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GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE IN INDUCED MUTAGENESIS BLACK GRAM (*VIGNA MUNGO* L. HEPPER)

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Abstract

Blackgram or urdbean, being a fourth important pulse crop in India has low genetic variability, low harvest index and improvement in its productivity is a challenge till date. Mutation population was developed by treating the EMS and Gamma rays. The genetic variability parameters were studied in a M_2 generation. The higher estimates of PCV were observed for all the traits, when compared with GCV. High estimates of PCV and GCV was observed for primary branches per plant, number of clusters per plant, number of pods per plan and single plant yield. High heritability per cent and high genetic advance as percentage of mean was found for number of primary branches and seed yield per plant. It indicating under the control of additive gene effects, may serve as better source for breeding programme to develop high yielding varieties.

Key words : Blackgram, genetic variability, gamma rays, EMS and quantitative traits.

Introduction

Among pulses, urdbean is an important short duration grain legume cultivated over a wide range of agro-climatic conditions. The total area under the crop has increased progressively from 1.98 million ha in 1964-65 to 3.26 million ha in 2010-11. Similarly, the production has increased from 0.64 million tonnes to 1.74 million tonnes during same period (AICRP report, 2011). Increase in both area and production has been observed in Andhra Pradesh, Karnataka, Maharashtra, Rajasthan, Uttar Pradesh and Tamil Nadu. Improvement of cultivated crops largely depends on the extent of genetic variability available within the species and self pollinated crop, such as urdbean, possesses limited variability. Mutation breeding is one of the conventional breeding methods in plant breeding. It is relevant with various fields like, morphology, cytogenetic, biotechnology and molecular biology etc. Mutation breeding has become increasingly popular in recent times as an effective tool for crop improvement and an efficient means supplementing existing germplasm for cultivar improvement in breeding programs. The 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. Mutagenesis has been widely used as a potent method of enhancing variability for crop improvement.

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Materials and Methods

Physical mutagen five sets of five hundred well matured seeds of black gram were subjected for gamma irradiation. These sets of seeds treated with 150, 200, 250, 300 and 350 Gy of gamma rays. Irradiation was done in TNAU at Coimbatore, India. The labelled Cobalt (Co^{60}) was used for source of gamma rays. Chemical mutagen five hundred well-matured healthy seeds were subjected to the mutagenic treatment. The seeds were pre-soaked in distilled water for five hours at room temperature (28±2°C) prior to treatment. After presoaking, the excess of moisture in the seeds were removed by filter paper. Then, the seeds soaked in the freshly prepared aqueous solution, which about three times than that of volume of seeds with corresponding concentrations of EMS *viz.*, 10, 15, 20, 25 and 30 mM for six hours at room temperature (28±2°C) with an hour intermittent shaking. After the treatment, seeds were washed thoroughly with distilled water. The untreated seeds presoaked in water used as control. Both treated and control seeds were sown in the field in randomized black design (RBD) with three replication to raise the M_1 generation. The mutant seed were grown during *summer* 2012 (M_1) and *kharif* 2012 (M_2). Each plant of M_1 was raised complete package of practices in single

Table 1 : Variability parameters for nine characters in blackgram.

S. no.	Characters	Treatment	Range	Mean	PCV (%)	GCV (%)	h^2 (%)	GA as percent of mean
1.	Days to 50% flowering	200Gy	23.00-40.00	36.37	5.27	4.65	5.38	5.05
		250Gy	22.00-38.00	36.53	4.79	4.35	83.61	3.86
		15mM	24.00-38.00	36.35	6.45	6.26	93.94	3.76
		20mM	28.00-40.00	36.63	4.60	4.21	83.57	3.74
2.	Plant hieght	200Gy	15.95-56.20	26.15	19.43	17.97	85.52	9.38
		250Gy	10.05-25.50	21.69	13.98	11.69	69.86	7.97
		15mM	15.25-48.10	28.45	15.67	14.78	88.97	8.09
		20mM	15.30-40.75	19.97	5.39	5.25	94.89	10.54
3.	Number of primary branches	200Gy	3.00-6.00	4.57	36.70	25.65	48.65	33.21
		250Gy	3.00 -7.00	5.11	49.60	33.95	46.67	38.61
		15mM	3.00-6.00	5.24	26.57	25.22	90.07	39.08
		20mM	3.00-7.00	5.07	32.58	30.56	87.98	51.48
4.	Number of clusters per plant	200Gy	2.00-9.00	9.82	29.72	28.09	31.31	18.12
		250Gy	4.00-16.00	12.36	31.17	28.91	48.66	28.98
		15mM	2.00-8.00	7.35	33.05	27.11	38.82	15.80
		20mM	3.00-18.00	10.00	34.53	26.31	26.44	14.33
5.	Number of pods per plant	200Gy	4.00-45.00	22.94	60.61	58.50	93.31	21.25
		250Gy	5.00-50.00	40.09	57.75	55.71	92.95	19.10
		15mM	2.00-29.00	23.58	13.45	12.91	65.24	17.69
		20mM	3.00-29.00	31.49	17.43	28.36	37.76	22.06
6.	Number of seeds per pods	200Gy	3.00-5.00	2.94	14.82	13.69	62.47	17.62
		250Gy	1.00-6.00	4.64	16.68	15.12	1.24	0.38
		15mM	2.00-5.00	2.04	9.01	7.52	63.94	9.90
		20mM	3.00-6.00	3.95	19.35	17.61	41.54	15.07
7.	Pod length (cm)	200Gy	2.90-5.30	4.21	19.38	18.78	93.84	37.47
		250Gy	2.30-5.47	3.60	11.63	10.28	78.12	18.71
		15mM	2.00-5.20	2.04	11.02	10.11	84.17	19.11
		20mM	2.00-5.00	3.48	10.59	10.18	92.37	20.16
8.	Hundred seed weight	200Gy	2.58-5.68	3.50	16.03	9.25	33.25	11.92
		250Gy	1.15-6.30	4.46	22.38	15.65	48.93	18.13
		15mM	2.38-5.42	3.98	22.49	15.39	46.81	17.79
		20mM	3.52-6.20	5.17	33.09	27.07	66.94	30.26
9.	Seed yield /plant	200Gy	3.00-5.36	7.22	24.28	21.36	77.40	26.48
		250Gy	1.15-12.05	6.10	28.47	25.74	81.71	24.35
		15mM	2.75-4.35	3.91	23.46	19.93	72.23	26.47
		20mM	1.18-11.75	5.25	27.52	16.12	33.37	11.08

replication. From the each treatment in M_1 generation, 10 randomly chosen plants from the each mutants families. From each were harvested and grown in successive seasons to develop M_2 generations. M_2 generation and control seeds were raise row-to-row spacing 45cm and plant-to-plant 15 cm.

Results and Discussion

Among the different dose of gamma rays and EMS, a gradual increase of mean values was observed up to optimal dose when compared to control in M_2 generation. Beyond the optimal dose of mutagen showed decreasing of mean values of quantitative traits (table 1). Variability analysis showed an increase all the traits. The wide range of variation in all the traits of four treatments. All the four treatment height means is recorded at 250Gy gamma rays for number of primary branches per plant, number of clusters per plant, number of pods per plant, number of seeds per pod, pod length and single plant yield was high in 200Gy and hundred seed weight was height in 20mM. This study showed plant height and other growth traits increased than control plant because effect of mutagen on genome may induce genetic variability. These results confirm the earlier findings (Wani and Anis, 2001 and Nagaraj Kampli *et al.*, 2002).

Genetic variability, in general, the estimates of phenotypic coefficient of variation (PCV) were higher than the estimates of genotypic coefficient of variation (GCV) for all the traits under study indicating the environmental influence over the traits. Konda *et al.* (2009) and Reddy *et al.* (2011) observed similar results in blackgram. All the treatment, the PCV and GCV were high for number of primary branches per plant, number of clusters per plant, number of pods per plant and single plant yield except EMS treatment in seed yield per plant. However, these traits were highly influenced by environment (table 1). Moderate PCV and GCV were observed in plant height and pod length. Selection will be effective based on the heritable nature of these traits. High heritability coupled with high genetic advance as percentage of mean was found for number of primary branches, seed yield per plant (except 20mM) in which selection may be effective due to the additive gene effects. It is in accordance with the findings of Malik *et al*. (2008) and Bhareti *et al*. (2011). This revealed the additive gene effects coupled with high environmental impact. High heritability with moderate genetic advance as percentage of mean was recorded for plant height (except 200Gy) indicates that these characters are influenced by environment and hence selection would be ineffective.

Conclusion

From the present investigation, it is evident that the wide range of variability for different traits coupled with high heritability and high genetic advance for important yield traits, hence selection is effective for these traits. Hence, 250Gy of Gamma ray (no. of cluster per plant and seed yield per plant) and also 20mM of EMS (hundred seed yield) were played a pivotal role in crop breeding through mutation. This stability of genetic variability should be analyzed next generation for important traits.

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