International Letters of Natural Sciences *Online: 2015-04-03*
ISSN: 2300-9675, Vol. 37, pp 46-50
doi:10.56431/p-fsymt9

Studies on effect of physical and chemical mutagens in sorghum (*sorghum bicolor* (L.) Moench) in M_2 generation

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Keywords: Sorghum; ethyl methane sulphonate (EMS); Gamma rays; Mutagens

ABSTRACT

Seeds of Sorghum (*sorghum bicolor* (L.) Moench) Variety CSV – 23. Were mutagenesis with gamma rays and EMS to determine their mutagenic sensitivity in morphological and yield characters. The spectrum of Mutation and induced variability for various quantitative and yield traits were observed in M_2 generation. Plant height (cm),total number of leaves, leaf length (cm), leaf width(cm), stem girth (cm),Days taken to first flowering (days),ear head length(cm),ear head width(cm), Grain weight(gm),100 seed weight(gm), Biomass weight(gm).

1. INTRODUCTION

Sorghum (*Sorghum bicolor* (L.)Moench), the second largest grain crop in India until the Green Revolution, Presently occupies the third place in term of Area sown and fourth place in production amongst the food grains. Sorghum is a typically an annual, but some cultivars perennial. Sorghum has a wide agroecological adaptation, drought tolerance, high production, low input crop and more resistant to pest and disease than other food crops. Meanwhile Sorghum also has high nutritive value so that it is very good to be used as alternative food and animal feed sources. Inspite rapid decline in Sorghum area in Asia due to the competition, for another remunerative crop, Sorghum grain production levels have not declined at the same rate of owing to adaptation, of hybrid. Sorghum is a multifunction plant due to its high economic value as a source of food, feed and Industrial raw material of Bio-fuel. The present study is to investigate the effect of mutagens on Morphological, Biochemical, Cytological, Molecular and yield parameters to improve the crop induced by Physical and chemical mutation Pampathy,1986.

Therefore, genetic variability is the basic requirement for making progress in crop breeding Appalsawamy, 2004. The objective of this study, using gamma rays and EMS was to create genetic variability to which improve the Quantitative traits and to evaluates the genetic variation.

Recent advances in Sorghum improvement are mainly due to spontaneous mutation followed by selection and hybridization. Induced mutations received relatively limited attention. A critical review of different aspects of mutagens sensitivity, considering the importance of such factors as genotype constitution of the material. Type of mutagen and dose, techniques of handling. The material and treatment procedures to maximize the induction of mutation together with the scope of induced mutation in sorghum improvement.

2. MATERIALS AND METHOD

The mature healthy and non dormancy uniform size M_1 50 seeds of sorghum variety CSV - 23 already treated were subjected to the Physical and chemical mutagens. The M_1 seeds were pre-soaked in 6 hr fin distilled water, the M1 seeds following concentration 20kr, 30kr,40kr of gamma rays and 30mM, 40mM, and 50mM of EMS. The seeds were washed thoroughly in distilled water and sown in field. Another 50 seeds were soaked in distilled water and used as control. All the M_1 seeds including control were raised 5m long rows with spacing of 30X10 cm between rows and Plant.

The M_2 Generation was grown in the field at the Botanical garden, Department of Botany, Annamalai University. All the recommended culture practices were carried out, during the plant growth period all the treatment including control were raised number of row to row distance 60cm plant to plant distance 15cm, number of replication was 4 between rows and plant respectively. Data of yield attributes were collected and all the data statistically analyzed for each character separately. The mean data of each genotype for different characters were used for statistical analysis. The data's were analyzed by using NPRC software.

2.1. RESULT AND DISCUSION

2.1.1. Quantitative characters in M_2 generation

Table 1. Shows quantitative characters of control as well as treated plants. A significant variation in mean value of plant height and number of leaves was observed ion the treatments of gamma rays and EMS in M_2 generation. Maximum increasing in plant height (166.07 - 171.02) and number of leaves (10.10-10.90) has been observed in 30Kr and 40mM of gamma rays and EMS respectively. In case of leaf length and leaf width maximum at 40mM of EMS (67.80-08.42) compared to control and other concentration of EMS and gamma rays treatment. Similarly, plant height and number of leaves showed significant improvement over the control in M_1 generation of Sorghum with effect of control than gamma rays and EMS Wani and Anis, 2001 the stimulatory effects were showed stem girth at 30 Kr (06.25) and 40mM (07.45)of physical and Chemical mutagens.

Photo 1. Quantitative Character view

Days to first flowering was taken to minimum days mean value in LD_{50} concentration of 30Kr (87.30) and 40mM (82.30) of physical and chemical mutagens. It's due to earned early maturity mutant. It has taken minimum days to maturity of plants. Both the mutagens at higher concentration used a delayed flowering and fruiting might be due to their inhibitory effect. Early flowering was also reported by Dhakshnamoorthy et al.2010 in *jatropha curcus* and Thilagavathi and Mullainathan 2011 in black gram found early mature mutant and seed production.

Table 1. Impact of Physical and Chemical Mutagenesis Treatment on Quantitative Characters in Sorghum

Mutagens	Treatments (Dose/conc.)	Plant height (cm)	Total no. Of leaves	Leaf length (cm)	Leaf width (cm)	Stem girth (cm)	Days taken to first flower
		Mean ±SE	Mean ±SE	Mean ±SE	Mean ±SE	Mean ±SE	Mean ±SE
Control		178.08-0.76	11.10-0.61	68.27-0.38	08.58-0.08	08.04-0.01	90.85-0.52
Gamma rays	20kR	164.08-0.37	09.25-0.50	63.65-6.48	06.98-0.15	05.70-0.17	89.70-0.67
	30kR	166.07-0.48	10.10-0.67	67.08-0.32	07.35-0.11	06.25-0.14	87.30-0.61
	40kR	158.03-0.74	09.00-0.49	62.99-6.99	06.72-0.12	05.77-0.19	89.90-0.53
EMS	30mM	169.07-0.73	10.05-0.54	67.39-0.29	07.78-0.17	06.68-0.18	83.95-0.79
	40mM	171.02-0.72	10.90-0.72	67.80-0.37	08.42-0.14	07.45-0.20	82.30-0.80
	50mM	166.08-0.25	10.30-0.43	67.16-0.27	07.67-0.08	06.54-0.20	86.80-0.56

2.1.2. Yield characters in M_2 generation

Table 2. shows significant variance was observed at Maximum height of ear head length(29.025),ear head width(17.543),100 seed weight(0.061),grain weight(2.593) and Biomass weight(0.086) recorded in 40mM of EMS when compared to that of control and other dose/concentration of gamma rays and EMS while minimum height of ear head length(27.004),ear head width(16.028),100 seed weight(0.048) grain weight(2.521) and Biomass weight. Recorded in 40Kr of gamma rays. A high degree of correlation between height of ear head length and ear head width was reported by Thilagavathi and Mullainathan 2011 in Black gram and RANA and B.S RAO, 2000 in Sorghum. Elangovan et al.2007 and Jain et al. 2010 obtained high yielding genetic variability in yield and maturity in Sorghum plants. Mutation breeding has played a productive role in sustainable agriculture Larik and Jamno, 1993 as it is supplementary approach for crop improvement which increase unselected genetic variability for practical breeding application

Photo 2. Yield character view

Table 2. Impact of Physical and Chemical Mutagenesis Treatment on Yield Characters in Sorghum

Mutagens	Treatments (Dose/conc.)	Ear head length (cm)	Ear head width (cm)	Grain weight (gm)	100 seed weight (gm)	Biomass weight (gm)
		Mean ±SE	Mean ±SE	Mean ±SE	Mean ±SE	Mean ±SE
Control		27.050-0.19	17.037-0.01	0.054-0.10	2.471-0.52	0.080-0.19
Gamma rays	20kR	27.042-0.20	16.064-0.01	0.051-0.14	2.476-0.17	0.079-0.13
	30kR	29.005-0.05	17.110-0.10	0.061-0.36	2.779-0.78	0.084-0.17
	40kR	27.004-0.08	16.028-0.09	0.048-0.17	2.521-0.27	0.072-0.13
EMS	30mM	28.004-0.09	16.086-0.15	0.055-0.11	2.593-0.42	0.082-0.14
	40mM	29.025-0.17	17.543-0.21	0.061-0.12	2.593-0.29	0.086-0.18
	50mM	27.065-0.08	16.046-0.07	0.052-0.10	2.665-0.49	0.080-0.13

Among the different dose of gamma rays and EMS a gradual increase of mean values was observed up to optimal dose when compared to control in M_2 generation.

3. CONCLUSION

In the present study revealed all growth and yield traits were significantly high at 30Kr of gamma rays and 40mM of EMS. Among these two mutagens used, particularly EMS (40mM) was found to be more yield were recorded as compared to control and gamma rays treatments.

From the present investigation it is evident that the wide range of variability for different traits coupled with high heritability and high genetic advances for important yield traits hence selection is effectiveness for these traits. Hence, gamma rays and EMS played a vital role in the crop breeding through Mutation. This stability of genetic variability to be analysed in the next generation for improvement of Sorghum in all Quantitative and Qualitative aspects.

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(Received 05 March 2015; accepted 19 March 2015)