International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 1 Jan-Feb 2021, pp: 802-806 www.ijaem.net ISSN: 2395-5252

Studies on induced Mutagenic Effectiveness And Efficiency on Proso Millet (panicum miliceium (L.)Var Co-3 in M_2 Generation

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Submitted: 25-01-2021 Revised: 05-02-2021 Accepted: 08-02-2021

ABSTRACT: Proso millet (Panicum miliceium (L.). provides food for millions of people in Africa and Asia. The present investigation was carried out to study mutagenic effectiveness and efficiency of EMS and DES treatments in Proso millet (panicum miliceium (L.). Var- Co_3. The relative effectiveness and efficiency of the both mutagen used were assessed from the data on biological damage in M_2 generation and frequency of chlorophyll and viable mutants inM_2 generation. The spectrum of chlorophyll mutants such as xantha, albino, chlorina and viridis, viable mutants such as tall, dwarf, early flower, early maturity, late maturity, bushy, high yield and seed mutants and observed in both the mutagenic treatments. Among the chlorophyll mutants xantha was found more in number. The mutagenic effectiveness and efficiency were found to be higher at 30 mM of EMS and 40 mM of DES. The mutation rate of EMS was higher in terms of effectiveness than that of DES. More number of chlorophyll and viable mutants was observed in EMS treatment when compared with DES and control.

Keywords: EMS, DES, Chlorophyll, effectiveness, efficiency, frequency, injury, lethality, mutagen, viable.

I. INTRODUCTION

Proso millet (panicum miliceium L.). (2n=36) is one of the most important small grain cereals grown in eastern and southern Africa for food security and subsistent economy its high nutritive and cultural value (Dida et al., 2008). prosomillet is an important food in traditional low input cereal-based farming system (Wolie and Dessalegn, 2011), and the crop is also highly cultivated in South India, Myanmar, Sri Lanka, Bhutan and China (Upadhyaya et al., 2004). The nutritional quality of Proso millet is highly superior to that of most cultivated cereals in the world, being rich in proteins, fiber and minerals; most importantly calcium and iron, which greatly help in alleviating the problems associated with malnutrition and anemia in countries where it is widely consumed as a staple food (Babu et al., 2006). This crop is also widely used as herbal medicine in many rural areas and this makes it the most important staple food for the rural populations in developing arid and semi-arid countries. Proso millet is a hardy crop that can withstand harsh environments, making it ideal for the areas that have unsuitable environment for production of other cereal crops (Upadhyaya et al., 2007). The crop can withstand longer periods with minimum rainfall.

Genetic improvement of crop depends on the amount of genetic variability present in the population. Mutation is gene level causes alterations in the structure and position of gene on chromosome called point mutation. This results in the alteration of phenotype of an organism. Changes in basic chromosome number either any addition of loss of any set or parts of them cause appearance or disappearance of new characters. Once the mutation in gene level or chromosomal level is firmly established in populations, they are subjected to natural or artificial selection.

II. MATERIALS AND METHODS

The seeds of Proso millet (Panicum miliceium(L.) Var- Co_3 . Varieties collected from Tamil Nadu Agricultural University Coimbatore. was used for the present study. The healthy seeds treated with various concentrations of chemical mutagens.

Ethyl Methane Sulphonate (EMS)

EMS (CH3SO2OC2H5), 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

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

Diethyl Sulphate (DES)

Seeds of Proso millet were subjected to different treatment levels (10, 20, 30, 40 and 50mM) 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 further studies. All the agricultural practices, namely, irrigation, weeding, and plant protection methods were carried out during the growth period of the crop. The seed germination, lethality, seedling injury, and plant survival at maturity were recorded in M_2 generation. For raising M_2 generation, the seeds were treated with different concentrations of EMS and DES were sown along with controls at the Botanical garden Department of Botany, Annamalai University, Annamalai Nagar in Randomized Block Design (RBD). The spacing was maintained at 15 cm (Plant to plant) and 30cm (between the rows) in the field. All the surviving individual plants were harvested in each treatment in M_2 generation. M_2 plants having sufficient seeds in different treatments were grown to raise M_2 generation with three replications. Screening was done for chlorophyll and viable mutation. Chlorophyll mutations were classified in accordance with the system of Gustaffson (1940) and Blixen Gottschalk (1975). Frequency of viable mutations was calculated in M_1 plants and M_2 seedling basis. Data on biological abnormalities such as injury and lethality in M_2 generation and chlorophyll mutation frequency in M_2 generation and M_2 generation were used to determine the mutagenic efficiency and effectiveness according to the formula suggested by Konzak et al. (1965).

Mutagenic effectiveness and mutagenic efficiency

$$\text{Mutagenic effectiveness(EMS)} \quad \frac{\text{Mutation rate}}{\text{Concentration of EMS in Mm}} \times 100$$

$$\text{Mutagenic effectiveness (DES)} \quad \frac{\text{Mutation rate}}{\text{Concentration of DES in Mm}} \times 100$$

$$\text{Mutation Efficiency} = \frac{\text{Mutation rate}}{\text{Percentage of lethal or biological Injury in } M_2 \text{ generation}}$$

Where

M - Mutation frequency for 100 M_2 plants
T - Period of treatment with chemical mutagen in hours
C - Concentration of chemical mutagens in mM
L - Reduction in height of seedling on 15^{th} day

I - Lethality percentage or survival reduction of seedling

III. RESULT AND DISCUSSION

Chlorophyll and Viable Mutation Frequency

In present investigation chlorophyll and viable mutations were observed in M_2 generation. Various chlorophyll mutants such as albino, xantha, chlorina and viridis and viable mutants such as tall, dwarf, bushy, early maturity, late maturity, seed mutant and high yield mutant were observed in all the mutagenic treatments. In intermediate concentrations was found to be more effective and producing high mutation frequency of chlorophyll and viable mutations in both mutagens. Such type of chlorophyll and viable mutants was observed earlier workers in different plants Solanki and Sharma (2001) in lentil, The frequency of chlorophyll and viable mutants observed in M_2 generation is mainly used as a dependable measure of genetic effects of mutagens. The mutagenic

efficiency increased concentration of both EMS and DES treatments.

IV. CONCLUSION

The seedling injury, lethality and mutation frequency increased with an increase in concentration of mutagenic treatments of both EMS and DES. Mutagenic effectiveness and efficiency varies on different concentration of mutagen. In the present study, it was concluded that30Mm of (EMS) and 40mM DES showed mutants in all parameters. So the 30mM EMS and 40mM DES were selected for further investigation.

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Frequency of chlorophyll and viable mutants in M_2 generation of Proso millet

Mutagens Conc.(mM)		EMS(mM)				DES(mM)	
		20mM	30mM	40mM	30mM	40mM	50mM
No. of Plant studied		290	280	260	270	250	235
Chlorophyll mutants	Albina	2	4	3	2	4	5
	Xantha	4	3	3	2	5	4
	Chlorina	2	5	4	3	4	2
	Virids	3	4	1	3	2	1
Viable and Morphological Mutants	Tall	4	4	2	3	1	3
	Dwarf	3	5	4	3	4	5
	Bushy	5	4	2	2	1	2
	Narrow leaf	3	2	1	3	-	2
	Tillers	3	4	5	3	6	3
	Early maturity	4	5	3	4	3	2
	Late maturity	3	5	3	3	5	-
	Long panicle	1	3	1	3	2	1
	Blackish brown Colour seed	4	5	4	3	4	2
	Whitish brown Colour seed	4	5	3	4	3	4
	Blod size seed	5	4	4	3	5	2
	Small size seed	3	2	4	5	2	1
	Total	51	64	47	49	51	39

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	Percentage of total Frequency	17.58	22.85	18.07	18.14	20.4	16. 59

Effect of mutagens on mutation frequency, effectiveness and efficiency in M_2 generation of Proso millet

Mutagens	Treatments Conc. (mM)	Survival reduction Lethality (L)	Height reduction Injury (I) (%)	Mutation frequency (MF) (%)	Effectiveness	Mutagenic Efficiency	
					MF/ct	L = MF/L	I = MF/I
EMS	20 Mm	13.60	14.23	17.58	87.9	1.48	6.17
	30 mM	14.70	20.68	22.85	76.16	5.18	3.68
	40 mM	50.16	24.57	18.07	45.35	0.90	1.84
DES	30 mM	32.76	44.46	18.14	64.46	1.96	1.44
	40 mM	62.79	53.71	20.4	51.00	0.81	0.94
	50 mM	50.30	58.5	16.59	33.18	0.65	0.56

International Journal of Advances in Engineering and Management
ISSN: 2395-5252

IJAEM

Volume: 03 Issue: 01 DOI: 10.35629/5252

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