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MUTAGENIC EFFECTIVENESS AND EFFEICIENCY OF GAMMARAYS AND ETHYL METHANE SULPHONATE AND THEIR COMINED TREATMENTS IN PAPRIKA (*CAPSICUM ANNUUM* L.)

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Summary

The effectiveness and efficiency of gamma rays and EMS in relation to chlorophyll mutations were studied in two rvrieties of paprika (*Capsicum annuum* L.) *viz.,* Ktp1-19 and Bydagi Kaddi in M_2 generation. Four types of cholorphyll mutants namely albina, xantha, chlorine, and viridis were observed. Orccurrence of chlorine type was found to be most frequent in the spectrum of chlorophyll mutants. The gamma rays caused more viable mutations affecting plant stature, leaf modification, duration, fruit type and colourant change followed by combination and EMS tratments.

सारांश

पैपरिका की प्रजाति के0 टी.पी.एल.–19 व ब्यादागी कद्दी का गामा किरणें तथा ई.एम.एस. द्वारा उत्परिवर्तित पैधों का अध्ययन किया गया। पौधों में चार प्रकार कें हरित लवक उत्पारिवर्त्य जैसें–अल्बीना, जैन्थरा, क्लोरीना व वोरीडीस पाये गये। हरति लवक उत्परिवर्त्य में क्लोरीना प्रकार की उपस्थिति बारम्बारता सबसे ज्यादा रही। गामा किरणें सबसे ज्यादा प्रभावी उत्परिवर्तन कारक पौध संरचना, पत्तीसंपरिवर्तित, समयकाल फल प्रकार तथा रंग परिवर्तन के लिए रहा। इसके बाद संयुक्त व ई.एम.एस. शोधक पाया गया।

Introduction

Mutation breeding offers a great scope for genetic improvement in any crop. Matants can also be incorporated into crossing programmes as conventional alleles to obtain the desired genotypes. The chlorophyll mutation rate is conveniently being used as preliminary index of effectiveness of mutagens and mutability of the variety which in turn could be helpful to realize the spectrum of desirable mutaitons in the trated populations. It also serves as a good indx for determining the doses of different mutagens. The proeent paper deals with the observations on effectiveness and efficiency in terms of seedling injury, lethality and chlorophyll mutations in M_2 generation of paprika (*Capsicum annuum* L.) induced by gamma rays and EMS.

Materials and Methods

Two paprika varieties viz. KtPI -19 and Bydagi Kaddi were treated with gamma rays (5 kR to 40 kR) and EMS (0.05% to 0.5%). The treated seeds song with their respective controls were sown immmdeately in the field to raise the M_1 generation with three replications in a Randomized Block Design during 2007-2009 at HC & RI, Coimbatore. Each M_1 plant was harvested individually and raised as M_2 progeny in separate rows during Jan-Mar(2008). The progeny of each M_1 plant constituted one M_2 family. Thte spacing between rows and plants were 60 and 45cm respectively. In M_2 generation, chlorophyll mutants were secored in five too fifteen day old seedlings and chlorophyll mutants were classified following the classification of Gustafsson (1940). The chlorophyll mutation frequency was calculated on M_1 plant and M_2 seedling basis. The mutagenic ettectiveness and efficiency were estimated following the method of Konzak et al. (1965). The most extensive studies to alter the spectrum of mutations and to achieve some degree of spectrum of mutagen specificity in hgher plants have been carried out with the chlorophyll deficient mutations because of their ease in detection and frequent appearance following mutagenic treatment (Nilan *et al.,* 1967). This was successfully procured through the following.

Results and Discussion

The frequencies of occurrence of chlorophyll deficient seedlings in the M_2 arre chiefly used as a dependable measure of genetic effects of mutagens. The frequency of chlorophyll mutation in M_2 generation has been suggested as the most reliable index of mutation rate because of greater accuracy of scoring (Gustaffson, 1940 and Gaul, 1946).

The number of plants segregated for chlorophyll deficiency on the basis of M_1 plant and M_2 sedlings were computed and furnished in Table 1. mutation rate in the crops can be computed by three methods *viz.*, (i) estimation of mutation rate per 100 M_1 plants, (ii) number of mutation per 100M_1 plants and (iii) number of mutation per 100 M_2 seedling. Of these, estimation of mutation frequency on M_2 seedling basis has been ranked as the best method as it is proportional to the initial mutation rate and its rather independent of the variations in progeny size and is also proportional to the sizes of the mutated sector (Gaul,1960). This has been further confirmed by Blixt (1966) in pisum. Further , D' Amato *et al.* (1962) stated that the expression of mutation frequency on M_2 generation plant basis leads to over estimation of the mutation rate and it differs from diplontic selection as shown byh a drop in mutation frequencies at higher doses.

In the present study, the paprika varieties Kt Pl-19 and Bydagi kaddi showed lower frequency of chlorophyll mutation at 10 kR. Similarly in EMS treatment, lower frequency of chlorophyll mutation was also noticed at 0.1% EMS in both the varieties. The present findings are in agreement with the findings of Sethupathi Ramalingam (1977), Pamidi Venkateswarlu (1986) and Rao *et al.* (1991) in chilli anf Thamaraiselvan (2004) in Tomato.

It is therefore, concluded here that although the chlorophyll mutations do not have any economic valued due to their lethal nature, such a study could be highly useful in identifying the threshold dose of a mutagen that would increase the genetic variability and number of economically useful mutants in the in the subsequent segregating generations.

Spectrum of chlorophyll mutants: Qualitative output of mutations in M_2 generation is expressed mutation spectrum. The chlorophyll mutation spectrum in the present study, comprised of albina, xantha, chlorian and viridis. The chlorine mutant plants were light green or pale green which persisted for throughout the crop growth period. The albina mutants which were white and without chlorophyll in leaves, branches or stem did not survive after few days. The chlorine and viridis were of more frequent in the varieties than albina and xantha. The chlorine and viridis mutants were more in all treatments irrespective of varieties tested.

A significant spectrum induced by alkylating agents and longing radiations wasdemonstrated earlier in many crops (Nilan and Konzak), 1961). The spectrum of induced mutants obtained in the present study differed between gamma rays and ethyl methane sulphonate. In both varieties 15 kR gamma irradiated mutant, 0.05% EMS and lower doses of combination were highly effective in producing wide spectrum of chlorophyll mutants. EMS was fond to induce more of chlorine types in paprika. Swaminathan *et al.* (1969) explained that a high frequency of particular type of chlorophyll mutation may be due to preferential action of EMS. The chlorophyll mutant such as xantha, chlorine and viridis were also reported by Pamidi Venkateswarlu (1986) in chillies, Vedamuthu (1991) in coriander, Sathyamoorhy (1997) in Bhendi and Thamaraiselvan (2004) in tomato

The gamma rays, EMS and combined treatments were found to be equally potent in inducing chlorophyll mutation as reported by Augustine *et al.* (1975) AND Pamidi VEnkateswarlu (1986) in chillies. Thus,it is clearly evident that number and type of chlorophyll mutations depend not only on type of mutagens but also on the varieties used.

Mutagenic effectiveness and efficiency: The data on mutaenic effectiveness and efficiency are furnished in Table 2 . among the gamma treated population of Kt Pl-19, the most effective and efficient dose on lethality and injuiry basis was 15 kR treatment. Similarly, in Bydagi kaddi also, the most effective dose based on ijury was 15 kR treatment. Among EMS treated population, the most effective and efficient dose was dose was 0.05% for KtP1-19 on injury basis. Whereas for variey Bydagi kaddi, the most efficient dose based on lethality and injury was also 0.05% EMS. A slight

Table 1. Frequency and spectrum of chlorophyll mutants in M_2 generation of paprika cultivar Bydagi Kaddi.

Treatment	Mutation Frequency		Spectrum of chlorophyll mutants							
	Ktp 1-19	Bydagi Kaddi	Ktp1-19				Bydagi Kaddi			
			Albina	Xantha	Chlorina	Viridis	Albina	Xantha	Chlorina	Viridis
Gamma rays										
10kR	2.32	2.19	–	12.00	18.00	12.00	4.00	169.00	22.00	2.00
15kR	4.96	5.47	–	18.00	26.00	–	–	13.00	25.00	–
20kR	2.35	4.58	–	21.00	20.00	2.00	–	19.00	21.00	2.00
EMS										
0.05%	5.00	3.90	–	--	36.00	–	–	–	46.00	–
0.1%	4.73	3.74	–	10.00	23.00	6.00	–	11.00	23.00	3.00
0.2%	7.85	6.29	–	8.00	21.00	9.00	–	14.00	24.00	4.00
Combinations (Gamma rays +EMS)										
15kR+0.1%	3.57	2.45	–	19.00	26.00	–	–	8.00	27.00	–
20kR+0.2%	7.74	5.22	–	22.00	20.00	–	–	12.00	23.00	–

Table 2. Mutaenic effectiveness and efficiency based on chlorophyll mutants of paprika cultivar KtP1-19

Treatments	%survival reduction at 30 days (lethality)	%height reduction at 30 days (injury)	Mutation (M) per 100 M_2 seedlings	Effectiveness MX 100 Cxt(or) kR	Mutagenic efficiency MX 100 / L	MX100 / I	Interaction coefficient (K)
Gamma rays							
10 kR	10.23	4.73	2.32	23.20	22.67	49.04	–
15 kR	14.54	14.85	4.96	33.06	34.11	33.40	–
20 kR	20.19	21.78	2.32	11.60	11.49	10.65	–
EMS							
0.05 %	7.45	4.86	5.00	16.66	67.11	10.28	–
0.1 %	10.83	17.27	4.73	7.88	43.67	27.38	–
0.2%	12.13	25.85	7.85	6.54	64.71	30.36	–
Combinations (Gamma rays + EMS)							
15kR +0.1%	12.12	18.23	3.57	–	29.45	19.58	0.32
20kR + .2%	10.81	16.67	7.74	–	71.60	46.43	1.13

Table 3. Mutagenic effectiveness and efficiency bsed on chlorophyll mutants of paprika cultivar Bydagi Kaddi

Treatments	%survival reduction at 30 days (lethality)	%height reduction at 30 days (injury)	Mutation (M) per 100 M_2 seedlings	Effectiveness MX 100 Cxt(or) kR	Mutagenic efficiency MX 100 / L	MX100 / I	Interaction coefficient (K)
Gamma rays							
10 kR	8.98	15.74	2.19	21.9	24.39	13.91	–
15 kR	14.93	18.24	5.47	36.46	36.64	29.99	–
20 kR	15.54	23.48	4.58	22.9	29.47	19.51	–
EMS							
0.05 %	6.77	17.32	3.90	13.00	57.61	22.52	–
0.1 %	10.07	23.01	3.74	6.23	37.14	16.25	–
0.2%	17.25	30.14	6.29	5.24	36.46	20.87	–
Combinations (Gamma rays + EMS)							
15kR + 0.1%	10.54	13.77	2.45	–	23.24	17.79	0.38
20kR +0.2%	18.80	17.91	5.22	–	27.77	29.15	0.72

decline was however observed at the highest concentration of gamma and EMS treatments in both the varieties. It seems that strong mutagens reach their saturation point even at a lower dose in the varieties having highly mutable allelic sites, and any further increase in the mutagen dose add to their mutation frequency. It has also been suggested that with increase in the mutation dose beyond a certain point, the strong mutagens become more toxic in nature than higher doses of relatively weak mutagens. Similar observations have been made in fenugreek seed spice by Sahba Parveen *et al.* (2006).

The studies of Mikaelson *et al.* (1971) and Sharma (1985) revealed the most effective mutagen treatment may not necessarily be the most efficient one. The efficiency was found to be greater at lower concentration of mutagens and the reasons relation to the fact that lethality increased with the mutagen level at much faster rate. So the lower concentration of mutagens causes relatively less damage enabling the organisms to manifest the induced mutations more frequently (Reddy *et al.,* 1998, Thamaraiselvan, 2004) in tomato.

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