



## Effect of physical and chemical mutagens on Chlorophyll mutations in M<sub>2</sub> generation in Linseed (*Linum usitatissimum* L.)

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### Abstract

In mutation breeding programme frequency of chlorophyll mutation is useful in assessing the potency of mutagen and it is also an indicator of factor mutation and dependable index for evaluating genetic effects of mutagenic treatments. Frequency of mutation helps study of specific gene products which responsible for chlorophyll synthesis. The spectrum of chlorophyll mutations became broader with increasing concentrations of the two mutagens in both the cultivars of Linseed. In the present investigation different types of chlorophyll mutant obtained, comprised: *xantha*, *chlorina*, *viridis* and *albino*. In the present study it has been shown that the *chlorina* mutants were predominant in variety RLC-4 then Sharda variety of Linseed. Marked varietal differences were present in the expression of induction of chlorophyll mutations at different doses/concentrations of mutagens due to genetic differences existing among the two varieties.

### INTRODUCTION

Linseed (Flax) belongs to the genus *Linum*, one of the ten genera in the family Linaceae. Cultivated flax pertains to the species, *Linum usitatissimum*, having two types: one is grown for oil (linseed) and the other for fibre (fibre flax). Flax fibres are superlative to cotton in textile properties. Flax ranked third largest natural fibre crop and one of the five top oilseed crops in the World. In Indian region flax is grown predominantly for linseed oil for human consumption, which was commercially utilized for paint, varnish, finished leather and printing ink.

Linseed is homogenous, and individual plants are considered homozygous (Anonymous, 1996). It is an annual plant growing 110 cm tall, with slender stems. The leaves are green, 15-35 mm long and 2 mm broad. The flowers are majorly pure pale blue and of various other colors, 10-20 mm diameter, with five petals. The fruit of Linseed is a round, dry capsule 5-9 mm diameter, which may

contain up to ten seeds when filled (Freeman, 1995).

Mutation breeding has a much greater potential to enhance the available traits in flax, including further modification to fatty acid profiles and the reduction of bast fiber content (McKenzie, 2011). Mutation breeding may have potential in the future to remove undesirable compounds from flaxseed, such as cyanogenic glycosides and linatine (Green *et al.*, 2008).

### MATERIALS AND METHODS

In the present investigation the two varieties of Linseed were practiced namely RLC-4 and Sharda. The experimental seeds procured from Regional Oilseed Research Centre Latur, Maharashtra. The seeds of both varieties of Linseed were treated by physical mutagen (10kR, 20kR and 30kR) doses of gamma rays and two chemical mutagens 0.5%, 0.10% and 0.15% Ethyl methane sulphonate (EMS) and 0.02 %, 0.04% and 0.06% concentration of Sodium azide (SA).

The types of chlorophyll mutations scored were *xantha*, *chlorine*, *albino* and *viridis* in different treatments. Chlorophyll mutations were scored in the M<sub>2</sub> generation of mutagen treated material at 2 to 3 leaf stage and was classified according to the system suggested by Gustafsson (1940). The frequency of chlorophyll mutants was calculated according to Gaul (1957) i.e. number of mutants /100 M<sub>2</sub> plants.

## RESULTS AND DISCUSSION

The chlorophyll mutations observed in the M<sub>2</sub> populations were comprised of *albina* (white), *Xantha* (yellow), *Chlorina* (yellowish green) and *viridis*. The *albina* and *Xantha* types of chlorophyll mutants did not survive, while *viridis* and *chlorine* were viable mutants and survived up to maturity.

The spectrum of different types of chlorophyll mutants in variety RLC-4 represents the frequency of *chlorina* mutant was highest (4.68%) in 0.04% SA mutagens followed by *xantha*, *albina*, and *viridis*. The SA mutagenic treatments represent highest frequency of chlorophyll mutation in *xantha* (4.24%) and *viridis* (4.32%) as compared to EMS and Gamma rays.

In variety Sharda, *chlorina* mutant's represents highest frequency (4.98%) in 0.06% SA treatments, the *chlorina* mutant was highest frequency followed by *xantha*, *viridis* and *albina*.

SA mutagen represents highest frequency of chlorophyll mutation as compared EMS and Gamma rays mutagens. All the doses of EMS, SA and Gamma rays were found to be effective in producing different types of chlorophyll mutants. But the occurrence of frequency of these chlorophyll mutants was found to be independent of mutagen concentrations.

In the present study the frequency of chlorophyll mutants was high in variety Sharda compared to RLC-4 variety of Linseed. This varietal difference with respect to the frequency of chlorophyll mutations may be attributed due to differences in radio sensitivity. The varietal differences and variations in incidence of chlorophyll mutations are due to the differences in the number of genes controlling the chlorophyll development in different varieties. Similar results have been obtained by Mackey (1967) in diploid wheat; Panda (1973) reported the gamma rays to be more effective in producing the chlorophyll mutations as compared to chemical mutagens in two varieties of wheat. The chlorophyll mutations were more effective in gamma ray treatment than EMS in the studies of Jambhale and Nerkar (1982), in okra. Malani *et al.* (1993) reported that the frequency of chlorophyll mutations was highest at 20kR gamma ray treatment in variety selection 2-2 of okra.

**Table: 1. Effect of mutagens on the frequency of chlorophyll mutant in M<sub>2</sub> generation in Linseed. Variety: RLC-4.**

Treatment	Concentration /Dose	Total No. of seedling recorded	No. of mutant	Total mutation frequency (%)
Control	-	-	-	
EMS (%)	0.05	503	4	0.80
	0.10	652	6	0.92
	0.15	523	11	2.10
SA (%)	0.02	654	16	2.45
	0.04	547	14	2.56
	0.06	499	17	3.41
Gamma rays	10 kR	465	11	2.37
	20 kR	538	10	1.86
	30 kR	624	17	2.72

**Table: 2. Effect of mutagens on the frequency of chlorophyll mutant in M<sub>2</sub> generation in Linseed. Variety: Sharda**

Treatment	Concentration /Dose	Total No. of seedling recorded	No. of mutant	Total mutation frequency (%)
Control	-	-	-	-
EMS (%)	0.05	463	8	1.73
	0.10	685	12	1.75
	0.15	563	10	1.78
SA (%)	0.02	467	12	2.57
	0.04	351	15	4.27
	0.06	743	16	2.15
Gamma rays	10 kR	563	9	1.60
	20 kR	649	11	1.69
	30 kR	275	13	4.72

**Table: 3. Effect of mutagens on the spectrum of chlorophyll mutant in M<sub>2</sub> generation in Linseed. Variety: RLC-4.**

Treatment	Concentration /Dose	Frequency of chlorophyll mutants	Relative % of Chlorophyll mutants.			
			<i>Albino</i>	<i>Xantha</i>	<i>Chlorina</i>	<i>Viridis</i>
Control	-		-	-	-	-
EMS (%)	0.05	0.80	0.42	1.12	2.30	1.16
	0.10	0.92	0.23	1.45	2.33	2.12
	0.15	2.10	-	2.65	2.32	2.54
SA (%)	0.02	2.45	0.36	3.65	3.99	3.28
	0.04	2.56	-	<b>4.24</b>	<b>4.68</b>	4.21
	0.06	3.41	0.50	3.54	3.96	<b>4.32</b>
Gamma rays	10 kR	2.37	0.48	1.32	1.33	1.54
	20 kR	1.86	0.68	1.34	1.64	1.26
	30 kR	2.72	0.84	2.16	2.92	2.42

**Table: 4. Effect of mutagens on the spectrum of chlorophyll mutant in M<sub>2</sub> generation in Linseed. Variety: Sharda.**

Treatment	Concentration /Dose	Frequency of chlorophyll mutants	Relative % of Chlorophyll mutants.			
			<i>Albino</i>	<i>Xantha</i>	<i>Chlorina</i>	<i>Viridis</i>
Control	-		-	-	-	-
EMS (%)	0.05	1.73	-	1.34	2.46	1.82
	0.10	1.75	0.72	1.68	1.94	1.76
	0.15	1.78	0.46	1.99	2.53	2.32
SA (%)	0.02	2.57	0.87	2.28	3.87	3.12
	0.04	4.27	0.49	3.21	4.16	3.54
	0.06	2.15	1.08	<b>3.42</b>	<b>4.98</b>	<b>3.96</b>
Gamma rays	10 kR	1.60	0.32	0.92	1.43	1.37
	20 kR	1.69	1.48	0.84	2.31	1.67
	30 kR	4.72	0.83	1.35	2.54	1.59

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