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RADIATION INDUCED CHLOROPHYLL MUTATIONS IN CHILIPEPPER (*CAPSICUM ANNUUM L*)

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Dry and dormant seeds of *Capsicum annuum* L Var PC 1 were exposed to different doses of gamma rays (50-50 KR) with a dosage rate of 5/KR/min. Six different chlorophyll deficient mutant types viz, Albina, Xantha, Chlorina, Xanthalba, Alboviridis and Virescence were isolated in several M_2 and M_3 progeny lines. The frequency and spectrum of chlorophyll mutants were found to be mostly dose dependent, Albina type predominated over other types. All the mutant types were recessive and are controlled by a single gene.

Keywords : *Capsicum annuum* L.; Chlorophyll mutations; Gamma rays.

Introduction

The role of induced mutations in developing new and better cultivars has by now been well recognised. Among the various mutagens ionising radiations remain the most potent tool in creating genetic variability. Chlorophyll mutations are one among the few dependable parameters for evaluation of genetic effects of various mutagens and are widely used as genetic markers in basic and applied research. *Capsicum annuum* L. is an important condiment and vegetable. Despite its economic importance as a cash crop not much mutational work has been carried out on this taxon. An attempt has now been made to induce useful mutations by gamma rays in chili pepper (*Capsicum annuum L*) with a view to elucidate valuable information about the genetic variants as well as the mechanism of genetic changes. Results on frequencies, spectrum of induced chlorophyll mutation and their inheritance are communicated in this paper.

Materials and Method

Dry and mature seeds of *Capsicum annuum L* var PC I with about 8% moisture were irradiated with gamma rays ranging from 5-50 KR/min with a dosage rate of 5 KR/ min. ^{60}Co was the source of gamma rays at Centre for Nuclear Techniques, Andhra University, Visakhapatnam. The treated seeds were sown in flower pots and later raised the cultures in the experimental plots of the Botany farm, A. U. and the different M_1 progenies were scored for various parameters. Seeds from each plant M_1 were harvested separately and sown at random in M_2 on a plant to progeny basis (individual M_2 lines). Frequency, spectrum and segregation of different chlorophyll mutants were scored. A few plants (heterozygous) were randomly taken from lines segregating for chlorophyll mutants in M_2 and seeds of these plants were shown to raise M_3 cultures to study the segregation pattern of the chlorophyll mutants. The chlorophyll mutation frequency was calculated dose wise per 100 M_2 plants[1].

Results and Discussion

Six types of chlorophyll deficient mutant seedlings were isolated in several M_2 lines of *Capsicum annuum L* var PC 1. The classification of chlorophyll mutants in Barely[2] was followed currently. The data on chlorophyll mutants and their frequencies in M_2 and M_3 progenies was provided in table-1. The spectrum of chlorophyll mutants comprised of Albina, Xantha, Chlorina, Xanthalba, Alboviridis and Virescence. The chlorophyll mutants recorded are described below.

1. Albina : Seedlings white; Lethal (7-10 days). The leaves of the mutant seedlings relatively smaller than in the corresponding control. Chlorophylls or carotenoids are not formed.
2. Xantha : Seedlings were strew yellow to yellowish white. They exhibited normal growth initially but started withering away from 10th day and died

Table 1. Frequency and spectrum of Chlorophyll mutations induced by Gamma-rays in M_2 nas M_3 generations of *C. annuum Var* PC 1.

Dose KR	Generation	Spectrum of Chlorophyll mutants (%)						
		Albina	Xantha	Chlorina	Xanthalba	Alboviridis	Virescence	Total
5 KR	M_2	3.59	2.05	1.54	1.03	0.77	0.51	9.49
	M_3	4.62	2.56	2.05	1.54	1.28	1.28	13.08
10 KR	M_2	4.53	1.60	1.07	1.60	1.07	0.53	10.40
	M_3	5.87	2.93	2.67	2.13	1.60	1.06	16.53
15 KR	M_2	5.51	2.61	1.16	0.58	1.16	0.86	11.88
	M_3	6.96	3.48	3.48	1.16	2.03	1.46	18.55
20 KR	M_2	6.36	3.03	0.91	0.61	1.82	0.91	13.64
	M_3	8.18	4.24	4.24	1.12	2.72	2.12	22.73
25 KR	M_2	7.08	3.69	1.23	--	1.53	1.85	15.38
	M_3	8.92	4.62	4.92	--	2.46	2.78	24.41
30 KR	M_2	7.81	3.13	2.50	2.18	--	1.25	16.87
	M_3	11.0	5.31	5.62	2.81	--	2.81	26.56
35 KR	M_2	9.33	3.67	2.33	1.67	1.33	1.67	20.00
	M_3	12.0	5.67	6.00	3.33	2.67	3.33	30.00
40 KR	M_2	10.34	5.86	2.08	--	2.06	1.38	21.72
	M_3	13.10	6.21	6.28	--	3.44	3.45	32.41
45 KR	M_2	11.85	6.67	2.59	1.85	--	1.11	24.07
	M_3	14.81	7.03	6.67	3.70	--	3.70	35.92
50 KR	M_2	13.08	7.69	2.31	1.54	1.15	--	25.77
	M_3	15.76	8.84	6.92	4.23	3.84	--	39.61

Table 2. Segregation in different chlorophyll mutants in M_2 and M_3 generations (pooled data) of *C. annuum Var* PC 1.

Chlorophyll Mutant	M_2 generation					M_3 generation				
	Frequency of		Total	X^2 (3:1)	P	Frequency of		Total	X^2 (3:1)	P
	Normal	Mutant				Normal	Mutant			
Albina	780	243	1023	0.847	0.50-0.30	962	307	1269	0.441	0.70-0.50
Xantha	392	121	513	0.546	0.50-0.30	482	156	638	0.113	0.80-0.70
Chlorina	186	58	244	0.196	0.70-0.50	428	146	574	0.059	0.80-0.70
Xanthalba	117	35	152	0.316	0.70-0.50	212	66	278	0.234	0.70-0.50
Alboviridis	112	35	147	0.073	0.80-0.70	197	63	260	0.083	0.80-0.70
Virescence	102	32	134	0.089	0.80-0.70	216	69	285	0.095	0.80-0.70

within 15 days. Carotenoids were present but chlorophylls were absent.

3. Chlorina : Seedlings pale yellowish green to yellowish green; Lethal (10-15 days). Rarely survived upto 30 days. However a few light yellowish green type seedlings not only survived till maturity but also set a few seeds.
4. Xanthalba : Seedlings were Albina type initially but turned yellowish later. Growth of the mutant seedlings was less than that in the normal. These died within 15 days except a few raised from 5KR and 15KR M_2 progenies. These survived till maturity but failed to set seed.
5. Alboviridis : Seedlings apparently were normal looking upto 30 days. Subsequently the tip of some of the leaves turned white. These survived till flowering and also set seed.
6. Virescence : Seedlings in the early stages, light green, subsequently changed to dark green colour and viable. These produced normal flowers and seeds.

Among the six chlorophyll mutants currently investigated, Albina predominated followed by Xantha, Chlorina, Xanthalba and Virescence in that order (Table 1). Similar trend was also reported in gamma ray induced chlorophyll mutants of cotton[3] and Triticale[4]. Nevertheless, such a pattern was not discernible in the chemical mutagens[5,6] and X-rays[7] treated M_2 progenies of Chillies though the cultivars employed were different.

The data further indicates a linear relationship between the dosage of the mutagen and the frquency and spectrum of chlorophyll mutations with a few exceptions. Such concomitant relationship was also reported in the chlorophyll mutants induced in several crops[8-14]. Besides, the mutagenic effectiveness decreased with an increase in the dose of the mutagen with a few exceptions. Similar pattern, though not in its entirely, was also recorded in Cowpea[12]. However in certain doses of gamma ray chlorophyll deficient mutant types viz; Xanthalba (25 and 40KR), Alboviridis (30 and 45 KR) and Virescence (50KR) have not been realised in M_2 and M_3 lines.

The presence/absence of chlorophyll mutants in some doses of gamma rays could be attributed to the differences in the availability of mutagenic loci to the mutagen. In the irradiated M_2 and M_3 progenies of Triticale[4], also certain chlorophyll mutant types in certain doses of gamma rays, were not pronounced.

The segregation of chlorophyll mutant types from apparently normal looking M_1 plants (heterozygous) was studied in individual M_2 and M_3 progeny lines. The frequencies of these chlorophyll mutants

in M_2 and M_3 lines was given (Table-1). The segregation pattern of all the six chlorophyll mutant types showed a good fit to 3:1 (Table 2). Hence the chlorophyll mutant of the present study are controlled by a single recessive gene as revealed by their segregation pattern in M_2 and M_3 progenies (Table 2). The elimination of recessive chlorophyll deficient lethals either due to genetic or zygotic or embryonal selections probably was negligible. This view was also shared by researchers on induced mutants of *Vigna radiata*[15], *Phaseolus mungo*[16] and Triticale[4]. Albina and Xantha types of the present study died with in 10-15 days after germination while Xanthalba and alboviridis survived upto 2 to 8 weeks. This suggest that these mutations are caused by the complete or incomplete gene blockage at various biochemical steps in the synthesis of photosynthetic green pigment, the chlorophyll, resulting in extreme lithality in the first two mutant types and partial lithality in others which facilitates their survival for longer periods and also allows to set seed in some.

The present study is the first report in gamma-ray induced chlorophyll mutantions in chillies and envisages tremendous potentialities in creating a diverse array of mutant phenotypes.

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