https://doi.org/10.29321/MAJ.10.A02098

Madars Agric. J. 75 (3-4) : 109-113 March-April, 1988

INDUCED VIABLE MUTATIONS IN *Sorghum bicolor* (L.) MOENCH WITH GAMMA RAYS AND METHYL METHANE SULPHONATE

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In a study of induced mutagenesis in Sorghum, a total of 374 viable mutants has been isolated from both single and alternate treatments. A linear trend of increase in the frequency of viable mutations with increase in dosage of the mutagens was observed. A high frequency of viable mutants was obtained in alternate treatment than in single treatment. In alternate treatments the spectrum of viable mutants was wider, affecting various traits such as stature, duration, leaf, Panicle size and shape, seed fertility than in single treatment.

Irungu cholam (*Sorghum bicolor* L. Moench.) is a very tall variety grown for fodder as well as for grain in the southern parts of Tamil Nadu. This variety is resistant to severe drought but yield and quality of the grain is poor. Very little crop improvement has been carried out on this crop. In the present study, the frequency, spectrum and description of a large number of viable mutants obtained through induced mutagenesis with gamma rays and methyl methane sulphonate are discussed.

MATERIALS AND METHODS

Well filled seeds of Irungu cholam treated with gamma rays ranging from 35 to 60 krad with an interval of 5 krad were used as first cycle treatments. In the second cycle, A.M_1 generation was obtained by applying 0.005 percent of MMS as alternate mutagen to the M_1 progeny seeds. The M_2 generation was raised in the field as individual M_1 plant progenies taking 30 seeds per plant at random. Similarly AM_1 generation was raised as individual M_1 plant progenies taking 30 seeds at random per plant. The M_2 and AM_1 plants were observed periodically during their entire life period and viable mutations were scored. These mutants were described with respect to deviations from normal plants.

RESULTS AND DISCUSSION

All mutations affecting the morphology of the different plant parts were classed as viable mutations in M_2 and AM_1.

(i) Frequency

Viable mutation frequency was estimated on M_1 plant and M_2 plant basis (Table 1). The frequency was higher on M_1 plant basis than on M_2 plant basis. The mutation frequency increased upto 50 krad in single and alternate treatments and decreased thereafter. The mutation frequency in single and alternate treatments respectively ranged from 3.85 to 6.58 percent and 9.62 to 22.37 percent on M_1 plant basis and 0.40 to 1.44 percent and 1.02 to 2.93 percent on M_2 plant basis. In general, there was a shift in the frequency in each initial dose of gamma rays in alternate treatments over that in corresponding dose of single treatment, the shift being more in alternate treatments than in single. This is in conformity with the results of Kao and Galdecott (1966) in wheat, Sorino (1964) in rice and Narayanan (1970) and Krishnasamy (1967) in cotton.

ii) Spectrum

A wider spectrum of viable mutants was recovered. The deviants from normal plant characters were identified and grouped on stature, duration, leaf, seed, panicle and fertility. The mutant requency computed in the segregating families and the spectrum of viable mutants in the M_1 and AM_1 are presented in the Table 2.

Types of Viable mutants

These mutants represented alterations for individual single plant character.

Stature Mutants

a. Tall types

The height of tall mutants varied from 485.1 to 506.2 cm while it ranged from 440 6 to 461.7 cm in control. One mutant isolated from 40 krad of M and two mutants isolated from 35 krad of AM_1 generation showed increased yield than control. All the other mutants resembled the control but for the height. Mutant with altered height has been reported by many workers in sorghum (Quinby and Karper, 1942; Reddy and Smith, 1975 and Viraktamath and Goud 1978). The tall mutants having yield potential to that of control may be of practical importance because of increased plant growth which may result in ultimate increase in fodder.

b. Dwarf types

These mutants were less than 407.6 cm height and were characterised either by reduced number of nodes or reduced internodal length. Two mutants isolated from the initial dose of 40 krad of AM_1 had panicle with much reduced size and length exhibited reduced fertility and yielded lower than the control.

c. Spreading type

Spreading type mutant was rare in occurrence. This mutant had thin stem with long internodes and the tillers of the lower quarter part were trailed on the ground and the upper stood erect giving a spreading habit.

d Ageotropic earread type

The earhead of these mutants bends downwards with loose and awned spikelets. These mutants were otherwise normal as control in both appearance and yielding ability.

e. High tillering type

These mutants possessed 5 to 7 tillers as against 2-3 in the normal. They yielded 18-25 percent more than the local Irungu cholam.

2. Duration mutants

Mutants with altered duration for maturity were either early or late. The early mutants flowered earlier by 8 to 10 days than the control. They had reduced number of nodes of 12 to 13 as compared to 14-18 in control. In general, they yielded lower than the control. In late mutants, the maturity was delayed by 18 to 24 days. Similar finding have been reported by Gustafsson (1960) and Dahiya (1973).

3. Leaf mutants

Mutants with crinkled leaves, broad leaves, narrow leaves are observed. Most of them were poor yielders. Divergent types of chlorophyll mutants were observed in almost all the treatments.

4. Culm mutant

Culm mutants with long and short internodes were observed with normal plant height. The mutant with shorter internode is high yielding in nature. Three mutants of juicy stalk plant was isolated from 50 krad of M_1 and two from 45 krad of AM_1. The stalk was less pithy and with high juice content than the control.

5. Earhead mutant

Mutant with varying shape of the earhead, viz., compact and lax types were obtained. The compact were characterised by closely developed panicle branches and reduced length. In the lax type mutents, the panicle branches were sparse.

6. Glume Mutants

a. Hairy glume type

In these mutants, the spikelets were highly pubescent, the colour of the hairs was dull white The pubescent nature was also observed in the peduncle and leaf sheath.

b. Half closed glume type

In this mutant the seed is partially covered with the glumes; and make threshing easy. Two mutants were isolated from 35 krad of AM_1 generation.

7. Seed Mutants

Bold seeded and small seeded mutants were obtained in this study. The 100 seed weight of bold seeded mutants ranged from 2.8 to 3.4 g as gainst 1 7 to 2.7 g in control. In the small seeded mutants the 100 seed weight ranged between 1.2 to 1.6 g and yield was less than control. Similar variations in grain size have been earlier reported by Reddy and Reddy (1973) and Regunathan (1977) in rice.

8. Sterile Mutants

In the sterile mutants the sterility ranged from 15.0 to 90.0 percent as against to 5-12 per cent in control. The seeds were shrivelled. Three lines for male sterility were obtained. The occurrence of sterile mutants was more frequent in alternate treatments. This is probably due to increased chromosomal disturbance. The high frequency of sterility was due to second cycle treatment to the population which is already loaded with aberrations caused by first irradiation.

9. Economic Mutants

Six mutants with increased yield ranging from 25 to 65 per cent over control were isolated. In general, they were tall, vigorous with large earheads and had the same duration as that of control. The earheads were either compact or semicompact. These are of considerable practical importance becase they offer scope for direct utilization as improved strains.

Table 1. Frequency of viable mutations in the M_2 and AM_1 Generations

Treatments		Mutation frequency	
First cycle (gamma rays in krad)	Second cycle (Gamma rays in Krad and mm in percentage	Per 100 M_1 plants	Per 100 plants
Control	—		—
35	—	4.97	0.40
40	—	5.60	0.85
45	—	5.88	1.19
50	—	6.58	1.44
55	—	6.26	0.93
60	—	3.85	0.74
AM_1			
35	0.005	10.56	1.02
40	0.005	14.40	1.39
45	0.005	18.63	1.64
50	0.005	22.37	2.93
55	0.005	14.06	1.54
60	0.005	9.62	1.34

Table 2. Spectrum of Viable Mutants In the M_2 and AM_1 Generations

Mutants	Frequency		Percentage	
	M_2	AM_1	M_2	AM_1
Stature mutants				
Tall types	12	24	8.70	10.17
Dwarf types	14	19	10.14	8.05
Spreading types	—	1	—	0.42
Ageotropic types	3	12	2.17	5.08
High tillering types	7	7	5.08	2.97
Duration mutants				
Early types	13	17	9.42	7.20
Late types	2	8	1.45	3.39
Leaf mutants				
Crinkled leaf	3	3	2.17	1.27
Broad leaf	2	5	1.45	2.12
Narrow leaf	2	5	1.45	2.12
Chlorophyll deficient types	3	7	2.17	2.97
Culm mutants				
Longer internode	7	9	5.08	3.81
Shorter internode	2	3	1.45	1.27
Juicy culm	3	5	2.17	2.12
Pithy culm	2	7	1.45	2.97

1	2	3	4	5
Earhead mutants				
Compact earhead	8	13	5.80	5-51
Lax earhead	6	9	4.35	3 81
Long earhead	5	8	3.63	3.39
Short earhead	4	7	2.90	2.97
Glume mutants				
Hairy glume	3	8	2.17	3.39
Half closed glume	1	2	0.72	0.85
Reddish purple	3	4	2.17	1.69
Dull red glume	3	3	2.17	1.27
Dull white glume	—	2	—	0.85
Seed mutants				
Bold seeded types	2	7	1.45	2.97
Small seeded types	4	6	2.90	2.54
Sterile mutants				
Complete sterile	3	7	2.17	2.97
Semi sterile	19	2	13.77	9.32
Male sterile	—	2	—	0.85
Economic mutants	2	4	1.45	1.69
Total	138	236	100.00	100.00

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