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Analysis of Genetic Parameters for Yield and its Components in M_2 Generation of Greengram (*Vigna radiata* (L.) Wilczek)

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Research work was carried out to assess the genetic variability parameters in the M_2 generation of greengram. Totally seven quantitative traits such as days to 50 per cent flowering, days to maturity, plant height, number of pods per plant, number of seeds per pod, 100 seed weight and single plant yield in M_2 generation were studied for the effect of mutation by gamma rays. The results showed significant increase in the mean values of plant height, number of pods per plant, number seeds per pod, 100 seed weight and single plant yield. High genetic variability, heritability and genetic advance with significant enhancement in yield and yield contributing traits were noticed. It is concluded that high yielding greengram genotypes can be created through gamma irradiation.

Key words: Heritability, Genetic advance, Yield, Greengram, Gamma rays.

Greengram (*Vigna radiata* (L.) Wilczek) is an important grain legume grown all over South East Asia. It is a short duration crop, which belongs to the genus *Vigna*, species *radiata* and family Fabaceae. It has diploid chromosome number 2n = 2x = 22 (Karpechenko, 1925). The origin of greengram was primarily in India, but it is also cultivated in Pakistan, Philippines, China, Vietnam, Europe and USA. Since, greengram is a self- pollinated crop, there exists limited variability in the populations. The main reason for the low productivity of greengram is lack of cultivars with high yield potentials, resistance to biotic and abiotic stresses. Due to the narrow genetic base, conventional breeding methods did not contribute much for the improvement of greengram. Mutation breeding is an effective tool for generating variability in the existing varieties and selecting desirable mutants with high yield. The objective of this study, using gamma rays on greengram was to create genetic variability to improve the quantitative traits and to evaluate the genetic variation. The estimates of genetic parameters could be useful in developing reliable selection indices for the important agronomic traits to get high yielding genotypes in greengram.

Materials and Methods

Greengram variety, Co(Gg) 7 was used for the gamma rays treatments. Dry seeds of this genotype were treated with different doses of gamma rays *viz*., 450Gy, 500Gy, 550Gy, 600Gy, 650Gy and 700Gy at Tamil Nadu Agricultural University, Coimbatore, using CO_{60} as the source. The untreated seeds were presoaked in distilled water and were used as control. Each treatment was carried out for 300 seeds and the treated seeds along with control were sown in Randomized Block Design (RBD) with three replications by adopting a spacing of 30cm between rows and 10cm between plants at the experimental farm of Agricultural Research Station, Vaigai dam during Kharif season, 2011. The recommended agronomic practices and plant protection measures were followed uniformly for all the treatments. All the surviving individual plants were harvested in each treatment in M_1 generation. Based on LD_{50} value three treatment plant seeds (550, 600 and 650Gy) were forwarded to M_2 generation. The M_2 progeny from M_1 generation was raised individually along with parental variety (control) without any replication. A total of 1963 mutant families of M_1 plant seeds from each treatment of gamma irradiation were forwarded to M_2 generation with the spacing of 30cm between the rows and 10cm between the plants. Biometrical observations were recorded for days to 50 per cent flowering, days to maturity, plant height, number of pods per plant, number of seeds per pod, 100 seed weight and single plant yield were subjected to statistical analysis in order to assess the extent of induced variation. Parameters estimated were subjected to analysis following the method suggested by Singh and Chaudhary (1985). Genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were determined by the formula suggested by Burton (1952) . Heritability in broad sense was computed by the formula suggested by Johnson *et al.* (1955) and the estimate of the expected genetic advance (GA, expressed as a percentage of mean) with an assumed 5 per cent selection intensity was computed by the formula of Allard (1960) as suggested by Khan (1979).

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Results and Discussion

Genetic variability is the basis for plant breeding and mutation induction has been used to create variation for utilization in crop improvement (Ignacimuthu and Babu, 1988). Radiations have been used successfully to induce useful mutations for plant breeding (Brady, 1982 and Micke *et al*., 1985). Induced mutation breeding procedure in the recent past has successfully been used for the improvement of various pulse crops (Singh and Singh, 2001). The data recorded and the estimates of variability for various quantitative traits in greengram are presented in Tables 1 and 2. This clearly shows that the mean values increased significantly for all the yield contributing traits. The trait days to 50 per cent flowering, the mean values ranged from 31.00 to 34.18 days this was earlier in flowering than the control (34.25 days). The

Table 1. Mean, variability and heritability estimates for DFF, DM, PH and NPP of Co(Gg) 7 mutants in M_2 generation

Gamma rays (Gy)	Mean	PV	GV	PCV	GCV	h^2	GA	GA as % of mean
				Days to 50 per cent flowering (DFF)				
550	34.18	3.02	1.78	5.08	3.90	58.94	2.11	6.17
600	33.68	2.61	1.37	4.80	3.48	52.49	1.75	5.19
650	31.00	2.91	2.36	5.09	4.52	81.09	2.84	8.40
Control	34.25							
				Days to maturity (DM)				
550	55.60	14.02	13.16	6.73	6.52	93.86	7.24	13.02
600	56.92	15.95	15.09	7.02	6.82	94.61	7.78	13.67
650	54.10	9.65	9.02	5.74	5.55	93.47	5.98	11.05
Control	55.15							
				Plant height (PH)				
550	60.31	87.12	52.76	15.47	12.04	60.56	11.64	19.30
600	62.16	75.80	41.44	14.01	10.36	54.67	9.81	15.77
650	55.10	31.81	9.61	10.23	5.62	30.21	3.51	6.37
Control	38.00							
				Number of pods per plant (NPP)				
550	31.37	183.89	162.20	43.22	40.49	88.20	24.63	78.54
600	28.79	128.65	106.96	39.40	35.92	83.14	19.43	67.47
650	27.84	88.05	65.86	33.70	29.15	74.79	14.45	51.93
Control	26.75							

PV – Phenotypic variances; GV – Genotypic variances; PCV – Phenotypic coefficient of variation; GCV – Genotypic coefficient of variation; h^2 – Heritability; GA – Genetic advance;GA as % of mean – Genetic advance as per cent of mean

development of early maturing genotypes in any crop primarily depends upon the reduction of days to 50 per cent flowering (Jabeen and Mirza, 2004). It was evident that the higher mutagen doses of 550, 600 and 650Gy reduced the days to 50 per cent flowering to a greater extent. The range of mean value for the trait days to maturity is 54.10 to 56.92 days with the control value of 55.15 days. The mean values for the traits *viz*., plant height, number of pods per plant, number of seeds per pod, 100 seed weight and single plant yield were recorded higher in all the treatments over control. The change in mean values in the positive direction indicated that more positive mutations have occurred for these traits (Arulbalachandran *et al.* 2010 and Hafiz Muhammad Ahmad *et al*., 2012).

Generally, the phenotypic coefficient of variation (PCV) was higher than its genotypic coefficient of variation (GCV) for all characters studied. In the present study, the high estimates of variability parameters differ from different treatments for all the characters. The traits *viz*., plant height, number of pods per plant and 100 seed weight exhibited high estimates of variability in 550Gy than other treatments. The values for genotypic and phenotypic variability, heritability and genetic advance were high in 600Gy treatments for the characters *viz*., days to maturity, number of seeds per pod and single plant yield. The gamma ray treatment 650Gy showed high estimates of variability for the character days to maturity. The resemblance between PCV and GCV in almost all the characters suggested that the environment had little effect on the expression of these characters and was consistent (Jagaonkar *et al*., 1990). Johnson *et al.* (1955) advocated that heritability estimates along with genetic advance are usually more helpful than the heritability value alone in predicting the resultant effects of selection. Genetic advance is indicative of the expected genetic progress for a particular trait under suitable selection procedure (Kaul and Garg, 1982) and consequently carries much significance in self-pollinated crops. The genetic variability parameters differed in mutagenic treatments and also from one variety to another (Shamim Ahmed Azad, 2012). Moreover, various traits exhibited high heritability with high

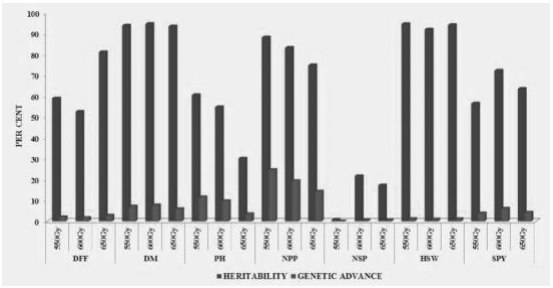
Table 2. Mean, variability and heritability estimates for NSP, HSW and SPY of Co(Gg) 7 mutants in M_2 generation

Gamma rays (Gy)	Mean	PV	GV	PCV	GCV	h_2	GA	GA as % of mean
				Number of seeds per pod (NSP)				
550	12.13	1.34	0.01	9.54	0.82	0.74	0.01	0.14
600	11.64	1.70	0.37	11.78	5.22	21.76	0.58	5.02
650	11.54	1.85	0.32	11.21	4.90	17.29	0.48	4.19
Control	10.35							
				100 seed weight (HSW)				
550	3.90	0.37	0.35	15.59	15.17	94.59	1.18	30.39
600	3.86	1.70	0.37	12.96	12.43	92.00	0.95	24.57
650	3.76	0.34	0.32	15.50	15.04	94.11	1.13	30.06
Control	3.75							
				Single plant yield (SPY)				
550	14.78	11.00	6.21	25.52	19.17	56.45	3.85	29.68
600	14.40	17.28	12.49	28.86	24.53	72.28	6.19	42.97
650	12.99	10.61	6.74	22.03	17.56	63.52	4.26	28.84
Control	12.01							

PV – Phenotypic variances; GV – Genotypic variances; PCV – Phenotypic coefficient of variation; GCV – Genotypic coefficient of variation; h_2 – Heritability; GA – Genetic advance;GA as % of mean – Genetic advance as per cent of mean

genetic advance and also high heritability with low genetic advance (Fig 1). Due to high heritability estimates, the traits were expected to re-main stable under varied environmental conditions and could

Fig 1. Heritability and Genetic advance for various quantitative traits of Co(Gg) 7 mutants in M_2 generation



DFF – Days to 50 per cent flowering; DM – Days to maturity; PH – Plant height; NPP – Number of pods per plant; NSP – Number of seeds per pod; HSW – Hundred seed weight; SPY – Single plant yield

easily be improved through selection (Khattak *et al*., 1997 and Siddique *et al*., 2006). The treatments showing maximum variation in quantitative characters may show the stable gene mutations in subsequent generation. The results are in conformity with other reports (Khan *et al.,* 2001; Singh *et al.,* 2001 and Raut *et al.,* 2004). In general, the higher values of heritability and genetic advance suggest that the variability so evolved can be effectively exploited for further genetic improvement of greengram. This study also revealed that induced genetic variability can be created through gamma irradiation in greengram.

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