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ORIGINAL ARTICLE

Study of Pollen Sterility in Clusterbean (*Cyamopsis Tetragonoloba* (L.) Taub.) Through Mutagenesis

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ABSTRACT

The *Cluster bean (Cyamopsis tetragonoloba (L.) Taub.) (2n=14) belongs to family Fabaceae. The importance of legume has been highly appreciated as a source of guar gum. Studies on pollen sterility can help to produce haploid plants for hybridization. The guar seeds have been used in Indian medicine as a laxative and a digestive tonic. It may be useful in prediabetic conditions and the early stages of late onset diabetes. Guar gum is also believed to lower cholesterol. The cultivar of cluster bean 'P.N.B' were 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. In M1 generation pollen sterility was studied. In control it was 9.25%. The maximum sterility was seen at 400Gy dosage. Of the two mutagens gamma rays revealed the maximum sterility than the EMS concentrations. Combination of both mutagens show low pollen sterility as compared to individual treatments.*

INTRODUCTION

The Cluster bean (*Cyamopsis tetragonoloba* (L.) Taub.) (2n=14) belongs to family Fabaceae. The importance of legume has been highly appreciated as a source of guar gum. Unlike the seeds of other legumes, Cluster bean has a large endosperm containing significant amount of hydrocolloid i.e galactomannen gum. The pods grown in clusters giving the common name Cluster bean. It is native to the Indian subcontinent. It is an erect, annual legume, extremely drought resistant and thrives in semi-arid regions where few plants thrive. The plants flower buds start out white and changes to a light pink as the flower opens and turns into deep purple following the fleshy seed pods. Flower is complete and hermaphrodite with papilionaceous corolla usually having ten stamens. Each stamen has two anther lobes which get burst at maturity to liberate pollen grains when stigma is receptive. Thus ensures the self pollination.

Spontaneous variations can occur due to mutation in various plants. But the frequency is very low and do not induce the full range of variations. So the mutation breeding has been used for the improvement of grain legumes. Induced mutation through physical and chemical mutagen is very effective tool to induce variations for significant characters. Induced mutagenesis may bring about changes in the overall morphology and physiology of the plant. Therefore the present investigation was undertaken to study the response of Cluster bean genotype to the physical mutagen gamma rays, chemical mutagen EMS and combination of both.

MATERIALS 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 Treatmentdominated the airspora and exhibited the highest concentration 152395/m3 and 8270/m3 followed by Ascomycotina

Mutagens	Concentration / Dose	Pollen Sterility (%)	± S.E.
Control	-	9.25	0.15
Gamma rays	100 Gy	10.79	0.35
	200 Gy	11.45	0.38
	300 Gy	11.82	0.65
	400 Gy	20.83	0.47
EMS	4 mM	12.06	0.32
	7 mM	13.80	0.25
	9 mM	14.35	0.32
	10 mM	16.41	0.28
Gamma rays+ EMS	100 Gy + 10 mM	9.42	0.28
	200 Gy + 9 mM	9.72	0.39
	300 Gy + 7 mM	10.41	0.33
	400 Gy + 4 mM	11.41	0.48

The seed material was irradiated at Nuclear Chemistry Division, Department of Chemistry, University of Pune, and 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 treated with EMS at the concentrations of 4mM, 7mM, 9mM and 10mM for 6hr.

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 M1 generation.

Pollen sterility test

Pollen sterility was determined in 10 randomly selected plants of each treatment along with control in the field by staining the pollen grains with 2% acetocarmine stain. It is known as acetocarmine smear test. Stained pollen grains were considered as fertile, while empty, partially stained and shriveled ones were considered as sterile. The values were expressed as percentage. Statistical analysis was done to know the standard error.

RESULTS AND DISCUSSION

According to the literature study the spontaneous occurrence of male sterility and partial male sterility in Cluster bean in India was studied by Mittal et al. [1]. In present investigation the Cluster bean was studied to analyze the effect of different mutagenic treatments on the pollen sterility.

Pollen sterility in control was 9.25%. The maximum sterility was recorded at 400Gy dose of gamma rays and that was 20.83%. Of the two mutagens gamma rays revealed the maximum sterility than that of the EMS. The rate of pollen sterility was increased with an increase in the concentration/dose of mutagen. Combination of both mutagens showed low pollen sterility as compared to the individual treatment. Table 1 shows the comparative account of pollen sterility in different treatments.

In whole population 0.24% plants are found to be completely male sterile. They are characterized by the determinate habit with elongated peduncles having 1 or 2 seeded pods. Acetocarmine smear test of pollen grainsshows them completely sterile, that means pollen sterility was present in flowers. The few pods formed were may be due to natural cross pollination.

CONCLUSION

The pollen sterility in Cluster bean after the gamma radiation, EMS and combination treatments showed quite lower values in a particular concentration/ dose within individual treatment. It observed that the induced mutagenic sterility

in the present investigation could be due to chromosomal aberrations.

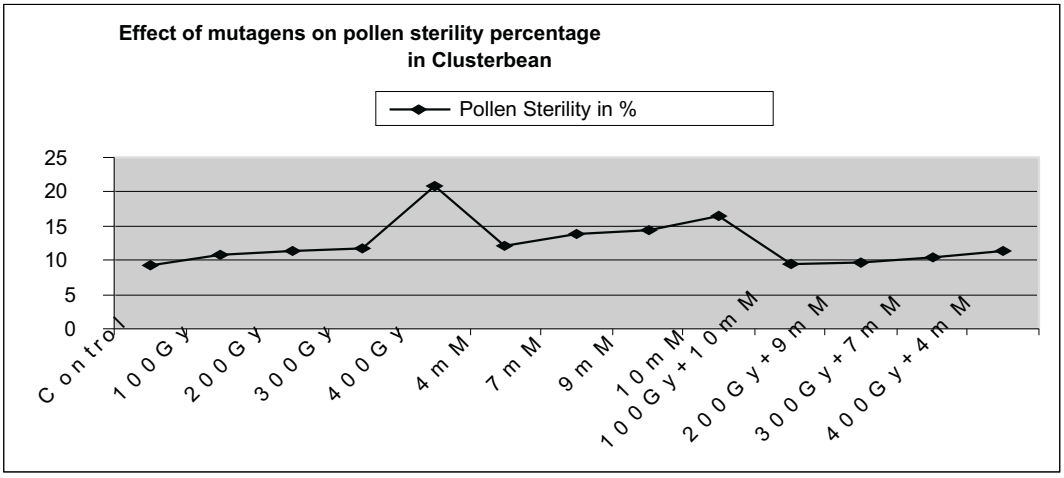
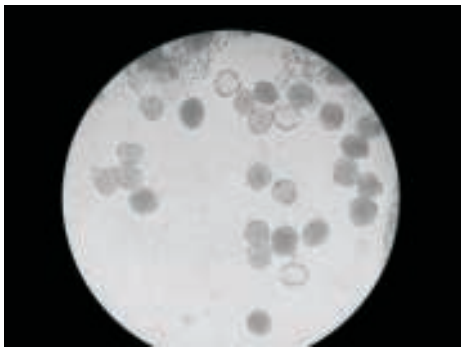
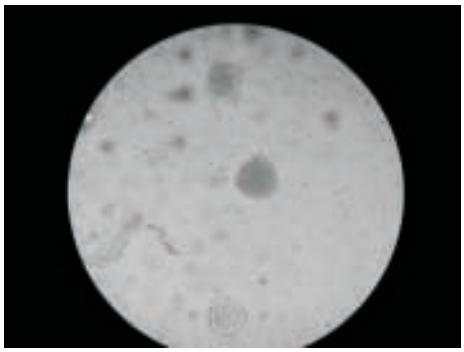


Table 1 Effect of mutagens on the pollen sterility percentage in Cluster bean



Complete slide view



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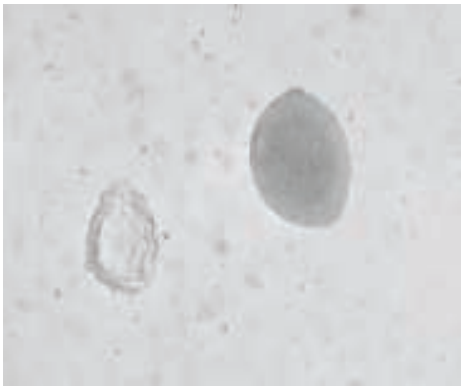
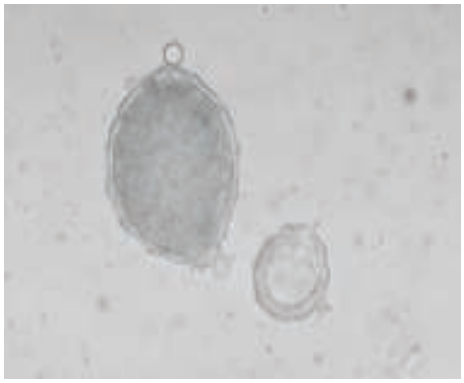


Sterile and Fertile pollen



Sterile and Fertile pollen

(Photo plates 1 Sterile and fertile pollen grains in Cluster bean)

300 Gy 200 Gy

(Photo plate 2 complete male sterile plants)

REFERENCES

[1]. Mittal S.P., Dabas.B.S., Thomas.T.A., (1968) Male sterility in guar (*Cyamopsis tetragonoloba* (L.) Taub.), Curr. Sci., 37: 357.

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