
Genetic Improvement of Cluster Bean (*Cyamopsis Tetragonoloba* (L.) Taub by Mutation Breeding

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Abstract:

The genus *Cyamopsis* belonging to family Fabaceae which is formed of 3 species viz *C. tetragonoloba*, *C. senegalensis*, *C. serrata* of these *C. tetragonoloba* is the only species of economic importance (Osman, *et al*). *C. tetragonoloba* (L.)Taub. is commonly known as Cluster bean or Guar which is an erect, herbaceous, and annual to perennial plant. The plant is the important source of guar gum, obtained from the seeds and used extensively in the food industry, commercially and medicinally. The plant is also a local source of food. A mutagenesis study was carried out on seed of Guar variety "Gavran" which was treated with various concentrations of chemical mutagens viz sodium azide (SA) and ethyl methane sulphonate (EMS). An increased yield of pods was recorded in plants treated with EMS as compared to control and seeds treated with SA. Maximum yield was obtained from the seeds treated with 0.02% EMS for 4 hrs according to the set objectives.

Key Words: Mutagenesis, *Cyamopsis tetragonoloba* (L.)Taub. Var. Gavran, Ethyl methane Sulphonate (EMS), Sodium Azide (SA).

Introduction:

Mutagenesis is an important tool for creating variation in crop like Guar where desirable genetic variations are easy to induce with various mutagens. The genus *Cyamopsis* belonging to family Fabaceae and is formed of 3 species viz. *C. tetragonoloba*, *C. senegalensis*, *C. serrata* of these *C. tetragonoloba* is only species of economic importance (Osman, *et al*). *C. tetragonoloba* (L.)Taub. Commonly known as Clusterbean or Guar is an erect, herbaceous, and annual to perennial plant. The plant is the source of guar gum, obtained from the seeds and used extensively in the food industry, commercially and medicinally. The plant is also a local source of food. It is often cultivated in India and South Eastern Asia for its seed and seed pods, which are also used as food (Che Vallier.A, 1996). It is a diploid species with $2n=14$ chromosome (Purseglove, 1981). It is self fertilized plant and maximum out crossing approaches 9% (Osman, *et al*, Stafford and Lewis, 1975). It is suitable for growing in warm temperature zone as an annual, although it is more commonly grown in lowland tropical and subtropical areas up to an elevation of 1000 meters (Tindall H.D., 1983). Established plants are very drought resistant some forms are tolerant of poor soil, alkaline or saline conditions and prefers a pH in range 7.5-8 (Tindall H.D, 1983).

Materials and Method:

The utilization of new mutagenic agents in several plant species has played an important role in mutation breeding (Silva and Barbosa, 1996). Among the chemical mutagens, EMS is reported to be the most effective and powerful mutagen (Minocha, 1962

and Hajra, 1979). In plants EMS usually causes point mutation (Okagaki, 1991). Sodium azide is marginally mutagenic in different organisms (Jones, 1980, Arenaz, 1989). SA has been reported to induce high frequency of point mutation (base substitution) and no detectible chromosomal aberrations (Nilan *et al*, 1973). The experimental seeds of Cluster bean var. Gavran were treated with chemical mutagens like EMS (0.01%, 0.02%, 0.03%) and SA (0.05%, 0.10%, 0.15%).

Prior to mutagenic treatment seeds were immersed in distilled water for 6 hrs. The presoaking 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 of EMS for 4 hrs and SA for 5 hrs. seeds soaked in distilled water for 6 hrs serves as control. Immediately after completion of treatment, the seeds were washed thoroughly under tap water (Osman, *et al*, 2006). Later on seeds with chemical mutagenic treatment were kept for post soaking in distilled for 1 hr. For each treatment a batch of 150 seeds was made. 50 seeds from each treatment were dried in folds of filter paper and germinated in Petri dishes to record germination percentage. The remaining 100 seeds from each treatment were sown in field following Randomize Block Design (RBD) with 3 replications along control as M1 generation.

Table1: Mutagen Treatment Schedule:

Mutagen	Concentration	Presoaking duration	Treatment duration
❖ EMS	0.01	6	4
	0.02	6	4
	0.03	6	4
❖ SA	0.05	6	5
	0.10	6	5
	0.15	6	5

Experimental Result: Results obtained during the experiment have been summarized below

- Germination Percentage:** Germination percentage of treated seeds was found to be more than control with both the chemical treatment i.e. EMS and SA for all concentration.
- Seedling Height:** Seeds treated with SA shows increase in height with increase in concentration from 0.05% to 0.10% except for 0.15% where seedling height is slightly less than 0.05% and also with that of control. In case of EMS same pattern was recorded, all concentrations of EMS showed more height than control.
- Frequency of Leaf morphological changes:**

Following leaf morphological changes was observed in m1 generation of Guar plant:

- Bifurcation of leaf
- Notch in leaf apex
- Smooth margins of leaf
- Bifoliate leaf
- Change in leaf shape

4. Chlorophyll Deficient Sector: Two types of chlorophyll mutants were observed viz chlorina and Viridis.

5. Pollen Viability: All mutagen treated plants show significantly high viability except for SA 0.05% and 0.15% which shows lesser percentage of viability than that of 0.10% SA and all concentrations of EMS treated seeds.

6. Survival Of plant at Maturity: Not specific trend occurred in plant at maturity in case of SA; whereas increase of EMS there is gradual increase in plant maturity with increase in EMS concentration from 0.01% to 0.02% except for 0.03% EMS.

Experimental Result:

Discussion:

Study of M1 generation comprises the collection of data on the different effects of mutagens on the various parameters like seed germination, seedling height, Pollen viability, leaf abnormalities, chlorophyll chimeras in leaves, survival of plant at maturity. These parameters help to understand the biological damage caused by mutagens, which further used to assess the effectiveness and efficiency of the mutagenic treatment. Results indicate that 0.05% SA leads to increase plant height (Osman, *et al*, 2006) and germination percentage as compared to control. Flower colour mutants were NOT found in M1 generation of treated seeds; similar results were found by “Manisha shamrao shinde in her study on Induced mutation in Guar”. In present investigation leaf mutations were observed like bifoliate leaves (Osman,*et al*,2006) and large no. of variation in shapes and size of leaf lamina was observed like bifurcation of leaf, heart shaped lamina, smooth margin of leaf, notch in the leaf apex etc. In case of pods; increase in pod per plant, and bold pods were observed (Manisha shamrao shinde).

Table 2: Effect of Mutagenic agent on *Cyamopsis tetragonoloba*

Sr No.	Treatment	Concentration	No. of Seeds Sown	Seed Germination %age	Lethality % age	Avg seed height	LM C	CD S	Pollen Viability	No of pods per plant	Survival of plant at maturity
1	Control	-	50	90%	10%	9.15	-	-	77.31	70.2	80%
2	EMS	0.01%	100	100%	0%	10.1	30%	20%	80%	72.3	63%
		0.02%	100	100%	0%	11.2	10%	20%	95%	81.6	90%
		0.03%	100	100%	0%	9.9	50%	40%	92%	78.5	66%
3	SA	0.05%	100	100%	0%	9.8	70%	30%	76%	65.4	66%
		0.10%	100	100%	0%	10.14	40%	50%	87.5%	72.2	73%
		0.15%	100	100%	0%	8.2	10%	40%	76%	60.4	80%

The data presented in Table 2 revealed that there is gradual decrease in seedling height with increased concentration of SA which shows similarity with the findings of Kousar,*et al*,2010,

and high dose of SA leads to decrease in pollen viability, and increase in plant survival at maturity(Kousar, *et al*, 2010).

Conclusion:

The mutagen successfully induced genetic variability and different mutants of agronomic traits were obtained viz increased yield of crop, increase pollen viability in EMS and SA. The maximum positive results were obtained from middle concentration of both the mutagen viz 0.02% EMS and 0.10% SA treated seeds. Such mutants could be promoted for cultivation after successful breeding program.

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Plate.1.Mutagenic studies in Cluster bean



Chlorophyll mutant; a. viridis



b. bifurcated leaf



Chlorophyll mutant; c. Chlorina



d. Change in leaf shape



Morphological mutant e. Bifoliate leaves



f. Change in leaf margin

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