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REGULAR ARTICLE

EFFECT OF MUTAGENS ON QUANTITATIVE CHARACTERS IN M3 GENERATION OF PEARL MILLET (*PENNISETUM TYPHOIDES* (BURN. F) STAPF. AND C. E. HUBB.)

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ABSTRACT

A study was conducted to estimate the effects of gamma rays and ethyl methane sulphonate (EMS) on mutagenesis of Pearl millet. Gamma rays (10, 20 and 30kR) and EMS (20, 30 and 40 mmol) treatments were done to find out different quantitative traits viz., Days to first bloom, Plant height, Number of leaves, Number of nodes, Length of earhead, Breadth of earhead, 1000 grains weight, Yield per plant, Chlorophyll and carbohydrate content. These parameters were better in 20kR of gamma rays and 30 mmol of EMS when compared with the control and other doses/concentrations and higher doses decreased the parameters.

Keywords: Mutation, Induced mutation, *Pennisetum typhoides*, M_3 generation, Ethyl methane sulphonate, Gamma rays.

INTRODUCTION

Pearl millet, is one among the important millets in India. Pearl millet belongs to the family *Poaceae* and is an important member of the genus *Pennisetum*. Pearl millet can be cultivated in various climatic conditions including abiotic stressed regions. As one of the major nutrient crop, it is cultivated throughout the various agro climatic regions. In order to increase the cultivation and production of pearl millet, the varietal selection and quality enhancement are necessary. One of the best ways to increase the cultivable qualities is mutation breeding. Induced mutations are one of the best suitable way to enhance and select genetic variations [1].

For inducing the mutations, the best suited methods are chemical (EMS), physical (Gamma rays) [2] mutagenic agents. Among these two mutants, ethyl methane sulphonate (EMS) is an effective and widely used chemical mutagen to induce point mutations. In this present investigation, mutagenic effects of Physical (gamma rays) and Chemical (ethyl methane sulphonate) mutagens in separate treatments have been studied on pearl millet M_3 generation.

MATERIALS AND METHODS

In this research, the seeds of cultivar (*Pennisetum typhoides* (Burn.) Stapf. and C. E. Hubb.) have been selected to induced mutagenesis. The seeds of *Pennisetum typhoides* were collected from Tamilnadu Agricultural University, Coimbatore was used for the present study. The seeds irradiated with different doses (10, 20 and 30kR) of gamma rays from [60]CO from The Sugarcane Breeding Institute, Coimbatore. For EMS treatment, healthy seeds were treated with different concentrations of (20, 30 and 40 mmol). After treatments, they were removed from the solution and washed for two to three times. Untreated dry seeds were presoaked in distilled water for 4 h and used as control.

Raising M_2 to M_3 generation

For raising M_2 generation, the seeds were treated with different doses/concentrations of Gamma rays and EMS were sown along with controls at the Botanical garden of Botany Department, Annamalai University, Annamalai nagar in a complete Randomized Block Design (CRBD). The spacing was maintained at 15 cm (Plant to plant in a row) and 30 cm (between the rows) in the field. The panicle was harvested separately and randomly from healthy individual of M_2 plants. The bulked seeds from the M_2 generation were used to rise the M_3 generation. It was grown in the randomized block design with three replications. After harvesting the following quantitative traits such as, Days to first bloom, Plant height, Number of leaves, number of nodes, Length of earhead, Breadth of earhead, 1000 grains weight, Yield per plant, Chlorophyll and Carbohydrate content. The data were analyzed by using NPRC software.

RESULTS AND DISCUSSION

The results are presented in table 1. It is clear from the

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table that the mean values increased significantly better in 20kR of gamma rays and 30 mmol of EMS when compared with the control and other doses/concentrations.

Days to first bloom

Different mutagens with various dose/concentration of M_3 generation showed slight level of decreasing in number of days for first flowering when comparing to the M_1 and M_2 generations (Table-1). Among them, 30 mmol of EMS (42.45 d) showed elimination of days for flowering then 20kR gamma rays (43.40 d). These mean performances showed lesser number of days was taken for blooming than the control plant (45.15 d). The similar results have been reported earlier Sanjai Gandhi *et al.,* (3) in Black gram and DhumalKondiram (4) in horse gram.

Plant height (cm/plant)

The highest plant height was observed in 30 mmol (202.12 cm) of EMS and 20kR (199.19 cm) of gamma rays. This was significantly increased than other concentration and control. The 40 mmol of EMS and 30kR gamma rays showed reduction in plant height than the control (195.77 cm and 192.26 cm). The quantitative characters of M_3 generation plant height were higher in EMS treatment when compared to the control Gajraj sing *et al.,* (5) in Mungbean.

Number of leaves

The number of leaves was observed in EMS when compared to the control and other treated plants. The highest number of leaves was observed in 30 mmol of EMS (11.5±0.98) and 20kR of gamma rays (10.95±1.39). The quantitative characters of M_3 generation number of leaves were higher in EMS treatment than the control Arulbalachandran and Mullainathan (6) in Black gram.

Number of nodes

The maximum number of nodes ranged between (11-16) number in 30 mmol of EMS (Table-1). In gamma treated plant, the maximum number of nodes observed between (10 to 14) and minimum (6 to 10). The similar results have been reported earlier Mathur *et al.,* (7-8) in Pearl millet.

Length of earhead (cm)

The highest length of earhead mean value was observed in 30 mmol of EMS (35.85±1.75) and lowest mean value was observed in 30kR of gamma rays (27.70±1.01). Every additional dose of irradiation progressively reduced length of earhead. Similar depression effects of gamma irradiations were also reported by Aslam and Siddiqui (9) in *Pennisetum americanum* Cheema and Atta (10) in *Oryza sativa* L.

Breadth of earhead (cm)

The breadth of earhead ranged between (3.0-4.9) maximum number in 30 mmol of EMS (Table-1). In gamma treated plant, ranged between (2.8-4.9) and minimum (2.4-3.8). The results indicated dose dependent increased in breadth of earhead. Breadth of earhead is an important parameter and it was increased concentration when we increased. This was in close agreement with those of Siddiqui *et al.,* (11-12)

1000 grains weight (cm)

The effect of mutagens on thousand grains weight of pearl millet plants are showed in Table-1. In all the mutagenic treatments, thousand grains weight was gradually increase in 30 mmol EMS (13.10g) and 20kR gamma rays (12.40g) when compared to control (10.60g) plants. The M_2 generation positive as well as negative impact on quantitative traits was recorded in horse gram BolbhatSudashiv and DhumalKondiran, (13).

Yield per plant (gm)

The seed content of *Pennisetum typhoides* significantly affected by different dose/conc. of physical and chemical mutagen treated plants. In the present studythere was slight variation found among the both mutagens with various concentrations. In M_2 generation, among the various treatments, highest mean value was recorded in 30 mmol of EMS (32.10±0.76g) and 20 kR gamma rays (31.65±0.71g) when compared to the control and other treatment. Whereas, higher dose/concentration showed less in number of seeds than the above mentioned mutagenic treatments. The quantitative characters of M_3 generation yield per plant were higher in EMS treatment when compared to the control Wani and Anis, (14) in Chick pea.

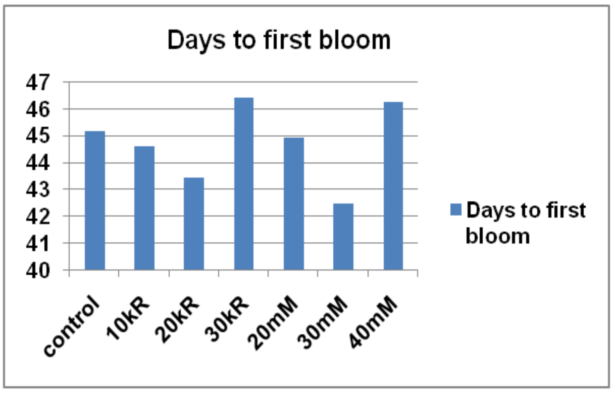
Total chlorophyll content

Chlorophyll content was higher in optimum doses of gamma rays and EMS showed Table-1. In EMS 30 mmol the maximum chlorophyll content and 20kR of gamma rays also observed. The similar results have been reported earlier Arulbalachandran *et al.* (15) in black gram. The increased levels of chlorophyll content may be due to efficacious activity of 'Cab' gene which code for chlorophyll protein. Hence, it infers that physical and chemical mutagens are influence on variation (decrease/increase) of chlorophyll content. Level of increase in chlorophyll content may increase photosynthesis and it may improve the crop yield.

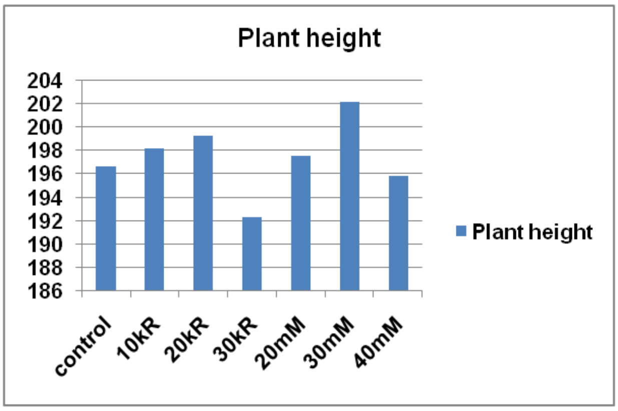
Carbohydrate (gm)

Carbohydrate content was significantly higher in 30 mmol of EMS treatments (42.65%) than gamma rays (42.44%) and control (40. 94%) plants in M_3 generation. Inyang and Zakari and Lasekan (16-17) found this decrease due to increase in α-amylase activity. Maneemegalai and Nandakumar (18) reported the carbohydrate content have been found to be significantly decreased correspondingly with the increase in the germination time in comparison with the dry seeds in *Pennisetum typhoides*.

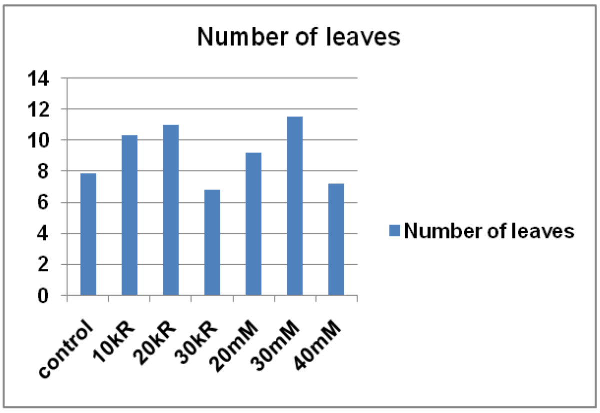
Days to first bloom



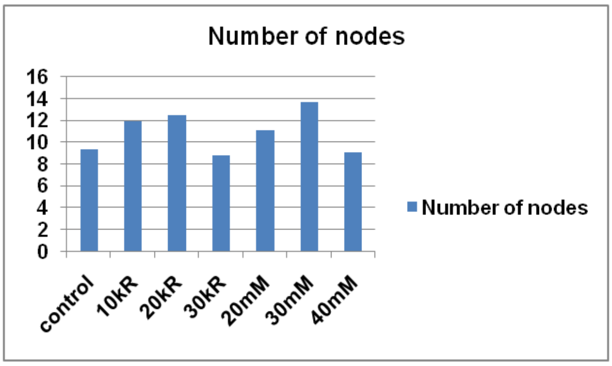
Plant height



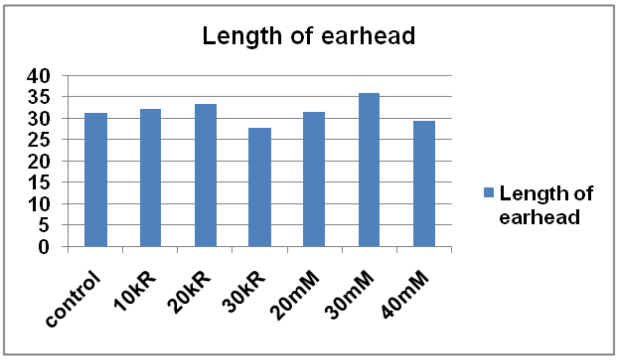
Number of leaves



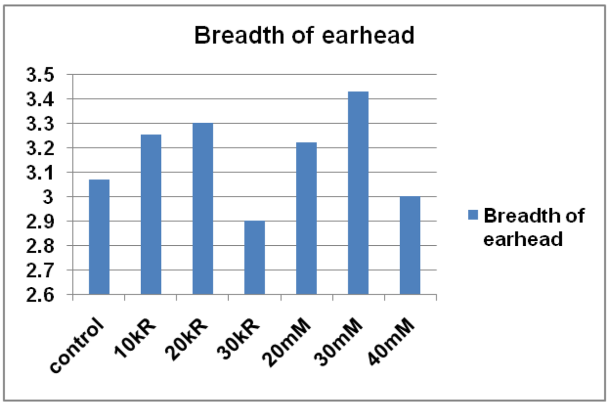
Number of nodes



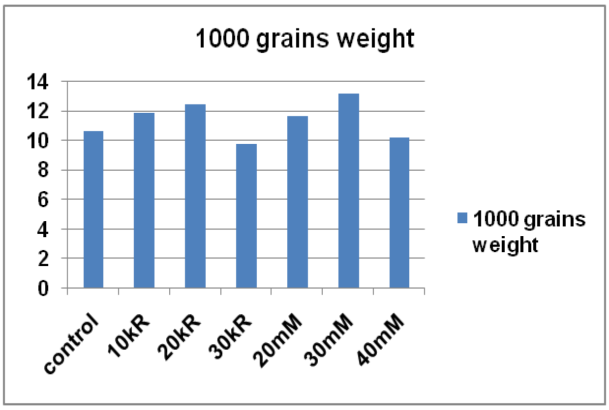
Length of earhead (cm)



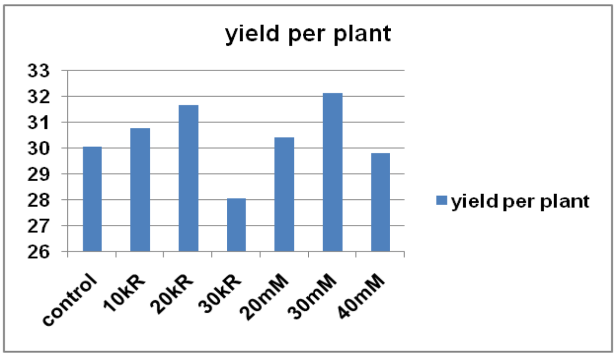
Breadth of earhead (cm)



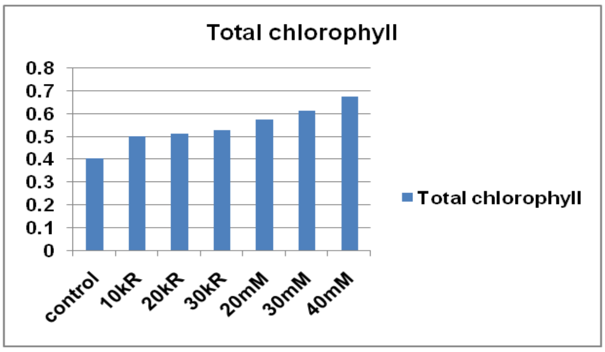
1000 grains weight (g)



Yield per plant



Total chlorophyll



Carbohydrate (g)

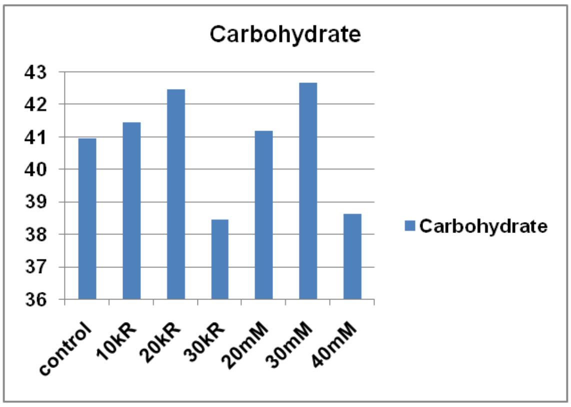


Table 1: Mutagenic effect of Gamma rays and Ethyl methane sulphonate in M_3 generation on days to first bloom, plant height, number of leaves, number of nodes, length of ear head, breadth of ear head, 1000 grains weight, yield per plant, total chlorophyll and carbohydrate

M	T	Days to first Bloom	Plant Height (cm)	No. of leaves	No. of nodes	Length of ear Head (cm)	Breadth of Earhead (cm)	1000 grains Weight (g)	Yield per Plant (g)	Total Chloro-phyll	Carbo-hydrate (g)
Gamma rays	Control	45.15± 0.20	196.59± 5.30	7.80± 0.61	9.25± 0.52	31.10± 1.02	3.07± 0.48	10.60± 0.52	30.05± 0.58	0.404± 0.010	40.94± 1.01
	10kR	44.60± 0.16	198.19± 6.29	10.30± 0.77	11.90± 0.84	32.10± 1.04	3.25± 0.40	11.85± 0.69	30.75± 0.59	0.500± 0.010	41.44± 1.09
	20kR	43.40± 0.13	199.19± 5.16	10.95± 1.39	12.45± 0.84	33.15± 0.91	3.30± 0.48	12.40± 0.53	31.65± 0.71	0.510± 0.010	42.44± 1.05
	30kR	46.40± 0.45	192.26± 6.60	6.75± 0.58	8.70± 0.50	27.70± 1.01	2.90± 0.48	9.70± 0.63	28.05± 0.52	0.527± 0.010	38.44± 0.24
EMS	20 mmol	44.90± 0.24	197.54± 5.65	9.15± 0.75	11.00± 0.78	31.30± 1.16	3.22± 0.46	11.60± 0.50	30.40± 0.71	0.572± 0.010	41.18± 0.89
	30 mmol	42.45± 0.17	202.12± 6.39	11.5± 0.98	13.65± 0.84	35.85± 1.75	3.43± 0.63	13.10± 0.50	32.10± 0.76	0.613± 0.010	42.65± 1.06
	40 mmol	46.25± 0.42	195.77± 5.66	7.15± 0.76	9.00± 0.52	29.40± 1.16	3.00± 0.49	10.15± 0.59	29.80± 0.46	0.673± 0.010	38.60± 0.23

M: Mutagen; T: Treatments

CONCLUSION

In this research, the different quantitative traits viz., Days to first bloom, Plant height, Number of leaves, Number of nodes, Length of earhead, Breadth of earhead, 1000 grains weight, Yield per plant, Chlorophyll and carbohydrate content. Mean performance of different quantitative traits was significantly better in 20kR of gamma rays and 30 mmol of EMS when compared with the control and other doses/concentrations. The higher doses of gamma rays and EMS (30kR and 40 mmol) were decreased when compared with the control and other doses. High values of heritability and genetic advance indicate the possibility for inducing desirable mutations and selection of effective polygenic traits in M_4 and further generations for crop improvement. The optimum doses of mutagens used in the present study could be successfully employed in enhancing genetic variability in this crop plant.

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