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Short Communication

Effectiveness and efficiency of chemical mutagens in cowpea (*Vigna unguiculata* (L.) Walp)

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A study was undertaken in a cowpea (*Vigna unguiculata* (L.) Walp.) variety CO 6 to assess the efficiency and effectiveness of chemical mutagens; ethyl methane sulphonate (EMS), diethyl sulphate (DES) and sodium azide (SA). EMS treatments were found highly effective than the other chemicals. Mutagenic effectiveness and efficiency decreased with increase in all mutagenic treatments.

Key words: Cowpea, mutagens, ethyl methane sulphonate, diethyl sulphate, sodium azide.

INTRODUCTION

Cowpea is an important pulse crop in India. The seeds are a major source of dietary protein in most developing countries (Duke, 1990). More than 8 million hectares of cowpea are group in west and central Africa. Nigeria is the largest producer with 4 million hectare, followed by Niger with 3 million hectare. Other producers are Mali, Burkina Faso and Senegal.

The production trend of cowpea in Nigeria shows a significant improvement with about 44% increase in area planted and 40% increase in yield from 1961 to 1995 (Ortiz, 1998). This development within two decades is attributable to this significant advances made on cowpea seeds improvement in the drylands by the International Institute of tropical Agriculture, Ibadan, Nigeria.

Induced mutation breeding, which has been recognized as a valuable supplement to conventional breeding in crop improvement, has been least applied in grain legumes. This study was undertaken in cowpea (*Vigna unguiculata* (L.) Walp.) variety CO 6 to assess the efficiency and effectiveness of chemical mutagens; ethyl methane sulphonate (EMS), diethyl sulphate (DES) and sodium azide (SA).

MATERIALS AND METHODS

Seeds of cowpea variety CO 6 were used for inducing mutation by ethyl methane sulphonate (EMS), diethyl sulphate (DES) and sodium azide (SA). For each treatment 100 dry and uniform seeds were used. The seeds were pre soaked in distilled water for six hours and then treated with solution of EMS at 0.3, 0.4 and 0.5%, DES at 0.05, 0.06 and 0.07% and SA at 0.03, 0.04 and 0.05% for 6 h, after which the seeds were thoroughly washed in running tap water. The seeds, after treatment along with their respective control, were sown in the field to raise M_1 generation in a randomized block design (RBD) with three replications. All the surviving individual plants were harvested in each treatment in M_1 generation. M_1 plants having sufficient seeds in different treatments were grown to raise M_2 in a randomized block design (RBD) with three replications. Thorough screening was done for chlorophyll and viable mutation.

Chlorophyll mutants were classified in accordance with the system of Gustaffson (1940) and Blixt and Gottschalk (1975). Frequency of viable mutations was calculated in M_1 plants and M_2 seedlings basis. Data on biological abnormalities such as injury and lethality in M_1 generation and chlorophyll mutation frequency in M_1 and M_2 generation were used to determine the mutagenic efficiency and effectiveness according to the formula suggested by Konzak et al. (1965).

RESULTS AND DISCUSSION

Mutation frequency

Chlorophyll and viable mutations as calculated in M_2 seedlings and plant basis. High frequency was observed at lower concentration while reduced frequency is seen in higher concentration of the mutagenic treatments. The frequency of chlorophyll and viable mutations induced by DES was comparatively higher than EMS and SA treatments. The spectrum of chlorophyll mutants were recorded and classified according to Gustafsson (1940) as Albino, Virescence and Xantha types. The viable mu-

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Table 1. Mutagenic effectiveness and efficiency in chlorophyll and viable mutation in cowpea var. CO 6.

Mutagens (Conc.)	Total No. of plant studied	Total No. of plant mutant	Mutation frequency % (M)	Lethality % (L)	Injury (%) (I)	Effectiveness $\frac{M}{C\times t}\times 100$	Efficiency	
							$\frac{M}{L}\times 100$	$\frac{M}{I}\times 100$
EMS 0.3%	310	8	2.58	45.24	13.81	143.33	5.70	18.68
0.4%	305	7	2.29	49.57	18.37	95.41	4.61	12.46
0.5%	295	6	2.03	54.88	27.56	67.66	3.69	7.36
DES 0.05%	312	9	2.88	40.20	18.71	115.20	5.24	15.39
0.06%	306	7	2.28	44.20	25.52	96.00	5.15	8.93
0.07%	298	7	2.34	64.88	31.81	55.71	3.60	7.35
SA 0.03%	275	6	2.18	27.38	17.63	121.11	7.96	12.36
0.04%	304	8	2.63	34.55	26.81	109.58	7.61	9.80
0.05%	279	7	2.50	46.09	34.71	83.33	5.42	7.20

tants were recorded as tall, dwarf, early and late flowering, early and late maturity, long pod and male sterility. Generally, chlorophyll mutants were identified in all mutagenic treatments. The mutation frequency increased with the elevation of mutagenic level which confirms most of earlier reports in mungbean (Khan, 1981; Dixit and Dubey, 1983; blackgram, 1995; Sharma et al., 2005). The chlorophyll and viable mutation frequency was maximum at 0.05% of DES (2.88), followed by 0.04% of SA (2.63) and 0.4% of EMS (2.58) (Table 1).

Mutagenic effectiveness

The mutagenic effectiveness was found to be the highest at lower concentration with all the mutagenic treatments. EMS was found to be more effective than DES and SA. The maximum effectiveness was observed at 0.04% of EMS (143.33) followed by 0.03% of SA (121.11) and 0.05% of DES (115.20) (Table 1). The present study showed that the effectiveness decreased with increase in concentration of EMS, DES and SA. This was in confirmation with the findings of Packiaraj (1988) in cowpea and Sharma et al. (2005) in blackgram.

Mutagenic efficiency

Efficiency of chlorophyll and viable mutations was based on lethality (L) and injury (I) in M_1 plant and M_2 seedling basis. The lethality basis maximum efficiency was achieved by 0.03% of SA (7.96) followed by 0.3% of EMS (5.70) and 0.05% of DES (5.24). The injury basis maximum efficiency was observed at 0.3% of EMS (18.68) followed by 0.05% of DES (15.39) and 0.03% of SA (12.36) (Table 1). Similarly results observations were made by Vannia Rajan (1989), Ahmed (1995) and Sharma et al. (2005) in blackgram.

REFERENCES

Ahmed JS (1995). Effectiveness and efficiency in urdbean (*Vigna mungo* (L.) Hepper). Indian J. Genet. 65(1): 20-22.

Blixt S, Gottschalk W (1975). Mutation in the leguminosae. Agric. Hort. Genet., 33: 33-85.

Dixit P, Dubey DK (1983). Seedling mutations induced by separate and combined applications of gamma rays and NMU in lens culinaris (Medk) variety T-36 pulse. Crop News Lett. 3: 14-17.

Duke L (1990). Introduction, In Singh SR (ed.) Insect pests of food legumes, Wiley, New York, p. 1-42.

Gustafsson A (1940). The mutation system of the chlorophyll apparatus. Lunds Univ. Arrks. N.F. Adv., 36: 1-40.

Khan IA (1981). Mutation studies in mungbean. Bot. Bull. Acad. Sci. 22: 113-121.

Konzak CF, Nilan RA, Wagner J, Foster RJ (1965). Efficient chemical mutagenesis in the use of induced mutations in plant breeding. Rad. Bot. 5: 49-70.

Ortiz R (1998).Cowpeas from Nigeria: A silent food revolution. Outlook Agric. 27(2): 125-128.

Packiaraj D (1988). Studies on induced mutagenesis of parents and hybrid in cowpea. M.Sc. *(Ag.)* Thesis, TNAU, Coimbatore.

Sharma SK, Ritu S, Pandey DP (2005). Studies on mutagen sensitivity, effectiveness and efficiency in urdbean (*Vigna mungo* (L.) Hepper). Indian J. Genet. 65(1): 20-22.

Vannia RC (1989). Studies on induced mutagenesis in blackgram (*Vigna mungo* (L.) Hepper). M.Sc. (Ag.) Thesis, TNAU, Coimbatore.