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Effect of Chemical Mutagens on Seedling Height in Cluster Beans {CyamopsisTetragonoloba (L)Taub.} by Mutation Breeding

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ABSTRACT

In the present study two varieties of cluster bean, namely, Golden Early – 36 (GE-36) and Harit Rani (HR) were used to induce genetic variability. For present study two chemical mutagens, namely, ethyl methanesulphonate (EMS) of different concentrations such as 0.05%, 0.10% and 0.15% and sodium azide (SA) of concentrations such as 0.01%, 0.02% and 0.03% were tried. Seeds from each treatment were sown in field following randomized block design (RBD) with three replications along with control as the M1 generation. Further two consequent generations were taken, M2 and M3 generations respectively. In M1generation seedling height was studied. After 10 days of duration, height of seedlings was noted. The seedling height decreased as the concentration(%) of the two mutagens increased in majority of the treatments in both the varieties of cluster bean.

Keyword: ethyl methanesulphonate, Golden Early – 36, Harit Rani, cluster bean.

I. INTRODUCTION

Rationale of study

Cluster bean is also called as guar. The word "GUAR" represents a derivation from the Sanskrit word "**GAUAAHAR**" which means cow fodder or fodder of live stock. Basically cluster bean is a drought hardy, deep rooted annual legume.The crop is mainly grown in the dry habitats of Rajasthan, Haryana, Gujarat and Punjab. In addition to its major cultivation in India, the crop is also grown as a cash crop, although to limited extent in other parts of the world like Australia, Brazil and South Africa. The crop is known for its exceptionally high adaptation towards poor and erratic rains, multiuse in cropping system, in industrial use in many ways besides other social and dietary uses. These qualities have made it most the favoured crop of marginal farmers in arid areas.

Mutation breeding in crop plants is an effective tool in hands of plant breeders especially in crops having narrow genetic base. Many mutants have been identified as donors of desirable traits in breeding program. Mutation breeding is built on mutation induction and mutation detection. Mutation

induction coupled with selection remains the "cleanest" and most inexpensive way to create varieties by changing single characters without affecting the overall phenotype. Mutation induction involves the treatment of plant propagules with mutagens (chemical or physical). This is followed by selection for desirable changes in the resulting mutants. Breeders use mutation induction to broaden the genetic base of germplasm, and use the mutant lines directly as new varieties or as sources of new variation in breeding programs.Mutation breeding has many comparative advantages. It is cost effective, quick, proven and robust. In addition, mutation breeding is transferrable, ubiquitously applicable, non-hazardous and environmentally friendly. There are more than 3200 mutant varieties officially released for commercial use in more than 210 plant species from more than 70 countries, as referenced in the Mutant Varieties Database. The vast majority of released mutant varieties consist of cereals, followed by flowers and legumes.Mutation breeding work in soybean crop has yielded in identification of many mutant lines with desirable traits. Variations in M1 generation, though less important in view of obtaining stable gene 2 mutations, are often considered as indicators in measuring efficiency of mutagen treatments (Plesnik, 1993).

Vegetables act as a good source of nutrients. To enhance variability in such crops the tool of mutation breeding is accepted by various plant breeders. To increase the productivity of vegetables various mutation breeding programs are carried out in brinjal (Datar and Ahstaputre 1984), chilli (Gupta and Yadav 1984), pea (Cemalettin et al., 2004), rye (Savaskan and Toker, 1991) and capsicum (Alcantara et al., 1996). Different vegetables contribute towards the fibre and protein production besides getting the induced genetic variability for disease /pest/insect resistance.

II. OBJECTIVE OF STUDY

1. To study the effect of mutagens on Cluster bean varieties.
2. To study morphological changes in M1 generation.
3. To screen early stages changes for understanding the effect of mutagens.
4. To understand the effectiveness of mutagens.
5. To analyze efficiency of two chemical mutagens, ethyl methane sulphonate and Sodium azide.

III. HYPOTHESIS

Mutation breeding as a tool makes genetic variations that can be used to develop and improve well adapted plant varieties by modifying one or two major traits to increase their productivity or quality. Treating with mutagens like ethyl methane sulphonate and sodium azide at different concentrations can show different morphological changes that can be responsible for progressive yield productions. In present study change in seedling height was screened with comparing with two control varieties of cluster bean.

IV. METHODOLOGY

The seed material of two varieties of cluster bean (*Cyamopsistetragonoloba* (L.)Taub.)namely, Golden Early 36 and Harit Rani obtained from Golden Seeds Pvt. Ltd, Bangalore, Karnataka and Navalakha Seeds Pvt. Ltd, Pune have been used in the present study.

Mutagens Used:

The chemical mutagens namely ethyl methane sulphonate (EMS) and sodium azide (SA).

Details of Mutagenic Treatments:-

To begin with the pilot experiments were conducted for determining the suitable concentrations/doses for further studies.

Preparation of mutagenic solution:-

The chemical mutagenic treatments were prepared at room temperature of 25±2°C. The fresh aqueous solutions of the mutagens were prepared prior to treatment.

Treatment:

Prior to chemical mutagenic treatments, seeds were immersed in distilled water for 6hrs. The pre-soaking enhances the rate of uptake of the mutagen through increase in cell permeability and also initiates metabolism in the seeds. Such presoaked seeds were later immersed in the mutagenic solution for 6hrs with regular shaking. Seeds soaked in distilled water for 6hrs served as control. For each treatment a batch of 300 presoaked seeds was used. 50 seeds from each treatment were dried between the folds of filter paper and germinated in petridishes to record germination percentage. The remaining 250 seeds from each treatment were sown in field following randomized block design (RBD) with three replications along with control as the M1 generation.

V. CONCLUSION

The results of present studies regarding mutagenic effects have been dealt in M1 generation. In M_1 generation, studies were carried out on differential effects of different mutagens on biological parameters and morphological abnormalities. The present investigation comprised the study of mutagenic sensitivity of two varieties {Golden Early-36 (GE-36) and Harit Rani (HR)} of cluster bean in regard to some biological and morphological parameters .The effect of EMS and SA on cluster bean was studied by choosing three concentrations(%)for each mutagen, such as EMS0.05%, 0.10% and 0.15%, SA0.01%, 0.02% and 0.03%.

The seedling height decreased as the concentration(%) of the three mutagens increased in majority of the treatments in both the varieties of cluster bean. After 10 days of duration, height of seedlings was noted. In control the seedling height was found to be 10cm and 07cm in GE-36 and HR. The seedling height ranged from 07cm to 14cm and 09cm to 11.5cm after EMS treatments, from 10cm to 15cm and 10cm to 11.5cm after SA treatments (table 1 and 2).

Table 1: Effect of mutagens on seedling height in M_1 generation of *Cyamopsistetragonoloba* (L.)Taub.variety GE-36.

Treatment	Concentration (%) / Dose	Seedling height in cm	± SE
Control	--	10	0.73
EMS	0.05	14	1.02
	0.10	08	1.43
	0.15	07	1.69
SA	0.01	15	1.16
	0.02	11	1.46
	0.03	10	1.72

SE = Standard Error

Table 2: Effect of mutagens on seedling height in M_1 generation of *Cyamopsistetragonoloba* (L.)Taub.variety HR.

Treatment	Concentration (%) / Dose	Seedling height in cm	± SE
Control	--	07	0.64
EMS	0.05	11.5	0.87
	0.10	10	2.02
	0.15	09	2.47
SA	0.01	11.5	1.39
	0.02	10	2.15
	0.03	10	2.58

SE = Standard Error

Suggestions/recommendations

Mutation breeding has been employed as a tool to induce mutations at loci controlling economically

important traits or for eliminating undesirable genes from the elite breeding lines (Lippert et al., 1964). In present investigation both physical and chemical mutagens were used to induce mutation. Observations recorded in present study revealed induction of broad genetic variability in case of cluster bean. Many crops with improved economic value have been obtained by using induced mutation (Broetzes 1988, BEAS 1995 and IAEA 1995). Besides the economic benefits, some mutants have also played important role in the study of genetics and plant development (Vanden et al., 1990 and Bretagne-Sgnard et al., 1996). The effect of mutagen can be examined through different biological parameters such as percentage of seedling height in M1 generation. In present study the data obtained on seedling height of cluster bean varieties indicated that the seedling height decreased with the increasing concentration/dose of mutagens. SA was found to be more sensitive in variety GE-36 and EMS and SA in variety HR, respectively. Studying seedling growth as a parameter to assess the effects of mutagens was proposed by Ahnstrom (1974). According to Sax (1935) mutagens might inactivate the meristems and cause hormonal disturbances leading to reduction in plant height.Gunckel and Sparrow (1966) indicated that although the genetic material of the cell is certainly sensitive to radiation damage, both primary and secondary physiological effects may be responsible for many changes. Conger and Stevenson (1969) reported that increased seedling injury at higher doses could be correlated with chromosomal damage.

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