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Flowering and bulb traits of tuberose (*Polianthes tuberosa* L.) affected by Mutagenic effect of ethyl methane Sulfonate (EMS)

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Abstract

Bulbs of Prajwal Tuberose were exposed to five levels of mutagenesis for three time interval to explore the possibility to enrich the plants, flowers and buds traits. The treatment of bulbs with EMS 0.25% with 8 hours dipping duration was found best for increase in spike length, rachis length, spike weight, number of opened florets, number of unopened florets and number of spikes per clump. Besides that earliness with respect to number of days taken for opening of first florets. The treatment of bulbs with 0.50% EMS with 4 hours dipping duration in EMS solution shows an increase in number of bulbs per clump, diameter of bulb and weight of bulbs. Lower doses of EMS coupled with shorter dipping duration seems promising for extending the vase-life of tuberose cut flowers.

Keywords: Tuberose, ethyl methane Sulfonate, dipping time interval, flower and bulb traits

Introduction

Floriculture has been emergent as an important industry to boost the farmers income. Avenues for the development of new and novel ornamental cultivars are many with the breeders (Dorajeerao and Mokashi, 2020) [2]. Mutation has been recognized to induce a sudden heritable change in the desirable traits (Contreras and Shearer, 2020) [1]. Though mutation occurs at a very slow rate in natural populations in spontaneously manner (Oladosu *et al.* 2016) [9]. Traditionally cross breeding, propagation, usually through *in vitro* techniques and leads to fixation of mutation event (Hoskins and Contreras, 2019) [6]. For the last 45 years, the International Atomic Energy Agency has sponsored extensive research and development activities on mutation induction to enhance the genetic diversity in the food and industrial crops. This mutant has created tremendous economic impact in Agriculture throughout the world. Thus, mutation induction has proven to be a workable, sustainable, highly-efficient, environmentally acceptable, flexible, unregulated, nonhazardous and a low-cost technology to enhance crop improvement (Hernández *et al.* 2019) [5]. Radiations or certain chemicals would be useful for a change at relatively higher frequencies (Hayashi *et al.* 2019; Sathyanarayana *et al.* 2019) [4, 11]. Such induced mutations have been well established and successfully utilized for the crop improvement programs (Samatadze *et al.* 2019) [10]. Induced mutagenesis was successful in improving many ornamental plants such chrysanthemum, gerbera and gladiolus, they are altered in flower and leaves characters (color, shape, size) and physiological traits (Jagdale *et al.* 2017) [7]. The mutagens treatments increase the random mutation rate, resulting in the faster accumulation of useful mutations at relatively low costs for breeding programs (Swaroop *et al.* 2015) [13]. Ornamental plant breeding has benefitted from the use of random mutagenesis as compared to genetic engineering applications (Smith and Noyszewski, 2018) [12]. Additionally, vegetative propagation is common in ornamentals, which means that mutants with novel phenotypes are relatively easily maintained (Ghosh *et al.* 2019) [3]. The present study was carried out to find out the effect of different doses of ethyl methane sulfonate (EMS) and different dipping duration of bulbs to point the changes in growth, flowering and yield of tuberose.

Materials and Methods

The bulbs of Prajwal Tuberose were dipped in five levels of EMS 0.25, 0.50, 0.75, 1.0% EMS solution for three dipping times for 5 min, 4 hours and 8 hours. The treatments of the experiment were laid out in Randomized Block Design with three replications at the experimental orchard of the Department of Horticulture,

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CCS HAU, Hisar during 2017 cropping season. Sixteen plants of each treatment combination were planted in each replication at spacing of 30cm x 30 cm in plots having area of 1.2 m x 1.2 m. Important flower and bulb traits were measured viz. Days taken for opening of first floret, Length of spike, Length of rachis, Stem diameter, Number of florets per spike, Number of florets opened per spike, Vase life Spike weight Number of spike per clump Number of florets unopened per spike for statistical analysis to have meaningful interpretations.

Results and Discussion

A. Important flower traits for tuberose Plants

1. Days taken for opening of first floret: The maximum days taken to opening of first floret was recorded in

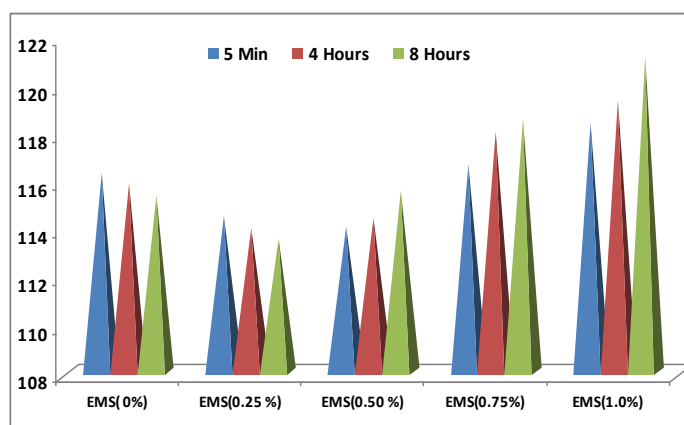


Fig 1: Effects of mutagenesis on Days for opening first floret

treatment 1. 0% EMS and the minimum number of days taken to opening of first floret were observed in bulbs treated with 0.25% EMS figure 1. The dipping duration was not found significant for days taken to opening of first floret. Jiang *et al.* 2014 reported the positive effects of EMS.

2. Length of spike: The maximum spike length was obtained at 0.25% EMS and minimum spike length was obtained at 1.0% EMS figure 2. The dipping duration significantly reduced the length of spike. Maximum length of spike was obtained at 5 minutes dipping and minimum was obtained at 8 hours dipping. The interactions were not found significant.

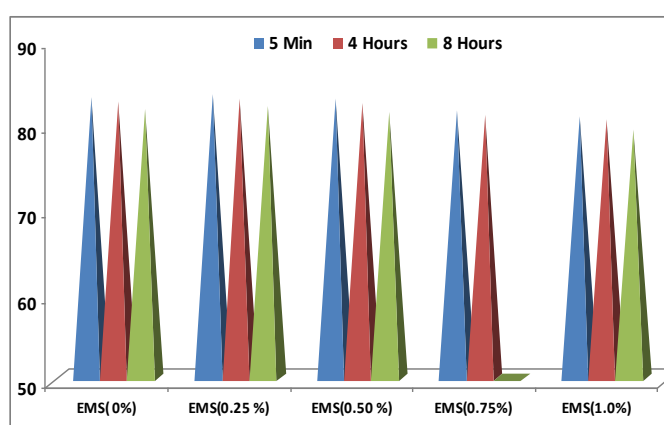


Fig 2: Effects of mutagenesis on Spike length (cm)

3. Length of rachis: The maximum rachis length was obtained at 0.25% EMS and minimum rachis length was obtained at 1.0% EMS figure 3. The dipping duration significantly reduced the length of rachis. Maximum length of rachis was obtained at 5 minutes dipping and

minimum at 8 hours dipping. In interactions, maximum length of rachis was found at 0.25% EMS with 4 hours dipping while minimum at 1.0% EMS with 8 hours dipping.

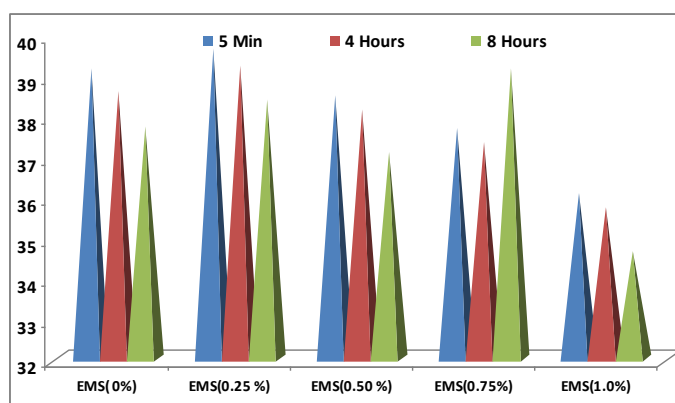


Fig 3: Effects of mutagenesis on Length of Rachis (cm)

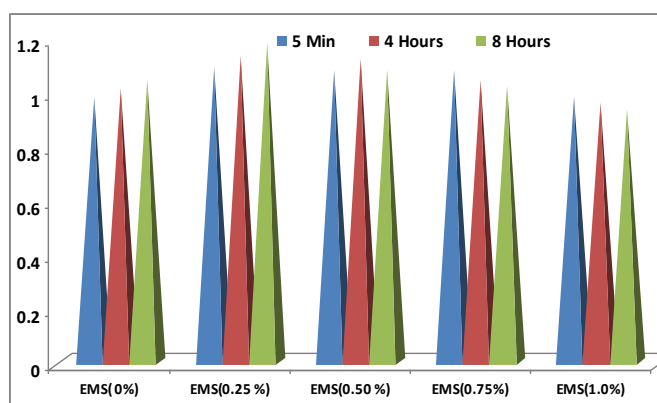


Fig 4: Effects of mutagenesis on Stem diameter (cm)

4. Stem diameter: The maximum stem diameter was obtained at 0.25% EMS and minimum was obtained at 1.0% EMS figure 4. The dipping duration was not found significant. The interactions showed maximum diameter of stem at 0.25% EMS with 8 hours dipping while minimum with 1.0% EMS with 8 hours dipping.

duration significantly reduced number of florets per spike. Maximum number of florets per spike was obtained at 5 minutes dipping and minimum at 8 hours dipping. The interaction shows reduction in number of florets per spike the maximum number of florets per spike was obtained at 0.25% EMS with 8 hours dipping and minimum was obtained at 1.0% EMS with 8 hours dipping.

5. Number of florets per spike: The maximum numbers of florets per spike were obtained at 0.25% EMS and minimum with 1.0% EMS figure 5. The dipping

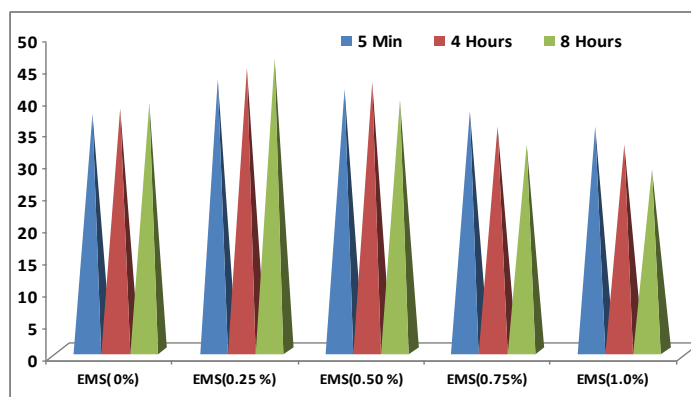


Fig 5: Effects of mutagenesis on Number of florets per spike

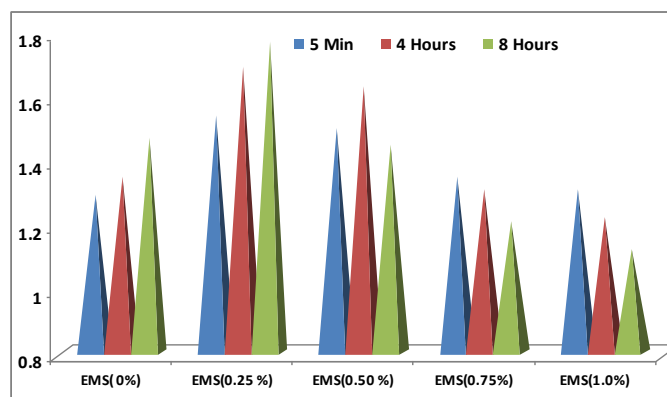


Fig 6: Effects of mutagenesis on Number of opened florets per spike

6. **Number of florets opened per spike:** The maximum number of florets opened per spike was obtained at 0.25% EMS and minimum with 1.0% EMS figure 6. The dipping duration significantly reduced number of florets opened per spike maximum number of florets opened per spike was obtained at 5 minutes dipping and minimum at 8 hours dipping. The interaction shows reduction in number of florets opened per spike the maximum number of florets opened per spike was obtained at 0.25% EMS with 8 hours dipping and minimum was obtained at 1.0% EMS with 8 hours dipping.

7. **Number of spike per clump:** The number of spikes per clump decreases significantly with increase in dose of EMS except lowest dose of EMS figure 7. The maximum number of spikes per clump was obtained in 0.25% EMS and minimum with 1.0% EMS. The dipping durations and interactions were not found significant.

8. **Spike weight:** The weight of spikes decreases significantly with increase in dose of EMS except lowest dose of EMS figure 8. The maximum weight of spikes was obtained in 0.25% EMS and minimum with 1.0% EMS. The dipping durations and interactions were not found significant.

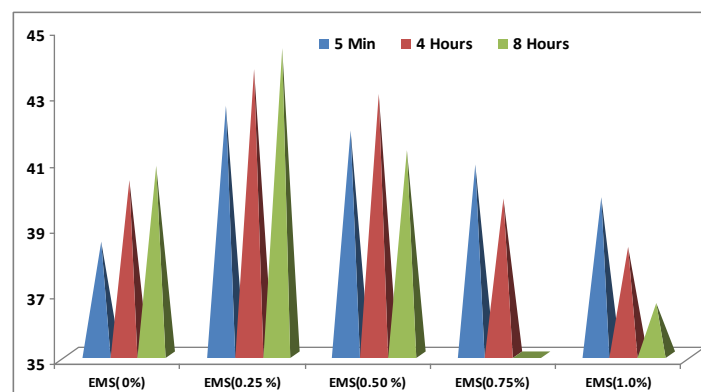


Fig 7: Effects of mutagenesis on Number of spikes per clump

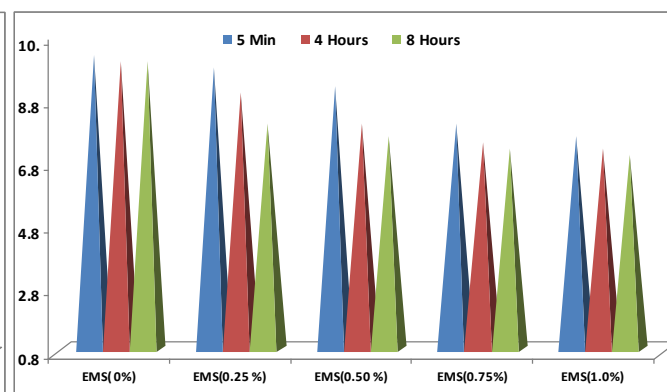


Fig 8: Effects of mutagenesis on Spike weight

9. **Vase life:** The maximum number of vase life was obtained at 0.25% EMS after control and minimum with 1.0% EMS figure 9. The dipping duration significantly reduced vase life maximum vase life was obtained at 5 minutes dipping and minimum at 8 hours dipping. The interaction shows reduction in vase life the maximum vase life was obtained at 0.25% EMS with 5 minutes dipping and minimum was obtained at 1.0% EMS with 8 hours dipping.

C. Important Bulb traits

1. Number of bulbs per clump

The maximum number of bulbs per clump was obtained at 0.50% EMS and minimum with control figure 10. The dipping duration significantly increased number of bulbs per clump. Maximum number of bulbs per clump was obtained at 4 hours dipping and minimum at 5 minutes dipping. The interaction shows reduction in number of bulbs per clump the maximum number of bulbs per clump was obtained at 0.50% EMS with 8 hours dipping and minimum was obtained at 0.25% EMS with 8 hours dipping.

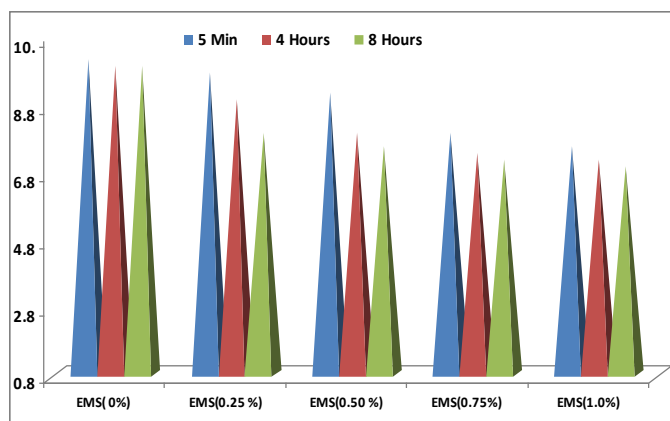


Fig 9: Effects of mutagenesis on Vase life (days)

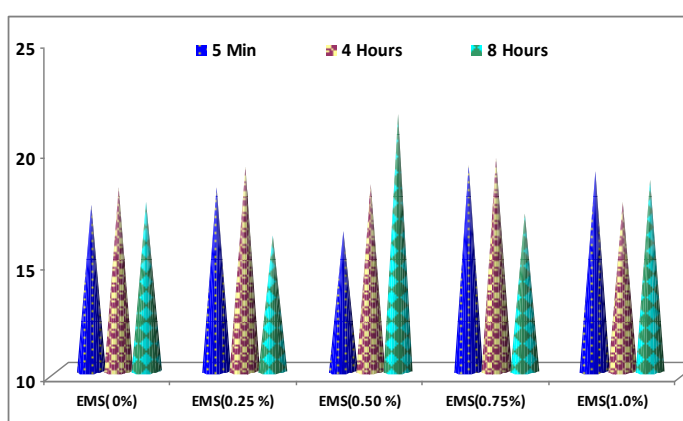


Fig 10: Effects of mutagenesis on Number of Bulbs per clump

2. Diameter of bulbs per clump: The maximum diameter of bulbs was obtained at 0.50% EMS and minimum with 1.0% EMS figure 11. The dipping duration significantly increased diameter of bulbs per clump maximum diameter of bulbs per clump was obtained at 8 hours dipping and minimum at 5

minutes dipping duration. The interaction shows increase in diameter of bulbs per clump the maximum diameter of bulbs per clump was obtained at 0.50% EMS with 8 hours dipping and minimum was obtained at 0.25% EMS with 8 hours dipping.

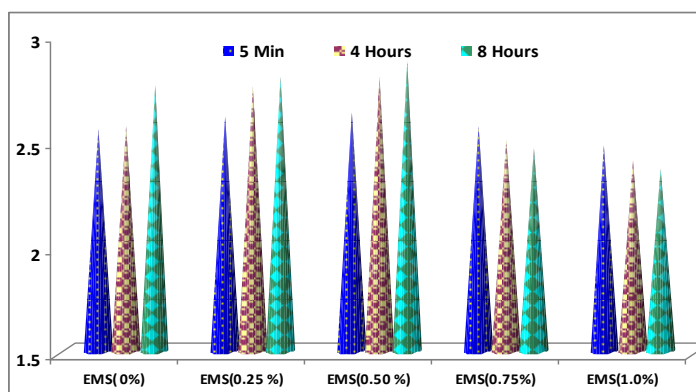


Fig 11: Effects of mutagenesis on Diameter of bulbs per clump

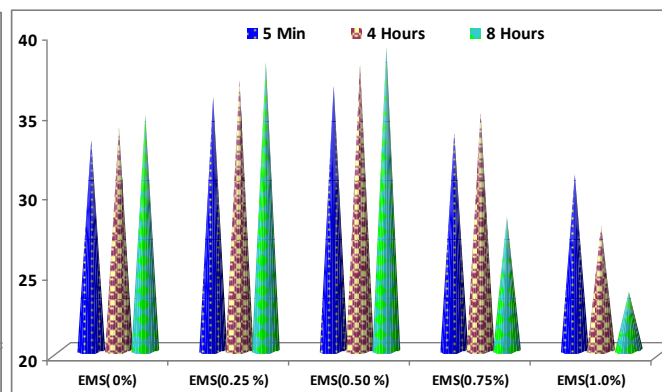


Fig 12: Effects of mutagenesis on weight of bulbs

3. Weight of bulbs

The maximum diameter of bulb was obtained at 0.50% EMS and minimum with 1.0% EMS figure 12. The dipping duration significantly reduced weight of bulbs maximum weight of bulbs was obtained at 4hours dipping and minimum at 8 hours dipping. The interaction shows increase in weight of bulbs the maximum weight of bulbs was obtained at 0.50% EMS with 8 hours dipping and minimum was obtained at 1.0% EMS with 8 hours dipping.

Conclusions

Results of the study may be summarized as the treatment of bulbs with mutagenesis EMS 0.25% with 8 hours dipping duration was more promising to increase in plant height, number of leaves per clump, length of leaves, spike length, rachis length, spike weight, number of opened florets, number of unopened florets and number of spikes per clump. And earliness with respect to number of days taken for sprouting, number of days taken for complete sprouting, number of days taken for opening of first florets, number of days taken for emergence of spike. The treatment of bulbs with 0.50% EMS with 4 hours dipping duration in EMS solution shows an increase in number of bulbs per clump, diameter of bulb and weight of bulbs. Lower doses of EMS coupled with shorter dipping duration seems promising for extending the vase-life

of tuberosc cut flowers.

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