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RESEARCH ARTICLE

Genetic variability on protein content of blackgram [*Vigna mungo* (L.) Hepper] induced by gamma rays and EMS

■ **K.S. USHARANI, C.R. ANANDA KUMAR AND C. VANNIARAJAN**

SUMMARY

Legumes are considered as the major source of protein, however, the protein and their amino acid constituents are less when compared to animals. The attempts were made to improve the protein quantity of legumes with various strategies and achieved a little improvement. However, it is not sufficient to fulfill the portion requirement. In the present investigation, blackgram var. VBN 4 was treated with physical mutagen gamma rays (40kR, 50kR and 60kR,) and chemical mutagen EMS (50mM, 60mM and 70mM) individually and also in combination with an objective to assess the genetic variability on protein content in M_2 generation. Genetic variability is the most essential prerequisite for any successful crop improvement programme as it provides spectrum of variants for the effective selection. Phenotypic co-efficient of variation was found to be greater than genotypic co-efficient of variation for all the treatment. The results showed some level of improvement in protein content in 60mM (23.31mg.g^{-1}) of EMS and 50kR+50mM (21.94mg.g^{-1}), 60kR+60mM (21.70mg.g^{-1}) and 60kR+70mM (23.14mg.g^{-1}) of combination treatments.

Key Words : Gamma rays, Ethyl methane sulphonate, Protein content, M_2 generation, Variability

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The pulse 'blackgram or urdbean' plays a significant role in Indian diet, as it contains vegetable protein and supplement to cereal based diet (Mandal and Mandalm, 2000). It provides a major share of the protein requirement of the vegetarian population of the country. In addition, it is an important source of human and animal feed. The essential amino acid composition of blackgram seed is tryptophan, lysine, methionine, phenylalanine, threonine, valine, leucine and isoleucine. The crop is resistant to adverse climatic conditions and improves the soil fertility by fixing atmospheric nitrogen in the soil (Kanade, 2006). Although legume seeds are important as protein source in human nutrition in many parts of the world (Brohult and Sandegren, 1954), the relative improvement of

MEMBERS OF THE RESEARCH FORUM

Author to be contacted :
K.S. USHARANI, Department of Plant Breeding and Genetics, Agricultural College and Research Institute, Tamil Nadu Agricultural University, MADURAI (T. N.) INDIA
Email: usharaniagri@gmail.com

Address of the Co-authors:
C.R. ANANDA KUMAR AND C. VANNIARAJAN, Department of Plant Breeding and Genetics, Agricultural College and Research Institute, Tamil Nadu Agricultural University, MADURAI (T. N.) INDIA

blackgram is limited by lack of variability.

Knowledge of genetic variability existing among different parameters is important in crop improvement. Heritability, which measures phenotypic variance and is attributable to genetic causes, is another important consideration for a successful breeding programme. Heritability with genetic advance helps in understanding the mode of inheritance of quantitative traits (Appalaswamy and Reddy, 2004). But creation of variability in blackgram is difficult through hybridization in order to improve yield and other polygenic characters, artificial induction variability by mutation breeding can be effectively utilized can generate new variability and it has been recognized as a valuable supplement to conventional breeding in crop improvement (Ali *et al.,* 2011).

The application of radiation and chemical mutation in blackgram breeding found high variation in yield per plant and nutritional quality, especially contents of protein, methionine and total sugars (Arulbalachandran and Mullainathan, 2009). The aim of this study was to generate information on the magnitude of induced genetic variability on protein content with the application of gamma rays and ethyl methane sulphonate (EMS).

MATERIAL AND METHODS

Seeds of VBN 4 urdbean were subjected to three different doses of gamma rays *viz.,* 40kR, 50kR and 60kR, EMS 50mM, 60mM and 70mM and combination treatments. To raise M_1 generation, a total of fifteen treatments along with the control was sown in the field at the rate of 150 seeds for each treatment at a spacing of 30 x 15cm at AC and RI, Madurai during August, 2010 in RBD with three replications. M_2 generation was raised on M_1 plant basis following plant to progeny method during January, 2011. Thirty plants per treatment were forwarded from the M_1 to the M_2 generation. The seed protein content was estimated according to the method suggested by Lowry *et al.* (1951) in M_2 generation. Data on protein content were analyzed statistically to estimate the PCV, GCV (Burton, 1952), broad sense heritability (h^2) and genetic advance (GA) as per cent of mean (Johnson *et al.,* 1955).

RESULTS AND DISCUSSION

The magnitude of genetic variability in particular decides the effectiveness of selection. The phenotypic variance measures the magnitude of variance arising out of phenotypic or genotypic values. It is an established fact that greater the variability among the genotypes better is the chance for further improvement in the crop. Assessment of variance has been the most dependable statistical measure to find the mutagenic effect on the polygene. The genotypic co-efficient of variation provides a mean to study the genetic variability generated in quantitative characters. The response of mutagens as measured by the magnitude and the nature of variability varied from character to character. However, mutagenic treatments induced both chromosomal and non-heritable physiological changes that contribute to total induced variation and assessment of the heritable component of variation, which will be useful in the mutation breeding programme. Genotypic co-efficient of variation provides a mean to study the genetic variability generated in quantitative characters (Johnson *et al.,* 1955). It is an indirect measure of the environmental influence on the inheritance pattern of the yield attributes, whereas heritability gives the picture of heritable portion of phenotypic variance. The genetic advance shows the extent of genetic gain that could be expected through selections in the character to be improved (Burton, 1952 and Johnson *et al.,* 1955). Heritability is also influenced by environmental factors, the information on heritability alone may not help in pin pointing characters enforcing selection. Simply, heritability gives the information on the magnitude of inheritance of metrical attributes, *i.e.* polygenic inheritance, while genetic advance will be helpful in formulating suitable selection procedures.

In order to assess the nature and magnitude of induced polygenic variability or micro mutations in gamma rays and EMS treatment population in M_2 generation of variety VBN 4 were evaluated for protein content through statistical parameters such as mean and variance. The results obtained for variability parameters for protein content are presented in Table 1. Many workers have reported success in the enhancement of protein in various crops through mutation breeding. In the present study, the mean protein content varied from 15.87 (60kR) to 20.30 (40kR). PCV and GCV varied between 17.48 per cent to 27.95 per cent and 13.01 per cent to 25.42 per cent, respectively due to gamma rays. The dose, 60kR registered maximum GCV (25.42%), heritability (82.98%) and moderate value of GA as per cent of mean (14.56%). In EMS, the mean protein content varied from 18.98 (50mM) to 23.31 (60mM). The highest value of PV, GV, PCV, GCV, heritability and GA as per cent of mean was observed at 50mM. In

Table 1: Mean and components of variance for seed protein content in M_2 generation - VBN 4

Treatments	Mean	PV	GV	PCV	GCV	h^2	GA%
Gamma rays							
Control	22.36	10.09	-	-	-	-	-
40kR	20.30	12.59	6.97	17.48	13.01	55.39	8.65
50kR	19.07	28.41	18.32	27.95	22.45	64.49	12.42
60kR	15.87	19.61	16.27	27.91	25.42	82.98	14.56
EMS							
Control	21.12	5.62	-	-	-	-	-
50mM	18.98	24.37	21.03	26.00	24.16	86.30	12.66
60mM	23.31	5.68	3.19	10.23	7.66	56.06	6.23
70mM	19.55	16.74	13.41	20.93	18.73	80.07	11.40
Combination							
Control	21.12	5.62	-	-	-	-	-
40kR+50mM	18.69	15.87	13.87	21.32	19.93	87.38	11.46
40kR+60mM	14.75	5.12	3.12	15.35	11.98	60.90	10.12
40kR+70mM	19.38	7.61	5.11	14.24	11.67	67.19	8.98
50kR+50mM	21.94	9.32	5.99	13.92	11.15	64.20	8.15
50kR+60mM	16.20	22.42	20.42	29.23	27.90	91.06	13.78
50kR+70mM	20.69	24.06	13.97	23.71	18.07	58.07	10.30
60kR+50mM	19.94	18.31	16.31	21.46	20.25	89.06	10.95
60kR+60mM	21.70	14.82	4.73	17.74	10.02	31.92	5.40
60kR+70mM	23.14	24.96	14.87	21.59	16.67	59.59	9.45

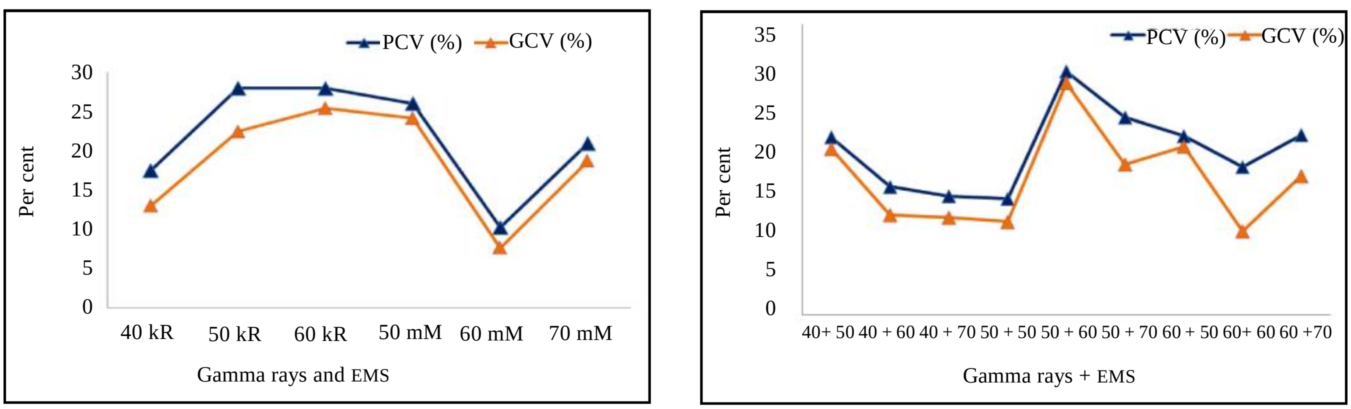

Fig. 1: Estimates of PCV and GCV for seed protein content in VBN 4 urdbean

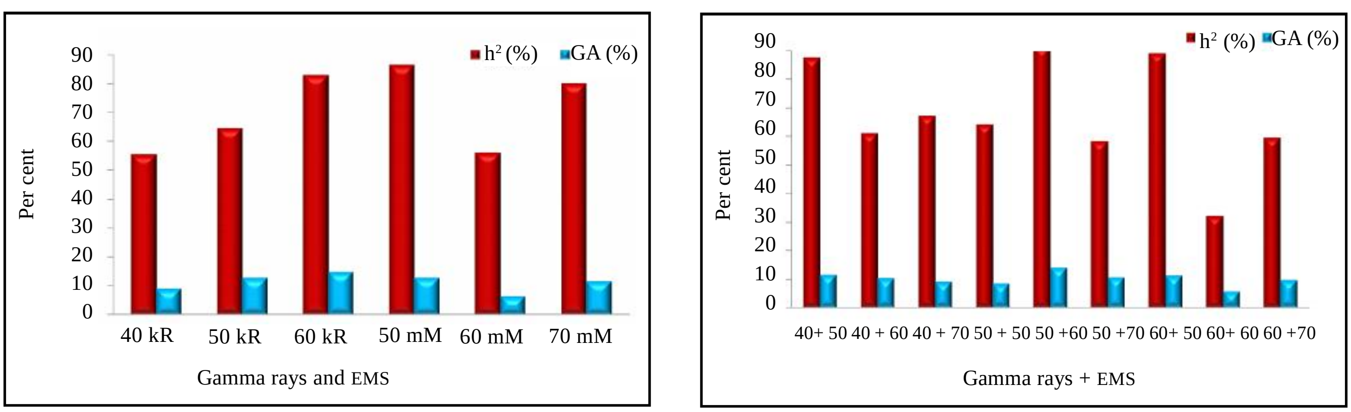

Fig. 2: Estimates of h^2 and GA (%) for seed protein content in VBN 4 urdbean

case of combination treatments, the mean protein content ranged from 14.75 (40kR+60mM) to 23.14 (60kR +70mM). In 50kR+60mM of combination treatment registered high values of PCV (29.23%), GCV (27.90%), heritability (91.06%) and moderate value of GA as percentage of mean (13.78%) (Fig. 1 and Fig. 2). The increase in mean values could due to the occurrence of polygenic mutations with cumulative effects in *Vigna radiata* L. (Singh *et al.*, 2001). Induced greater variability in polygenic traits might be due to increased mutations and recombination induced by gamma rays and EMS (Sareen and Singh, 1990). Arulbalachandran and Mullainathan (2009) also reported several high protein content mutants in blackgram through gamma rays and EMS. Ranjan (2006) also reported increase in protein content in mungbean and Odeigah *et al.* (1998) in cowpea.

Conclusion :

Genetic variability and heritability along with genetic advance of traits are essential for crop improvement. In M_2 generation, the seed protein content was higher than the control at 60mM (23.31mg.g^{-1}) of EMS treatments and 50kR+50mM (21.94mg.g^{-1}), 60kR+60mM (21.70mg.g^{-1}) and 60kR+70mM (23.14 mg.g^{-1}) of combination treatments. These high protein mutants may be put to use as donor parents in plant improvement projects in order to select genotypes for the genetic enrichment of the nutritive value of blackgram.

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