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CHARACTERISATION AND SEGREGATION PATTERN OF SOME MACROMUTATIONS INDUCED IN BLACK GRAM (*VIGNA MUNGO* L. HEPPER)

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ABSTRACT

Performance and segregation pattern of some black gram (*Vigna mungo* L. Hepper) mutants was studied. Some mutants, such as shining-seeded, early, bold seeded, slow leaf senescence, erect, small-leaved, compact type etc., may prove useful for the improvement of this crop. Most of the true breeding mutants were conditioned by a single recessive gene.

Key words: Macromutants, black gram, EMS, gamma-rays.

Black gram (*Vigna mungo* L. Hepper) improvement has primarily concentrated on the exploitation of genetic diversity available in the local germplasm. One of the most important breeding objectives should be the improvement of plant type of black gram. The work on cereals, especially in wheat [1, 2] and rice [3] has shown that an improvement of this kind could be achieved through manipulation of a few major genes. Induced mutations may produce new genetic variants for plant types in the existing varieties. The present investigation was undertaken to induce and isolate macromutants which could be used for improvement of this crop.

MATERIALS AND METHODS

Dry seeds of uniform size of black gram variety Mash Kullu No. 1 were exposed to 5, 10, 15, 20, 25 and 30 kR gamma rays using 5500 Ci Co^{60} gamma chamber (BARC, India) at a dose rate of 120 R/sec. In addition, 300 seeds were treated with unbuffered solution of ethylmethane sulphonate, EMS (8, 10, 15, 20 and 25 mM) for 8 h, then washed six times with distilled water. Treated seeds were sown in 5 m long rows with a 40 x 10 cm spacing. The surviving plants were harvested and individual plant progenies were raised in M_2. A search

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of marked variants was made throughout the crop season. Variants and their normal sibs from the segregating progenies were harvested separately to study their breeding behaviour and inheritance pattern in M_3. The ratio between the mutants and normal plants in segregating progenies in M_3 was tested following χ^2 test [4]. Macromutation frequency was calculated after confirming the true breeding behaviour of the M_2 variants in the M_3 generation.

Some of the promising variants having sufficient seeds were also grown in M_3 in a random block design with three replications. The remaining variants were grown in a single row plots. Observations were recorded on five competitive plants from each replication for days to flowering, days to maturity, plant height, 100-seed weight, and seed yield/plant.

RESULTS AND DISCUSSION

The mutation frequency was appreciably higher when EMS was used than with gamma rays. However, there was no linear relationship between the dose of the mutagen and the frequency of mutants. Several other workers have also reported a higher mutation frequency in legumes following treatments with chemical mutagens [5–8].

MUTANTS ISOLATED IN M_2 GENERATION

Most of the mutants yielded either equal or lower than the control (Table 1). In the unreplicated trial, the performance of mutants erect, late, slow leaf senescence and bold-seeded was superior to that of the parent (Table 2). In case of the remaining mutants, the performance was either equal to or less than that of the parent. Characteristic features of some of the macromutants are described below.

Shining seed. It was induced by 5 mM EMS and had shining seed coat. It exhibited higher seed weight and pods per plant than the control (Table 2). When soaked overnight, its seeds did not absorb water whereas those of the control swelled normally. However, when the seeds were planted in the field, the mutant took the same time to germinate as the control (4 days).

Green seed. It had spreading growth habit with small, green pods and green seeds. It recorded lower seed yield as compared to the control due to less pods per plant, seeds per pod and 100-seed weight (Table 2). It was late in flowering and maturity.

Early. An early bold mutant (Early-2) was isolated from 15 kR gamma-rays treatment (Table 1). Another early maturing mutant, (Early-1) was induced following 15 mM EMS treatment. The third early mutant (Early-3) isolated from the 25 mM EMS treatment

Table 1. Metric traits of true-breeding mutants of black gram in M_3 generation (expressed as per cent of control)

Macromutant	Mutagen treatment	Days to flowering	Days to maturity	Plant height (cm)	100-seed weight (g)	Seed yield per plant (g)
Erect-3	EMS: 10 mM	103.3	100.0	102.1	123.5	146.2
Erect-2	EMS: 5 mM	98.0	102.7	98.6	90.6	95.9
Compact-1	Rad: 10 kR	100.0	100.9	61.1	116.5	96.3
Short pod-1	Rad: 25 kR	100.0	100.0	106.4	145.2	93.3
Minute-leaved	Rad: 25 kR	86.9	81.3	36.5	54.3	36.4
Erect-4	EMS: 15 mM	102.2	117.1	100.1	122.2	175.9
Crinkled leaves	EMS: 20 mM	101.7	96.4	69.9	103.0	65.7
Early-3	EMS: 25 mM	86.0	97.3	34.6	135.7	95.5
Thin stemmed	EMS: 25 mM	98.6	101.8	100.3	107.0	106.3
Mash Kullu No. 1 (mean values)		63.8	108.2	81.3	3.35	4.44
-Do- (%)		—	100.0	100.0	100.0	100.0

exhibited 36% higher seed weight than the parental genotype. However, the plants were 65.4% shorter than the control (Table 2).

Erect. Erect-1 mutant with black seeds, isolated from M_2 generation of 5 mM EMS treatment, showed lower leaves and primary branches per plant (Table 1). Two more such mutants were isolated from 5 mM (Erect-2) and 10 mM (Erect-3) EMS treatments in M_3 generation. Erect-2 was comparable to the parent in yield, while Erect-3 exhibited a marked increase in the 100-seed weight and seed yield. Similar results were observed in mung bean also [9].

Another bold-seeded and erect mutant (Erect-4) induced following 15 mM EMS treatment exhibited a lower incidence of leaf spot, larger pods and slower leaf senescence (Table 2) than the parent. But it was late flowering. It surpassed the control in seed yield and 100 seed weight by a margin of 75.9 and 22.2%, respectively.

Compact. The mutant was induced following 40 kR treatment with gamma rays. It showed 40% decrease and 16% increase in plant height and test weight, respectively, as compared to the control (Table 2). Due to its desirable growth habit, more plants can be accommodated per unit area. Thus, the slight reduction in seed yield/plant could be compensated with the higher plant density.

Table 2. Character means of true breeding black gram macromutants in M_3 trial

Mutant	Mutagen treatment	Days to flowering	Days to maturity	Plant height (cm)	Leaves per plant	Primay branches per plant	Pods per plant	100-seed weight (g)	Seed yield per plants (g)
Shining seed	EMS: 5 mM	66.6	112.0	70.0	39.4	4.0	46.2	4.17	8.9
Green seed	EMS: 5 mM	78.4**	119.3*	62.3	54.7	5.6	6.6	2.91	2.6
Early-1	EMS: 15 mM	64.4**	104.7*	70.0	35.5	4.5	41.5	3.69	6.3
Early-2	Rad: 15 kR	62.5**	105.0**	77.6	41.6	5.1	33.9	3.95	4.9
Erect-1	EMS: 5 mM	69.6	108.0	75.2	28.3**	3.4*	26.5	3.89	3.9
Mash Kullu No. 1	—	67.3	109.7	70.0	46.0	5.1	35.2	3.35	5.0
CD 1%	4.6	4.7	27.8	18.8	1.77	19.3	0.92	3.6	
CV (%)	3.2	2.1	18.1	19.0	18.8	17.9	12.5	18.0	

Short pod. It was isolated from 25 kR gamma-ray treatment. It had short but bold pods and showed an increase of 45% in 100-seed weight (Table 2). Mutants affecting the size of pods and seeds are known in French bean [10] and lentil [11].

Minute leaves. The mutant with narrow leaves like those of *Murraya exotica* was induced in 5 mM EMS treatment. The seed yield was reduced by a margin 63.6% as compared to the control, possibly due to reduced pod and seed size, smaller numbers of pods/plant, seeds/pod and primary branches/plant. It matured 5–6 days earlier than control. Similarly, another mutant designated as 'minute' isolated from 25 kR gamma rays exhibited reduction in various plant parts, seed yield and its components.

Crinkled leaves. It was isolated from 5 mM EMS treatment, exhibiting reduction in plant height by 30% over the control (Table 2). The seed yield declined by 30% over the control. Mutants with malformed and rolled leaves were reported in lentil [12] and black gram [13].

Thin stem. It was isolated from 25 mM EMS treatment with its performance comparable to the parent (Table 2).

MUTANTS ISOLATED IN M_3 GENERATION

Sterile and early. A sterile and early flowering mutant was isolated from 25 mM EMS treatment (Table 2).

Fuzzy seed. It was isolated from 25 kR gamma-ray treatment, having flat seeds with white fuzz mostly on the sides.

Small, roundish seed. It was screened in 15 mM EMS treatment, exhibiting an increase in seeds/pod. It flowered and matured alongwith control but showed reduction in leaves and primary branches/plant.

The inheritance pattern of some mutants in M_2 and M_3 generations revealed that each of these were conditioned by a single recessive gene. A wide range of X-ray induced mutant in black gram, ranging from completely sterile to fertile, have been reported [13]. A majority of the induced mutants in the present study were different from those reported earlier, except sterile and early types. Jana [14] reported three tall mutants of black gram having reduced fruit n ber induced with X-rays. Most of these mutants were also conditioned by single recessive genes.

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