



STUDIES ON EFFECTS OF INDUCED MUTAGENESIS ON QUANTITATIVE CHARACTERISTICS OF FINGER MILLET (*ELEUSINE CORACANA* (L.) GAERTN.) VAR- CO 13 IN M_2 and M_3 GENERATIONS

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ABSTRACT

Ragi or finger millet (Eleusine coracana (L.) Gaertn.) is an important crop used for food, forage, and industrial products. It is distributed in tropical and temperate regions of the world. Induced mutation by EMS and DES has been found to be a very useful technique for crop improvement. Apart from this, the proper use of induced mutation in plant breeding has become a profitable approach. For the present study, the seeds of Finger millet (Eleusine coracana (L.) Gaertn.) were treated with different concentrations of EMS (10, 20, 30, 40 and 50mM) and (20, 30, 40, 50 and 60mM) of DES. This investigation was carried out to determine the effect of EMS and DES on M_2 and M_3 generation, Plant height(cm), Number of leaves per plant, Leaf length (cm/plant), Number of finger per plant, Finger length (cm/plant), Days to first bloom, Yield per plant (g) and 1000 grains weight (g). All parameters evaluated and showed significant differences among the different concentration of mutagenic treatments. EMS was found to be quite effective in inducing genetic variability in M_2 and M_3 generation than DES. The results revealed significant difference in all the traits studied. The study further revealed that the use of EMS both generations is an effective approach for creating improved varieties in (Eleusine coracana (L.) Gaertn.) Var- Co 13.

Keywords : EMS, DES, Finger millet, M_2 germination, M_3 germination Var-Co-13.

INTRODUCTION

Finger millet (*Eleusine coracana* (L.) Gaertn.) popularly known as 'Ragi' or 'Mandua', belongs to family 'Poaceae'. Eleusine, the generic name, which is a Greek word meaning



‘Goddess of Cereals’, is supposed to have originated in the Ethiopian islands and was introduced into India approximately 3000 years ago. Finger millet is the most important crop from the nutritional as well as fodder point of view. Finger millet is highly adaptable to higher elevations and is grown in Himalaya upto an altitude of 3000 mean sea level (Bisht and Singh, 2009). Finger millet has high yield potential and grains can be stored for years without storage pests, which make it a perfect food grain for famine prone areas (National Research Council, 1996). Plant height, number of cluster per plant and number of pods per plant exhibit high heritability coupled with high to moderate genetic advance as percent of mean (>20), which may be improved through simple plant selection according to Mehandi *et al.* (2013). The availability of genetic diversity is pre-requisite for genetic improvement of a crop. There is a great genetic variation among varieties of finger millets. Besides the availability of genetic diversity, their characterization is essential for the effective utilization in the crop improvement (Upadhyaya *et al.*, 2007).

Mutation breeding is comparatively a quicker method for improvement of crops. It has been observed that induced mutations can increase yield as well as other quantitative traits in plants (Dhulgande *et al.*, 2010). Most of the crop improvement programs attempted through conventional breeding methods have exploited only the natural variability available in the germplasm. Adequate variability is not available in the gene pool to change the plant ideotypes. The induced mutagenesis can be efficiently employed as an alternative to induce the variability in morphological and physiological characters. The artificial induction of mutation in a crop species is achieved through the use of physical and chemical mutagens that increase the mutation frequency when compared to the spontaneous mutation. Therefore, the present study was conducted to characterize the finger millet (*Eleusine coracana*) for morphological parameters under field conditions.

MATERIALS AND METHODS

The seeds of Finger millet (*Eleusine coracana* (L.) Gaertn.) Var- Co 13. Varieties collected from Tamilnadu Agricultural Research Institute Villupuram. and used for the present study. The healthy seeds treated with various concentrations of chemical mutagens.

Ethyl methane Sulphonate (EMS)

EMS ($\text{CH}_3\text{SO}_2\text{OC}_2\text{H}_5$), an alkylating agent having molecular weight 124.16 was used in the present study. For the treatment of EMS, the seeds were pre-soaked in distilled water for 6 hours in order to make them relatively more sensitive to mutagenic action. Pre soaked seeds were treated with different concentrations of EMS (10, 20, 30, 40 and 50mM) for 4hours with repeated stirring. After the chemical treatment, the treated seeds were washed throughly in

running tap water to remove the residues of the chemicals and Healthy, well- matured and untreated seeds were used as control.

Diethyl sulphate (DES)

Seeds of Finger millet were subjected to different treatment levels (20, 30, 40, 50 and 60mM) of Diethyl sulphate for induced mutagenesis. Before treatment, seeds were pre-soaked in distilled water for 12hrs at room temperature. Later on these seeds were dried on filter paper. All seeds were uniformly exposed to Diethyl sulphate solution by stirring with a glass rod. After treatment seeds were rinsed thoroughly with distilled water, air-dried and stored for later studies.

The treated seeds were sown in seed beds along with control. After 30 days, old seedlings were transplanted to experimental field in Completely Randomized Block Designs with three replicates to raise M_1 population. The M_1 generation (produced directly from mutagen treated seeds) was grown in the seed bed culture experiment at the Botanical Garden, Department of Botany, Annamalai University. All the recommended cultural practices were carried out during the plant growth period. The M_2 generation (produced directly from M_1 seeds) M_3 generation (produced directly from M_2 seeds) was grown in the field experiment. All the recommended cultural practices were carried out during the plant growth period. All surviving M_2 and M_3 plants were harvested to find out the mean performance of quantitative traits.

RESULT AND DISCUSSION

Plant height (cm/plant)

A gradual increase plant height was noticed with increasing concentrations of mutagens in M_2 and M_3 generation than control (Table-1, 2). Among them higher mean for plant height was observed at 30mM EMS (68.76-70.32cm) followed by 40mM DES (66.29-68.92cm).

Number of leaves per plant

Among the various concentrations of mutagens, 30mM of EMS (27.60-28.54) showed more number of leaves followed by 40mM of DES (25.97-27.25). Above mentioned mean performance was slightly increased than control (23.33-24.35) (Table.1, 2).

Leaf length (cm/plant)

The leaf length was showed a gradual increase in LD₅₀ concentrations than control. It was higher at 30mM EMS (53.74-55.41) followed by 40mM (51.96-53.95) of DES when compared with control (47.23-48.84) values in M₂ and M₃ generation (Table.1, 2).

Number of fingers per plant

There was an enhanced level of for number of fingers per plant in M₂ and M₃ generation was observed. A gradual increase of was observed in the mutagen at lowest and LD₅₀ concentration. The higher mean performance was observed at 30mM EMS (6.65-7.02) and 40mM (6.37-6.81) of DES, whereas it was (5.54-5.91) in control (Table.1, 2).

Finger length (cm/plant)

Among the various concentrations of mutagens, the finger length maximum in 30mM EMS (9.53-9.89) followed by 40mM of DES (9.10-9.58) treated plants. Above mentioned mean performance was slightly increased than control (7.52-8.12) (Table.1, 2).

Days to first bloom

Different mutagens with various concentrations on M₂ and M₃ generation showed slight level of decreasing in number of days to first bloom. Among them, 30mM EMS (54.65-52.54) showed elimination of days followed by 40mM of DES (57.87-55.23). These mean performances showed lesser number of days was taken for blooming than the control plant (61-12-60.52) (Table.1, 2).

Yield per plant (g)

There was a significant variation in yield per plant with increasing concentrations. The higher yield per plant was observed at 30mM EMS (9.11-9.63) and 40mM of DES (8.65-9.15) (Table.1, 2).

1000 grains weight (g)

A gradual increase of mean for 1000 grains weight (g) was noticed with increasing concentrations of mutagens up to certain level. Among them, higher mean for 1000 grains weight was observed at 30mM EMS (3.61-4.01) followed by 40mM (3.43-3.83) of DES. This was significantly increased than other concentrations and control (3.11-3.41) (Table.1, 2).

Among the different mutagens with various concentrations, a gradual increase of mean values was observed at certain level in the M₂, and M₃ generations beyond it defined. Therefore,



higher concentrations showed decreasing trend on mean performance than that of other mutagenic concentrations and control.

Genetic variations induced by mutation represent a more efficient source of genetic variability than gene pools conserved by nature. A significant positive shift in mean performance was observed at 30mM of EMS in Plant height(cm), Number of leaves per plant, Leaf length (cm/plant), Number of finger per plant, Finger length (cm/plant), Days to first bloom, Yield per plant (g) and 1000 grains weight (g) in M_2 and M_3 generation.

Jabeen and Mirza (2002) reported that plant height, number of branches, number of leaves, leaf area, days to first flowering, days to fruiting, number of fruits per plant and chlorophyll content and minimum variances were observed in control and the maximum variance were observed in the treated plants of chilli. These results support an earlier report by Patil *et al.* (1997) and Sri Devi and Mullainathan (2011) *C. annuum*. Seeds of *C. annuum* were treated with 0.1, 0.2 and 0.5% EMS and Dimethyl sulphate for 12 and 18 hours on plant height, number of branches, number of fruits and fruit yield per plant were recorded. Variances for all characters under study were increased in the treated plants. Similar results have been reported in *Avena sativa* (Krishna Murthy and Vasudevan, 1984) in oats. The observed variation in the treated population was more than that in the control population. This is the expected result because the control plants are supposed to be genetically similar and any kind of differences observed in the control plants is only due to environment.

CONCLUSION

In this study, Plant height (cm), Number of leaves per plant, Leaf length (cm/plant), Number of finger per plant, Finger length (cm/plant), Days to first bloom, Yield per plant (g) and 1000 grains weight (g) were studied under the field condition in M_2 and M_3 generation. Mean performance of different quantitative traits were better in EMS in both generations when compared with control and other treated plants. Induced mutagenesis is the best method to enlarge genetic variability within short time. Creation of genetic variability by induced mutagenesis proved best for strengthening crop improvement programmers and represents a more efficient source of genetic variability than the gene pool protect by nature.

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