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GAMMA-RAY INDUCED BOLD SEEDED MUTANT IN *VIGNA MUNGO* (L.) HEPPER

R. K. SINGH*

Plant Genetics Unit, Department of Botany, Lucknow University
Lucknow 226007

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ABSTRACT

A vigorous and bold seeded mutant was isolated from M_2 progeny of 20 kR gamma-ray irradiated plant population of *Vigna mungo* cv. T-9. The mutant had larger leaves and flowers similar to control but upper part of style and stigma of each flower was curved. The mutant had larger and healthy pods bearing bolder seeds and showed higher seed yield/plant. Cytologically, it showed normal meiosis. The χ^2 test showed that the mutation is controlled by a single recessive gene. The protein content was higher in the mutant while amino acids and trypsin inhibitor activity were more are less similar to the control.

Key words: *Vigna mungo*, gamma-rays, genetic nature, amino acids, trypsin inhibitor activity.

Vigna mungo has very limited natural variability for yield and its component traits. Mutagen induced quantitative variation not only serves as an alternative source of germplasm to natural variation, it is also useful in generating appropriate linked gene complexes which are responsible for improvement in yield and other characters of economic value of a crop. Keeping this in view, a programme was initiated to induce mutations in this crop through physical and chemical mutagens [1]. The present paper deals with the bold seeded mutant.

MATERIALS AND METHODS

Dry seeds of blackgram [*Vigna mungo* (L.) Hepper] cv. T-9, standardized for moisture content at 12.2%, were irradiated with gamma rays from a ^{60}Co source at 30°C at N.B.R.I., Lucknow, with the doses 10, 20 and 30 kR. For chemical mutagenic treatment, one irradiated set of each dose was treated with 0.25% freshly prepared EMS in 0.1 M phosphate buffer (pH7.0) at 30 ± 1°C. After 6 h treatment seeds were washed thoroughly in running water.

*Present address: U.P. Council of Sugarcane Research, 11 Butler Road, Lucknow 226001.

Treated seeds were sown in three replications to raise M_1 population. Seeds from the M_1 plants were sown next year to raise M_2 plant progenies and a bold seeded mutant was isolated. To determine its inheritance, the mutant plants were crossed with control. The segregation pattern was observed in F_2 generation and χ^2 test was applied. The mutant was grown for six more years and observation recorded in M_8 generation. Detailed morphological studies on flower and meiosis of the mutant along with control were carried out. Data were recorded for different agronomical traits on 20 random plants. For nutritional and antinutritional assessments, the dry seeds were powdered to pass through 40 mesh screen, defatted, hydrolysed, and analysed for protein and amino acid composition [2]. The trypsin inhibitor activity was assayed by the method of [3].

RESULTS AND DISCUSSION

The bold seeded mutant isolated from 20 kR M_2 progeny showed vigorous growth (Fig. 1: 1). Comparison of mutant with control plant (Fig. 1: 2) revealed larger and thicker leaves with increased leaf area. The sepals, petals and other floral parts of mutant were similar to that of control but the upper portion of style including stigma of each flower was curved (Figs 1: 3 & 4). The pods of mutant (Fig. 1: 5) were longer, healthy and showed constrictions in comparison to control (Fig. 1: 6). The seeds of the mutant (Fig. 1: 7) were larger and heavier than in control (Fig. 1: 8). The mutant had greater plant height, more number of leaves, pods/plant, pod length, and seed weight (Table 1). The seed yield/plant of the mutant was almost double of the control. Increase in number and area of leaves and seed size improved productivity of this mutant as also reported in other pulse crops by [4, 5]. Increased leaf area (biomass) of this mutant can also be useful for green manuring. The agronomical characters were studied up to M_8 generation and they were more stabilized as compared to M_3 (Table 1).

To test the genetic nature of the mutant, crosses were made with the control. The F_1 plants were like the control and F_2 showed segregation into 143 normal : 35 mutants. The χ^2 test (2.704) revealed that the segregation did not deviate significantly from an expected 3 : 1 ratio. This indicates that the bold seeded condition is the result of a single recessive gene mutation.

Table 1. Seed yield and other agronomic traits of the mutant and its parent variety in *Vigna mungo*

Character	Control	Performance of mutant	
		M_3 generation	M_8 generation
Plant height (cm)	50.8 ± 1.99	60.9 ± 3.81	62.2 ± 3.15
No. of branches/plant	3.01 ± 0.23	3.8 ± 0.20	4.1 ± 0.46
No. of leaves/plant	22.1 ± 1.44	21.8 ± 1.16	26.9 ± 0.86
No. of nodes/plant	15.8 ± 0.36	16.0 ± 0.31	16.9 ± 0.65
Internodal length (cm)	3.3 ± 0.12	3.1 ± 0.18	3.6 ± 0.11
No. of pods/plant	41.6 ± 5.34	54.6 ± 7.28	49.8 ± 5.31
Pod length (cm)	3.7 ± 0.04	4.2 ± 0.07	4.3 ± 0.03
No. of seeds/pod	6.2 ± 0.09	5.3 ± 0.14	5.5 ± 0.67
50-seed weight (g)	1.6 ± 1.95	2.9 ± 0.08	2.9 ± 0.01
Seed yield/plant (g)	8.7 ± 0.87	16.8 ± 2.67	16.2 ± 1.40

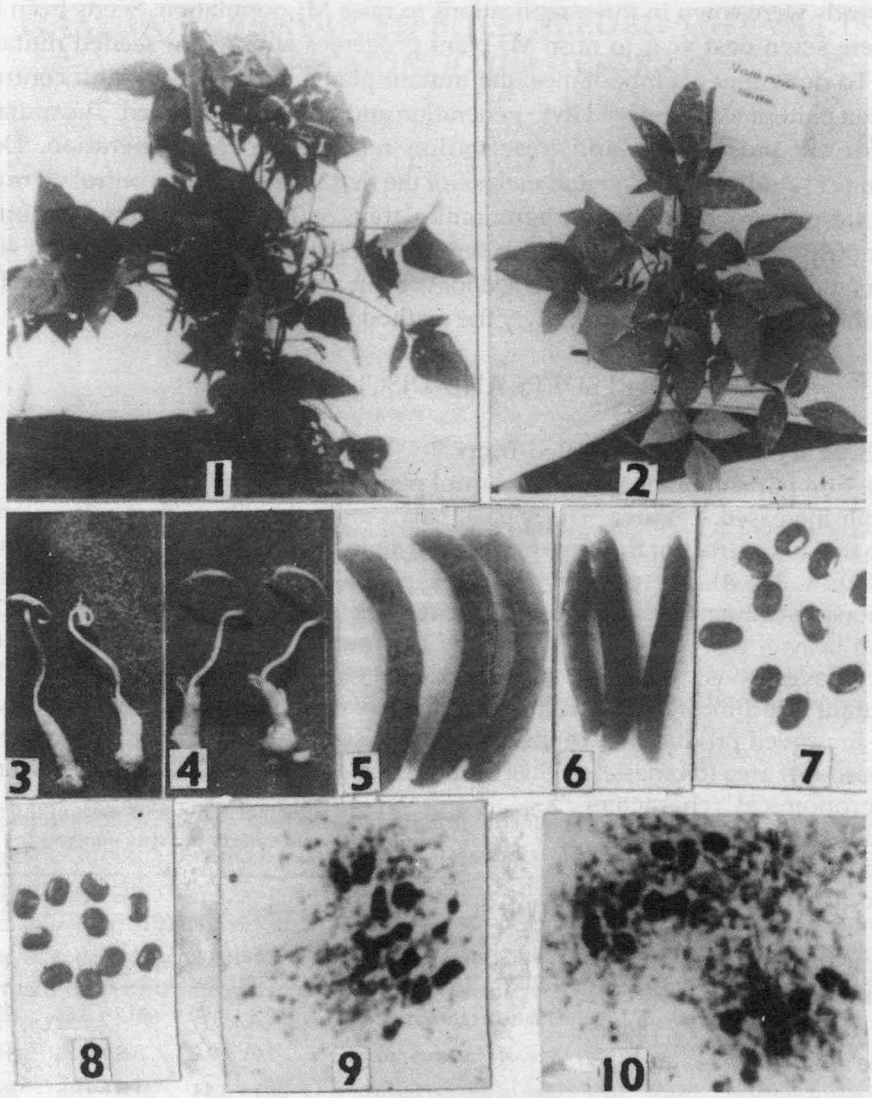

Fig. 1. Black gram variety T 9 and bold seeded mutant: 1) mutant, 2) plant of parent variety, 3) pistil of mutant with curved stigma, 4) pistil of parent variety with normal stigma, 5) pods of mutant, 6) pods of parent variety, 7) seeds of mutant, 8) seeds of parent variety, 9) metaphase I of mutant, and 10) anaphase I of mutant.

The amino acid composition and protein percentage are given in Table 2. The total protein content of the mutant (22.2%) was slightly higher than the control (21.2%), however, essential amino acids profile was more or less the same (Table 2). The trypsin inhibitor activity of the mutant (13 mg/g) was slightly lower than in control (13.3 mg/g).

Cytologically, the mutant was normal, showing 11 bivalents at metaphase and behaved normally at telophase and other stages of meiosis (Figs. 1: 9 & 10). The mutant is stable for cytomorphological characters over the generations. Chiasma frequency (Table 3) of the mutant plant is 0.704 ± 0.005 as against 0.779 ± 0.015 in the parent genotype. Ring bivalent frequency decreased in the mutant (4.72 ± 0.105) in comparison to control (6.04 ± 0.299). Similar results were also reported in *Vigna radiata* [6]. Reduction in chiasma frequency and ring bivalents have been explained as chiasma interference (when chiasma formation in one chromosomal arm interferes with chiasma formation in the other arm) [7]. The normal cytological behaviour of the present mutant may indicate its genetic nature, however, the cryptic structural changes in the chromosome cannot be denied.

Table 2. Protein content and amino acid composition (% of protein) of *Vigna mungo* cv. T-9 and its mutant

Amino acid	Control	Mutant
Protein (%)	21.1 ± 0.23	22.2 ± 0.06
Aspartic acid	13.2 ± 0.05	13.7 ± 0.01
Thereonine	4.9 ± 0.01	4.9 ± 0.08
Serine	8.9 ± 0.09	7.6 ± 0.06
Glutamic acid	13.5 ± 0.08	14.4 ± 0.02
Proline	4.4 ± 0.005	3.4 ± 0.002
Glycine	8.8 ± 0.03	8.2 ± 0.03
Alanine	6.4 ± 0.05	6.2 ± 0.06
½ Cystine	0.2 ± 0.06	0.3 ± 0.01
Valine	5.2 ± 0.01	5.4 ± 0.02
Methionine	1.0 ± 0.002	4.3 ± 0.004
Leucine	7.5 ± 0.04	8.2 ± 0.08
Tyrosine	1.8 ± 0.09	1.9 ± 0.02
Phenylalanine	4.5 ± 0.03	4.2 ± 0.04
Histidine	2.7 ± 0.01	2.8 ± 0.06
Lysine	5.7 ± 0.02	5.3 ± 0.06
Arginine	3.7 ± 0.09	3.9 ± 0.05

Table 3. Chiasma frequency, chromosomal configurations, variation in bivalent formation within and between PMC at metaphase in the control variety and mutant of *Vigna mungo*

Meiotic configuration	Control	Mutant
Chiasma/chromosome	0.779 ± 0.015	0.704 ± 0.005
Ring bivalents/cell	6.04 ± 0.299	4.72 ± 0.105
Rod bivalents/cell	4.96 ± 0.289	6.28 ± 0.139
Sum of squares of bivalents between nuclei	28.304	407.643
Sum of squares of bivalents with nuclei	2.795	485.456
Variance ratio	0.089	9.537**
Pollen fertility (%)	99.5 ± 0.061	98.9 ± 0.298

**Significant at 1% level.

The mutant showed change in a series of characters. From this it seems that recessive mutations have been induced for a series of closely linked genes, which are transmitted en-block from one generation to the next, with the result that the genetic ratio of 3:1 is obtained from the mutant x control cross.

Thus, the bold seeded mutant may be utilized in various breeding programmes as a donor parent for boldness character of the mutant.

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