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Influence of physical and chemical mutagens on quantitative characters of *Vigna mungo* (L. Hepper)

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Abstract: Seeds of Urdbean (*Vigna mungo* (L.) Hepper) Variety Vamban1 was mutagenised with physical and chemical mutagens namely, gamma rays, EMS and dES. In the M1 generation germination percentage, plant growth and yield parameters were adversely affected in the mutagenic treatments and the effects were more pronounced in higher doses indicating almost a linear relationship. The LD50 value was observed in 15 mM of EMS and 25 mM of dES and 60 kR of gamma rays. The increasing dose / concentrations of gamma rays, EMS and dES decreased in phenotypic and yield characters. The decrease quantitative and yield characters have been attributed to the physiological disturbance or chromosomal damage caused to the cells of the plant by the mutagen.

Keywords: *Vigna mungo*, Variety VBN1, gamma rays, Ethyl Methane Sulphonate (EMS), Diethyl Sulphate (dES).

INTRODUCTION

Black gram is an important pulse crop occupying unique position in Indian agriculture. Among the pulses in India 3.25 million hectares are cultivating black gram and an annual production is 1.45 million tons. About the 70 percent of the total area is in central and southern part of the country, which contributes about 77 percent of the total production. However the national productivity of black gram is around 500 kg per / ha due to restricted cultivation in the marginal lands (14 & 9). Research on this species is lagging behind than that of cereals and other legumes. In order to improve yield and other polygenic characters mutation breeding can be effectively utilized (2).

Mutation induction has become an establishment tool in plant breeding to supplement existing germplasm and to improve cultivars in certain specific traits (6). Induced mutations represent the same kind of changes as occur from natural causes (3). Mutagenesis has been widely used as a potent method of enhancing variability for crop improvement (12). Induced mutation using physical and chemical mutagen is one method to create genetic variation resulting to new varieties with better characteristic (15). Gamma rays are the most energetic form of electromagnetic radiation, possesses the energy level from 10 keV to several hundred kilo electron volts, and they are considered as the most penetrating in comparison to other radiation such as alpha and beta rays(5).

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MATERIALS AND METHODS

Seeds of black gram variety VBN1 500 dry healthy and uniform size seeds were treated with gamma rays at 20,40,60,80,100 kR doses, EMS 5,10,15,20, 25mM and dES 10, 15, 20, 25, 30mM concentrations. The treatment was followed by 4 hrs at room temperature (25°± 2) after washed in running water, untreated seeds were used as control. 15 treatments seeds of gamma rays, EMS, dES and control seeds were immediately sown in the field in a randomized block design (RBD) with three replications. Each treatment consists of three rows of 5m length/ replications, in which 100 seeds per row were sown with 10× 30cm distance between plants and rows respectively. Data were recorded on seven quantitative characters and further statistically analyzed. The treatments were compared with NPRC statistically analyzed. Mean values for seven quantitative traits in different treatments and percentage over control are presented..

RESULTS AND DISCUSSION

Germination percentage was found to be significantly reduced in all the physical and chemical mutagen treatments. 50% reduction recorded at 60kR of gamma rays (50.47%), 15mM of EMS (50.06%), and 25mM of dES (51.65%). These results indicated that germination percentage was reduced under the influence of mutagenic treatment with increasing dose/ concentrations. Similar results were reported in red gram (4 &13).Significant survival reduction was observed in the higher dose/concentration of gamma rays 100 kR (38.72), EMS 25mM (39.92) and dES 30mM (35.65). This might have been due to the effect of mutagens on meristamatic tissues of the seed. Morphological variations,

especially leaf abnormalities are the indicators of effective mutagen treatment. In different treatments morphological variation like trifoliate, tetrafoliate, pentafoliate, hexafoliate and fused leafs were observed in the present studies. Plant height was also found to be significantly reduced in higher doses of physical and chemical mutagenic treatments. The maximum plant height reduction was observed in 100kR of gamma rays (28.26). The number of cluster/ plant was also significantly affected in these (7.75) in 100kR of gamma rays, 25 mM of EMS (7.00) and 30mM of dES (8.36) treatments. Similar results were reported the quantitative parameter such as number of primary branches per plant, number of cluster per plant, number of pods per plant, pod length per plant, number of seeds per pod and single plant yield were decreased in gamma rays and EMS treatment than control in M1 generation of Vigna unguiculata (10) .However, seed weight per plant in different treatments indicated significant reduction in the higher doses of physical and chemical treatment. Percentage reduction in seed weight was maximum (3.15) in 100kR of gamma rays treatment. Plant yield for each treatment was recorded in grams and was converted to kg/ ha. Maximum seed yield of 834 kg/ ha. was recorded in control. There was significant reduction in seed yield in all the treatments.

Table1. Impact of Physical and chemical mutagen treatment on growth and yield characters in Black gram.

Treatment	Seed Germination (%)	Plant height (cm)	No. of cluster / plant	No. of pods / plant	100 seed weight / plant(gm)	Yield / plant (kg/ ha)
Control	93.63	52.50	13.36	30.36	4.94	834
Gamma rays (kR) 20	83.88	42.44	12.58	27.23	4.71	789.9
40	70.93	40.46	11.47	26.91	4.62	681.0
60	50.47	39.37	10.76	24.55	4.24	527.1
80	45.13	32.34	9.35	22.37	3.84	419.0
100	38.72	28.26	7.75	20.39	3.15	392.9
EMS (mM) 5	84.27	43.49	13.00	30.25	4.79	704.9
10	77.46	40.36	12.13	28.48	4.61	669.1
15	51.12	39.46	11.56	26.81	4.53	589.9
20	44.06	37.34	9.47	23.54	4.00	454.0
25	39.92	34.41	7.00	20.19	3.10	319.0
dES(mM)10	80.81	42.36	12.87	27.21	4.67	757.0
15	69.46	37.26	11.21	26.65	4.53	654.9
20	52.49	34.19	10.00	25.54	4.42	564.9
25	47.92	30.61	9.21	23.25	3.19	475.0
30	35.65	29.41	8.36	20.16	3.06	384.9
SE	1.365	0.2434	2.1247	1.123	0.2456	9.1578
SED	1.462	0.3658	3.0048	1.426	0.3214	12.5024
CD (P=05)	0.1436	0.1651	6.0396	0.2632	0.0142	2.5627
CD (P= 01)	0.7431	0.1863	8.0528	0.2841	0.0426	3.4170

In the present study, reduction in seed germination and germination percentage was concentration/ dose dependent and linear. Reduction germination in mutagenic treatments has been explained due to delay or inhibition of physiological and biological processes ne¬cessary for seed germination which include enzyme acti¬vity (7). The treatments showing maximum variation in quantitative characters may show the stable gene mutations in subsequent generation.

CONCLUSION

All the quantitative and yield traits were proportionately decreased with increase dose/ concentrations of physical and chemical mutagens. The decrease quantitative characters have been attributed to the physiological disturbance or chromosomal damage caused to the cells of the plant by the mutagen. Gamma rays belong to ionizing radiation and interact on atoms or molecules to produce free radicals in cells. These radicals can damage or modify important components of plant cells and have been reported to affect differentially the morphology, anatomy, biochemistry and physiology of plants depending on the irradiation level. Chemical mutagens usually cause point mutation, but loss of a chromosome segment or deletion can also occur. Studies suggested that the most important parameters for inducing physical and chemical mutagen growth and yield characters were reduced consider based on the dose / concentration and duration of treatment. In the investigation of gamma irradiation and Ethyl Methane Sulphonate effects on Urd bean we observed morphological changes such as, stunted plants, reduction of the plant height and yield parameters.

REFERENCES

[1] Aparma, D and Ravishankar, C. 2003. Study on the efficiency of EMS in inducing mutations in water melon, Citrulus lanatus (Thunb) Mansf: the Andhra Agric. J. 50(122): 90-92.

[2] Deepalakshmi, A. J and Anandakumar, C.R. 2004. Creation of genetic variability for different pylogenic traits in black gram (Vigna mungo (L.) Hepper) through induced mutagenesis. Legume Res. 27 (3): 188-192.

[3] Govindan, A. 2000. Studies on induction of mutations on black grams (Vigna mungo L.) varieties and hybrid populations and mutational effect of genetic parameters through generation. Ph.D., Thesis, India.

[4] Jayanthi,S. 1986. Biological effects of gamma rays and EMS in the M1¬ generation of Redgram (Cajanus Cajan L.) M.Sc (Agric) thesis, Kerala University, India.

[5] Kovacs, E. and A. Keresztes. 2002. Effect of gamma and UV-B/C radiation on plant cell. Micron, 33: 199-210.

[6] Kumar, B and Ramesh, B. 2004. Characterization and evalution of induced mutants in barley (Hordeum vulgare). Indian J.Agric.Sci., 74(9): 492-495.

[7] Kurobane I, Yamaguchi H, Sander C, Nilan R 1979. The effects of gamma irradiation on the production and secretion of enzymes and enzymatic activities in barley. Env. Exp. Bot. 19: 75-84.
[8] Mensah, J.K and Akomeah P.A.1992. Mutagenetic effects of hydroxylamine and streptomycin on the growth and yield of Cowpea (Vigna unguiculata (L.) Walp.) Legume Res. 15: 39-44.
[9] Pawar,S.E. 2001. Impact of mutant varieties of blackgram in releasing important productivity. Mut. Breed. Newsl. 45: 7-9.
[10] Rizwana Banu,M., Kalamani, A., Ashok, S and Makesh, S. 2005. Effect of mutagenic treatments on quantitative charactes in M1 generation of cow pea (Vigna unguiculater L. walp, Adv. Plant sci. 18 (II): 505-510.
[11] Singh,M. and Singh, V.P. 2001. Genetic analysis of certain mutant lines of urdbean for yield and quality traits in M4 generation. Ind. J. Pulses Res. 14(1): 60-62.
[12] Subuthi, P.K., Mohapatra, B.K and Sinha, S.K.1991. Use of pollen traits for early detection of induced micro mutations in wheat. Indian J. Genet. 5 (1): 101-111.
[13] Veeresh, L.C., Shivashankar, G and Shailaja,H. 1995. Effect of seed irradiation on some plant characteristics of winged bean Mysore J.Agric. Sci. (29): 1-4.
[14] Venkatesan,S. 1998. Fertilizer and Agricultural Statistics Souther Region Fertilizer Association of India. Souther Region, P. 41.
[15] Wongpiyasatid,A., Chotechuen, S., Hormchan,P. 2000. Induced mutations in mungbean breeding Regional yield trail of mungbean mutant lines. Kasetsart J. (Nat. Sci.). 34: 443-449.