

RADIATION INDUCED VARIATION IN *PHASEOLUS VULGARIS* L. FOR SEED YIELD TRAITS AND BIOTIC STRESS

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Significant within line and between lines variation was induced for seed yield under 5kR, 10kR and 15kR doses of gamma-rays in M₂ of 'Jawala' and 'HPR35' varieties; and for biological yield, number of seeds and number of pods under 5kR and for seeds per pod under 10kR in M₂ of 'Jawala' variety. between lines variation was also observed for seed yield under 20kR in M₂ of 'Jawala'. Within line and between lines, variation was induced for seed yield under 10kR, and for plant height under 10kR and 15kR in M₃ of 'Jawala'. However, within line variation was also observed for seed yield under 5kR, 10kR and 15kR in M₃ of 'Jawala' whereas between lines, variation was induced for seed yield under 5kR and for biological yield under 5kR and under 15kR in M₃ of 'HPR35'. However, within line variation was also observed for harvest index, seeds per pod, pod yield and pod length under 15kR and for seeds per pod and pod length under 5kR in M₃ of HPR 35. Mutants 128 (10kR) of 'Jawala'; and 232-1 (5kR), 236-2 and 238-1 (10kR) and 208 (15kR) of 'HPR 35' were found moderately resistant against anthracnose (*Colletotrichum lindemuthianum*) in M₃ when tested under laboratory conditions. Mutants 32-1, 236-2, 238-1 and 208 (all of 'HPR 35') also had higher seed yields than the parent 'HPR 35'.

Key words : *Phaseolus vulgaris*, variability, radiation, biotic stress, mutation

Induction and selection of mutations in crop plants offer the prospects of generating variability which may not be present in the natural gene pool. In rajmash (*Phaseolus vulgaris* L.), where crossing is little tedious and there is not sufficient variation in the available germplasm with respect to resistance to diseases, the use of mutations would be more efficient. In the present studies, radiation induced mutation was used as a tool for creating variability for desired traits including disease resistance in two released varieties of *Phaseolus vulgaris* L.

MATERIALS AND METHODS

The experimental material consisted of M₂ and M₃ generations of 'Jawala' and 'HPR 35' which are the two released varieties of *P.vulgaris* L. for Himachal

Pradesh. One hundred dry seeds of each variety were got irradiated with 5, 10, 15 and 20kR doses of gamma-rays at IARI, New Delhi. These seeds were raised as M_2 generation in rows of 3m length with plant to plant and row to row distance of 15cm and 30cm, respectively, during 1991-92. On the other hand, the M_2 generation, of earlier generated material under the same doses of these two varieties, was raised in single plant completely randomized design (SPCRD) alongwith parents (control) during 1991-92. During 1992-93, the M_2 generation was raised in SPCRd alongwith control and M_3 generation, under each dose of the two varieties, was raised alongwith control in randomized block design (RBD) with two replications.

The data in M_2 were recorded on plant basis in each dose in each variety, whereas the data were recorded on five random plants and then averaged in M_2 per replication in each dose and in each variety. The observations were recorded on seed yield/plant (g), biological yield/plant (g), harvest (%), plant height (cm), number of seeds, seeds/pod, number of pods, pod yield (g), pod length (cm), number of nodes and internode length (cm). The analysis of variance in M_2 and M_2 in each dose was carried as suggested by Yonezawa (1979). In M_2 within line analysis of variance was also done for the individual lines. The M_3 mutants were screened against anthracnose in the laboratory by detached hypocotyle method as per Chakrabarty and Bambawale (1991).

RESULTS AND DISCUSSION

Both between lines and within line variation was induced in M_2 of 'Jawala' variety of *Phaseolus vulgaris* L. for seed yield under all the doses, i.e. 5kR, 10kR and 15kR of gamma-rays, except for 20kR where under only between lines variation was induced for this trait (Table 1). Within line and between lines variation was also induced for biological yield, number of seeds and number of pods under 5kR. and for seeds per pod under 10kR of gamma-rays (Table 1). Table 1 also revealed that within line variation was induced in M_2 of 'Jawala' for biological yield and number of seeds under 10kR and 15kR, for seeds per pod under 5kR and 20kR, and for pod yield under 10kR. Only between lines variation was observed for pod length under 5kR and 10kR, for number of pods under 10kR, and for seeds per pod under 15kR doses. Data in Table 2 indicated the induction of within line and between lines variation for seed yield under 5kR, 10kR and 15 kR doses in M_2 of 'HPR 35' variety whereas only between lines variation was induced under 5kR for number of nodes in the M_2 of this variety. Persual for Table 3 revealed the induction of within line and between lines variation for seed yield under 10kR doses in M_3 of 'Jawala'. Within line variation also existed for seed yield under 5kR and 15kR in M_3 in this variety. Table 4 revealed that between lines variation was induced for seed yield, harvest index and pod yield under 15kR doses in M_3 of 'HPR 35' variety.

Kozera and Roszoko (1986) also found that irradiation of seeds with 4 doses of neutrons (6-15 J/kg) increased the range of variation for seed yield per plant, 1000-seed weight, pod length, pods per plant, plant height and branch number in M₂.

Variable results were obtained with respect to radiation induced variation in *P.vulgaris* L. which suggest that sufficient amount of variation, both within and between lines, was induced for seed yield M₂ generation of both the varieties ('Jawala' and 'HPR 35') and for some other traits in 'Jawala' under all the doses of gamma-rays. Besides between lines variation, within line variation was also observed for seed yield and some related traits under different doses in the M₃ generation of both the varieties. This indicates that within line selection can be practiced in M₃ alongwith between line selection for seed yield and some other traits.

Table 1. Analysis of variance for induced genetic variation for various traits in M₂ generation of 'Jawala' variety of rajmash (*Phaseolus vulgaris* L.) under different doses of gamma rays

Traits	Mean sum of squares								Parental variance
	5kR		10kR		15kR		20kR		
	L	WL	L	WL	L	WL	L	WL	
df	39	140	13	63	4	6	2	2	3
SY	10.03*	16.77*	10.70*	17.40*	16.22*	12.33*	15.70*	2.57*	0.63
BY	67.58*	98.91*	28.42	140.97*	66.43	107.99*	67.19	19.81	7.68
HI	215.41	109.84	175.76	107.25	218.23	72.35	12.58	28.78	44.92
pH	33.82	57.95	71.33	75.93	30.32	21.07	37.35	1.25	36.42
NS	65.80*	90.46*	54.06	90.80*	106.56	70.11*	50.50	12.50	7.58
SP	0.26	0.66*	4.37*	0.99*	0.92*	0.16	0.05	0.65*	0.05
NP	11.69*	7.92	8.43*	7.37	6.50	5.70	5.40	8.00	0.92
PY	22.49	31.15*	17.22	31.35*	28.42	22.64	27.03	4.81	3.48
PL	15.90*	2.25	38.38*	2.88	0.95	0.21	1.86	1.04	1.54
NN	0.25	1.39	0.68	0.66	0.39	0.53	1.15	0.25	0.17
IL	1.13	0.25	0.56	0.36	0.39	0.33	0.79	0.06	0.20

SY = Seed yield (g), BY = Biological yield (g), HI = Harvest index (%)

pH = Plant height (cm), NS = no. of seeds, SP = Seeds/pod

NP = No. of pods, PY = pod yield (g), PL = Pod Length (cm)

NN = No. of nodes, IL = Internode length (cm)

L = lines, WL = Within lines

* Significant at 5% level when tested against parental MS

Table 2. Analysis of variance for induced genetic variation for various traits in M₂ generation of 'HPR 35' variety of rajmash (*Phaseolus vulgaris* L.) under different doses of gamma rays

Traits	Mean sum of squares						Parental variance
	5kR		10kR		15kR		
	L	WL	L	WL	L	WL	
df	31	72	59	91	4	2	2
SY	46.71*	21.45*	21.31*	10.50*	43.37*	11.73*	0.14
BY	93.38	78.18	87.56	33.17	123.51	27.09	44.81
HI	404.37	176.77	165.91	134.29	75.68	95.86	85.84
PH	191.83	115.81	107.70	73.14	57.30	81.09	126.77
NS	142.99	107.78	100.65	52.65	220.83	86.34	117.00
SP	0.98	0.36	0.01	0.49	0.20	0.39	0.41
NP	10.23	8.83	9.28	4.71	28.00	26.34	13.00
PY	53.44	39.66	36.70	16.57	84.39	19.65	45.20
PL	1.72	1.73	3.09	1.47	2.90	4.21	1.63
NN	6.20*	0.77	0.87	0.78	0.86	1.00	0.19
IL	0.60	1.41	1.97	0.72	0.32	0.08	0.44

SY = Seed yield (g), BY = Biological yield (g), HI = Harvest index (%)

PH = Plant height (cm), NS = No. of seeds, SP = Seeds/pod

NP = No. of pods, PY = Pod yield (g), PL = Pod length (cm)

NN = No. of nodes, IL = Internode length (cm)

L = Lines, WL = Within lines

* Significant at 5% level when tested against parental MS

The mutants were also screened for resistance against anthracnose disease (*Colletotrichum lindemuthianum*) under laboratory conditions. The mutants number 128 (10kR) of 'Jawala'; and 232-1 (5kR), 236-2 and 238-1 (10kR), and 208 (15kR) of HPR 35 were found moderately resistant against anthracnose in M₃ generation (Table 5). The mutants number 232-1, 236-2, 238-1 and 208 (all of 'HPR 35') also had higher seed yield than the parent ('HPR 35'). These mutants can be used un breeding programme for obtaining novel genotypes or can be released as improved varieties after proper evaluation. Rubaihayo (1975) also reported that seed yield of a variety of *P. vulgaris* L. was increased in M₃ to M₅ following mutagenesis with 7-21kR gamma-rays. Hussain and Abdalla (1979) showed that some mutants of field bean surpassed their control significantly in two successive generations from M₄ to M₃ for seed yield. Popa *et al.* (1982) observed that some high yielding induced mutants were found resistant to *Colletotrichum lindemuthianum* in an adapted variety of *P. vulgaris* L.

Table 3. Analysis of variance for induced genetic variation for various traits in M₃ generation of 'Jawala' variety of rajmash (*Phaseolus vulgaris* L.) under different doses of gamma rays

Traits	Mean sum of squares						LB (Error)	Parental variance
	5kR		10 kR		15 kR			
	L	WL	L	WL	L	WL		
df	11	53	3	27	15	81	32	8
SY	0.75	2.14*	2.77*	2.80	1.84	2.67*	2.22*	0.63
BY	2.08	9.84	9.98	16.55	6.03	8.63	7.24	6.00
HI	100.98	120.98*	60.10	114.11*	77.33	194.03*	92.81	33.25
PH	14.41	14.80	41.56*	62.61*	40.62*	29.26	20.05*	5.42
NS	3.90	11.67	16.75	16.29	12.74	12.17	13.74	21.00
SP	0.33	0.79*	0.23	0.60*	0.45	0.52*	0.37	0.14
NP	0.23	1.16	1.34	1.99	0.82	1.16	1.47	2.15
PY	1.57	3.24	2.19	5.83	4.19	3.74	4.63	3.65
NN	0.08	0.34	0.75	0.67	0.41	0.69	0.25	0.45
IL	0.18	0.18	0.05	0.38	0.22	0.29	0.17	0.38

SY = Seed yield (g), BY = Biological yield (g), HI = Harvest index (%)

PH = Plant height (cm), NS = No. of seeds, SP = Seeds/pod

NP = No. of pods, PY = Pod yield (g), PL = Pod length (cm)

NN = No of nodes, IL = Internode length (cm)

L = Lines, WL = Within lines, LB = Line x Block i.e. Error variance

*Significant at 5% level when tested against parental MS

Table 4. Analysis of variance for induced genetic variation for various traits in M₃ generation of 'HPR 35' variety of rajmash (*Phaseolus vulgaris* L.) under different doses of gamma rays

Traits	Mean sum of squares						LB (Error)	Parental variance
	5kR		10kR		15kR			
	L	WL	L	WL	L	WL		
df	13	92	7	45	26	178	49	7
SY	5.70*	4.36	1.83	4.11	3.79	4.08	4.03	1.51
BY	15.85	16.38	6.45	16.50	20.95*	15.74	16.59	5.94
HI	140.05*	108.66	49.90	107.49	73.56	147.59*	89.19	37.38
PH	41.63	48.44	41.53	58.58	52.18	59.51	44.30	27.65
NS	34.14	30.44	14.52	23.24	24.93	24.67	28.35	19.31
SP	0.39	6.26*	0.13	0.23	0.14	0.54*	0.19	0.16
NP	3.47	3.17	2.24	3.31	2.03	2.28	2.41	1.82
PY	10.46*	7.75	3.20	6.97	7.19	13.74*	7.17	2.85
PL	0.75	1.34*	2.54*	0.67	0.87	1.57*	0.98	0.31
NN	0.39	0.78	0.60	0.01	0.43	1.15	0.43	0.46
IL	0.33	0.74	0.17	0.53	0.22	0.38	0.27	0.48

SY = Seed yield (g), BY = Biological yield (g), HI = Harvest index (%)

PH = Plant height (cm), NS = No. of seeds, SP = Seeds/pod

NP = No. of pods, PY = Pod yield (g), PL = Pod length (cm)

NN = No. of nodes, IL = Internode length (cm)

L = Lines, WL = Within lines, LB = Line × Block i.e. Error variance

*Significant at 5% level when tested against parental MS

Table 5. Reaction types of moderately resistant radiation induced mutants of rajmash (*Phaseolus vulgaris* L.) in M₃ generation against *Colletotrichum lindemuthianum* on four point scale

Mutant number	Seed yield (g/plant)	No. of infection points on detached hypocotyle	Reaction type							
			After 4 days				After 7 days			
			1	2	3	4	1	2	3	4
'Jawala' variety										
128 (10kR)	5.13	3	1	2	0	0	0	0	0	0
Control	5.95	7	0	1	3	3	0	0	3	4
'HPR 35' variety										
232-1 (5kR)	5.50	10	9	1	0	0	7	1	1	1
236-2 (10kR)	5.38	6	4	2	0	0	3	3	0	0
238-1 (10kR)	4.52	6	1	5	0	0	1	5	0	0
208 (15kR)	5.02	8	7	1	0	0	7	0	0	1
Control	4.14	-	-	-	-	-	-	-	-	-

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