ORIGINAL RESEARCH PAPER | Botany | Volume : 6 | Issue : 9 | September 2016 | ISSN - 2249-555X | IF : 3.919 | IC Value : 74.50

Mutagenic Effect of Ethyl Methane Sulfonate and Sodium Azide on Pod Characters in Winged Bean[*Psophocarpus tetragonolobus* (L.)DC.]

KEYWORDS: Chemical mutagen, pods per plant, winged bean, mutants.

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ABSTRACT *In the present studies an attempt was made to estimate the induced variability with reference to quantitative parameters in M2 and M3 generations. A through statistical analysis of the data on individual quantitative characters was done to analyses the effect of mutations in shifting the mean and variance in either direction. The effect of chemical mutagen on pod characters, the productivity in terms pods per plant as compared with control/ normal plants was found to be better in some of the viable mutants like high yielding, anthostem mutant, long pod mutant and flat pod mutant in both the varieties of winged bean such as II-EC-178313 and 2I-EC-38825. The other mutants like early flowering, late flowering and early maturing were observed in both the varieties of winged bean with slightly reduced pods per plant as compared with control.*

INTRODUCTION:

Winged bean botanically described as a Psophocarpus *tetragonolobus* (L.) DC.,belongs to family fabaceae. It is popularly also known as Goa bean, Asparagus bean or pea, four angled or four corned bean.Mostly it is cultivated in the humid tropics of India, Srilanka, Bangladesh, Combodia, Myanmar, Thailand, Phillipines, Papua New Guinea and Indonesia. As it possess extra-ordinary merit, due to this it has recently aroused great enthusiasm which could do much to alleviate malnutrition and poverty in countries of the third world. It is also called as wonder legume because almost all parts of the plant are edible. The young green bean constitute an important item which may be consumed fresh as green vegetable or on ripening the mature seeds provide source of good quality edible oil and high protein food. In context of the serious deficit of oil and protein in developing countries like India, the winged bean is of particular importance as an alternative source.

The resemblance of winged bean seeds with soybean in quality indicates that seeds could be used for the same kind of products as that of soybean. Therefore different workers are now hailing the winged bean as "a possible soybean for the tropics". Thus as compared with groundnut and soybean, no other legume can rival the winged bean in regard to the combination of protein and oil. The tubers of winged bean are a potential source of both protein and carbohydrate. This rare combination makes the winged bean tuber unusual among the tropical rro crops Burkhill (1935). As it is a potential new source of protein for the humid tropics. Perhaps the most important product of winged bean is the mature seed which will play avital role in the development of the bean as food. The seed contain a high proportion of protein (29-42%) NAS (1981). The leaves show the presence of vitamin A precursor, amino acid and folic acid. Various kinds of delicious products are prepared from seeds, leaves, flowers and tubers of winged bean.

Genetic enhancement for yield, synchronization, tolerance to major biotic/abiotic stresses and minimizing the antinutritional factors and increasing the nutrient composition of the crop to large extent is a major concern due to less genetic variability in winged bean. Since genetic variability is a prerequisite for any successful breeding programme and creation and management of such induced variability becomes a central base for the improvement of any crop species. Creation of genetic variability followed by screening and selection of the best plants is a major target for this crop. The possibility offered by mutagenic agents to induce new genetic variation, is therefore, of extreme interest and importance. Since winged bean is a self-pollinated crop, mutation breeding could be rewarding for broadening the genetic base of total yield, yield contributing traits and other important characters like nutrition composition.

Experiments on higher plants have shown that chemical mutagens, apart from easy handling and better efficiency have much greater advantage and specificity than ionizing radiations due to a milder effect on the genetic material of a cell as against the physical mutagens which break the chromosome (Aurebach,1965). Rapoport (1946) discovered overwhelming majority of strong chemical mutagens which are being used widely in genetic and breeding research.

MATERIAL AND METHODS.

In the present mutation breeding programme, two varieties of winged bean namely II-EC-178313 and 2I-EC-38825 obtained from the National Bureau of Plant Genetic Resources, Regional station, PKV, Akola (M.S.) India, for induction of the mutations. Mutations were induced in winged bean by using different concentrations of two chemical mutagens like 0.05%, 0,10& 0.15% of Ethyl methane sulfonate (EMS) and 0.01%, 0.02%, and 0.03% of Sodium azide (SA). The programme of mutation breeding was spread over three generations viz.. M_1, M_2 and M_3. Pods were counted for each plant and noted as the number of pods per plant.

Various statistical data were calculated using the following formulae,

$$\text{Standard deviation (S. D.)} = \sqrt{\text{Variance}}$$

$$\text{Standard Error (S.E.)} = \frac{\text{S. D}}{\sqrt{\text{N}}}$$

$$\text{Coefficient of variation (C.V.)} = \frac{\text{S. D.}}{\text{Mean}} \text{ X } 100$$

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Critical difference (C. D.) = S. E. (d) x t e.d.f. (Error degree of freedom)

Where,

$$S.E.(m) = S.E.(mean) = \sqrt{\frac{\text{Mean error sum of squares}}{r}}$$

r = Number of replication

RESULT AND DISCUSSION.

The effect of all the mutagenic treatments on pods per plant revealed negative as well as positive shift in mean values in both the varieties of winged bean namely II-EC-178313 and 2I-EC-38825.

In case of EMS treatment, a significant negative shift in mean values was noted at all the concentrations of EMS in M_2 and M_3 generations of variety II-EC-178313 and the variety 2I-EC-38825.

As regards the SA treatment, at 0.01% concentration of SA in variety 2I-EC-38825 in M_2 and M_3 generations and 0.02% of SA in variety II-EC-178313in M_3 generation, a significant positive shift in mean values could be recorded.

Mutation has become an alternative to conventional breeding since the last theee decades with the sole objective of developing better cultivars of economically impotant crops. An increase in mutation rate by mutagenic agents enhances the chance of getting desired variations and to help accelarate the breeding process as compared to the usual practice of developing novelties. Micromutations may be useful in plant breeding as they might occur much more frequently and the change in the physiological features could be less drastic in them.

Singh and Raghuvanshi (1991) reported that positive shift in mean value for number of pods per plant due to induced mutagenesis with EMS treatment in blackgram. There were an increased number of pods per plant, number of seeds per plant in soybean as the dose of gamma rays increased. Muhammad et al.(2001) observed in mungbean that the critical dose prevented the shoot and root elongation varied among species and also ranged from genotype to genotype within the crop species.

In the present investigation, some of the parameters exhibited a shift in mean values in positive direction in the M_2 and M_3 generation of both the experimental material. The significant mean shift in positive direction, however, was evident only for a few parameters. The parameters such as pods per plant, seeds per pod, pod length, hundreed seed weight and yield per plant showed shift of mean values in positive direction in both the varieties of winged bean at different concentrations of EMS and SA.

Ignacimuthu and Babu (1989) reported more number of clusters per plant in blackgram due to to gamma rays and Ahmed John (1993) recorded the number of pods per plant decreased in all the genotypes as the dose of irradiation increased.

In the present investigation, the mean values showed shift in positive as well as negative directions for various characters in M_2/M_3 generations Similar results were obtined by Rajput (1974) and Hakande (1992).Also Ticco and Jain (1979) in green gram reported negative shift in mean values in M_2 generation. The main three traits like number of pods bearing branches, nuber of pods per plant and nuber of flowers seem to be highly correlated It has been suggested (Khan and Goyal,2009, Wani 2009) that an increase in the yield of pulses could be achieved by enhancing pod number.

From these studies, it is clear that the mutagens EMS & SA used in present study although acted differentialty have definitely proved successful in brodening the genetic base to an appreciable extent. This can very much create additional opportunities for making effective selection and for incorporating the breeding programme of winged bean for developing its desirable recombinant types.

Table-1: The effect of EMS on pods per plant in M_2 generation of *Psophocarpus tetragonolobus* (L.) DC.

Variety	Concentration	Mean	Shift in mean
II-EC-178313	Control	22.00	
	0.05%	19.66	-2.34
	0.10%	17.66	-4.34
	0.15%	15.66	-6.34
	S.E.(Mean)	0.47	
	f (Replication)	0.68	
	f (Treatment)	2.04	
	C.D. at 1%	2.16	
	C.D. at 5%	1.36	
2I-EC-38825	Control	24.40	
	0.05%	23.33	-1.07
	0.10%	21.33	-3.07
	0.15%	19.00	-5.40
	S.E.(Mean)	0.34	
	f (Replication)	2.85	
	f (Treatment)	5.40	
	C.D.at 1%	1.56	
	C.D.at 5%	0.94	

Table-2: The effect of SA on pods per plant in M_2 generation of *Psophocarpus tetragonolobus* (L.) DC.

Variety	Concentration	Mean	Shift in mean
II-EC-178313	Control	22.00	
	0.01%	19.66	-2.34
	0.02%	20.33	-1.67
	0.03%	16.66	-5.34
	S.E.(Mean)	0.40	
	f (Replication)	3.02	
	f (Treatment)	3.02	
	C.D.at 1%	1.88	
	C.D.at 5%	1.13	
2I-EC-38825	Control	24.40	
	0.01%	25.16	-0.76
	0.02%	24.00	-0.40
	0.03%	22.43	-1.97
	S.E.(Mean)	0.20	
	f (Replication)	6.08	
	f (Treatment)	18.23	
	C.D.at 1%	0.93	
	C.D.at 5%	0.56	

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Table-3: The effect of EMS on pods per plant in M_3 generation of *Psophocarpus tetragonolobus* (L.) DC.

Variety	Concentration	Mean	Shift in mean
II-EC-178313	Control	23.00	
	0.05%	20.66	-2.34
	0.10%	19.48	-3.52
	0.15%	13.33	-5.67
	S.E.(Mean)	0.36	
	f (Replication)	2.88	
	f (Treatment)	4.37	
	C.D.at 1%	1.67	
	C.D.at 5%	1.00	
2I-EC-38825	Control	23.70	
	0.05%	20.00	-3.70
	0.10%	22.66	-1.04
	0.15%	19.66	-4.04
	S.E.(Mean)	0.45	
	f (Replication)	0.31	
	f (Treatment)	1.75	
	C.D.at 1%	2.08	
	C.D.at 5%	1.25	

Table-4: The effect of SA on pods per plant in M_3 generation of *Psophocarpus tetragonolobus* (L.) DC.

Variety	Concentration	Mean	Shift in mean
II-EC-178313	Control	23.00	
	0.01%	19.00	-4.00
	0.02%	24.00	-1.00
	0.03%	18.00	-5.00
	S.E.(Mean)	0.21	
	f (Replication)	4.00	
	f (Treatment)	31.00	
	C.D.at 1%	0.96	
	C.D.at 5%	0.58	
2I-EC-38825	Control	23.70	
	0.01%	24.66	0.66
	0.02%	23.33	-0.37
	0.03%	22.66	-1.04
	S.E.(Mean)	0.40	
	f (Replication)	0.86	
	f (Treatment)	6.86	
	C.D.at 1%	1.84	
	C.D.at 5%	1.11	

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