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Effect of chemical mutagens on growth and flowering of carnation

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Abstract
Mutation breeding is one of the most reliable techniques in improving crop plants. Mutagens are used to bring the variability in floricultural crop, like *Dianthus*. The genetic variability created by mutation will be studied for development of new cultivar in carnation having significant consumer preference. Therefore, with consideration to the above factors, the present experiment was undertaken with the objective are to explore the possibilities of chemical mutagens to create genetic variability in carnation and to study the morphological changes occurs in carnation as a result of mutagenesis. In present study, three different concentrations (0.25, 0.50 and 0.75%) of ethyl methane sulphonate (EMS) and (0.1, 0.3 and 0.5%) of methyl methane sulphonate were used to treated *Dianthus* seedling and without treated plant used as controlled to assess the quantitative and qualitative parameter of carnation cultivar Pink Donna.

It was noted that plant height was significantly influenced in treated plant in all the treatment except T_7 i.e. control. Treatment T_7 recorded significantly highest plant height (73.67) cm over rest of treatments while treatment T_3 recorded lowest plant height (57.31) cm. T_7 (control) took significantly highest number of days (135.53) for first flowering followed by T_3 (129.80) days. Highest stalk length of flower (70.19) cm was observed in control plant as compared to other treated plant. The data revealed that the there was no significant difference in no. of shoot per plant, thickness of flower stalk and flower diameter of treated and control plants. The data showed that mean number of nodes was influenced by chemical mutagens. T_6 produced significantly least number of nodes per stalk (8) while T_7 (control) produced significantly maximum number of nodes per stalk (11.40). T_3 recorded the least per cent of calyx splitting (15.33%). There was no flower, leaves abnormalities and petal colour variation between treated and control plants.

Keywords: *Dianthus caryophyllus*, chemical mutagens, EMS, MMS, mutation breeding

Introduction
The objectives of carnation breeding are to develop cultivars which do not produce shoots at upper nodes, breed cultivars resistant to calyx splitting, cultivars with high productivity and to develop cultivars resistant to pest and disease. Introduction, selection, Hybridization and mutation breeding are the different methods used for carnation improvement.

Mutation breeding has been widely used for the improvement of plant characters in various crops. It is a powerful and effective tool in the hands of plant breeders especially for autogamous crops having narrow genetic base (Micke, 1988) [6]. The prime strategy in mutation breeding has been to upgrade the well-adapted plant varieties by altering one or two major agronomic metrical traits which limit their productivity or enhance their quality. *Dianthus caryophyllus* L., commonly known as Carnation, belongs to the angiospermic family Caryophyllaceae, is an important floricultural crop all over the world and ranks just next to Rose in popularity. One way of creating variability in such a self pollinated crop is attempting crosses between two genotypes complementing the characters of each other but, due to autogamous nature of this crop, hybridization at appropriate time is a difficult process. The only alternative left with breeders to create variability is mutation breeding.

Mutation breeding is also a efficient way to produce heritable changes particularly for flower colours. Genetic variation is essential in any plant breeding programme for crop improvement. Induction mutations are highly effective to enhance natural genetic resources. (Jain S. M., 2006). Mutation breeding is easy tool for generation of variability in carnation. Both physical and chemical mutagens can be used for creation of genetic variability. Chemical mutagenesis (the non-GMO approach) is a simple approach to create mutation in plants for their improvement of potential agronomic traits. In any mutation breeding programme, selection of an effective and efficient mutagen is very essential to produce high frequency of desirable mutation. Many chemical mutagens have been employed for obtaining useful mutants in various crop species (Singh and Singh, 2001) [9].

However the various workers emphasizes that artificial induction of mutation by colchicine (Col), ethyl methane sulphonate (EMS) and sodium azide (SA) provides tool to overcome the limitations of variability in plants especially Carnation and induces specific improvement without disturbing their better attributes (Roychowdhury and Tah, 2011) [8].

While going for mutation breeding programme various factors like the choice of parents, characters to be improved, the type of mutagens and its doses to be used, experimental procedures to be chosen shall be considered. Thus through mutation breeding it is possible to induce a genetic variation for quantitative and qualitative characters that is heritable of sufficient magnitude and frequency of interest in the breeding programme.

Thus the genetic variability created by mutation will be studied for development of new cultivar in carnation having significant consumer preference. Therefore, with consideration to the above factors, the present experiment was undertaken with objective are to explore the possibilities of chemical mutagens to create genetic variability in carnation and to study the morphological changes occurs in carnation as a result of mutagenesis.

Materials and Methods

The experimental material for the present investigation, i.e. planting material of cv. Dona (Pink Colour) was procured from Florance flora at Bangalore and these readymade carnation plantlets were dipped in the solution of ethyl methyl sulphonate and methyl methane sulphonate for 6 hrs with different concentration and then transplanting was done. The present investigation entitled "Mutation breeding in carnation (*Dianthus caryophyllus* L.)" was undertaken during the year 2009-10 Hi- tech Floriculture project, College of Agriculture, Pune - 5.

The experimental was laid out in Completely Randomized Design with seven treatment replicated three times. Uniform dose of fertilizer and manure was applied to the field for conducting the experiment. Drenching of Bavistin (0.1%) was done 10 days after planting to prevent soil borne disease like root rot.

Raised beds with dimension of 24 m of length, 0.75 m breath and 0.3m height were prepared by using soil, sand and well decomposed farm yard Manure (FYM) in the proportion of 2:1:1. Formaline was used for soil sterilization 15 days prior to planting. Fifty percent shade was provided at the time of planting by using 50 per cent black coloured shade net. Eight drippers per square meter were laid out prior to planting for irrigation. The planting was done by maintaining the spacing of 15 x 15 cm. Thus, per square meter plant population was maintained as 24 plants per square meter. Water soluble fertilizers were used for fertigation of carnation through drip irrigation system. Observations on twenty five randomly selected plants from each treatment in each replication were recorded during the course of experiment for vegetative growth characters and flower characters. The statistical analysis was done by standard statistical method suggested by Panse and Sukhatme (1985) [7].

Result and Discussion

The effect of chemical mutagens i.e. EMS and MMS with different concentration on quantitative and qualitative parameter of *Dianthus caryophyllus* are given in table 1.The height of plant differed significantly in various treatments when measured at the time of flowering. The control recorded maximum plant height than treated plants. Treatment T_4 (MMS 0.1%) recorded maximum height and T_3 (EMS 0.75%) recorded minimum plant height. Due to chemical mutagens, cell multiplication rate decreases leading to dwarfness in treated plants, where as in control increase in plant height was due to unintrupted cell multiplication. Similar trend of reduction in plant height in treated plant have been reported by Banerji (2002) [1], Kang *et al.* (2007) [3], Boersen *et al.* (2006) [2] in chrysanthemum and rose. There was no change in number of sprouting vegetative buds for shoot formation on plant as a result of mutagenesis.

Leaf length of control plant was observed to be maximum than of treated plants. In treatment T_3 (EMS 0.75%) recorded minimum leaf (8.90) cm length and treatment T_1 (EMS 0.25%) recorded maximum leaf length (9.33) cm. This was due to different growth rate observed in plants as a result of mutagenesis. These results are in agreement to that of Singh *et al.* (2010) [10] who observed the length of treated plant was reduced after mutagenesis in african marigold. Treated plants required minimum days for flowering than control plants. In treated plants, treatment T_5 (MMS 0.3%) observed minimum days (128.06), while treatment T_7 (control) took maximum days for first flowering (135.53). Due to physiological dwarfing as a result of chemical mutagens all energy was utilised for early flowering. Thus stunted vegetative growth caused early flowering. Similar finding in respect to days required for flowering were also reported by Kang *et al.* (2007) [3] in rose.

The treatment T_7 (control) recorded maximum stalk length than treated plants. In treated plant treatment T_1 (EMS 0.25%), treatment T_2 (EMS 0.50%), treatment T_3 (EMS 0.75%) were recorded minimum stalk length of flower. The vegetative growth was not hampered in control plants, due to which stalk length of flower was more in control plants. Fast growth rate of control plants offered highest stalk length of flower in control plants. There finding are supported by Wosinska (1985) [11], Leshem (1986) [5], Kanwar *et al.* (2002) [4]. Minimum stalk length in treated plants is observed over control plants in china aster and carnation. The data revealed that the there was no significant difference in no. of shoot per plant, thickness of flower stalk and flower diameter of treated and control plants. There was no flower, leaves abnormalities and petal colour variation between treated and control plants.

Calyx splitting percentage was influenced by different treatments was found to be significant. There was less variation between treated and control plant. The treatment T_7 (control) reported maximum calyx splitting percentage (20.67%) where as in treated plant treatment T_1 (EMS 0.25%) reported minimum calyx splitting percentage (15.47%) This was a complete phenomenon which involve factor like environment, nutrition, pest and disease incidence.

Table 1: Effect of chemical mutagens on quantitative and qualitative characters of *Dianthus caryophyllus*

Tret No.	Mutagen Concentration (%)	Plant height (cm)	No. of shoots per plant	Leaf length (cm)	Days required For 1st flower	Stalk length of flower (cm)	Stalk thickness (mm)	Diameter of flower (cm)	% Calyx splitting	No. of node
T_1	EMS (0.25)	57.75	4.20	9.33	128.47	54.13	3.81	4.89	15.47	8.73
T_2	EMS (0.50)	57.67	4.33	9.26	129.20	53.79	3.84	4.83	16.00	8.67
T_3	EMS (0.75)	57.31	4.20	8.90	129.80	53.77	3.79	4.97	15.33	8.60
T_4	MMS (0.1)	60.09	4.00	9.30	128.73	56.57	3.82	4.91	17.00	9.00
T_5	MMS (0.3)	59.65	4.00	9.20	128.06	56.11	3.80	4.91	15.67	8.87
T_6	MMS (0.5)	58.89	3.93	9.30	128.47	55.27	3.85	4.83	16.67	8.00
T_7	Control	73.67	4.00	9.48	135.53	70.19	3.86	4.90	20.67	11.40
	SE ±	0.44	0.07	0.04	0.35	0.44	0.03	0.03	0.44	0.08
	C.D. at 5 %	2.23	NS	0.015	1.79	2.22	NS	NS	1.76	0.39

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