The Pharma Innovation Journal 2019; 8(4): 453-455

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2019; 8(4): 453-455

www.thepharmajournal.com
Received: 09-02-2019
Accepted: 13-03-2019

Madhuri Pradhan
Department of Plant Breeding and Genetics, College of Agriculture, OUAT, Bhubaneswar, Odisha, India

Amitava Paul
Department of Genetics and Plant Breeding, Institute of Agriculture, Visva-Bharati, Sriniketan, West Bengal, India

Correspondence
Madhuri Pradhan
Department of Plant Breeding and Genetics, College of Agriculture, OUAT, Bhubaneswar, Odisha, India

Spectrum and frequency of chlorophyll mutation in Sesame (*Sesamum indicum*)

Madhuri Pradhan and Amitava Paul

Abstract
The field experiment was conducted during post-*kharif* season, 2015 and pre-*kharif* season, 2016 at the Agricultural Farm of Palli Siksha Bhavana (Institute of Agriculture), Visva-Bharati, Sriniketan. Dry and homogeneous seeds of two varieties of sesame were irradiated with different doses of gamma rays viz. 250, 300, 350 and 400 Gy. Different types of chlorophyll mutants were identified in M_2 generation and frequency of mutants and spectrum of chlorophyll mutation was studied. The frequency of chlorophyll mutations increased with increase in the dose of mutagen. The highest frequency of chlorophyll mutation (0.54%) was induced in Tillotoma at 400 Gy treatment. Chlorina was highest in frequency in Rama, whereas, xantha was highest in frequency in Tillotoma. It was also observed that frequency of chlorina was the most frequent chlorophyll mutant followed by xantha > albina in both the genotypes. The variety Tillotoma appeared to be more sensitive towards the mutagenic treatment as compared to Rama.

Keywords: *Sesamum indicum*, γ- rays, chlorophyll, mutation, spectrum, frequency

Introduction

Sesame (*Sesamum indicum* L.) is one of the world's important oil seed crops and belongs to the family Pedaliaceae. It is self-pollinated annual shrub grown in tropical, sub-tropical and southern temperate areas of the world, especially in India, China, South America and Africa. Sesame is commonly known as "Queen of the oil seeds", because among the oil crops, it contains highest oil content and protein. The oil and fatty acid compositions are determined by genetic and environmental factors and the oil content of sesame ranges from 34 to 63%). Sesame seed oil has high shelf life due to the presence of lignans (Sesamin, sesaminol, sesamolinol), which have remarkable antioxidant function, resisting oxidation.

On area basis, sesame is the fifth most important oil seed crop in the world next to soybean, groundnut, sunflower, rape seed and mustard. Globally, yields of sesame are the lowest of all the major oilseed crops. But, its importance is proportionately more than its share of production because of multiplicity of its uses as compared to other oil yielding crops.

Mutation breeding is relatively a quicker method for improvement of crops and induced mutation serves as an effective on development of economically high yielding mutants. Applications of appropriate doses of physical mutagen have brought about adequate mutations that could benefit sesame breeding programme. The mutagenic effect is being reflected in the form of segregation of chlorophyll mutants and it serves as a good indicator to forecast the spectrum of genetic variability that can arise from the mutated sectors (Sengupta and Datta, 2005) [9]. Leaf colour mutations are one kind of most frequently observed mutation in both spontaneous and induced mutant populations, and are often used as a measure to assess the effectiveness of various mutagens. Chlorophyll development seems to be controlled by many genes located on several chromosomes, which could be adjacent to centromere and proximal segment of chromosome (Swaminathan, 1964) [10].

Majority of agricultural crop plants exhibit a high percentage of chlorophyll mutations. The spectrum of induced chlorophyll variations reveals the presence of viable mutations in irradiated population. Thus, provides assurance of the treated population to be mutated up on the mutagenic treatment. The frequency of chlorophyll mutation is being used as a convenient guide for the effectiveness of different mutagen dose.

The present paper deals with the spectrum of chlorophyll mutations and frequency of occurrence of each type as a function of the mutagen. It also attempted to determine chlorophyll mutation rate including the families segregating for one or more types of chlorophyll mutations in M_2 generation.

Materials and Methods

Dry, uniform, bold seeds of variety Rama and Tillotoma each weighing 150g were irradiated with 250,300,350,400 Gy doses of gamma rays (^{60}Co) at BARC, Trombay, Mumbai. The irradiated seed along with the control planted during post-kharif season, 2016 for raising M_1 generation. Single plant seed of M_1 generation was collected for raising M_2 generation during pre-kharif season, 2017.

In M_2 generation, the two-respective control and treatment progenies were screened several times for morphological mutations throughout the crop duration. In the present investigation, different chlorotic abnormalities were scored in sesame. The frequency and spectrum of cholorophyll mutations per 100 M_2 plants were scored at the seedling stage following the classification of Blitox and Gottschalk (1975) [2] as albina, chlorina and xantha. Albina mutants were completely deficient in chlorophyll pigments and were characterised by entirely while leaves and did not survive beyond 8-10 days after germination.

Xantha mutants were characterised golden yellow coloured leaves indicating presence of carotenoid pigments and survived only 15-20 days after emergence.

Chlorina was pale dull green-yellow to yellow-green and was distinguished from xantha by the presence of green in colour. Most of them were either lethal or those recovered green colour after 20-25 days were sterile.

Chlorophyll mutants were identified, tagged and counted until the completion of germination. In the same time normal looking plant population was also counted and recorded dose wise in each variety to estimate the frequency of chlorophyll mutation.

Results and Discussion

The different types of chlorophyll mutations, their frequencies, spectrum and segregation pattern in different gamma- rays treated M_2 populations of Rama and Tillotoma are presented in Table: 1. It is evident from the data that frequency of chlorophyll mutations increased with increase in those of mutagen. This is in agreement with the earlier reports by Sarwar *et al.* (2005) [8], Bouriema *et al*. (2012) [3], Kulkarni *et al*. (2013) [5] Anabarasan *et al*. (2015) [1] and Kumari et al. (2016) [6]. The highest frequency of chlorophyll mutagens (0.54%) was induced in Tillotoma at 400 Gy treatment.

Perusal of Table: 1. Also revealed that in both the genotypes, the frequency of chlorophyll mutations was higher in higher doses. The result showed that among the different mutant classes induced, chlorina was highest in frequency in Rama, whereas, xantha was highest in frequency in Tillotoma. Kulkarni *et al.* (2013) [5], Ravichandran and Jay kumar (2015) [7] reported that cholrina and xantha type of mutant were most frequent in induced sesame mutants. Chlorophyll mutations albina was not observed at 250 Gy in Rama, and this mutant type was found to occur in least frequencies in all the doses of gamma-rays (as compared to other mutant types) in both the genotypes under study. It was observed that frequency of chlorina was the most frequent chlorophyll mutant followed by xantha > albina in both the genotypes.

Marked varietal differences were present in terms of induction of chlorophyll mutations at different dose of gamma-rays. The variety Tillotoma appeared to be more sensitive towards the mutagenic treatment as compared to Rama. Swaminathan (1964) [10] suggested that differences in mutation spectrum and rate in different genotypes might be due to differences in the location on genes in relation to the centromere. Estimation of mutation frequency on the basis of M_2 plants gives the best estimate of actual mutation frequency. Even from breeder's point of view, the frequency of mutation expressed on M_2 population basis is more realistic and helpful.

Moreover, the absence of chlorophyll mutants in the M_1 generation and their appearance in M_2 generation indicates the recessive nature of chlorophyll mutation. Chlorophyll development seems to be controlled by many genes located on several chromosomes, and mutation in this gene may induce chlorophyll mutations.

Table 1: Frequency and spectrum of chlorophyll mutation in M_2 generation Different chlorophyll mutant classes

Dose	Total no. of M_2 seedlings raised	Albino		Chlorina		Xantha		Number of mutant seedlings	Percentage of mutant seedlings (frequency %)
		X	Y	X	Y	X	Y		
Rama									
250 Gy	11444	-	-	10	0.08	7	0.06	17	0.15
300 Gy	9720	1	0.01	21	0.21	7	0.07	29	0.30
350 Gy	8578	3	0.03	25	0.29	10	0.11	38	0.44
400 Gy	6932	10	0.14	32	0.46	19	0.27	61	0.88
Tillotoma									
250 Gy	6721	1	0.01	9	0.13	9	0.13	19	0.28
300 Gy	4567	3	0.04	10	0.21	10	0.21	22	0.48
350 Gy	3456	9	0.26	12	0.34	8	0.23	29	0.84
400 Gy	2589	6	0.23	10	0.38	14	0.54	30	1.16

X = Number of M_2 mutant seedlings

Y = Frequency (Number of individual class per 100 total seedlings)

References

1. Anbarasan K, Rajendran R, Sivalingam D. Studies on the Mutagenic Effectiveness and Efficiency of Gamma Rays, EMS and Combined Treatment in Sesame (*Sesamum indicum* L.) var. TMV3. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2015; 6(4):589-595.
2. Blitox S, Gottschalk W. Mutation in the Leguminosae. 1975; 33:33-85.
3. Bouriema S, Oukarroum A, Diouf M, Cisse N, Damme PV. Screening of drought tolerance in mutant germplasm of sesame (*Sesamum indicum*) probing by chlorophyll a fluroscence, Environmental and Experimental Botany. 2012; 81:37-43.
4. Gaul H. The concept of macro and micro mutations and results on induced micro-mutations in barley, In: The Use of Induced Mutations in Plant Breeding, Pergamen Press, Oxford, 1965, 407-428.
5. Kulkarni GB, Mogle UP. effects of mutagen on chlorophyll mutation in [horse gram *Macrotyloma*

uniflorum (Lam) Verdcourt], Bioscience Discovery. 2013; 4(2):214-219.
6. Kumari V *et al*. Frequency and Spectrum of Mutations induced by Gamma radiations and Ethyl methane sulphonate in Sesame (Sesamum indicum L.), Sci. Agri. 2016; 14(3):270-278.
7. Ravichandran V, Jayakumar S. Effect of Mutagens on Quantitative Characters in M_2 and M_3 generation of Sesame (*Sesamum indicum* L.), International Letters of Natural Sciences. 2015; 42:76-82.
8. Sarwar G, Haq MA. Radiation induced chlorophyll mutation in sesame (*Sesamum indicum* L.). Journal of Agricultural Research. 2005; 43(4):317-322.
9. Sengupta S, Datta AK. Induced narrow leaf mutant of Sesame (*Sesamum indicum* L.). Indian J Genet. 2005; 65(1):59-60.
10. Swaminathan MS. A comparison of mutation induction in diploids and polyploids, In: The use of induced mutations in plant breeding, Rad. Mut. Organ: FAO/IAEA, Vienna, 1964, 619-641.