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Gamma Radiation Induced Mutations in Black gram (*Vigna mungo* (L.) Hepper)

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ABSTRACT

The present investigation was conducted during the kharif season of 2009, seeds of black gram [Vingo mungo (L) Hepper] variety TPU-4 was exposed to gamma rays doses at 10, 20, 30, 40, and 50KR. Wide range of chlorophyll and viable morphological mutations affecting almost all the parts of plant and were isolated in M_2 generation. Mutant characters were grouped as Chlorophyll, leaf, and pod mutants. Chlorophyll mutations include albino, coppery leaf, light green leaf, variegated leaf, waxy leaf, xantha leaf. Leaf mutations were lanceolate, narrow-rugose leaf, round cuneate leaf, unifoliate, and tetrafoliate leaf. Pod mutations were lobed and hairy pods. Higher chlorophyll mutation rate was observed with gamma rays dose of 30KR.

Key words: Black gram, gamma rays, Chlorophyll and viable mutations.

INTRODUCTION

Black gram (*Vigna mungo* L. Hepper), popularly known as urdbean, urid or mash is an important self-pollinating diploid grain legume and belongs to the family Leguminosae and subfamily Papilionaceae. It is an important food legume crop of the Indian subcontinent [22], It is rich protein content [9]. And is widely cultivated grain legume in the Indian sub-continent, comprising of India, Burma, Bangladesh, and Sri Lanka. [15]. Black gram is considered to have been domesticated in India from its wild ancestral form *V.mungo* var.*silvestris* [14]. Center of genetic diversity is found in India [24]. The chromosome number of this crop is 2n=2x=22 [3].

Mutation breeding is one of the conventional breeding methods in plant breeding. It is relevant with various fields like, morphology, cytogenetics, biotechnology, and molecular biology etc. Mutation breeding has become increasingly popular in recent times as an effective tool for crop improvement [1] and an efficient means supplementing existing germplasm for cultivar improvement in breeding program's [6]. Shaha [19] reported that mutagens may cause genetic changes in an organism, break the linkages and produce many new promising traits for the improvement of crop plants. Mutations could be induced through physical and chemical mutagens [2, 5, 11, 17]. Mutagenesis has been widely used as a potent method of enhancing variability for crop improvement. The chlorophyll mutation frequency in M generation is the most dependable index for evaluating the genetic effects of mutagenic treatments [12, 23]. A large number of desirable varieties have been developed through mutation breeding in field and horticulture crops. But the application and success of mutation breeding in improvement of grain legume crops is relatively limited except perhaps soybean and groundnut. Chlorophyll mutations offer one of the most reliable indices for the assessment of genetic effects of mutagenic treatments [7]. The present investigation was undertaken to induce mutation in black gram using gamma radiations to study mutagenic effect of gamma rays to determine the mutation percentage and to screen the different mutants in M_2 generation and purify them for possible uses.

MATERIALS AND METHODS

The experimental material for the present study comprised of one prominent black gram variety TPU-4. 300 dry seeds were to 10, 20, 30, 40, and 50KR gamma radiation ^{60}Co gamma cell at BARC Trombay, exposed 300 seeds of each doses along with equal number of control (untreated) seeds were grown in randomized block design to study the M1 generation during kharif (rainy season) 2008, all the surviving plants were selfed and harvested individually to raise the M_2 generation, M_2 population was screened in next rainy season of 2009. The chlorophyll, leaf, pod mutants were periodically observed right from germination. In each visit to the field the mutant plants were marked for subsequent observations. Data were recorded on characters and number of the mutant. At maturity each mutant plant was individually harvested. The remaining plants were bulk harvested for M_3 generation.

Field control practices on this experiment were conducted based on standard management for black gram grown in MPKV Rahuri. Briefly the treated seeds along with control were sown in the field with a spacing of 30X15 cm in randomized block design (RBD) with three replications. Weeds were controlled by eradicating by hand weeding twice at 30 and 45 days after sowing; insects were controlled by spraying with trizophose at the rate of 40 cc per 20 liters of water when the insect population was building up beyond the threshold level. Irrigation was applied during the cropping season as need.

RESULTS AND DISCUSSION

Chlorophyll mutations provide one of the most dependable indices for the evaluation of genetic effects of mutagenic treatments and have been reported in various pulse crops by several workers [8]. Since the gamma rate of 30 KR was almost at the lethal dose-50 (LD-50) for black gram. The M_1 seeds lost its germination up to 40-50% from the effect of irradiation, some seedling showed either albino or xantha leaf and died prematurely. A number of mutant plants were identified in M_2 generation and the mutation percentages in 10, 20, 30, 40, and 50 KR were 3.10, 5.09, 5.68, 4.29, and 3.96 respectively. The data on chlorophyll, leaflet, and pod mutation rate observed under various doses of gamma rays under treatment are presented in table. No. 1

Table No.1 Number of M_2 plants studied, and percent of mutants found in different treatments of gamma rays.

Treatment	No. of plants studied	Mutant type			Total	Percent of mutants
		Chlorophyll	Leaf type	Pod		
10 KR	257	5	2	1	8	3.10
20 KR	255	8	3	2	13	5.09
30 KR	264	7	5	3	15	5.68
40 KR	256	5	5	1	11	4.29
50 KR	252	6	4	0	10	3.96

Table No. 2 Types and number of mutants found in M_2 plants of black gram population.

S. No.	Mutants Characters	Treatment					Total
		10KR	20KR	30KR	40KR	50KR	
1	Chlorophyll mutation						
	Albino	2	1	0	1	0	4
	Coppery leaf	1	2	0	0	1	4
	Light green leaf	0	2	2	1	1	6
	Variegated leaf	1	2	1	1	2	7
	Waxy leaf	1	0	2	1	1	5
	Xantha leaf	0	1	2	1	1	5
2	Leaf let mutations						
	Lanceolate leaflet	1	0	0	1	1	3
	Multiple leaflet	0	0	0	0	2	2
	Narrow rugose leaflet	0	1	2	1	0	4
	Round cuneate leaflet	1	1	2	0	1	5
	Unifoliate leaf	0	1	0	1	0	2
	wrinkled leaf	0	0	1	2	0	3
3	Pod mutation						
	Lobed pod	0	0	2	1	0	3
	Hairy pod	1	2	1	0	0	4
	Total	8	13	15	11	10	57

The mutants found were mainly of leaf chlorophyll mutation such as albino, coppery leaf, light-green leaf, variegated leaf, waxy leaf, and xantha leaf. Leaf mutations were lanceolate leaflet, multiple leaflet, narrow rugose leaflet, round-cuneat leaflet, unifoliate leaf and wrinkled leaf. Similar mutants were also reported by many workers, [13, 18, 21, 4.].

A number of mutant plants were identified in M_2 generation. The percentage observed is similar than that reported by Arvind kumar, Mishra, and Kharakwal. Who found mutant up to 0.97 to 5.60 in different doses of gamma rays. The mutants found were mainly of leaf chlorophyll mutations such as albino, coppery leaf, light green, variegated, waxy, and xantha leaf. Leaf mutations were lanceolate, narrow-rugose, tetrafoliate, round-cuneat, unifoliate, and wrinkled leaf. Leaflet mutants and other types are given in Fig. The unifoliate leaf mutant was also sterile, in agreement with that reported by Santos (1969) and Chontira et.al (2005). The mutant produced numerous flower buds but failed to open. The round cuneat leaflet mutant produced flowers but its pollen scattered all over the corolla and thus expressed partial sterility. However, coppery leaf, variegated leaf, waxy leaf, white steak leaf, lanceolate leaflet, narrow-rugose leaflet, multiple leaflet, and wrinkled leaf were fertile with low yield. The variegated leaf and narrow-rugose leaf mutants produced only few pods while waxy leaf produced pods with lean seeds. These mutants have been reported by a number of scientists, Gupta PK (1996), Singh VP (1993), and Chontira (2005). In pod mutants lobed and hairy pods are also found, lobed pods mutations with fewer seeds per pod was also found, this trait may associated with partial sterility, causing constriction at the point where there was undeveloped seeds. The number of mutants found are shown in table no. 2, these mutants were not found in the control populations, therefore they were considered as real mutants and not the results of genetic recombination between the parental lines.

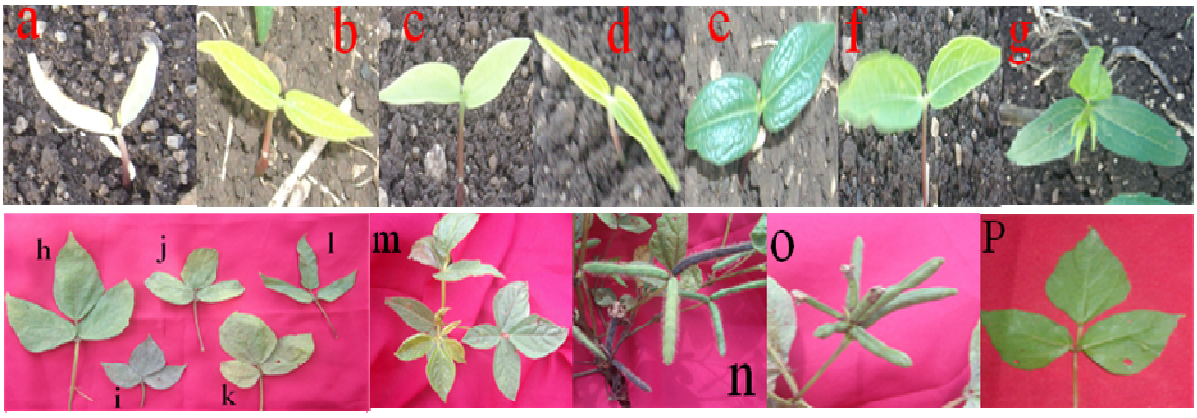

Fig.1. Chlorophyll mutations: a- albino, b- xantha, c- waxy, d- variegated, e- coppery, f- light green,
Leaf let mutations: g- unifoliate, h&i- lanceolate, j- wrinkled leaf, k- round cuneate, l- narrow rugose, m- multiple,
pod mutations: n- hairy, o- lobed, p- control leaf.

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