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STUDIES ON EFFECTS OF INDUCED MUTAGENESIS ON QUANTITATIVE CHARACTERISTICS OF PROSO MILLET (*PANICUM MILIACEUM* L.) *VAR-CO₃* IN *M₂* AND *M₃* GENERATION

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ABSTRACT

Proso millet (*Panicum miliceium* L.) Var-co$_3$ 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. A part from this, the proper use of induced mutation in plant breeding has become a profitable approach. For the Present study, the seeds of Proso millet (*Panicum miliceium L.) Var-co$_3$* were treated with different concentrations of EMS (10, 20, 30, 40 and 50mM) and (10, 20, 30, 40 and 50mM) of DES. This investigation was carried out to determine the effect of EMS and DES on M_2 and M_2 generation, Plant height (cm), Number of leaves per plant, Leaf length (cm/plant), Number of panicle per plant, Days to first flowering, 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 (*Panicum miliceium L.)* Var- Co$_3$.

Keywords: EMS, DES, Proso millet, M_2 germination, M_3 germination Var-Co$_3$

I. INTRODUCTION

Proso millet (*Panicum miliceium* L.) popularly known as varagu' belongs to family 'Poaceae' panicum the generic name, which is a Greek word meaning is supposed to have originated in the Ethiopian islands and was introduced into India approximately 3000 years ago Proso millet is the most important crop from the nutritional as well as fodder point of view. Proso millet is highly adaptable to higher elevations and is grown in Himalaya upto an altitude of 3000 mean sea level

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(Bisht and Singh, 2009). Proso 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, which may be improved through simple plant selection according to Mehandi *et al.* (2013). The availability of genetic diversity is pre-requisite for genetic 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 Proso millet (*Panicum miliceium* L.) for morphological parameters under field conditions.

II. MATERIALS AND METHODS

The seeds of Proso millet (*Panicum miliceium* L.) Var- Co_3. Varieties collected from Tamilnadu Agricultural Research University coimbutore. And 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 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 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 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

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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 presoaked sown in 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_2 generation (produced directly from mutagen treated seeds) was grown in the following quantitative traits such as seed of control 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_1 and M_2 plants were harvested to find out the mean performance of quantitative traits.

III. 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 (60.8-52.3cm) followed by 40mM DES (63.7-62.2cm).

Number of leaves per plant

Among the various concentrations of mutagens, 30mM of EMS (18.9-10.3) showed more number of leaves followed by 40mM of DES (8.3-7.7).

Above mentioned mean performance was slightly increased than control (12.2-10.3) (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 (69.7-72.1) followed by 40mM (45.0-60.1) of DES when compared with control (**63.7-62.2**) values in M_2 and M_3 generation (Table.1, 2).

Number of Panicle per plant

There was an enhanced level of for number of fingers per plant in M_2 and M_3 generation was observed. A gradual increase of was observed in the mutagen at lowest and LD50 concentration.

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The higher mean performance was observed at 30mM EMS (**24.75-21.3**) and 40mM (**37.3-31.2**) of DES, whereas it was (**23.0-28.8**) in control (Table.1, 2).

Days to first flowering

Different mutagens with various concentrations on M2 and M3 generation showed slight level of decreasing in number of days to first flowering. Among them, 30mM EMS (59.6-52.00) showed elimination of days followed by 40mM of DES (**62.7-70.8**). These mean performances showed lesser number of days was taken for flowering than the control plant (**73.81-63.3**) (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 (**2.88 -3.20**) and 40mM of DES (**3.05-3.20**) (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 M_2, and M_3 generations 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 panicle per plant, (cm/plant), Days to first flowering, 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 Diethyl 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.

IV. CONCLUSION

In this study, Plant height (cm), Number of leaves per plant, Leaf length (cm/plant), Number of panicle per plant, Days to first Flowering, 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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TABLES:

Effects of mutagens on Plant height (cm/plant) M_2,and M_3 generations of Proso millet

Mutagens	Treatments Conc. (mM)	M_2 generation			M_3 generation		
		Range	Mean±SE	% over control	Range	Mean±SE	% over control
	Control	60-79	**73.7±1.87**	100.0	56-74	**67±1.55**	100.00
EMS	20Mm	60-74	**66.8±1.72**	10.32	53-65	**57.7±1.300**	16.11
	30mM	48-71	60.8±**2.54**	21.21	45-58	52.3±1.42	28.10
	40mM	58-64	**62.4±0.54**	18.10	40.0-58	50.9±2.04	31.63
DES	30mM	50-70	**63.3±2.79**	16.42	50-75	**66.2±2.71**	1.20

	40mM	50-73	**63.7±2.53**	15.69	48-76	**62.2±3.06**	7.71
	50mM	33-70	**53.3± 4.39**	38.27	50-73	**63.7±2.53**	5.18

SE: 1.6754
SED: 2.5771
CD (P=0.01): 4.2584

SE: 38.181
SED:2.1345
CD (P=0.01): 40508

Effects of mutagens on Days to first flowering in M_2 and M_3 generations of Prosomillet

Mutagens	**Treatments Conc. (mM)**	**M_2 generation**			**M_3 generation**		
		Range	**Mean±SE**	**% over control**	**Range**	**Mean±SE**	**% over control**
	Control	72-.76	73.81±0.41	100.00	59-79	63.3±0.966	100.0
EMS	20mM	64-74	67.88±1.03	8.73	53-63	59.6±1.714	6.20
	30mM	56-65	59.6±1.034	23.84	45-60	52.00±1.59	21.73
	40mM	50-66	68.1±1.47	8.38	62-78	70.2±1.749	9.82
DES	30mM	53-69	63.4±1.61	16.4	55-71	63.8±1.902	0.78
	40mM	52-79	62.7±2022	17.7	67-75	70.8±0.840	10.59
	50mM	54-78	66.9±2.95	10.32	68-80	71.3±1.16	11.22

						4	

SE : 42.0354
SED : 9.3387
CD (P=0.05) : 2.7452

SE : 3.7
SED : 3.6833
CD(P=0.05) :1.2345

Effects of mutagens on Number of leaves per plant in M_2 and M_3 generations of Proso millet

Mutagen	Treatment Conc. (mM)	M_2 generation			M_3 generation		
		Range	**Mean±SE**	**% over control**	**Range**	**Mean±SE**	**% over control**
	Control	7-19	**12.2±1.38**	100.00	5-17	**10.3±1.17**	100.00
EMS	20mM	4-15	8.2±1.143	48.78	4-14	9.10±0.99	13.18
	30mM	10-17	18.9±0.69	12.23	5-13	10.3±0.78	100.00
	40mM	9-19	14.6±0.95	16.43	4-10	3.40±0.83	202.9
DES	30mM	8-15	11.6±0.71	15.17	5-14	8.80±0.99	17.04
	40mM	4-11	8.3±0.73	46.98	3-12	7.7±0.98	33.76
	50mM	4-14	8.8±1.041	38.63	2-13	6.9±1.159	49.27

SE:7.5090
SED:3.2930
CD(P=0.05):2.082

SE: 5.1363
SED: 3.6652
CD(P=0.05): 4.6789

Effects of mutagens on leaf length (cm) in M_2,and M_3 generations of Proso millet

Mutagens	Treatments Conc. (mM)	M_2 generation			M_3 generation		
		Range	Mean±SE	% over control	Range	Mean±SE	% over control
	Control	62-65	**63.7±0.32**	100.00	45-70	**62.2±2.82**	100.00
EMS	20Mm	62-66	63.8±0.41	0.156	40-59	51.4±2.039	21.01
	30Mm	65-73	69.7±0.94	8.60	68-76	72.1±0.822	13.73
	40Mm	76-80	77.8±0.41	18.12	60-80	69.1±2.365	9.98
DES	30Mm	34-50	44.0±1.67	44.77	54-64	59.2±1.162	5.06
	40Mm	38-50	45.0±1.27	41.55	55-65	60.1±1.095	3.49
	50mM	30-56	46.9±3.08	35.82	39-58	50.4±1.921	23.41

SE : 37.354 SE: 38.590
SED : 7.950 SED; 6.0773
CD(P=05):10.362 CD(P=05):20.524

Effects of mutagens on panicle length (cm) in M_2, and M_3 generations of Proso millet

Mutagens	Treatment Conc. (mM)	M_2 generation			M_3 generation		
		Range	Mean±SE	%over control	Range	Mean±SE	% over Control
	Control	20-26	**23.0±0.57**	100.00	26.5-23	**28.8±0.757**	100.00
EMS	20mM	15.1-23	18.1±0.68	27.07	19.0-16.5	19.8±0.869	45.45
	30mM	21.5-29	24.75±0.84	7.07	21.5-17.5	21.3±0.86	35.21
	40mM	23-30	26.2±0.72	12.21	26.5-24	26.8±0.742	7.46

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DES	30mM	20.8-32	30.8±0.66	25.32	31.0-28.5	31.11±0.61	7.42
	40mM	30-45	37.3±1.30	38.33	30.5-28.4	31.2±0.69	76.79
	50mM	33-40	36.5±0.68	36.98	35.5-30.9	35±1.021	17.71

SE: 17.8772
SED: 2.1731
CD(P=0.05): 0.8987

SE: 0.3657
SED: 0.5621
CD(P=0.05): 0.5874

Effects of mutagens on yield per plant (g) in M_2,and M_3 generations of Proso millet

Mutagens	Treatments Conc. (mM)	M_2 generation			M_3 generation		
		Range	Mean±SE	% over control	Range	Mean±SE	% over control
	Control	15.14-15.34	**15.23±0.4**	100.00	3.04-3.33	**3.8 ± 0.43**	100.00
EMS	20mM	16.33-15.5	**16.20±0.3**	5.98	3.03-3.22	**3.11 ± 0.15**	22.18
	30mM	2.70-2.95	**2.88 ± 0.82**	42.8	2.14-2.12	**3.20± 0.55**	18.75
	40mM	3.14-3.34	**3.12± 0.15**	388.14	2.29-2.34	**2.90 ± 0.60**	31.03
DES	30mM	2.51-2.94	**2.70 ± 0.17**	46.4	2.90-3.15	**3.1 ± 0.13**	22.58
	40mM	3.00-3.15	**3.05± 0.23**	39.9	3.05-3.36	**3.20 ± 0.30**	18.75
	50mM	3.05-3.20	**3.9±0.18**	29.05	2.60-2.90	**2.80 ± 0.26**	35.71

SE : 0.3428
SED : 0.4833
CD (P=0.05) : 0.9395

SE : 0.33
SED: 0.5214
CD(P=0.05) : 0.9425

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Effects of mutagens on 1000 grains weight (g) in M_2, and M_3 generations of Prosomillet

Mutagens	Treatments Conc. (mM)	M_2 generation			M_3 generation		
		Range	Mean±SE	% over control	Range	Mean±SE	% over control
	Control	3.09-3.3	**3.11±0.19**	100.00	3.85-3.44	**3.41±0.22**	100.00
EMS	20mM	3.21-3.7	**3.40±0.20**	8.52	3.68-4.15	**3.72±0.26**	8.33
	30mM	3.10-4.8	**3.61±0.39**	13.85	4.03-4.55	**4.01±0.40**	14.96
	40mM	2.12-2.80	**2.84±0.24**	9.50	3.11-3.36	**3.14±0.32**	8.59
DES	30mM	3.05-3.13	**3.14±0.30**	0.95	4.81-44.3	**3.60±0.36**	5.27
	40mM	3.27-3.96	**3.43±0.41**	9.32	4.16-3.93	**3.83±0.37**	10.96
	50mM	2.03-2.44	**2.56±0.23**	21.48	3.60-13.3	**3.02±0.25**	12.91
		SE: 0.2800 SED: 0.7145 CD (P=0.05): 0.8272			SE : 3.532 SED : 0.82540 CD (P=0.05):0.8568		

