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Frequency spectrum and segregating pattern of chlorophyll mutations in sesame (*Sesamum indicum* L.)

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Abstract
Sesame (*Sesamum indicum* L.) variety Rama and Tillotoma were exposed to different doses *viz.* 250, 300, 350, 400 and 450 Gy of gamma rays from Bhaba Atomic Research Centre (BARC) and grown (along with control) during pre-*kharif* 2015 and 2016 as M_1 and M_2 generation, respectively, at University experimental farm Visva-Bharati. The spectrum of chlorophyll mutation observed in M_2 generation was found to be quite narrow as only three kinds namely albina, chlorina and xantha occurred in different treatments. Highest mutation frequency of chlorophyll mutations (1.38%) was induced at 350Gy for both variety Rama and Tillotoma, however, chlorina types was more frequent (0.93%) other than two types. All the three types of chlorophyll mutations segregated in the ratio of 15 normal: 1 mutant (P<1.0 in most of the cases) suggesting that inheritance of chlorophyll mutation is governed by double recessive genes.

Keywords: Gamma irradiation, chlorophyll mutation, segregation, sesame, frequency and spectrum

1. Introduction
Sesame (*Sesamum indicum* L.; 2n= 26) is one of the most ancient oil seed crop belonging to the family pedaliaceae and is known for high protein content having high nutritional value similar to that of soybean [5]. It is regarded as "Queen of oilseed" as it is contains highest oil and protein among the oil crops, though, the productivity of sesame is alarmingly poor in India comparing to other oil yielding crops. To improve the seed yield combination the desirable yield component is a pre requisite which can be exploited through selection from the segregating population [1, 2, 8]. Induced mutation by radiation or chemicals is an effective technique to provide variation in plant structure and function from which breeders can select plants having useful traits.
The chlorophyll mutation rate is conveniently being used as a preliminary index of the efficiencies of mutagens and mutability of the variety that could help realize the spectrum of desirable mutations in treated population [4]. Frequency of chlorophyll mutation serves as a good index to determine the different doses of mutagens. Further induced chlorophyll variations serves as diagnostic markers for viable mutation in irradiated population. In the present study, the spectrum and frequency of chlorophyll mutation against different dose of gamma rays along with their segregating pattern in M_2 generation was studied.

2. Materials and Methods
2.1 Location of experiments
The study was carried out at Agriculture Farm of Palli Siksha Bhavana (Institute of Agriculture), Visva-Bharati, Sriniketan ($23^0 29^/$ N latitude and $87^0 42^/$ E longitudes and at an altitude of 58.9 m above the mean sea level under sub-humid, sub-tropical, lateritic belt of West Bengal) in pre-*kharif* season of 2015 and 2016.

2.2 Plant materials and their basic characteristics
Two selected popular sesame genotypes from West Bengal, India had following characteristics:

2.2.1 The genotype "Rama": brown, rough, glossy seeds (1000 seed weight ~ 3.5gm), medium in size and maturity (92-100 days);

2.2.2 The genotype "Tillotoma": black, rough, dull seeds (1000 seed weight ~ 3.1gm), medium in sizes and maturity (100-110 days).

2.3 Gamma irradiation
10,000 dry, uniform and healthy seeds of these two genotypes of sesame were irradiated using ^{60}Co (Cobalt 60) gamma source (Gamma Chamber 900) with different doses (250, 300, 350, 400, 450 Gy) of gamma rays at the Bhabha Atomic Research Centre (BARC), Trombay, India.

2.4 Experimental layout
Irradiated seeds (M_0) along with the controls (un-irradiated) were sown in the field (treatment and variety wise) in a Split Plot Design with three replications in twelve rows plot of 5m length keeping plant to plant and row to row distance of 10 and 30 cm., respectively during pre-*kharif* season 2015. Four to five capsules of each M_1 plants against all the treatments were collected separately to rise the M_2progenies during next pre-kharif sesason 2016, for attempting desirable selection.

2.5 Observations taken
Observations were taken on various types of chlorophyll mutation to study the mutagenic effect of different doses in M_2 generation. Chlorophyll mutants were identified tagged and counted just after germination. The process continued for a few days until the completion of germination. At the same time, normal looking plant population was also counted and recorded dose wise in each variety to estimate the chlorophyll frequency.

2.6 Statistical analysis
Frequency of chlorophyll mutations wereestimated following the modified classification of Blixt [3] and their segregation pattern were studied through chi-square (χ^2) test outlined by Panse and Sukhatme [7]. All statistical analyses were carried out by SPSS 20.0 and Microsoft's Excel 2007.

3. Results and Discussion
Different types of chlorophyll mutations, their frequencies, spectrum and segregating pattern in different gamma rays treated in M_2 populations of Rama and Tillotoma are presented in Table 1, Fig. 1 (a, b, c). It is evident from the data that differential response of genotypes i.e. marked varietal differences were present in terms of induction of chlorophyll mutations at different doses of gamma rays. Three types of chlorophyll mutant such as albina, chlorina, xantha were recorded in different frequencies with highest mutation frequency of chlorophyll mutations (1.38%) was induced at 350Gy for both variety Rama and Tillotoma. In this investigation, chlorina type chlorophyll mutations were highest (0.93%) at 350Gy in the variety Rama; however, albino type chlorophyll mutations were highest (0.54%) at 250Gy in the variety Tillotoma. Thus, most of the mutations showed independent response to different doses of the gamma rays as they occur at random.

Table 1: Frequency, spectrum and segregating pattern of chlorophyll mutations in M_2 generation in sesame.

Variety	*Dose (Gy)*	*Total no. of M_2 progenies studied*	*Total no. of progenies segregating*	*Total no. of M_2 seedling studied*	*No. of mutant seedling*	*Mutation frequency (Mf %)*	*Spectrum and frequency of chlorophyll mutation*						*Chi-square (χ^2) value (1:15)*
							Albina		*Chlorina*		*Xantha*		
							Mutant	**Normal**	**Mutant**	**Normal**	**Mutant**	**Normal**	
Rama	Control	10	0	626	-	-	-		-		-		-
	250	192	42	14299	138	0.97	38 (0.27)	508	56 (0.39)	825	44 (0.31)	794	0.47^{a}
													0.02^{c}
													1.47^{x}
	300	176	59	10926	139	1.27	34 (0.31)	500	55 (0.50)	762	50 (0.46)	703	0.61^{a}
													0.33^{c}
													0.19^{x}
	350	154	85	8697	120	1.38	19 (0.22)	326	81 (0.93)	1190	20 (0.23)	289	0.32^{a}
													0.04^{c}
													0.02^{x}
	400	142	50	8226	100	1.22	32 (0.39)	393	41 (0.50)	691	27 (0.33)	381	1.78^{a}
													0.52^{c}
													0.09^{x}
	450	96	39	5518	59	1.07	42 (0.76)	597	10 (0.18)	188	7 (0.13)	96	0.12^{a}
													0.48^{c}
													0.05^{x}
Tillotoma	Control	10	0	589	-	-	-		-		-	-	--
	250	184	38	17645	153	0.87	23 (0.13)	302	35 (0.20)	498	95 (0.54)	1320	0.38^{a}
													0.09^{c}
													0.52^{x}
	300	154	69	12425	152	1.22	35 (0.28)	456	52 (0.42)	638	65 (0.53)	899	0.64^{a}
													1.94^{c}
													0.39^{x}
	350	150	61	8383	116	1.38	40 (0.48)	521	32 (0.38)	503	44 (0.52)	695	0.75^{a}
													0.06^{c}
													0.12^{x}
	400	128	52	8057	105	1.30	35 (0.44)	383	41 (0.51)	564	29 (0.36)	452	3.21^{a}
													0.23^{c}
													0.04^{x}
	450	64	40	7958	74	0.93	29 (0.36)	299	26 (0.33)	335	19 (0.24)	305	3.75^{a}
													0.55^{c}

Figures in parentheses are the percentage values; Alphabetical superscripts indicating ^{a} = albina, ^{c} = chlorina, ^{x} = xantha

All the three types of chlorophyll mutations segregated in the ratio of 15 normal: 1 mutant (P<1.0 in most of the cases) (Table 1) suggesting that inheritance of chlorophyll mutation is governed by double recessive genes.

Chlorophyll mutation rate is a critical parameter to determine the effectiveness and efficiency of treatment of different mutagens. Several scientists [2, 6, 8] has described and classified several chlorophyll mutations (albina, chlorina, xantha) in sesame and other crops. According to Swaminathan [9], chlorophyll development seems to be controlled by many genes located on several chromosomes which could be adjacent to centromere and proximal segments of the chromosome.

(a) (b) (c)

Fig. 1: Rama 300 Gy *Chlorina* chlorophyll mutation (a), Rama 450 Gy *Xantha* chlorophyll mutation (b), Tillotoma 450 Gy *Albina* chlorophyll mutation (c).

4. Conclusion

It is, therefore, concluded that although the chlorophyll mutations do not have any economic value due to their lethal nature, such a study could be useful in identifying number of economically useful mutants in the segregating generations as well as helpful in the selection of new elite recombinants.

5. References

1. Ambavane AR, Sawardekar SV, Sawantdesai SA, Gokhale NB. Studies on mutagenic effectiveness and efficiency of gamma rays and its effect on quantitative traits in finger millet (*Eleusine coracana* L. Gaertn). Journal of Radiation Research and Applied Sciences 2015; 8:120-125.
2. Bara BM, Chaurasia AK, Verma P. Gamma rays effect on frequency and spectrum of chlorophyll mutation in chickpea (*Cicer arietinum* L.). Journal of Pharmacognosy and Phytochemistry 2017; 6(3):590-591.
3. Blixt S. Mutation genetics in Pisum. Agriculture and Horticultural Genetics 1972; 30:1-293.
4. Gaul H. Mutation in plant breeding. Radiation Botany, 1964; 2(1):12-16.
5. Naerls. Beniseed production and utilisation in Nigeria. Extension Bulletin No 154, Horticulture Series No 5. 2010. Available at www.naerls.gov.ng /extmat/ bulletins/ Beniseed.pdf.
6. Paul A, Singh DP. Frequency Spectrum and segregation pattern of chlorophyll and macro mutations in field pea (*Pisum sativum*). Legume Research, 2005; 28(2):94-98.
7. Panse VG, Sukhatame PV. Statistical methods for Agricultural workers. ICAR publication, New Delhi, 1985; 3:68-96.
8. Sarwar G, Haq MA. Radiation induced chlorophyll mutation in sesame (*Sesamum indicum* L.). Journal of Agriculture Research, 2005; 43(4):317-322.
9. Swaminathan MS. The induced mutation in plant breeding, FAO/IAEA, Vienna 1964, 619-641.