Himachal Journal of Agricultural Research 33 (2):287-289, 2007

Short Note

Effect of gamma rays and ethyl methane sulphonate on the mutagenized population means in french bean (*Phaseolus vulgaris* L.)

Meenakshi Sood and N.K. Pathania
Department of Vegetable Science and Floriculture
CSK Himachal Pradesh Krishi Vishvavavidyalaya, Palampur -176 062, India.

Use of mutations is a valuable supplementary approach to plant breeding. It creates variability - qualitative and quantitative, which is required for selection. Mutations are very helpful particularly when it is desired to improve one or two easily identifiable characters in an otherwise well adapted variety. A desired mutation can be recovered in a homozygous stage in M_2 or M_3 generation compared with F_6 or F_7 generation in case of hybridization (Sigurbjornsson, 1977). Furthermore, a single mutant can be exploited easily to develop a new variety through pedigree selection in self-pollinated crops since they do not suffer from drastic inbreeding depression.

Experimental material for the present study was developed by treating the samples of 350 healthy uniform sized seeds of variety 'Contender' with different doses of physical and chemical mutagens, and their combinations. The doses administered were,5kR, 10kR, 20kR, 30kR and 40kR gamma-ray; 0.1%, 0.2% and 0.3% ethyl-methane sulphonate (EMS) solutions, and 5kR+0.1%EMS, 5kR+0.2%EMS, 10kR+ 0.1%EMS and 10kR+0.2% EMS combination treatments. Gamma irradiation was done in ^{60}Co gamma chamber at National Physical Laboratory, New Delhi. For treatment with EMS, three hundred fifty seeds for each treatment were first soaked in water at room temperature for 8 hours and then treated with freshly prepared buffered EMS solution of different doses for four hours followed by one hour washing of the seeds under running tap water. These M_1 seeds along with control were then sown in the field in Randomized Block Design with 3 replications to raise M_1 generation during summer, 2002. Normal looking M_1 plants were harvested individually at maturity to obtain M_2 seed. Single M_2 seed from each harvested M_1 plant was bulked treatment wise for planting along with M_3 generation. Remaining M_2 seed was sown during April, 2003 in plant to progeny rows along with the parent in Augmented Block Design to generate M_3 seed. Final trial was conducted at Research Farm, HAREC, Bajaura, during 2004, where M_2, M_3 generations were raised along with the parental variety in RBD with two replications under each dose. Row to row and plant to plant spacing was 30 cm and 10 cm, respectively. Row length was kept 3 m. Recommended package of practices was followed for raising the crop.

The perusal of table 1 revealed that the traits days to first flowering and days to first picking exhibited significant shift towards lateness under all the treatments studied in both M_2 and M_3 generations except for 10 kR gamma-irradiation in M_3 in the former trait. Pods per plant showed shift in negative direction in both the generations except in M_2 under 30kR gamma-irradiation where the shift was non-significant. The combined treatment 10 kR+0.1% EMS in both the generations and 30kR in M_2 exhibited non-significant shift for green pod yield per plant while all other treatments showed significantly negative shift for this trait. Pod length was found to exhibit mean shift towards negative direction under all the treatments studied.

In M_2, the shift in mean plant height was observed in negative side under all treatments except 20 kR and 40 kR gamma-irradiation. However, there was significant positive shift in mean plant height in M_3 generation under all the treatments except for 10kR+0.1% EMS combined treatment. Seeds per pod exhibited significant positive shift in mean only under 0.1% EMS and 0.2% EMS treatments in M_2 generation. All the treatments under both the generations exhibited negative shift in mean for the trait seed yield per plant.

Hence, the shift in days to first flowering and days to first picking has been towards lateness under all the treatments in both M_2 and M_3 generations. Green pod yield per plant and related traits *viz.*, pods per plant and pod length have exhibited shift in negative direction. Likewise seed yield per plant has also exhibited negative shift in means except in 10 kR in M_2. The unchanged means might have been due to

Table 1. Estimates of parental (M_0), M_2 and M_3 means with respect to various traits under different mutagenic treatments

Trait		Days to first flowering	Days to first picking	Pods/ plant	Green pod yield / plant (g)	Pod length (cm)	Plant height (cm)	Seeds/ pod	Seed yield/ plant (g)
Dose	Generation								
	M_0	45.72	62.71	19.04	146.88	14.07	34.95	4.20	35.80
		±0.59	±0.46	±1.31	±12.66	±0.25	±1.16	±0.12	±2.77
5kR	M_2	47.00^p	64.43^p	16.29^n	107.63^n	13.22^n	31.04^n	4.17	27.98^n
		±0.35	±0.53	±1.23	±9.37	±0.16	±0.71	±0.10	±2.76
	M_3	45.97^p	63.90^p	15.34^n	116.77^n	13.76	39.66^p	3.68^n	28.99^n
		±0.10	±0.15	±0.26	±2.88	±0.59	±0.35	±0.02	±0.61
10 kR	M_2	47.57^p	66.00^p	17.00^n	121.00^n	13.41^n	34.15^n	4.28	33.58
		±0.50	±0.77	±1.77	±14.56	±0.14	±0.84	±0.11	±3.95
	M_3	45.89	63.94^p	15.90^n	121.54^n	13.31^n	38.90^p	4.01^n	27.02^n
		±0.15	±0.18	±0.42	±3.01	±0.09	±0.68	±0.03	±1.00
20 kR	M_2	47.42^p	64.80^p	18.11^n	134.51^n	13.50^n	36.85^p	3.87^n	31.90^n
		±0.46	±0.65	±1.39	±8.85	±0.14	±0.77	±0.13	±3.47
	M_3	46.77^p	64.83^p	15.03^n	112.15^n	13.01^n	39.37^p	3.99^n	25.17^n
		±0.14	±0.30	±0.51	±4.14	±0.12	±0.37	±0.02	±0.76
30 kR	M_2	48.60^p	65.87^p	18.89	142.78	13.19^n	33.40^n	3.85^n	30.04^n
		±0.68	±0.64	±1.41	±8.41	±0.23	±0.93	±0.15	±2.40
	M_3	47.75^p	67.55^p	16.60^n	128.25^n	13.44^n	41.35^p	4.10^n	19.18^n
		±0.52	±0.44	±0.19	±8.87	±0.25	±0.62	±0.04	±1.45
40 kR	M_2	47.27^p	67.63^p	15.73^n	135.73^n	13.27^n	36.37^p	3.57^n	22.93^n
		±0.83	±0.65	±1.69	±11.88	±0.21	±1.15	±0.14	±1.82
	M_3	49.45^p	68.70^p	13.90^n	130.85^n	13.92	46.70^p	3.83^n	17.29^n
		±0.83	±0.18	±0.99	±12.66	±0.22	±0.80	±0.06	±0.84
5 kR +0.1%	M_2	47.88^p	65.32^p	14.52^n	106.96^n	13.40^n	35.39	4.27	27.20^n
		±0.44	±0.60	±0.90	±7.62	±0.21	±0.56	±0.08	±1.78
	M_3	46.84^p	64.82^p	15.16^n	113.95^n	13.40^n	37.99^p	3.79^n	25.38^n
		±0.12	±0.84	±0.41	±3.07	±0.06	±0.41	±0.02	±0.84
5 kR +0.2%	M_2	47.89^p	66.00^p	13.99^n	111.58^n	13.57^n	32.99^n	4.30^p	25.88^n
		±0.37	±0.63	±1.13	±12.07	±0.17	±0.60	±0.10	±1.85
	M_3	47.11^p	64.52^p	16.87^n	127.60^n	13.31^n	38.37^p	3.83^n	27.38^n
		±0.18	±0.69	±0.53	±3.94	±0.09	±0.48	±0.04	±1.12
10 kR +0.1%	M_2	47.76^p	64.59^p	16.16^n	144.98	13.51^n	32.71^n	4.10^n	29.65^n
		±0.48	±0.68	±1.37	±17.23	±0.16	±0.57	±0.07	±1.71
	M_3	47.27^p	64.40^p	17.03^n	135.53	13.65^n	33.40^n	4.05^n	29.01^n
		±0.74	±0.17	±2.08	±17.06	±0.14	±0.88	±0.09	±2.69
10 kR +0.2%	M_2	48.74^p	66.54^p	14.75^n	105.37^n	13.06^n	31.79^n	4.10^n	23.66^n
		±0.63	±0.68	±1.19	±9.67	±0.14	±0.78	±0.11	±1.61
	M_3	46.80^p	64.93^p	11.43^n	90.50^n	13.37^n	37.80^p	4.02^n	19.69^n
		±0.43	±0.22	±0.80	±6.07	±0.18	±0.58	±0.05	±1.57
0.1%	M_2	46.60^p	62.97^p	16.81^n	129.48^n	13.67^n	33.67^n	4.37^p	30.89^n
		±0.29	±0.32	±1.21	±10.07	±0.15	±0.71	±0.09	±2.30
	M_3	46.52^p	63.41^p	17.47^n	132.94^n	13.51^n	35.06	4.04^n	31.32^n
		±0.26	±1.03	±0.70	±5.13	±0.07	±0.42	±0.04	±1.41
0.2%	M_2	46.78^p	63.78^p	16.63^n	121.92^n	13.74^n	34.52	4.31^p	30.81^n
		±0.42	±0.34	±0.89	±7.04	±0.16	±0.63	±0.07	±1.81
	M_3	46.50^p	64.65^p	17.35^n	139.45^n	13.40^n	38.27^p	3.93^n	28.79^n
		±0.30	±0.41	±0.68	±5.71	±0.12	±0.76	±0.04	±1.12
0.3%	M_2	47.89^p	65.04^p	13.49^n	95.32^n	13.66^n	32.67^n	4.13	24.54^n
		±0.40	±0.49	±0.77	±4.94	±0.12	±0.81	±0.11	±1.78
	M_3	-	-	-	-	-	-	-	-

^{p} Significantly positive shift in mean

^{n} Significantly negative shift in mean

the symmetrical induction of polygenic mutations in both the directions (Oka *et al.*, 1958). Shift in means for seeds per pod has been towards negative direction under 5kR, 10kR, 5kR+0.1% EMS, 5kR+0.2% EMS, 0.1% EMS and 0.2% EMS in M_3 generation, and under 20kR, 30kR, 40kR, 10kR+0.1% EMS and 10kR+0.2% EMS in both the generations. However, 5kR+0.2% EMS, 0.1% EMS and 0.2% EMS treatments have positive shift in means in M_2 generation for seeds per pod. For plant height, the shift in mean has been in positive direction under 10kR, 20kR, 30kR, 5kR+0.1% EMS, 5kR+0.2% EMS, 10kR+0.2% EMS and 0.2% EMS in M_3 generation only. Negative shift for this trait has been induced under 5kR, 10kR, 30kR, 5kR+0.2% EMS, 10kR+0.1% EMS, 10kR+0.2% EMS, 0.1% EMS and 0.3% EMS in M_2 and under 10kR+0.1% EMS in M_3 generation. The shift in positive direction is probably due to the accumulation of more number of increasing alleles in M_3 generation.

In the present study, Brock's hypothesis fits well for almost all the traits except for plant height and seeds per pod. Research findings in agreement (Bansal, 1969, Raja Ram, 1973 and Swaminathan, 1965) as well as at variance (Frey, 1968 and Gaul, 1996) of the hypothesis are available. However, Frey (1968) argued that shifts in population means induced by mutagens are generally unpredictable and are dependent upon specific genotype-trait combination. Similar observations have also been advocated by Jai Dev (1993).

References

Bansal HC 1969. Studies on the induction of mutations with special reference to biochemical traits in chilli and polygenic characters in wheat and barley. Ph D Thesis, Sardar Patel University, Vallabh Vidyanagar (unpublished).

Brock RD 1965. Induced mutations affecting quantitative characters. Uses of induced mutation in plant breeding (Supplement). Rad. Bot. **5**: 451-464.

Frey KJ 1968. Induced variability in diploid and polyploid *Avena* species (I). Reprinted from Gamma field symposia, *7th present state of mutation breeding*: 41- 46.

Gaul H and Aastveit A 1996. Induced variability of culm length in different genotypes of hexaploid wheat following X-irradiation and EMS treatment. Proc.Fifty Yugoslav Symp. Res. Wheat: 263 - 267.

Jai Dev 1993. Genetic analysis of induced variation in *Phaseolus vulgaris* L. Ph D Thesis, Himachal Pradesh Krishi Vishvavidyalaya, Palampur (unpublished).

Oka HI, Hayashi J and Shijiri I 1958. Induced mutations in polygenes for quantitative characters in rice. J. Heredity **49**: 11-14.

Raja Ram 1973. Irradiation studies in diploid and tetraploid varieties of gram (*Cicer arietinum* L.). Ph D Thesis, Haryana Agricultural University, Hisar (unpublished).

Sigurbjornsson B 1977. Introduction: Mutations in Plant Breeding Programmes. In: *Manual on Mutation Breeding*. 2nd Edition, International Atomic Energy Agency. Vienna.

Swaminathan MS 1965. A comparison of mutation induction in diploids and polyploids. Uses of induced mutation in plant breeding (Supplement). Rad. Bot. **5**: 619-653.