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Effect of Ems and Sa on seed germination percentage in M_1 generation of *Psophocarpus tetragonolobus* (L.) Dc.

A. S. Sonavane
Department of Botany, Shardabai Pawar Mahila Mahavidyalaya, Shardanagar, Baramati, Dist. Pune-413115, Maharashtra State, India.

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Abstract: In the present investigation, the two chemical mutagens namely Ethyl methanesulfonate (EMS) and Sodium azide (SA) were used to induce mutations in winged bean (*Psophocarpus tetragonolobus* (L.) DC.). Winged bean is a potential legume crop of the tropics with high protein and oil content in the seeds. For larger scale cultivation, however, the major drawbacks possessed by winged bean should be minimized. The drawbacks such as presence of undesirable antinutritional factors, absence of market demands and labour intensive nature of crop. Hence its production and productivity need to be improved from the present level. A mutation breeding programme was undertaken with the objective of developing improved varieties of winged bean so that it can be popularized among the farmers for its cultivation over large areas. Thus, in the present studies, attempts have been made to induce mutations in winged bean and to find out the effect of EMS and SA on seed germination percentage in M_1 generation.

Key words: Winged bean; Antinutritional factors; EMS; SA; Mutation

Introduction

The winged bean (*Psophocarpus tetragonolobus* (L.) DC.) comprises a versatile grain legume for tropical countries. It has demonstrated potentialities of a new food crop in different regions of the world. Every part of the winged bean plant is quite edible and immensely nutritious. The nutritional value of the winged bean is mainly due to the various positive attributes carried by its mature seeds. The seeds contain high amount of proteins (20% - 42%) and edible oil (15% - 20%) NAS (1981).

The winged bean plant is a legume that resembles the pole bean. It is a mass of twining, leafy stems that climb as high 13 feet or more and produce long, heavily seeded four cornered pods with wing like projections at each corner. The leaves are like spinach in taste and nutritive value, the flowers sweetened by nectar, can be sautéed to produce a food that resembles mushrooms. The immature pods are like green beans, the immature seeds are like green peas, the mature dry seeds are like soybeans and the tuberous roots are rich in protein than the potato, yam, or cassava. Chomchalow (1983) succeeded in producing a vegetable milk from the winged bean seeds which contains 3% protein. This is a high protein, long life milk which is cheaper to produce than soymilk.

Though it possesses several positive attributes, but it is neglected throughout the world due to few shortcomings. The shortcomings such as labor intensive nature of crop, the relatively long duration of its life cycle and the presence of antinutritional factors in its seeds and tubers. By keeping this view in mind, the approach of mutation breeding is employed for the development of superior varieties of winged bean.

Materials and Methods

Two varieties of winged bean (*Psophocarpus tetragonolobus* (L.) DC.) viz. II-EC-178313 and 2I-EC-38825 were used for the present study. These two varieties were obtained from National Bureau of Plant Genetic Resources, Regional Station, PKV, Akola.

Mutagens used

The chemical mutagens namely Ethyl methanesulfonate (EMS) and Sodium azide (SA) were used in the present study.

Details of mutagenic treatments

To begin with the pilot experiments were conducted for determining the suitable concentrations for further studies. Prior to mutagenic treatment seeds were immersed in distilled water for 6 hours. The presoaking enhances the rate of uptake of the mutagen through increase in cell permeability and also initiates metabolism in the seeds for treatment.

***Corresponding Author**:
Dr. A. S. Sonavane,
Department of Botany,
Shardabai Pawar Mahila Mahavidyalaya,
Shardanagar, Baramati,
Dist. Pune, 413115 (MS), India.
E-mail: ajinathsonavane@gmail.com

Such presoaked seeds were later on immersed in the mutagenic solution for 6 hours with an intermittent shaking. Seeds soaked in distilled water for 12 hours served as control.

The different concentrations used for the chemical mutagenic treatments were 0.05%, 0.10% and 0.15% for EMS and 0.01%, 0.02% and 0.03% for SA respectively. Immediately after the completion of treatment, the seeds were washed thoroughly under running tap water. Later on, they were kept for post soaking in distilled water for 2 hours.

For each treatment, a batch of 450 presoaked seeds was used. 150 seeds from each treatment were dried between the folds of filter paper and germinated in petridishes to record seed germination percentage and other characters.

Results and Discussion

In the present investigation, it is observed that the maximum number of seeds germinated on 7th day after sowing in both the varieties of winged bean, namely II-EC-178313 and 2I-EC-38825.

In control the germination percentage was found to be 81.33% in II-EC-178313 and 82.00% in 2I-EC-38825, respectively.

The germination period in M_1 generation was reduced by 3 days in case of variety II-EC-178313 particularly at the lower concentrations of EMS and SA. At higher concentrations of EMS and SA (0.15% and 0.03%) the germination period got delayed. In case of variety 2I-EC-38825 the germination period was reduced by 4 days at lower concentrations of EMS and SA, while at higher concentrations (0.15% and 0.03%) of these mutagens, a delay in germination was noticeable.

Decrease in germination which is usually expressed as percentage of lethality, revealed an increase along with the increasing concentration in majority of the mutagenic treatments administered to both the varieties of winged bean.

In the present work, the EMS treatment showed a gradual decrease in germination percentage from lower concentration to higher concentration. It was 75.33%, 72.00% and 66.66% at 0.05% 0.10% and 0.15% EMS concentration in variety II-EC-178313 and 80.00%, 79.33% and 77.33% in variety 2I-EC-38825 at the same concentration.

In both the varieties of winged bean after the SA treatment, a gradual reduction in germination percentage with the increasing concentration of the mutagen could be noticed. In case of variety II-EC-178313, the highest germination percentage was 77.33% at 0.01% SA and the lowest one was 68.33% at 0.03% concentration of the same mutagen. In case of variety 2I-EC-38825, the highest germination percentage was the same (77.33%) as found in variety II-EC-178313 at 0.01% of SA and the lowest was 70.00% at 0.03% concentration of the SA treatment (**Table 1 and 2**).

Table 1: The effect of EMS on seed germination percentage in M_1 generation of *Psophocarpus tetragonolobus* (L.) DC.

Variety	Concentration	Germination (%)	± S.E.
II-EC-178313	Control	81.33	0.66
	0.05%	75.33	1.20
	0.10%	72.00	1.52
	0.15%	66.66	1.76
2I-EC-38825	Control	82.00	1.15
	0.05%	80.00	0.57
	0.10%	79.33	1.20
	0.15%	77.33	0.88

± S.E. = Standard Error.

Table 2: Effect of SA on seed germination percentage in M_1 generation of *Psophocarpus tetragonolobus* (L.) DC.

Variety	Concentration	Germination (%)	± S.E.
II-EC-178313	Control	81.33	0.66
	0.01%	77.33	0.88
	0.02%	73.33	1.20
	0.03%	68.00	1.52
2I-EC-38825	Control	82.00	1.15
	0.01%	77.33	0.88
	0.02%	75.33	0.88
	0.03%	70.33	0.57

± S.E.= Standard Error

In the present investigation, the seed germination percentage exhibited a declining trend with an increase in concentration of EMS and SA in both, II-EC-178313 and 2I-EC-38825 varieties of winged bean. All the treatments showed a marked tendency of reduction in germination at higher doses. Similar type of results were reported earlier by several researchers such as Gregory (1968) in peanut, Goud (1967) in wheat, Bajaj (1970) in *Phaseolus vulgaris*, Singh and Choudhary (1972) in cluster bean, Satpute (1994) in Safflower and Panchabhaye (1997) in Sunflower after the mutagenic treatment. An enhancement in seed germination gamma rays and EMS treatment was recorded by Dutta (1969) and Rao (1983) in okra and Kothekar (1978) in *Solanum nigrum*.

The reduction in seed germination observable in winged bean may have developed due to the action of the mutagens on seed metabolic processes leading to the disturbances in the physiological and cytogenetic makeup of the germinating seed. Aman (1968) proposed that the endogenous growth regulators play an important role in the seed germination and there exists a striking balance between the promoters and the inhibitors. Several researchers have reviewed the effect of alkylating agents and their mechanism of action in biological systems. They include Ross (1962), Loveless (1966) and Sun and Singer (1975).

During the present investigation, it was found that the two varieties of winged bean responded differentially to EMS and SA treatments in respect of seed germination. The higher germination percentage was found in variety 2I-EC-38825 of winged bean due to chemical mutagens. This is because of less damage of cell material, chemo sensitivity and differential oil content.

Conclusion

From the pertinent study, it is clear that the seed germination percentage in M_1 generation demonstrated a gradual reduction with the progressive increase in mutagenic concentration in both the varieties of winged bean.

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