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Short Communication

Radiation induced pod and seed mutants and MMS induced closed flower mutant in broad bean (*Vicia faba* L.)

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Present study reports induced pod and seed mutants obtained at 10kR of gamma rays and a closed flower mutant at 0.04% of MMS in *Vicia faba* L. variety minor. Dry (10-12% moisture) and healthy seeds of *Vicia faba* L. var. minor were irradiated with four different doses (10, 20,30 and 40kR) of gamma rays. Another set of seeds presoaked in distilled water for 12 hours was treated with four different concentrations (0.01, 0.02, 0.03 and 0.04%) of MMS for 6 hours. One set of seeds was kept untreated for comparison. All the sets of seeds were sown following complete randomized block design (CRBD) to raise the M_1 generation in *rabi* season of 2003-2004. The seeds were collected individually from the M_1 plants and sown in field to raise M_2 and from individual M_2 plants M_3 generation in the same season of 2004-2005 and 2005-2006.

One variant plant with exceptionally bigger size of pods and larger seeds (Figs. 1, 2) was isolated in M_1 generation from the 10kR treatment. The breeding behaviour of this mutant was studied by raising M_2 and M_3 generations. Of the 10 and 25 seeds sown, 7 and 20 seedlings survived to their maturity in M_2 and M_3 generations respectively and showed characteristic features of the mutant as given in Table 1. The mutant was isolated in M_1 and is expected to be dominant, and showed the presence of same features in M_2 and M_3 generations. Joshi and Verma [1] characterized the mutantions obtained in *Vicia faba* L. as "gene mutations" as there were no visible chromosomal changes associated with them. The present *Vicia faba* L. mutant also falls in this category as no cytological changes were observed. The mutant showed 90% pollen fertility which is slightly less than control (93%).

Another mutant characterized by presence of closed round flowers that did not open at all was isolated in M_2 population of 0.04% MMS treatment. The quantitative features of closed flower mutant are given in Table 1. The mutant showed premature fall of flowers and leaves (Fig. 7) and was completely sterile, no pod and seed setting was observed in this mutant, the floral parts *viz.*, calyx, corolla, androecium and gynoecium did not develop normally. This may be due to the pleiotropic activity of mutated gene/genes or mutation of closely linked genes affecting the development of floral whorls simultaneously [2].

The PMCs of control plants showed 6 bivalents at metaphase-I and 6:6 distributions of chromosomes at anaphase-I. The meiotic aberrations at different stages in closed flower mutant was studied and given in Table 2, Figs. 8-16. Different types of chromosomal

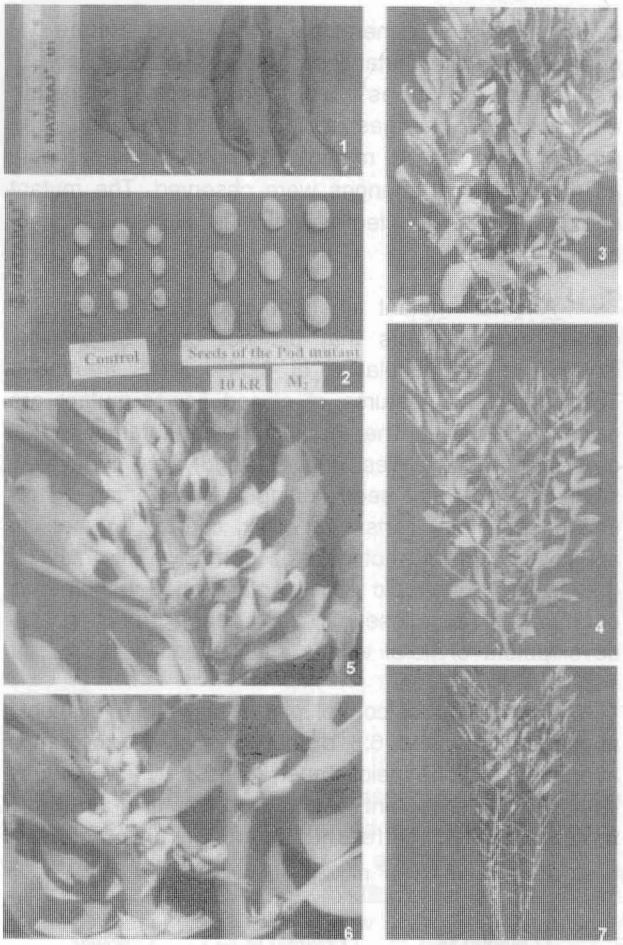
Table 1. Comparison of control (Parent variety) with the large podded and closed flower mutant of broad bean

No.	Character	Control (7 plants) Mean±S.E.	Mutant (1 plant) M_1, Mean±S.E.	Mutants (7 plants) M_2, Mean ± S.E.	Mutants (7 plants) M_3, Mean ± S.E.	Closed flower mutants
1.	Plant height (cm)	62.57±0.52	60.00	60.57±0.68	61.52±0.62	58.00
2.	Leaf area (cm^2)	26.14±0.76	33.57±0.75	31.57±0.57	33.22±0.64	18.10
3.	Days to 1st flower open	73.83±0.44	62.00	60.71±0.89	60.22±0.88	99.00
4.	Days to 50% flowering	91.42±0.52	85.00	82.42±0.75	80.44±0.73	110.00
5.	No. of flowers	50.71±1.64	67.00	68.85±1.37	70.88±1.22	38.00
6.	No. of branches	8.22±0.66	11.00±0.70	12.24±0.68	14.21±0.82	5.00
7.	No. of leaves	54.22±1.32	92.33±1.68	94.33±1.72	96.33±1.88	40.00
8.	No. of leaflets	165.33±1.83	368.22±1.92	374.18±1.90	380.22±1.93	88.00
9.	Fertile branches	5.28±0.28	8.00	7.57±0.68	8.83±0.72	-
10.	No. of pods/plant	24.00±0.81	32.00	32.42±0.71	33.44±0.72	-
11.	Pod length (cm)	3.34±0.12	5.1±0.06	5.07±0.07	5.03±0.04	-
12.	Pod girth (cm)	2.04±0.08	3.65±0.22	3.80±0.29	3.82±0.32	-
13.	No. of seeds/pod	2.57±0.20	3.85±0.34	4.00±0.37	4.00±0.34	-
14.	No. of seeds/plant	63.28±0.52	122.00	126.00±1.40	130.00±1.20	-
15.	100-seed weight (g)	26.71±0.52	84.28±1.30	85.71±1.32	86.72±1.34	-

Table 2. Frequency of meiotic abnormalities induced by MMS in broad bean mutant

Treatment	PMCs observed	Abnormal PMCs	Metaphase-I/III (%)				Anaphase-I/II (%)			Telophase-I/II (%)				Abnormal PMCs (%)	Pollen fertility (%)
			Multivalents	Stickiness	Precocious separation	Fragments	Laggards	Bridges	Non-disjunction	Laggards	Bridges	Disturbed polarity	Micro nuclei		
Control	130	-	-	-	-	-	-	-	-	-	-	-	-	-	93.00
Closed flower mutant	160	75	3.75 (6)	6.25 (10)	3.75 (6)	4.37 (7)	5.00 (8)	6.25 (10)	3.75 (6)	2.50 (4)	5.00 (8)	4.57 (7)	1.25 (2)	46.25	00.00

Values in parenthesis represent the actual no. of PMCs with the abnormality



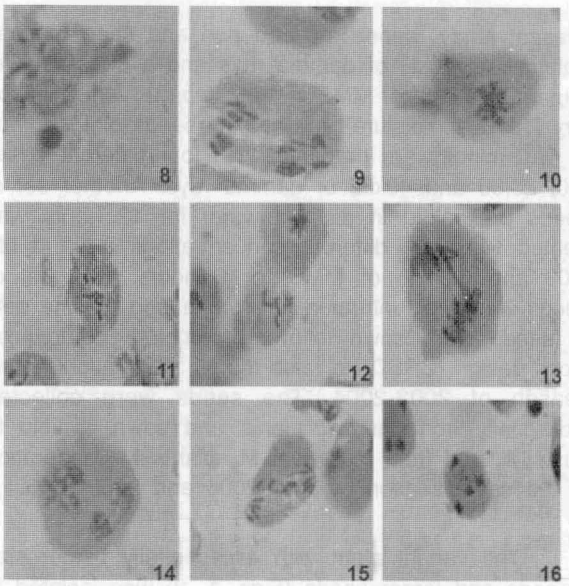


Fig. 1-16: ***Vicia faba*** **L. control, mutants and their cytological features: (1) Pods of control (left) and the mutant (right); (2) Seeds of the control (left) and the mutant (right); (3) Control plant; (4) Closed flower mutant; (5) Close view of control plants; (6) Close view of closed flower mutant; (7) Closed flower mutant showing premature fall of flowers and leaves; (8)** 6_{11} **at M-I; (9) 6:6 segregation at A-I; (10) Stickiness at M-I; (11,12) Secondary association at M-I; (13) Bridge at A-I.; (14) Bridge and unsynchronisation at A-II; (15) Laggards at A-I; (16) Disturbed polarity at T-II.**

abnormalities observed during the present investigation have also been reported by various workers in different plant materials after treatment with physical and chemical mutagens [3]. Multivalent formation can be attributed to irregular pairing and breakage followed by translocations and inversions [4]. The precocious separation and disturbed polarity is probably caused by spindle disturbance, while the fragments may be due to breakage of the chromosomes by the mutagen. The formation of chromatin bridges might be due to the failure of chiasmata in a bivalent to terminalise and the chromosomes get stretched between the poles. The laggards may be due to abnormal spindle formation and chromosomal breakage. The cytological observations suggest that in the present case the floral abnormalities may be due to chromosomal rearrangement. Because of poor flowering and complete sterility, the progeny of this mutant could not be studied further.

References

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