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Effect of Viable Mutants in M_2 Generation of Urdbean *Vigna Mungo* (L.) Hepper Through Induced Mutation in Variety ADT 3 and Co 6

S. Anandhi Lavanya[1], C. Vanniarajan[2], J. Souframanien[3]

[1]Associate Professor, Department of Plant Breeding and Genetics, Faculty of Agricultural Sciences, Bharath Institute of Higher Education and Research, Chennai - 600073
[2]Department of Plant Breeding and Genetics, Agricultural College and Research Institute, Madurai, 625104
[3]Nuclear Agriculture and Biotechnology Division, Bhabha Atomic Research Centre, Mumbai 400085, India

Abstract:

Mutations were induced in Black gram (*Vigna Mungo* (L.) Hepper) varieties namely ADT 3 and Co- 6. Seeds treated with gamma rays doses at 200, 300 and 400 Gy and Electron beam *viz.,* 200, 300 and 400 Gy and combined treatment (Electron beam + gamma rays) 200+200, 300+300 and 400 +400 Gy. Different types of Macro mutants and micro mutants were screened in M_2 generation. The frequency and the spectrum of the viable mutants were estimated in M_2 generation both in M_1 plants basis and M_2 seedling basis. The highest frequency of viable mutants was recorded in ADT 3.The highest number of mutants was recorded in electron beam followed by Gamma rays and combined treatment (Electron beam + gamma rays). The present study reveals good scope for isolation of suitable morphological traits mutants induced may be useful in breeding programmes for the improvement of blackgram with agronomically desirable character which force is utilized in future breeding programme.

Keywords: Blackgram, Gamma rays, Electron beam, Viable mutants

Introduction

Black gram is an important kharif crop in India grown on about 2.7 lakh hectares. The seeds are mostly consumed by the people owing to its high protein content (Akhaury, 1991). The natural productivity of black gram is only 480 kg/ha (Chaturvedi and Ali, 2002). This low yield may be due to non availability of high yielding and disease resistant varieties. Natural variability is an essential pre-requisite for any successful breeding programme. Mutation breeding is a supplementary breeding programme to identify the mutants with high yield potential, early maturity, disease and pests resistance (Singh, 1981). Mutation breeding requires handling of more population as chances of induction and detection of mutation in a particular gene is rare. This increases the cost of breeding and create the selection procedure time consuming and unvarying.

The mutagens are gamma rays, electron beam and combined treatment (Electron beam + gamma rays) belong to three non- identical categories. Therefore, study were undertaken to study the comparative mutagenicity of these mutagens under similar treatment conditions. Chlorophyll mutations

although not useful for plant breeding purpose, may be used to evaluate the efficiency and effectiveness of mutagens in order to choose suitable mutagen at appropriate concentration so as to use them in applied mutagenesis programme. In the present study, the effect of gamma rays, electron beam and combined treatment (Electron beam + Gamma rays) employed singly or in combinations was studied on frequency and spectrum of viable macro mutations in M_2 generation in urdbean.

Materials and Methods

The dried seeds of the blackgram varieties ADT 3 and CO 6 were exposed with gamma cell and exposed to gamma irradiation of 2000 curie 60CO gamma source for suitable time at 25C by moving down the cylindrical gasket carrying the seeds at the Bhabha Atomic Research Centre, Kharghar, Navi Mumbai, India at 200, 300 and 400 Gy dose and electron beam at 200, 300 and 400gy and combination treatment (Electronbeam and gamma ray) at 200 , 300, and 400 gy .for each treatment , well filled 500 seeds with the moisture content of Beam Centre, Bhabha Atomic Research Centre,Kharghar, Navi Mumbai, India. The seeds of ADT 3 and Co 6 were irradiated apply 10 MeV electron beam from electron accelerator facility at Electron Beam Centre, Bhabha Atomic Research Centre, Kharghar, Navi Mumbai, India.

For sowing of M_2 generations, the seeds of randomly evaluated plants of M_1 generation were space planted in the field in two replications. M_2 generation was selected for lethal chlorophyll mutations during the first four weeks, after germination. Whereas, viable macro mutants were scored throughout the crop duration. The population was screened for viable macro mutations according to the procedure given by Gustafesson (1947) with appropriate modifications.

Viable mutants

The frequency and spectrum of non - identical types of viable mutants were achieve at various developmental stages of M_2 plants particularly from flowering to maturity period. These mutants were classified as deviation from the normal looking plants and taking into consideration of the most conspicuous characters namely, stature, duration, leaf shape, pod size etc. The frequency and spectrum of viable mutants were calculated on M_2 seedling basis.

Non-viable mutants

The non-viable mutations were scored on M_2 plants from the 50% flowering stage to maturity. Sterile and non flowering mutants were identified in M_2 generation. The scores for chlorophyll, viable and non-viable mutations were considered together for estimating the total mutation frequency.

Results and Discussion

The viable mutants were scored in M2 generation based on their phenotypic expression on different characters. They were categorized into several groups as stature, duration, leaf, pod and seed. The mutant frequency computed in the segregating families and the spectrum of viable mutants in M2 generation are presented in Table 1 and 2.

The viable mutants were scored in M_2 generation based on their phenotypic changes in quality attributes. The viable mutants were grouped based on variability in plant height, leaf modification, poding habit, branching habit, inflorescence modification, seed and other characters in ADT 3 and CO 6. A total of 156 mutants in ADT 3 and 106 mutants in CO 6 from gamma irradiated population, 213

mutants in ADT 3 and 139 mutants in CO 6 from electron beam treated and 139 mutants in ADT 3 and 88 mutants in CO 6 from combined treatment (electron beam + gamma rays) populations were identified. Similar result of comparison of genotypes in inducing viable mutations was reported by Thanga Hemavathy and Balaji (2007), Senapati *et al.* (2008) and Yogalakshmi (2013), Loyavar Ramchander *et al.* (2016) in black gram; Dhanavel *et al.* (2012) Girija and Dhanavel (2009), Ashok Kumar, *et al.* (2009) in cowpea.

Viable macro mutations with changes in attributes like stature mutants namely dwarf, tall, trailing, spreading and duration mutants like early and late mutants were observed in both the varieties *viz.*, ADT 3 and CO 6.

The plant stature such as tall mutants with range from 50.40 to 63.60 cm height were found in ADT 3 and tall mutants with range from 52.50 to 61.2 cm in CO 6. Similar mutants were obtained by Juliet Hepziba and Subramanian (2002), Senapati *et al*. (2008), Kumar *et al*. (2009), Arulbalachandran and Mullainathan (2009), Makeen *et al*., (2013) and Senbagam (2014) in blackgram.

Frequency of non-viable mutants was lower when expressed on M_2 seedlings basis. In the treated populations, higher doses produced high number of non-viable mutants. In the present investigation, different type of sterile mutants *viz.*, completely sterile and semi sterile mutants were identified. Similar types of mutants had been reported by Ranjan Tah (2006) in greengram, Deepalakshmi and Anandakumar (2004), Arulbalachandran and Mullainathan (2009), Usharani and Anandakumar (2015), Surendar (2014) in blackgram.

Conclusion

In Morphological, mutants are viable and useful to breeding approach to obtain suitable ideotype in greengram. The two methods, combination of recombination and mutagenesis and among the mutagens, electron beam irradiation can be used to create a large variations for quantitative trait. The various induced morphological mutants isolated in the present study may be used in the genetic studies as well as in the improvement of grain yield and quality.

Table 1. Frequency of viable and non-viable mutation in M_2 generation- ADT 3

S.No	Mutants	Frequency			Percentage		
		Gamma rays	Electron beam	Electron beam + Gamma rays	Gamma rays	Electron beam	Electron beam + Gamma rays
1. Cotyledonary abnormalities (Viable mutants)							
A	One leaf cotyledon	1	2	2	0.64	0.94	1.44
B	Tricotyledon	2	2	1	1.28	0.94	0.72
2. Stature mutants							
A	Tall type	9	13	7	5.77	6.10	5.04
B	Dwarf type	10	15	11	6.41	7.04	7.91
C	Spreading type	6	7	6	3.85	3.29	4.32
D	Trailing type	7	9	8	4.49	4.23	5.76
E	Bushy	19	22	16	11.54	10.33	11.51

F	Determinate	8	16	9	5.13	6.57	6.47
G	Open	5	9	7	3.21	4.23	5.04
H	Twinning	9	17	5	5.77	7.98	3.60
3. Duration mutants							
A	Early type	13	16	11	8.33	7.51	7.91
B	Late type	7	5	8	4.49	2.35	5.76
C	Synchronized maturity	14	13	9	7.05	6.10	6.47
4. Leaf mutant							
A	Wrinkled leaf	2	1	3	1.28	0.47	2.16
B	Narrow leaf mutant	3	2	1	1.92	0.94	0.72
C	Broad leaf mutant	4	5	3	2.56	2.35	2.16
D	Tetra leaves	2	4	2	1.28	1.88	1.44
E	Anthocyinin pigment leaves	4	6	1	2.56	2.82	0.72
5. Pod mutants							
A	Lengthy pod mutant	7	9	8	4.49	4.23	5.76
B	Profuse pods per cluster	2	3	2	1.28	1.41	1.44
C	Brown colour hairs on pod	3	2	1	1.92	0.94	0.72
D	Top poding mutant	17	29	15	10.90	12.68	10.79
6. High yield mutant		4	6	3	2.56	2.82	2.16
7. Chimeric mutant		1	2	0	0.64	0.94	0.00
8. Sterile mutant (Non Viable)		1	2	0	0.64	1.28	0.00
	Total	**161**	**215**	**139**			

Table 2. Frequency of viable and non-viable mutation in M_2 generation- CO 6

S.No	Mutants	Frequency			Percentage		
		Gamma rays	Electron beam	Electron beam + Gamma rays	Gamma rays	Electron beam	Electron beam + Gamma rays
1. Cotyledonary abnormalities (Viable mutants)							
A	One leaf cotyledon	1	2	2	0.94	1.38	2.27
B	Tricotyledon	1	1	1	0.94	0.69	1.14
2. Stature mutants							
A	Tall type	7	10	5	6.60	6.90	5.68
B	Dwarf type	8	11	7	7.55	7.59	7.95
C	Spreading type	5	6	5	4.72	4.14	5.68
D	Trailing type	3	5	2	2.83	3.45	2.27
E	Bushy	12	14	11	11.32	9.66	12.50

F	Determinate	8	11	7	7.55	7.59	7.95
G	Open	5	7	6	4.72	4.83	6.82
H	Twinning	7	9	4	6.60	6.21	4.55
3. Duration mutants							
A	Early type	11	12	9	10.38	8.28	10.23
B	Late type	4	7	5	3.77	4.83	5.68
C	Synchronized maturity	6	7	4	5.66	4.83	4.55
4. Leaf mutant							
A	Wrinkled leaf	1	1	1	0.94	0.69	1.14
B	Narrow leaf mutant	2	2	1	1.89	1.38	1.14
C	Broad leaf mutant	2	3	1	1.89	2.07	1.14
D	Tetra leaves	2	3	1	1.89	2.07	1.14
E	Anthocyinin pigment leaves	1	1	1	0.94	0.69	1.14
5. Pod mutants							
A	Lengthy pod mutant	2	5	1	1.89	3.45	1.14
B	Profuse pods per cluster	1	2	1	0.94	1.38	1.14
C	Brown colour hairs on pod	1	1	1	0.94	0.69	1.14
D	Top poding mutant	13	19	10	12.26	13.10	11.36
6. High yield mutant		2	4	1	1.89	2.76	1.14
7.Chimeric mutant		1	1	1	0.94	0.69	1.14
8. Sterile mutant(Non Viable)		0	1	0	0.00	0.69	0.00
	Total	**106**	**145**	**88**			

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