Asian J. of Bio Sci. (2007) Vol. 2 No. 2 : (110-112)

Mutagenic effectiveness and efficiency of gamma rays in blackgram (*Vigna mungo* L.) Hepper) in M_2 generation

A. THANGA HEMAVATHY[1]* AND K. BALAJI[2]
[1] Dept. of Entomology, Centre for Plant Molecular Biology & Biotechnology, T.N.A.U., COIMBATORE (T.N.) INDIA
[2] Dept. of Entomology, Tamil Nadu Agricultural University, COIMBATORE (T.N.) INDIA

(Accepted : August, 2007)

The mutagenic effectiveness and efficiency of gamma rays *viz.*, 40, 50, 60, 70 and 80 kR in three varieties of urd bean cultivars namely ADT 3, ADT 5 and APK 1 were studied. The effectiveness of gamma ray shows a consistent relationship of lower doses of gamma ray was found more effective in M_1 plant and M_2 seedling basis. The high effectiveness was recorded in ADT 5 at 40 kR followed by 50 kR in ADT 3 and APK 1 at 50 kR on M_1 plant basis. In M_2 seedling basis the high effectiveness was recorded in ADT 3 at 50 kR followed by ADT 5 at 40 kR and APK 1 at 60 kR. The mutagenic efficiency directly proportional with the increase in the dose among all the varieties studied.

Key words: Gamma ray, ADT 3, ADT 5, APK 1, Effectiveness, Efficiency, Blackgram.

INTRODUCTION

Blackgram is an important pulse crop, occupying unique position in Indian agriculture. Among the pulses, it stands fourth in production and acreage. For any successful mutation breeding programme, selection of efficient and effective mutagenesis is very essential to recover high frequency of desirable mutations. Mutagenic effectiveness is a measure of the frequency of mutations induced by a unit dose of mutagen while mutagenic efficiency gives an idea of the proportion of mutations in relation to other associated undesirable biological effects such as lethality and sterility induced by the mutagen. (Konaz *et al*., 1965). The present study reveals on effectiveness, efficiency and synergistic effect of gamma rays in blackgram varieties *viz.*, ADT 3, ADT5 and APK1.

MATERIALS AND METHODS

Three varieties of *Vigna mungo viz.*, ADT 3, ADT 5 and APK 1 were treated with gamma rays. Well filled, undamaged and uniform sized seeds were hand picked from the seed lot and equilibrated to the moisture content of 12 per cent. For each dose of physical mutagen, a random sample of 370 seeds were treated in each variety. The dry seeds of blackgram varieties (ADT 3, ADT 5 and APK 1) were treated in ^{60}CO gamma ray chamber available at Indira Gandhi Atomic research Center, Kalpakkam. The seeds were irradiated at ten different doses starting from 10 to 100 kR with an interval of 10 kR.

The irradiated seeds were sown in *Kharif* 2000 in the field immediately after the treatment. The total of 270 seeds in each treatment were sown in the field under randomized block design in three replications with a spacing of 30 cm between rows and 15 cm between plants. The recommended agronomic practices and plant protection measures were followed uniformly for all treatments. Survival of plants at the maturity was recorded and expressed as percentage over control. The seed sterility was worked out as number of seeds produced per plant and was expressed as reduction in the seed number in relation to control. Pollen sterility was determined by acteocarmine stainability. The effectiveness and efficiency was calculated as per the formulae suggested by Konazk *et al*. (1965).

RESULTS AND DISCUSSION

The results are presented in Table 1 and 2. Mutagenic effectiveness is measured by the percentage of mutated families divided by a unit mutagen dose. (Konazk *et al.*, 1965). In the present study, the effectiveness of different varieties by gamma ray was assessed by their mutagen dose and the efficiency was assessed on four different biological parameters *viz.*, plant height, and seed sterility and plant survival. The results indicated that, the mutagenic effectiveness of gamma rays ranged from 25.00 to 80.00, 1.33 to 4.26 on M_1 plant and M_2 seedling basis,

* Author for Correspondence

Table 1 : Mutagenic effectiveness and efficiency of Chlorophyll mutants in M_1 plant basis

Doses	Lethality	Injury	Sterility	Mutants/ 100 M_1 plants (M_p)	Effectiveness M_p/kR x 100	Efficiency		
						M_p/L x 100	M_p/I x 100	M_p/S x 100
ADT 3								
40 KR	1.47	16.52	6.09	30.00	75.00	2040.81	181.59	492.61
50 KR	8.63	23.65	11.95	40.00	80.00	463.89	169.13	334.73
60 KR	15.69	24.70	20.86	30.00	50.00	191.204	121.46	143.82
70 KR	18.49	18.14	22.82	30.00	42.85	162.25	165.38	131.46
80 KR	30.01	23.41	27.48	20.00	25.00	66.64	85.43	72.78
ADT 5								
40 KR	1.37	19.45	9.08	50.00	125.00	3649.60	257.07	550.66
50 KR	12.12	10.37	10.47	30.00	60.00	247.52	289.09	286.53
60 KR	15.91	23.72	18.04	40.00	66.66	251.41	168.63	281.73
70 KR	18.99	27.61	17.61	30.00	42.85	157.97	110.25	170.36
80 KR	27.31	23.88	20.59	20.00	25.00	73.23	83.75	97.73
APK 1								
40 KR	2.35	21.55	11.21	50.00	25.00	2127.65	232.02	446.03
50 KR	5.45	14.05	4.33	30.00	60.00	550.46	213.52	692.84
60 KR	6.44	27.90	9.33	30.00	50.00	465.84	107.53	321.54
70 KR	23.59	29.13	13.68	30.00	42.85	211.96	102.97	219.29
80 KR	21.69	29.47	19.28	20.00	25.00	92.21	67.86	103.73

* Selected blackgram varieties

respectively in ADT 3. In ADT 5 it ranges from 25.00 to 125.00 and 0.98 to 2.12 on M_1 plant and M_2 seedling basis, respectively. APK 1 variety had the ranges of 25.00 to 60.00 and 1.37 to 2.05 on M_1 plant and M_2 seedling basis, respectively. The high effectiveness recorded in ADT 5 (40 kR) followed by ADT 3 (50kR) than APK 1 (50 kR) in M_1 plant basis. In M_2 plant basis high effectiveness recorded in ADT 3 (50 kR) followed by ADT 5 (40 kR), APK 1 (60 kR). The great efficiency of lower concentration of mutagenic agent is due to the fact that the biological damage increases with increasing dose at faster rate than the mutation (Konzak *et al*., 1965). The efficiency of mutagenic agent not only depends on the biological system but also of physiological damage, chromosomal aberration and sterility induced in addition to mutation.

In the present study, the effectiveness showed a proportionate decrease with increase of the mutagen. Same trend was observed by Ramasamy (1973) and Ahmed John (1991). The dose 40 kR had high effectiveness in all the varieties (Table 1 and 2). Birhman *et al*. (1980) in *Vigna radiata* L. reported that 30 kR gamma ray was found to be more effective than other higher doses. Sharma (1990) reported that the proportionate increase in the mutation rate was lower than the proportionate increase in the dose of mutagens. In the present study, gamma ray was found to be generally efficient and effective mutagen. Same report was denoted by Gautam *et al*. (1991) in *Vigna mungo*. The mutagenic efficiency ranged from 66.64 to 2040.81, 85.43 to 181.59 and 72.78 to 492.61 on the basis of lethality, injury and sterility, respectively on M_1 plant basis for ADT 3. The maximum efficiency recorded at 40 kR for all bases in M_2. In M_2 40, 50, 40 kR had high efficiency on the bases of lethality, injury and sterility in ADT 3 variety. In ADT 5 the efficiency of chlorophyll mutations were the least at the dose of 80 kR based on M_1 plant and M_2 seedling basis on all the three varieties. In APK 1 also 40 kR was more efficient.

The effectiveness of gamma rays was found to high at lower doses in all the varieties. Ahmed John (1991) found that there was a decrease in mutagenic efficiency

Table 2 : Mutagenic effectiveness and efficiency of Chlorophyll mutants in M_2 seedling basis

Doses	Lethality	Injury	Sterility	Mutants/ 100 M_1 plants (M_p)	Effectiveness M_p/kR x 100	Efficiency		
						M_p/L x 100	M_p /I x 100	M_p/S x 100
*ADT 3								
40 KR	1.47	16.52	6.09	0.68	1.69	46.25	6.84	18.55
50 KR	8.63	23.65	11.95	2.13	4.26	24.68	9.01	17.82
60 KR	15.69	24.70	20.86	1.69	2.82	10.77	6.78	8.10
70 KR	18.49	18.14	22.82	0.93	1.33	5.02	5.12	4.07
80 KR	30.01	23.41	27.48	1.15	1.44	3.83	4.91	4.18
*ADT 5								
40 KR	1.37	19.45	9.08	0.85	2.12	62.04	4.37	9.36
50 KR	12.12	10.37	10.47	0.86	1.72	7.09	8.29	8.21
60 KR	15.91	23.72	18.04	1.07	1.78	6.72	4.51	5.93
70 KR	18.99	27.61	17.61	1.01	1.44	5.31	3.71	5.73
80 KR	27.31	23.88	20.59	0.79	0.98	2.89	3.31	4.75
*APK 1								
40 KR	2.35	21.55	11.21	0.76	1.90	32.34	3.52	6.78
50 KR	5.45	14.05	4.33	0.99	1.98	1.816	7.04	22.86
60 KR	6.44	27.90	9.33	1.23	2.05	19.09	4.40	13.18
70 KR	23.59	29.13	13.68	0.96	1.37	4.06	3.29	7.01
80 KR	21.69	29.47	19.28	1.35	1.68	6.22	4.58	7.00

* Selected blackgram varieties

with increase in mutagenic dose.

In the present study, ADT 5 had high efficiency in injury, lethality and APK 1 had high efficiency in sterility in M_1 plant basis. In M_2 seedling basis ADT 5 had high efficiency in lethality and ADT 3 had high efficiency in injury and APK 1 had high sterility compared with ADT 3 and ADT 5.

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