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Effects of Mutagens on Morphological traits of *Psoralea corylifolia*-A Medicinally Important Plant

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ABSTRACT

Mutation breeding like in other plants can significantly strengthen medicinal plants breeding programs and help to produce novel varieties with higher yield potential and improved yield quality. The dry and healthy seeds of *P. corylifolia* IC 111228 were subjected to mutagenic treatments namely ethyl methane sulphonate (EMS) and sodium azide (SA). The treatment concentrations 15mM, 30mM, 45mM and 60mM of EMS and 1mM, 2mM, 3mM and 4mM of SA were chosen to evaluate the mutagenic potential in either case. The morphological traits were evaluated in M_1 generation *viz.* plant height, days to flowering initiation, seed yield/plant and 100-seed weight. In EMS treatment 15 mM increased the plant height and seed yield, while in SA treatment 4 mM increased the seed yield/plant and 100-seed yield.

Figure : 01 References : 11 Table : 01

KEY WORDS : Ethyl methane sulphonate, Mutation, *Psoralea corylifolia,* Sodium azide.

Introduction

The methods of plant breeding have become increasingly sophisticated since the days of simple selection method of vigorous plants among natural populations consisting of a mixture of parental genotypes and new having arisen as a result of various cytogenetic processes including genetic recombination known to occur in nature. Modern day plant breeding is based on creating variations and making selections, evaluation and multiplication of the desired genotypes. Mutagenesis is highly instrumental in plant biology for inducing genetic variability, in a great number of crops, mainly due to the fact that the technology is simple, relatively cheap to perform, applicable to all plant species and equally usable on small and large scale[7,8]. There are more than 120 species of *Psoralea* found worldwide, of which *Psoralea corylifolia* is widely used in the traditional system of remedies. *P. corylifolia* belongs to the family Fabaceae (chromosome no. 2n = 22). It is commonly known as Babchi in Hindi. In India, it is found in Rajasthan and the eastern districts of Punjab, Uttar Pradesh and Chhattisgarh. The seed-oil is used externally for the treatment of leucoderma, psoriasis and leprosy in Indian folk medicine[4]. It has potential to cure immune disorders[2], and also has been noted as an anticancerous agent against leukemia and other cancer lines[5,9,11]. Additionally, this plant has antifungal activity against dermatophytic fungi such as *Trichophyton rubrum* and *Trichophyton mentagrophytes*[5]. Mutation breeding like in other plants can significantly strengthen medicinal plants breeding programs and help produce novel varieties with higher yield potential and improved yield quality of the *P. corylifolia.*

Materials and Methods

Seeds of *P. corylifolia* IC 111228 procured from National Bureau of Plant Genetic Resources (NBPGR), New Delhi, were used for induction of mutagenesis. Two chemical mutagens, namely ethyl methane sulphonate (EMS) and sodium azide (SA) were selected for this study.

Dry, healthy and uniform seeds of the *P. corylifolia*

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IC 111228 were soaked in distilled water for 15 hours. The seeds were then blotted and exposed to room temperature (28±1°C) for removing surface water from the seeds. The pre-soaked seeds were treated at room temperature with the above chosen concentrations of EMS and sodium azide (NaN_3) for 4 and 8 hours durations. The treatment concentrations 15mM, 30mM, 45mM and 60mM of EMS and 1mM, 2mM, 3mM and 4mM of SA were chosen to evaluate the mutagenic potential in either case. The seeds were directly sown in the plots following a randomized block design (RBD) in triplicate containing with control. The following parameters were recorded in M_1 generations for assessment of morphological traits viz. plant height, number of primary branches, leaf area, internode distance, flowering time, spike length, number of seeds per spike, seed yield/plant and 100-seed weight.

Results and Discussion

The data related to mean and coefficient of variation for morphological traits in treated as well as control populations of *P. corylifolia* IC 111228 in M_1 generation are presented in Table 1. The growing plants of control and treated were well flourished in M_1 generation (Figure 1). The reduction in leaf area was maximum in M_1 generation reaching to 79.62±2.23 cm^2 with 60 mM EMS applied for 8 hours, whereas maximum shift towards increase in leaf area was 120.74±4.20 cm^2 with 15 mM EMS administered for 4 hours. In M_1 generation, both the mutagens showed a progressive decrease in leaf area at all the treatment doses except 15 mM EMS for 4 hours. A significant increase or decrease in plant height was observed with most of the doses of EMS and SA in M_1 generation plants. In M_1 generation maximum increase in height (187.35±3.14 cm) was observed with 15 mM EMS applied for 4 hours. In response to SA treatment a significant increase (38.10±1.17) in the mean values of primary branches in M_1 generation was observed with 4 mM applied for 4 hours. It is evident from the Table-1 that decrease in internodal length was a common phenomenon in M_1 generation plants with increase in concentration of both the mutagens. Contrarily, with EMS treatment a shift towards maximum increase in mean values of internode distance (4.53±0.20 cm) was observed in M_1 generation with 15 mM EMS for 4 hours.

In M_1 generation, EMS treated population with 45 mM for 4 hours showed significant effect on early initiation of flowering (53.90±1.84), while late flowering initiation (83.90±1.23) was observed in SA treated population with 4 mM for 8 hours. Days to 50% flowering therefore, significantly increased or decreased in EMS and SA treated populations over control in both the generations. A significant reduction in the mean values for spike length except with 15 mM EMS treated population was recorded in both the generations with all the treatments. In M_1 generation, EMS treated population showed greater extent of variability with maximum increase in number of seeds per spike (23.30±0.99) with 15 mM EMS for 4 hours and maximum decrease in number of seeds per spike (14.00±1.17) with 60 mM for 8 hours. The most useful treatment was 4 mM SA for 4 hours, as it maximally enhanced the total yield per plant (283.58±21.67 g) in M_1 generation, compared with control (217.90±9.07 g). The results obtained showed that a considerable increase in average values for 100-seed weight was recorded in few treated populations of both mutagens in M_1 generation. The 100-seed weight in M_1 population revealed significantly increased maximum 1.99±0.06 g with 60 mM for 8 hours EMS treatment, while maximum reduction in mean value 1.39±0.03 g was recorded with 4 mM SA administered for 8 hours, compared with mean value 1.50±0.02 g for control.

It has been demonstrated that genetic variability for several desired characters can be induced successfully through mutations and its practical value in plant improvement programs has been well established. A number of workers[1,3,10] have reported the role of chemical mutagens in enhancing genetic variability in higher plants. Genetic variability is the fundamental to successful breeding programs in both vegetatively and sexually propagated plants. Majority of the mutagenic treatments caused negative shift in the mean away from controls for yield and yield components in M_1 generations. Only a few treatments induced significant positive shift in the mean in M_1 generations. In the present study, some treatments showed slight increase or decrease in the mean values of different characters. The experimental findings under reference suggested that the mutagen induced variability measured as coefficient of variation (CV) normally increased in the treated populations as compared to their respective controls for all the polygenic characters of *P. corylifolia* IC 111228. All the administered doses of SA reduced plant height in M1 generation over control with maximum decrease at 4 mM dose applied for 8 hours. Almost all the EMS treatments showed dose dependent decrease with the increasing concentrations and durations, except with the lowest dose which showed significant increase in plant height at 15 mM EMS applied for 4 hours in M_1 generations. It was also noted that the relationship between increase in variability and the corresponding doses administered was not linear. That might be due to DNA repair mechanism and natural selection process that reducing the number of variants/mutants and expected level of genetic variability.

Conclusion

The present experiment showed that in the case of SA treatment, 4 mM concentration applied for 4 hours

TABLE- 1: Effect of EMS and SA on morphological traits of *Psoralea corylifolia* IC 111228 in M_1 generation

Mutagens	Treatments		Leaf area (cm^2)		Plant height (cm)		No. of primary branches		Internode distance (cm)		Flowering initiation (days)	
	Conc. (mM)	Dur. (hr)	1		2		3		4		5	
			Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
	Control	0	106.92±2.44	6.85	175.32±4.25	7.66	28.40±0.90	9.99	4.32±0.15	10.96	74.90±0.99	4.20
	15	4	120.74±4.20*	11.01	187.35±3.14*	5.29	30.20±1.37	14.37	4.53±0.20	13.89	70.60±1.34*	5.71
	30	4	101.56±3.86	12.03	163.53±4.67	9.04	24.40±1.15*	14.86	4.42±0.22	15.52	67.80±1.96**	8.65
	45	4	94.77±3.27**	10.91	161.18±4.94*	9.69	23.10±0.92**	12.65	3.68±0.22*	18.90	53.90±1.84***	10.80
EMS	60	4	85.60±4.43***	16.39	155.86±4.52**	9.18	22.20±0.87***	12.35	3.55±0.17**	14.98	79.80±1.36**	5.41
	15	8	104.85±3.76	11.34	166.59±3.50	6.64	25.10±1.20*	15.08	4.18±0.07	5.27	70.80±0.68**	3.04
	30	8	102.31±5.47	16.89	158.88±4.25*	8.45	23.70±0.88**	11.78	4.13±0.18	13.56	72.10±0.77*	3.36
	45	8	93.74±4.35*	14.67	153.42±3.78***	7.79	23.00±1.02***	14.05	3.62±0.16**	13.71	74.70±0.87	3.68
	60	8	79.62±2.23***	8.87	151.48±3.50***	7.31	22.10±1.06***	15.15	3.52±0.21**	19.02	82.60±1.32***	5.05
	1	4	105.65±2.69	8.04	164.11±4.35	8.38	26.40±0.97	11.04	4.06±0.21	16.35	71.60±0.48**	2.10
	2	4	101.67±3.96	12.33	161.11±4.68*	9.19	25.60±1.07	12.52	3.82±0.19	15.60	72.40±0.64	2.78
	3	4	96.94±2.43**	7.52	159.07±5.50*	10.90	24.60±0.86**	10.53	3.63±0.07***	5.67	75.90±0.64	2.67
SA	4	4	93.67±2.44***	7.83	157.30±4.69*	9.43	38.10±1.17***	9.21	3.42±0.17***	15.27	76.70±1.33	5.46
	1	8	103.21±3.68	11.26	161.19±4.46*	8.75	25.90±1.09	12.67	3.91±0.20	15.79	71.80±0.66*	2.92
	2	8	100.13±5.34	16.85	158.98±4.11*	8.17	24.80±0.84**	10.20	3.34±0.16***	15.15	73.60±1.01	4.35
	3	8	94.90±3.01**	9.50	151.38±4.62***	9.65	23.90±1.01**	12.70	3.53±0.26**	23.70	76.70±1.17	4.84
	4	8	82.69±3.25***	12.42	149.81±4.06***	8.58	23.50±0.86***	11.03	3.25±0.26**	25.51	83.90±1.23***	4.65

Cont.…

TABLE- 1: Effect of EMS and SA on morphological traits of *Psoralea corylifolia* IC 111228 in M_1 generation

Mutagens	Treatments		50% Flowering (days)		Spike length (cm)		No. of seeds per spike		Seed yield per plant (g)		100-seed weight (g)	
	Conc. (mM)	Dur. (hr)	6		7		8		9		10	
			Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
	Control	0	91.10±0.59	2.03	1.51±0.04	7.93	19.30±0.83	13.61	217.90±9.07	13.16	1.50±0.02	3.94
	15	4	87.70±1.82	6.20	2.20±0.08***	11.34	23.30±0.99**	13.43	254.80±11.43*	14.19	1.60±0.02***	3.03
	30	4	85.70±1.25***	4.40	1.49±0.05	11.16	18.20±1.25	21.64	206.91±8.18	12.50	1.54±0.02	3.27
	45	4	76.90±1.11***	4.56	1.41±0.07	15.5	17.30±1.71	31.19	192.19±17.15	28.21	1.59±0.03*	6.78
EMS	60	4	98.30±1.14***	3.65	1.37±0.05*	11.4	15.80±1.22*	24.39	175.28±6.54***	11.80	1.65±0.03***	6.00
	15	8	86.90±1.15**	4.18	1.54±0.04	8.77	20.40±1.07	16.53	197.41±11.35	18.18	1.52±0.06	11.93
	30	8	87.70±1.23*	4.43	1.44±0.04	8.15	18.50±1.18	20.10	184.30±7.30**	12.53	1.53±0.02	3.55
	45	8	93.90±0.89*	2.99	1.37±0.05*	11.9	17.80±1.15	20.48	183.53±9.75*	16.80	1.57±0.04	8.03
	60	8	101.50±0.96***	2.98	1.29±0.06**	14.4	14.00±1.17**	26.51	178.13±11.45*	20.32	1.99±0.06***	10.25
	1	4	87.00±0.97**	3.51	1.51±0.05	11.02	18.40±1.09	18.69	187.68±5.83*	9.83	1.44±0.05	10.01
	2	4	89.60±0.98	3.46	1.48±0.03	6.21	18.00±1.30	22.83	224.21±13.80	19.46	1.48±0.03	6.44
	3	4	93.20±1.98	6.71	1.38±0.06	13.10	16.30±1.33	25.71	213.89±8.62	12.75	1.59±0.03*	4.99
SA	4	4	97.50±1.33***	4.30	1.41±0.06	12.70	17.60±1.20	21.63	283.58±21.67*	24.16	1.71±0.05***	8.47
	1	8	89.30±1.19	4.22	1.49±0.05	10.23	19.20±1.10	18.18	214.93±14.04	20.80	1.66±0.02***	4.72
	2	8	92.40±1.28	4.36	1.46±0.05	9.79	18.40±1.15	19.71	203.33±11.12	17.29	1.56±0.03	5.58
	3	8	93.80±1.10*	3.72	1.39±0.06	13.30	16.70±1.34	25.41	197.84±11.54	18.44	1.46±0.03	6.27
	4	8	98.50±1.09***	3.49	1.31±0.05**	12.70	15.10±1.20**	25.06	189.79±10.23	17.04	1.39±0.03**	7.32

*P $\leq$ 0.05; **P 0.01; ***P 0.001 compared to control
(CV= Coefficient of Variation)

Control plants EMS treated plants SA treated plants

Fig. 1: EMS and SA mutagens treated plants of *Psoralea corylifolia* IC 111228 in M_1 generation growing in the field

proved most effective in increasing total grain yield per plant and 15 mM EMS applied for 4 hours increased the plant height in *P. corylifolia* IC 111228. The total yield per plant is a quantitative character and depends on a group of yield attributes (such as spike length, no. of seeds per spike, 100-seed weight, *etc.*), and the effect of mutagenic treatments on these characters give additive effect on total yield of the plants.

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