of different levels of EMS on chrysanthemum (*Dendranthema grandiflora* L.)

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ABSTRACT

Chrysanthemums are widely cultivated and have a significant market value due to their popularity as ornamental plants and their traditional medicinal uses. The global chrysanthemum market includes various segments, such as cut flowers, potted plants, and medicinal products. Therefore, the present investigation was carried out with title at the Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, Uttar Pradesh during the Winter-2022 with a view to determine the effect of different doses of EMS mutagen application on chrysanthemum variety Sunburst cushion for its growth quality and to work out the economics of various treatments. Under this experiment, overall, 7 treatment was prepared by soaking planting material in different doses of EMS mutagens prepared for five hours each, Treatments comprised of T0 (Control), T1 (0.5% EMS mutagen), T2 (0.75% EMS mutagen), T3 (1.0% EMS mutagen), T4 (1.5% EMS mutagen), T5 (1.25% EMS mutagen), and T6 (2.5% EMS mutagen). The current study found that the use of EMS mutagen at lower concentration had a significant positive impact on the survival, growth, and development of chrysanthemums. Among the treatments tested, T1 showed the most favorable results in terms of leaf width, leaf length, stem length, number of flowers per plant, early flowering. T1 was composed of 0.5% EMS mutagen.

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Keywords: *Chrysanthemum, EMS, Mutagens.*

1.INTRODUCTION

Chrysanthemum, botanically known as *Dendranthema grandiflora* (L.) is a perennial crop with compound inflorescence is an array of several flower heads, or sometimes a solitary head. The head has a base covered in layers of phyllaries. The simple row of ray florets is white, yellow, or red. The disc florets are yellow. The fruit is a ribbed achene. Chrysanthemum cultivation began in Japan during the Nara and Heian periods (early 8th to late 12th centuries) and gained popularity in the Edo period (early 17th to late 19th century). Many flower shapes, colours, and varieties were created. The flower heads occur in various forms, and can be daisy-like or decorative, like pompons or buttons. This genus contains many hybrids and thousands of cultivars developed for horticultural purposes. In addition to the traditional yellow, other colours are available, such as white, purple, and red. The most important hybrid is *Chrysanthemum* × *morifolium* (syn. *C.* × *grandiflorum*), derived primarily from *C. indicum*, but also involving other species. Chromosome number of chrysanthemum is 2n=18. Chrysanthemums are divided into two basic groups, garden hardy and exhibition. Garden hardy chrysanthemums are perennials capable of wintering in most northern latitudes. Exhibition varieties are not usually as sturdy. Mutagens can make abundant mutations in different organs of plants, such as seeds, bulbs, callus, pollen, etc. (Mba *et al*., 2010). Plants make different mutagenesis sites, which can be\ selected according to the needs of the experiment, and EMS can be used for mutagenesis. Jankowicz-Cieslak *et al*. (2012) considered that seeds are the most common mutagenic plant materials, and there is also a wealth of data in other plant species on doses used to achieve high densities of induced mutations. In general, for plants propagated by seeds, their seeds are usually preferentially selected mutagenic material (Gottwald *et al*., 2009). Chrysanthemum is a popular ornamental plant that belongs to the family Asteraceae. It is widely cultivated for its attractive flowers, which come in a variety of colors, shapes, and sizes, making it a popular choice for floral decoration and landscaping. Chrysanthemums are also valued for their medicinal properties and are used in traditional medicine for the treatment of various ailments. With the increasing demand for new varieties of chrysanthemums with improved characteristics such as flower size, color, and shape, there has been a growing interest in the application of mutagenic agents to induce genetic variations in chrysanthemums. Among the various mutagenic agents, Ethyl Methane Sulfonate (EMS) is widely used as a chemical mutagen for inducing point mutations in plants. The present study aimed to investigate the effects of EMS mutagenic treatments on chrysanthemum and to develop new and improved varieties with desirable traits.

2.MATERIALS AND METHODS

The present investigation was done to understand the effect of EMS mutagen at different doses combination on growth, and quality of chrysanthemum variety Sunburst cushion. The experiment was carried out at Horticultural Research Farm (HRF), Department of Horticulture, Naini Agricultural Institute SHUATS, Prayagraj, U.P., during the *Rabi* season of 2022 Observations were recorded at different stages of growth periods. The data were statistically analysed by the method suggested by Fisher and Yates, 1963**.** The different combination doses of EMS mutagen comprised of T_0 (Control Plot); T_1 (0.5 % (EMS Mutagen); T_2 (0.75 % (EMS Mutagen); T_3 (1 % (EMS Mutagen); T_4 (1.5 % (EMS Mutagen); T_5 (1.25 % (EMS Mutagen) and T_6 (2.5 % (EMS Mutagen).

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3.RESULTS AND DISCUSSION:

3.1 Vegetative parameters

3.1.1 Influence of EMS mutagens on survival percentage (%) and Leaf length (cm)

The survival percentage significantly varied among different treatment combinations. The maximum survival percentage (60.25%) was observed with treatment T_0 (Control pot) followed by T_1 (0.5% EMS mutagen) with 45.70%. Minimum survival percentage (38.00%) was observed in T_3 (1% EMS Mutagen), while the remaining treatments were moderate in their growth habit. It was found that T_1 (0.5% EMS mutagen) had maximum leaf width at 60 DAP i.e. 10.03 cm followed by T_2 (0.75 % EMS mutagen) with 9.66 cm whereas the minimum leaf width was observed in treatment T_0 (Control) with 9.21 cm. There was significant difference between the treatments at among the treatments applied. It was found that T_1 (0.5% EMS mutagen) had maximum leaf length at 60 DAP i.e. 5.40 cm followed by T_2 (0.75 % EMS mutagen) with 5.14 cm whereas the minimum leaf length was observed in treatment T_0 (Control) with 4.93 cm. The application of different level of EMS mutagen at lower concentrations induce less DNA damage, leading to fewer lethal mutations, resulting in improved survival rates of chrysanthemum. EMS mutagens at lower concentrations induce favourable mutations in genes responsible for leaf development, resulting in improved leaf width and leaf length. Similar findings were reported by Aravind *et al.*, (2021) in marigold; Ghani *et al.*, (2014) in gerbera; Rajasekar *et al.* (2019); Ghormade *et al.* (2020); Purente *et al.* (2020); Ganisetti *et al.* (2021); Guo *et al.* (2021); Li *et al.* (2021); Sun *et al.* (2021); Nasri *et al.*, (2022) and Palekar *et al.* (2022) in chrysanthemum.

3.1.2 Influence of EMS mutagens on Stem growth (cm), stem length (cm) and plant spread (cm) [N-S and W-S]

There was significant difference between the treatments at among the treatments applied. It was found that T_1 (0.5% EMS mutagen) had maximum stem growth at 60 DAP i.e. 4.47 cm followed by T_2 (0.75 % EMS mutagen) with 4.18 cm whereas the minimum stem growth was observed in treatment T_0 (Control) with 3.50 cm. There was significant difference between the treatments at among the treatments applied. It was found that T_1 (0.5% EMS mutagen) had maximum stem length at 60 DAP i.e. 16.37 cm followed by T_2 (0.75 % EMS mutagen) with 15.98 cm whereas the minimum stem length was observed in treatment T_0 (Control) with 11.30 cm. Lower concentrations of EMS mutagens may cause mutations that enhance stem growth and stem length in chrysanthemums. There was significant difference between the treatments at among the treatments applied. It was found that T_1 (0.5% EMS mutagen) had maximum plant spread [N-S] at 40 DAP i.e. 6.34 cm followed by T_2 (0.75 % EMS mutagen) with 6.33 cm whereas the minimum plant spread [N-S] was observed in treatment T_0 (Control) with 5.72 cm. There was significant difference between the treatments at among the treatments applied. It was found that T_1 (0.5% EMS mutagen) had maximum plant spread [W-S] at 40 DAP i.e. 6.72 cm followed by T_2 (0.75 % EMS mutagen) with 6.34 cm whereas the minimum plant spread [W-S] was observed in treatment T_0 (Control) with 5.70 cm. Lower concentrations of EMS mutagens may cause alteration of gene responsible for controlling stem growth and stem length length leading to producing effect that enhance stem growth and stem stem length in chrysanthemums thus in turn plant spread too. The findings of the present investigation are in conformity with the reports of Aravind *et al.,* (2021) in marigold; Ghani *et al.,* (2014) in gerbera; Rajasekar *et al.* (2019); Ghormade *et al.* (2020); Purente *et al.* (2020); Ganisetti *et al.* (2021); Guo *et al.* (2021); Li *et al.* (2021); Sun *et al.* (2021); Nasri *et al.,* (2022) and Palekar *et al.* (2022) in chrysanthemum.

3.2. Floral parameter

3.2.1 Influence of EMS mutagens on Days to first bud initiation and days to first flower opening

There was significant difference between the treatments at among the treatments applied. It was found that T_1 (0.5% EMS mutagen) had minimum days to first flower bud initiation 39.90 days followed by T_2 (0.75 % EMS mutagen) with 42.00 days whereas the maximum days to first flower bud initiation was observed in treatment T_0 (Control) with 46.00 days. There was significant difference between the treatments at among the treatments applied. It was found that T_1 (0.5% EMS mutagen) had minimum days to first flower opening 48.45 days followed by T_2 (0.75 % EMS mutagen) with 52.35 days whereas the maximum days to first flower opening was observed in treatment T_0 (Control) with 56.70 days. EMS mutagen triggered for early appearance of flower bud by causing alteration in gene expression controlling days to flower bud initiation in chrysanthemum. The findings of the present investigation are in conformity with the reports of Aravind *et al.,* (2021) in marigold; Ghani *et al.,* (2014) in gerbera; Rajasekar *et al.* (2019); Ghormade *et al.* (2020); Purente *et al.* (2020); Ganisetti *et al.* (2021); Guo *et al.* (2021); Li *et al.* (2021); Sun *et al.* (2021); Nasri *et al.,* (2022) and Palekar *et al.* (2022) in chrysanthemum.

3.2.1 Influence of EMS mutagens on Number of flowers per plant and number of ray florets

There was significant difference between the treatments at among the treatments applied. It was found that T_1 (0.5% EMS mutagen) had maximum number of flowers plant 49.93 flowers followed by T_2 (0.75 % EMS mutagen) with 44.13 flowers whereas the minimum number of flowers plant was observed in treatment T_0 (Control) with 33.73 flowers. There was significant difference between the treatments at among the treatments applied. It was found that T_1 (0.5% EMS mutagen) had maximum number of ray florets 59.48 ray florets followed by T_2 (0.75 % EMS mutagen) with 59.25 ray florets whereas the minimum number of ray florets was observed in treatment T_0 (Control) with 56.55 ray florets. It was noticed that number of flowers per plant increased at lower concentration of EMS mutagen. This might be due to changes in gene segments controlling bud formation in chrysanthemum. At higher concentrations gene controlling for bud formation might have become inactive leading to less flower bud formation in turn flower numbers in chrysanthemum. It was noticed that number of ray florets increased at lower concentration of EMS mutagen. This might be due to changes in gene segments controlling ray floret formation in chrysanthemum. At higher concentrations gene controlling for ray florets formation might have become inactive leading to a smaller number of ray florets formation in chrysanthemum. The findings of the present investigation are in conformity with the reports of Aravind *et al.,* (2021) in marigold; Ghani *et al.,* (2014) in gerbera; Rajasekar *et al.* (2019); Ghormade *et al.* (2020); Purente *et al.* (2020); Wang *et al.,* (2020); Ganisetti *et al.* (2021); Guo *et al.* (2021); Li *et al.* (2021); Sun *et al.* (2021); Nasri *et al.,* (2022) and Palekar *et al.* (2022) in chrysanthemum.

4.CONCLUSION

The current study found that the use of different doses of EMS mutagen had a significant positive impact on the growth, and development of chrysanthemums. From the present investigation it is concluded that T_1 (0.5% EMS Mutagen) was found to be best among all treatment in terms of yield and growth of chrysanthemum flower.

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Table 1 Performance of different doses of EMS mutagen on vegetative and floral parameters for Chrysanthemum.

Treatment Notation	Treatment details	Survival Percentage (%)	Leaf width (cm) [60 DAP]	Leaf length (cm) [60 DAP]	Stem growth (mm [60 DAP]	Stem length (cm [60 DAP]	Plant Spread (N-S) [40 DAP] (cm)	Plant Spread (W-S) [60 DAP] (cm)	Days to first flower bud appearance [DAP]	Days to first flower opening [DAP]	No of flowers per plant	No of ray florets
T_0	Control Pot	60.25	9.21	4.93	3.50	11.30	5.72	8.23	46.00	56.70	33.73	56.55
T_1	0.5 % (EMS Mutagen)	45.70	10.03	5.40	4.47	16.37	6.34	9.28	39.90	48.45	49.93	59.48
T_2	0.75 % (EMS Mutagen)	40.15	9.66	5.14	4.18	15.98	6.33	8.82	42.00	52.35	44.13	59.25
T_3	1 % (EMS Mutagen)	38.00	9.37	5.00	4.08	15.00	5.72	8.25	44.00	53.50	39.40	58.53
T_4	1.5 % (EMS Mutagen)	39.22	9.41	4.99	3.74	14.88	6.02	8.66	45.97	54.02	36.22	56.99
T_5	1.25 % (EMS Mutagen)	41.42	9.36	5.02	3.61	13.22	5.99	8.54	45.35	55.33	38.14	57.12
T_6	2.5 % (EMS Mutagen)	42.66	9.49	5.12	3.84	13.77	6.21	8.69	43.66	55.87	37.75	58.33
'F' test		**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
S.E. (m) ±		**3.24**	**0.57**	**0.21**	**0.24**	**0.22**	**0.28**	**0.27**	**0.45**	**0.47**	**3.34**	**3.47**
C.D. at 5%		**6.87**	**1.11**	**0.28**	**0.18**	**0.19**	**0.67**	**0.76**	**1.21**	**1.17**	**9.87**	**2.14**
C.V.		**30.59**	**26.94**	**16.70**	**17.09**	**16.44**	**15.77**	**11.22**	**4.33**	**3.52**	**40.22**	**30.15**