Int.J.Curr.Microbiol.App.Sci (2020) *9*(9): 3196-3200

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 9 Number 9 (2020)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2020.909.395

Effect of Gamma Radiation, EMS and Colchicine on Sprouting in Garlic (*Allium sativum* L.)

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Keywords

Garlic, mutation, Gamma radiation, Ethyl methane sulphonate, Colchicine, Sprouting percent

Article Info

Accepted:
20 August 2020
Available Online:
10 September 2020

A B S T R A C T

A field trial was conducted to study the effect of Gamma Radiation, EMS and Colchicine on Sprouting percentage in garlic variety 'Buldhana local'. The experiment was carried out at Vegetable Instructional farm, Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (M.S.) during *Rabi* season in the year 2017-2018. It was laid out in Randomized Block Design. The garlic cloves were treated with five levels of gamma radiation (2, 3, 4, 5, and 6 Gy), EMS (0.45%, 0.55%, 0.65%, 0.75% and 0.85 %) and Colchicine (0.08%, 0.10 % and 0.12%) for 12 hrs. The study revealed that sprouting percentage decreased with increasing dose of mutagens.

Introduction

Garlic (*Allium sativum* L.) is one of the most popular widely cultivated bulbous crop member of Alliaceae family and it's been consumed nearly by every person for various purposes. Garlic is a diploid (2n=2x=16) predominantly cross fertilizing species. It is originated from the progenitor *Allium longicuspis* and its centre of origin is Central Asia (Mc Collum, 1976). Garlic has several medicinal properties such as antibacterial (Arora and Kaur, 1999), antifungal (Hughes and Lawson, 1991), antiviral (Meng *et al.*, 1993), antiprotozoal (Reuter *et al.*, 1996), antioxidant and anticancer properties (Harris *et al.*, 2001).

Mutation breeding is an important tool in crop improvement of vegetatively propagated crops, particularly in plants with reproductive sterility, where this is the only alternative (Broertjes and Harten, 1988). Irradiation of garlic cloves by physical and chemical mutagens is widely used to induce variability at the genetic level which alters number of biochemical processes leading to the desirable changes in the genotype.

Garlic being a vegetatively propagated crop, posse's low variability. Clonal selection is one of the main methods for garlic improvement (Agrawal *et al.*, 2003), hence it is difficult to create variability to the breeders for selecting the promising genotypes. Consequently, garlic breeding has been limited to the selection of the pre-existing genetic variability and increase in garlic variability was attempted *via* mutation breeding techniques.

Materials and Methods

The study entitled "Effect of Gamma Radiation, EMS and Colchicine on Sprouting in Garlic (*Allium sativum* L.)" was conducted to explore the effect of mutagens in garlic. The Garlic cloves were treated with gamma rays, EMS and colchicine and were planted as per the treatment on 20th October, 2017 in Randomized Block Design with three replications as per the methods suggested by Panse and Sukhatme (1967). Two hundred and fifty cloves were planted under each treatment. The local cultivar Buldhana local was selected with the different doses of gamma rays and was treated at Bhaba Atomic Research Centre, Trombay, Mumbai and chemical treatment with Ethyl Methyl Sulphonate (EMS) and Colchicine was carried out at Horticulture Analytical Laboratory, Department of Horticulture, as an experimental material for the VM_1 generation. The cloves were treated with different concentrations of EMS and Colchicine by immersing in EMS and Colchicine solution for 12 hours. After the treatment, these cloves were kept under running tap water for 1 hour to remove adjuvant to the cloves. Thereafter, these were planted in the experimental field at spacing of 15 X 10 cm. Data recorded on different parameters was analysed statistically to express the results.

Treatment details

Treatment	Dose of gamma rays	Treatment	Dose of gamma rays	Treatment	Dose of gamma rays
T_1	2 Gy	T_6	0.45 % EMS	T_{11}	0.08 % Colchicine
T_2	3 Gy	T_7	0.55 % EMS	T_{12}	0.10 % Colchicine
T_3	4 Gy	T_8	0.65 % EMS	T_{13}	0.12 % Colchicine
T_4	5 Gy	T_9	0.75 % EMS	T_{14}	Control
T_5	6 Gy	T_{10}	0.85 % EMS		

Results and Discussion

Sprouting percentage (%)

As the data presented in Table 1, it clearly showed that, concentration of gamma rays, EMS and Colchicine had significantly decreased the sprouting percentage of cloves over the control treatment T_{14} (31.73%). Further, it was also clear from the data that, the reduction in sprouting of cloves was increased with an increase in dose of gamma rays, EMS and Colchicine. Among the gamma rays and chemical mutagens, the significantly maximum sprouting percent was recorded (30.67 %) in the treatment T_{11} -0.08 % colchicine and it was followed by the treatment T_{12} (30.13%) 0.10 % colchicine, T_1 (29.20%) 2 Gy and T_{13} (28.40 %) 0.12 % colchicine.

However, significantly minimum sprouting percentage of cloves were recorded in the treatment T_{10} (13.60 %) 0.85 % EMS and was followed by the treatment T_9 (16.13 %) 0.75 % EMS 10 DAP of garlic cloves.

Table.1 Effect of physical and chemical mutagens on sprouting percentage of garlic at 10 DAP

Treatments	Sprouting percentage (%) 10 DAP
T1- 2 Gy	29.20
T2- 3 Gy	25.47
T3- 4 Gy	23.60
T4- 5 Gy	23.07
T5- 6 Gy	18.93
T6- 0.45 % EMS	24.00
T7- 0.55 % EMS	20.93
T8- 0.65 % EMS	19.47
T9- 0.75 % EMS	16.13
T10- 0.85 % EMS	13.60
T11- 0.08 % Colchicine	30.67
T12- 0.10 % Colchicine	30.13
T13- 0.12 % Colchicine	28.40
T14- Control	31.73
F test	Sig
SE (m) ±	0.16
CD at 5%	0.47

Table.2 Effect of physical and chemical mutagens on sprouting percentage of garlic at 20 DAP

Treatments	Sprouting percentage (%) 20 DAP
T1- 2 Gy	49.89
T2- 3 Gy	47.87
T3- 4 Gy	46.40
T4- 5 Gy	45.07
T5- 6 Gy	35.07
T6- 0.45 % EMS	47.07
T7- 0.55 % EMS	42.40
T8- 0.65 % EMS	38.40
T9- 0.75 % EMS	32.27
T10- 0.85 % EMS	29.07
T11- 0.08 % Colchicine	50.40
T12- 0.10 % Colchicine	50.13
T13- 0.12 % Colchicine	48.27
T14- Control	52.93
F test	Sig
SE (m) ±	0.15
CD at 5%	0.43

Table.3 Effect of physical and chemical mutagens on sprouting percentage of garlic at 30 DAP

Treatments	Sprouting percentage (%) 30 DAP
T1- 2 Gy	76.80
T2- 3 Gy	71.20
T3- 4 Gy	66.00
T4- 5 Gy	65.33
T5- 6 Gy	61.47
T6- 0.45 % EMS	70.13
T7- 0.55 % EMS	65.07
T8- 0.65 % EMS	62.40
T9- 0.75 % EMS	59.33
T10- 0.85 % EMS	55.73
T11- 0.08 % Colchicine	80.40
T12- 0.10 % Colchicine	79.33
T13- 0.12 % Colchicine	72.00
T14- Control	93.20
F test	Sig
SE (m) ±	1.72
CD at 5%	5.00

The results obtained at 20 DAP in Table 2, specified that, doses of gamma rays, EMS and Colchicine had significantly decreased the sprouting percentage of cloves over the control treatment T_{14} (52.93 %). Further, it was also clear from the data that, the reduction in sprouting of cloves was increased with an increase in dose of gamma rays, EMS and Colchicine. Among the gamma rays and chemical mutagens, the significantly maximum sprouting percent was recorded (50.40 %) in the treatment T_{11} -0.08 % colchicine and it was followed by the treatment T_{12} (50.13 %) 0.10 % colchicine, T_1 (49.89 %) 2 Gy and T_{13} (48.27 %) 0.12 % colchicine. However, significantly minimum sprouting percentage of cloves was recorded in the treatment T_{10} (29.07 %) 0.85 % EMS and was followed by the treatment T_9 (32.27 %) 0.75 % EMS 20 DAP of garlic cloves.

As the data presented in Table 3 at 30 DAP, it indicated that, concentration of gamma rays, EMS and Colchicine had significantly decreased the sprouting percentage of cloves over the control treatment T_{14} (93.20 %). Further, it was also clear from the data that, the reduction in sprouting of cloves was increased with an increase in dose of gamma rays, EMS and Colchicine. Among the gamma rays and chemical mutagens, the significantly maximum sprouting percent was recorded (80.40 %) in the treatment T_{11} -0.08 % colchicine and it was followed by the treatment T_{12} (79.33 %) 0.10 % colchicine, T_1 (76.80 %) 2 Gy and T_{13} (72.00 %) 0.12 % colchicine. However, significantly minimum sprouting percentage of cloves was recorded in the treatment T_{10} (55.73 %) 0.85 % EMS and was followed by the treatment T_9 (59.33 %) 0.75 % EMS. Similar results were also studied by (Banjare *et al.,* 2016)

This reduction in sprouting percent may be due to delay or inhibition of physiological and biological processes considered necessary for sprouting, including enzyme activity, hormonal imbalance, and inhibition of mitotic

processes. Further, sprouting may be inhibited due to the toxic nature of the mutagen (Kumar *et al.*, 2013), damage to cell constituents at the molecular level, or altered enzyme activity (Khan and Goyal, 2009).

In conclusion the sprouting percent decreased as the rate of concentration of mutagens increased. Based on the observation recorded at 10, 20 and 30 days after planting, treatment T_{14} (Control) recorded maximum sprouting percentage followed by treatment T_{11} (0.08 % Colchicine) and T_{12} (0.10 % Colchicine), whereas minimum sprouting percentage was recorded in T_{10} (0.85 % EMS) followed by treatment T_9 (0.75 % EMS) and T_5 (6Gy).

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How to cite this article:

Pawar, A. P., V. S. Kale, P. K. Nagre, A. M. Sonkamble and Mane, S. S. 2020. Effect of Gamma Radiation, EMS and Colchicine on Sprouting in Garlic (*Allium sativum* L.). *Int.J.Curr.Microbiol.App.Sci.* 9(09): 3196-3200. doi: https://doi.org/10.20546/ijcmas.2020.909.395