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INDUCTION OF MACROMUTATIONS IN CLUSTER BEAN (*CYMOPSIS TETRAGONOLOBA* (L.) TAUB.) THROUGH MUTAGENS

Botany

Dr. Manisha Shamrao Shinde. Assistant Professor, Department of Botany, H. V. Desai, College Pune 05.

Dr. Anil Deoba More Associate Professor, Department of Botany, Fergusson College, Pune-04.

ABSTRACT

Cluster bean (*Cyamopsis tetragonoloba* (L.) Taub.) is drought tolerant protein rich legume crop belongs to family Fabaceae. The cultivar of Cluster bean 'P.N.B' was treated with chemical mutagen Ethyl Methane Sulphonate (EMS) at the concentration of 4mM, 7mM, 9mM, 10mM, and physical mutagen gamma rays at the dosage of 100Gy, 200Gy, 300Gy, 400Gy and also with combination of both (Gamma rays and EMS) like 100Gy + 10mM, 200Gy + 9mM, 300Gy + 7mM, 400Gy + 4mM.

Macromutations play an important role to assess the effect of mutagenic treatments. In present investigation all the mutagenic treatments are successful in inducing macromutaions in Cluster bean, but the combination shows the highest range of such mutations. In the combination of 300Gy + 7mM the number of pods increased significantly as compare to the control. The other parameters like length of pods, seeds per pod and 100 seeds weight also show the significant results.

KEYWORDS

EMS, Gamma rays, Cluster bean, Macromutations

INTRODUCTION

Cyamopsis tetragonoloba (L.) Taub is commonly known as Cluster bean or Guar, belongs to family Fabacea. It is an erect annual legume, grows from 2 feet to 9 feet high. The plants flower buds start out white and change to a light pink as the flower opens. The flowers turn deep purple and are followed by fleshy seed pods. The seed pods grow in cluster giving Guar the common name cluster bean. It is minor legume crop, still today it has great economic importance after Second World War. The 42% of the seed endosperm is mucilage,[2] contains important hydrocolloid galactomannen gum. A gum extracted from the Guar beans forms a gel in water, commonly regarded as Guar gum. It is primary marketable product and used across a broad spectrum of industries like paper and textile, pharmaceutical, cosmetics and food industries Guar, native to the Indian subcontinent is grown mainly in India, Pakistan, and the United states with smaller crop grown in Africa and Australia. Guar is extremely drought resistant and thrives in semi-arid regions where few plants thrive. When limited moisture is available the plant will stop growing but does not die With the increase in population and depletion in food resources, many researchers have diverted their attention to exploit the food crops at lesser importance, to develop it as the major food crop species, such mutation type of studies may bring about valuable mutants with higher food and medicinal values. Induction of agronomically and economically significant mutants is now important objective behind such mutation breeding studies. Spontaneous variations occurring due to mutation in various plants.[7] But the frequency is very low and not induces the full range of variations. So the induced mutation through physical and chemical mutagen is very effective tool to induce variations for significant characters as well as it helps in the domestication of crop.[9]

MATERIAL AND METHODS

Collection of Genotype:

The experimental seed material of Cluster bean, variety 'P.N.B' was collected from National Seed Corporation, Gultekadi, Market yard, Pune-37. Released by National Seed Corporation Ltd. (Govt of India), Beej Bhavan, Pusa Complex, New Delhi-110 012.

Mutagens Used:

Physical mutagen gamma ray, chemical mutagen EMS and combination of both mutagens were used for the treatment.

Gamma Rays Treatment:

The seed material was irradiated at Nuclear Chemistry Division, Department of Chemistry, University of Pune, Pune -07. For gamma rays treatment the sets of dry and healthy seeds were packed and irradiated with 100Gy, 200Gy, 300Gy and 400Gy gamma rays obtained from the source of Co^{60}.

EMS Treatment:

Chemical mutagen Ethyl Methane Sulphonate (EMS) was obtained from Spectrochem Pvt. Ltd. Mumbai with a molecular weight 124.16 and density 1.20. Sets of dry and healthy seeds were kept in distilled water for the pre-soaking of 4hr. The Pre-soaking increase the rate of uptake of mutagen because of increased cell permeability.[8] After the pre-soaking the seeds were treated with EMS at the concentrations of 4mM, 7mM, 9mM and 10mM for 6hr. After the completion of treatment seeds were again kept in distilled water for the post-soaking.

Combination Treatment:

A set of irradiated seeds were used for combination treatment. They are then treated with EMS at the combinations of 100Gy + 10mM, 200Gy + 9mM, 300Gy + 7mM, 400Gy + 4mM as per the process given in the EMS treatment.

Experimental Setup:

The seeds of each treatment along with control (untreated seeds) were sown in research field by Complete Randomized Block Design (CRBD) with three replications in order to raise the M_1 generation. The seed material collected from M_1 generation is used to raise the M_2 generation. The M^1 progenies were access for the macromutations.

RESULT AND DISSCUSION

Macromutations play an important role to assess the effect of mutagenic treatments.[4] The objective behind the present investigation of mutation is to study the effect of mutagen on the parameters like number of pods per plant, length of pods, seeds per pod and 100 seeds weight of a Cluster bean in M_1 generation. The quantitative analysis of these four characters can show the increased yield in mutagenic treatments over the control of whole population of M_1 generation.[11] The yield contributing characters are the most desirable characters in any breeding program.[1]

All the mutagenic treatments are successful to induce such desirable yield contributing traits in Cluster bean. Combination of both mutagens (Gamma rays + EMS) shows the more significant results as compared to the individual treatment. Number of Pods per plant increased significantly in 300Gy + 7mM which is 62.86 ± 3.01 over the control of 51.66 ± 2.33. Treatment of 100Gy gamma ray follows the same range 61.53 ± 3.70. Highest length of pods 6.426 ± 0.24 is found in the 200Gy + 9mM treatment over the 5.567 ± 0.30 of control. The 300Gy gamma rays treatment is found to be more superior (6.22 ± 0.27) to induce the highest number of seeds per pod as compared to the control (5.44 ± 0.17). 7mM (6.09 ± 0.23), 9mM (6.15 ± 0.48), 100Gy +10Mm (6.10 ± 0.29), 200Gy + 9mM (6.05 ± 0.31) treatments follows the same range of results.5 As the 300Gy gamma rays treatments has the highest number of seeds per pod, the 100 seeds weight get increased in the same treatment which is 3.786 ± 0.05. Following table

shows the mean values of number of pods per plant, length of pods, seeds per pod and 100 seeds weight of a Cluster bean in M_1 generation.

Table 1. Effect of mutagenic treatments on the number of pods per plant, length of pods, seeds per pod and 100 seeds weight of a Cluster bean in M_1 generation.

Mutagens	Concentrations / Doses	Number of Pods/ Plant	± S.E.	Length of Pods	± S.E.	Seeds/ Pod	± S.E.	100 Seeds weight	± S.E.
Control	_	**51.66**	**2.33**	**5.567**	**0.30**	**5.44**	**0.17**	**3.479**	**0.00**
Gamma Rays	100Gy	61.53	3.70	6.156	0.03	5.50	0.19	3.773	0.03
	200Gy	53.30	3.80	5.825	0.41	5.83	0.16	3.553	0.09
	300Gy	52.43	0.75	6.150	0.08	6.22	0.27	3.783	0.05
	400Gy	55	0.06	5.804	0.55	4.87	0.16	3.487	0.07
EMS	4mM	48.93	2.55	5.894	0.22	5.81	0.10	3.506	0.03
	7mM	51.33	0.72	6.086	0.37	6.09	0.23	3.659	0.12
	9mM	54.50	0.87	6.298	0.17	6.15	0.48	3.627	0.14
	10mM	45.63	2.27	5.956	0.26	5.87	0.08	3.620	0.05
Gamma rays + EMS	100Gy+10mM	51.06	3.99	5.885	0.29	6.10	0.29	3.662	0.11
	200Gy+9mM	44.03	1.87	6.426	0.24	6.05	0.31	3.744	0.03
	300Gy+7mM	62.86	3.01	5.490	0.29	5.90	0.17	3.657	0.05
	400Gy+4mM	59.63	3.22	6.051	0.27	4.59	0.21	3.695	0.12

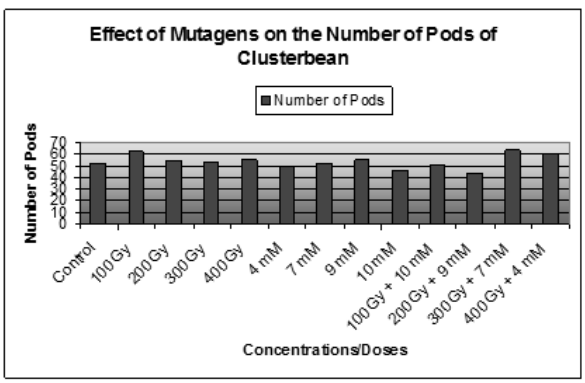

Fig 1.

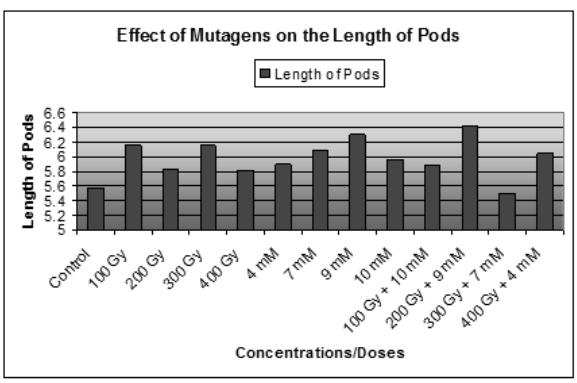

Fig 2.

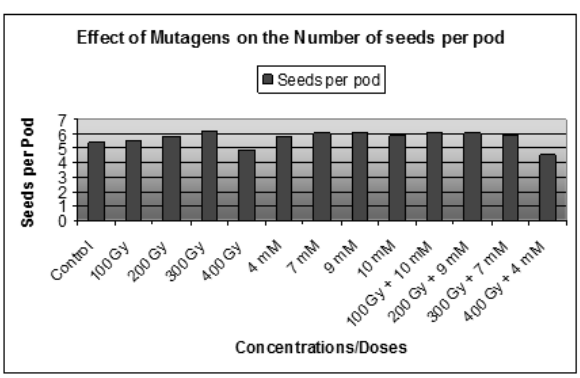

Fig 3.

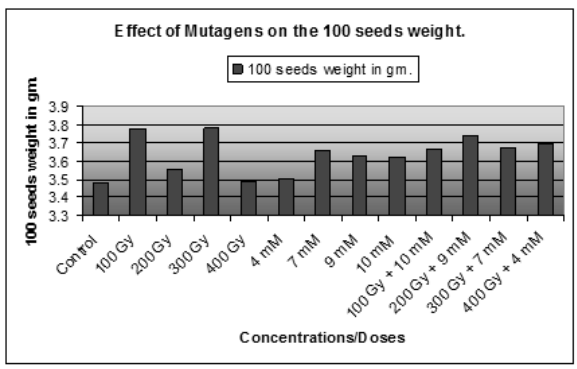

Fig 4.



Fig 5 : Control



Fig 6 : Length of Pods and Seeds/ pod



Fig 7 : Number of Pods/plant in 100Gy

CONCLUSION

The frequency of induced macromutation in M_1 generation has been considered to be a reliable index for estimating the potency of mutagens. In the present investigation the combination treatments are more successful to induce yield contributing trait. EMS acts much better in combination with gamma rays than the individual.[3,10] It indicates that each mutagen has acted differently and specifically. Some of the yield contributing mutants can be very well exploited on the commercial basis in view of varied positive attributes .[6]

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