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MUTAGENIC EFFICIENCY OF GAMMA RAYS IN SESAMUN

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Sesamum is the second important oil seed crop of Kerala. Only very little work has been done on the genetic improvment of this crop. According to Gregory (1968) modern techniques involving radiation treatments form an integral part in the genetic improvment of oil seed crops. Hence it is necessary to study the radiobiological effects on sesamum and explore the possibility of its improvement through mutation breeding.

Materials and Methods

The biological material consisted of the CV. Kayamkulam-I, Gamma irradiation was done at the Department of Botany, Kerala University Centre, Kariyavattom utilizing the cobalt 60 "Gamma shine 1000 curies". The source was operating with a dose rate of 32.81 krad per hour. Six samples cf dry seeds (1000 each) were exposed to gamma radiation at doses 5, 10, 15, 20, 25 and 30 krad

Studies on germination of seeds and seedling emergence were conducted under laboratory conditions. The seeds were sown in the field on the third day after irradiation adopting a Randomised Block Design replicated thrice. Survival percentage was calculated at 30 days after sowing. Plant height was measured on the same day in 20 plants per treatment and the mean was estimated. Pollen fertility was studied in 30 plants in each of the treatments. Plants exhibiting chlorophyll deficient sectors on their leaves were recorded as chimeras.

50 M_1 plants per treatment were carried forward. The M_2 generation was raised as M_1 plant progenies. Seedlings were examined frequently and chlorophyll mutations were scored. Mutation frequency was estimated on M_1 and M_2 plant basis. The different types of chlorophyll mutants in each of the segregating progenies were counted separately and the mutation spectrum was calculated. The segregation ratio was estimated as a percentage of the number of mutants in the segregating M, progenies. Mutagenic effectiveness and efficiency were estimated by methods suggested by Konzak *et al.* (1965).

Results and Discussion

The effects of mutagen in the M_1 generation are presented in table 1. Germination percentages of seeds irradiated with different doses did not show

Table 1

Effect of mutagen in the M, generation

	Control	Doses					
		5 krad	10 krad	15 krad	20 krad	25 krad	30 krad
1. Germination %	94.00	94.00	98.00	97.00	98.00	98.00	96.00
% on control	100.00	100.00	104.25	103.20	104.25	104.25	102.12
2, Emergence							
a. Kadicte (Mean period hrs)	27.90	27.40	28.80	28.50	27.90	32.20	29.00
% on control	100.00	98.20	103.22	102.15	100.00	115.41	103.94
b. Plumule (Mean period hrs)	62.10	66.00	65.40	62.10	61.50	65.50	61.90
% on control	100.00	106.30	105.30	100.00	99.00	105.50	99.70
3. Suvival at 30 days %	23.30	17.30	12.20	14.90	11.50	8.50	7.00
% on control	100.00	74.24	52.40	63.94	49.35	36.50	30.00
4. Plant height at 30 days in cm	5.80	6.00	5.70	5.50	6.00	5.80	5.50
on control	100.00	100.44	98.30	94.80	103.44	100.00	94.80
5. Fertility (Pollen) %	93.30	70.50	74.40	71.10	65.80	58.60	51.90
% *on* control	100.00	75.60	79.70	76.20	70.50	62.80	55.60

any significant difference indicating that the doses employed had no effect on germination of seeds. This is in confirmity with the observations of Joshua ef *al* (1972) in jute. The mean period for radicle and plumule emergence also did not show any difference between the doses. Survival of plants at 30 days decreased steadily with increase in the dose of radiation. Similar findings were reported by Joshua ef *al* (1972) in jute and Mujeeb and Greig (1973) in *Phaseolus vulgaris*. The reduction in survival percentage with increased doses of radiation can be explained in cytological terms. Mitotic abnormalities due to irradiation results in structural changes in chromosomal compliments. This interferes with growth and development leading to a fall in survival percentage at higher doses. Plant height measured on the 30th day did not show any relationship with the doses employed. Greater variability in plant height was observed within treatments at higher doses. According to Gaul (1970) the larger variability after treatment with gamma rays is apparently by the result of modifying factors. The percentage of pollen fertility decreased with increase in doses. Chromosome mutations are probably the major cause of all mutagen induced sterility (Gaul 1970). Chlorophyll deficient plants were observed in the 30 krad treatment only. Although the genetic basis of leaf spots is not exactly known Kaplan (1954) has suggested that chromosomal aberrations were responsible for the induction of the spots.

Table 2

Effect of mutagen in tbe M_2 generation (chlorophyll mutations)

	5 krad	10 krad	15 krad	20 krad	25 krad	30 krad
1. *Frequency*						
a. *M_1 plant basis*						
No. of M_1 plant progenies Scored	44.00	43.00	43.00	46.00	41.00	46.00
Segregating	7.00	8.00	9. 00	8.00	8.00	9.90
No. of mutations per 100 M_1 plants	15.91	18.60	20.93	17.39	19.51	19.46
b. *M_2 plant basis*						
No. of M_2 plants scored	9941.00	7752.00	5434.00	5791.00	5043.00	1934.00
No. of mutants	61.00	97.00	54.00	23.00	19.00	19.00
No. of mutants per 100 M_2 plants	6.61	1,25	0.99	0.39	0.37	0.98
2 *Spectrum*						
Total number of mutants						
Relative percentage	61.00	97.00	54.00	23 00	19.00	19.00
Xantha (yellow)	77.00	4.12	14.81	39.13	78.94	5.26
Chlorina (Yellow green)	23.00	95.88	85.19	60.87	21.06	94.74
3. *Segregation ratio*						
Total No. of plants scord in Segregating *M_1* progenies	2391.00	1723.00	1023.00	1123.00	1111.00	511.00
No. of mutants	61 00	97.00	54.00	23 00	19.00	19.00.
Segregation ratio	2,55	5.62	5.28	2.05	1.71	3,72

Mutagenic effects in the M generation are presented in table 2. Mutation frequencies estimated as number of mutations per 100 M_1 plants gave higher values than the estimate on M_2 plant basis at each of the doses employed. This evidently was on over estimation of the mutation event in consideration of the differentiated nature of the embryo. Two types of chlorophyll mutations viz, xantha (yellow) and chlorina (yellow green) were seen in all the treatments. But the relative percentages of these mutations varied with doses. The mutation spectrum reveals that chlorina was more frequent than xantha. Segregation ratio was maximum at 10 krad and minimum 25 krad. With high segregation ratios a high proportion of mutants will be observed facilitating their selection in segregating populations.

The mutagenic effectiveness and efficiency of gamma rays in inducing chlorophyll mutations were estimated and presented in table 3. Effectiveness was highest at the lowest dose employed and decreased with increasing doses. This inverse relationship could be explained as due to the failure of mutations to increase proportionately with increasing doses. Efficiency in relation to lethality and sterility was high at the tower doses and decreased with increasing doses. According to Konzak *et al* (1965) the greater efficiency of low doses of mutagen relate the fact that lethality and sterility increased with increase in mutagen doses at faster rates than mutations.

Table 3

Mutagenic effectiveness and efficiency

Doses	Mutation frequency (M_1 plant basis) (M)	M_1 damage: Lethality (L)	Injury (I)	Sterility (S)	Mutagenic effectivenss $\frac{M \times 100}{krad}$	Mutagenic efficiency $\frac{M \times 100}{L}$	$\frac{M \times 100}{I}$	$\frac{M \times 100}{S}$
5 krad	15.91	25.76	0	24.4	318.20	61.76	[illegible]	65.20
10 krad	18,60	47.60	1.7	20.3	186.00	39.07	1094.11	91.62
krad	20.93	36.06	[illegible]	23,8	139.53	58.04	402.50	87.94
20 krad	17.39	50.65	0	29.5	86.95	34.33	∞	58.95
25 krad	19.51	63.50	0	37.2	78.04	30.72	∞	52.45
30 krad	19.56	70.00	[illegible]	44.4	65.20	27.94	376 15	44.05

Summary

Seeds of sesamum Cv. Kayamkulam–I were irradiated with gamma rays at doses *5* to 30 krad. The effects of irradiation in the M and M, generations were studied. The doses employed had no effect on germination, seedling emergence and plant height in the M_1 generation. With increase in the dose there was a steady decrease in survival and pollen fertility. The frequency of chlorophyll mutation estimated on M_1 plant basis was higher than the estimate on M plant basis The mutation spectrum included xantha (yellow) and chlorina (yellow green). Segregation ratio was maximum at 10 krad and minimum at 25 krad. Mutagenic effectiveness and efficiency were high at the lower doses and decreased with increasing doses. These observations indicate that gamma rays at low fo medium doses can be successfully employed for inducing mutations in sesamum.

സംഗ്രഹം

കായംകുളം—ഒന്ന് എന്നയിനം എള്ള് വിത്ത് ഗാമാ rooB"n1 വികിരണത്തിന് വിധേയമാക്കി. വിവിധ ഡോസുകൾക്ക് വിത്തിന്റെ അങ്കുരണത്തിലും, മുളയുടെ നിർഗമനത്തിലും, തൈയുടെ വളർച്ചയ' _ ഇല്ലെന്ന് കണ്ടു. പക്ഷേ ഡോസു കൂടുംതോറും അതിജീവിതം കുറയുന്നതായും പരാഗവന്ധ്യത കൂടുന്നതായും കണ്ടു. M_1 ചെടികളെ അടിസ്ഥാനമാക്കിയുള്ള ക്ലോറോഫിൽ ഉൽപരിവർത്തന ആവൃത്തി M_2 ചെടികളെ അടിസ്ഥാനമാക്കിയുള്ളതിനേക്കാരം കൂടുതലായി കാണപ്പെട്ടു. rasni roiroo ഉൽപരിവർത്തിതങ്ങളം കണ്ടത് മഞ്ഞയും ,ffl6T!5Tt!)<0jeJC?iaT)ച്ചനിറമുള്ളവയും ആയിരുന്നു. പൃഥക്കരണ അനുപാതം കൂടുതൽ **10 krad** ലും, കുറവ് **25 krad** ലും ആണ്. ഏറ്റവും കൂടിയ കാര്യകാരതം ഏറ്റവും താഴ്ന്ന ഡോസായ **5 krad** ലാണ് ഡോസു കൂടുംതോറും ക്ഷമത ആനുപാതികമായി കുറയുന്നതായി കണ്ടു. TOD പഠനങ്ങളിൽ എള്ളിൽ ഗാമാ roa3L'fl)1 കുറഞ്ഞ ഡോസുകളിൽ ഫലപ്രദമായ ഉൽപരിവർത്തനങ്ങൾക്ക് പ്രേരിതമാണെന്നു കണ്ടു.

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