Agri. Res. J. Kerala. 1978, 16 (2) 176—180

EFFECT OF RECURRENT AND ALTERNATE MUTAGENIC TREATMENTS IN RICE

V. GOPINATHAN NAIR

College of Agriculture, Vellayani, Kerala

Repeated mutagenic treatments in successive generations is a method of accumulating mutations. Gaul (1964) and Swaminathan (1965) reported that polyploids respond favourably to recurrent irradiation through an increase in the frequency of mutations. Swaminathan (1966) further stated that rice being a secondary polyploid, several traits can be expected to be governed by duplicate genes and in such cases repeated mutagenic treatments will have an unmasking effect on the external manifestation of characters. The present work was undertaken to study the effect of repeated mutagenic treatments on sensitivity of seeds and mutation frequency.

Materials and Methods

Seeds of the rice variety Co 29 were irradiated with gamma rays at doses 10, 20 and 30 krad. One fertile primary ear was selected from each of 100 M_1 plants in the 3 doses and the control. 3 seeds were selected at random from each of the 100 ears in a dose to form a lot of 300 seeds. Seven such lots of 300 seeds were made up in each of the 3 doses and the control to form the seed material for the second cycle of mutagen treatment. Out of the 7 seed lots in each dose, one was kept untreated, 3 were subjected to irradiation with 3 doses viz. 10, 20 and 30 krad of gamma rays in the recurrent treatment and the remaining 3 were treated with 3 doses viz. 1, 2 and 3 mM of nitroso methyl urea (NMH) in the alternate treatment.

Seeds after repeated mutagenic treatment were sown in 3 replications to raise the second (M_2^2) generation. Seedling survival counts and height measurements were made on the 30th day. The main panicles of all surviving plants were labelled and ears harvested separately. The third (M_3^2) generation was raised on ear progeny basis. Chlorophyll mutations were scored and frequencies per 100 M^3 ears were estimated.

Results and Discussion

The data on survival and seedling height in the M_2^2 generation and chlorophyll mutation frequency in the M_1^2 generation following recurrent and alternate mutagenic treatments in successive generations are presented in Table 1. For evaluating the mutagenic effects of the repeated treatment, the data are presented in a two way table along with the expected values based on cumulative effects (Table 2),

Table 1

Effects in the second (M_2^2) and third (M_3^2) generations . repeated mutagenic treatments

Mutagen and dose		Effects in M_2^2		Mutations M_3^2		
First treatment (Gamma rays)	Second treatment (Gamma rays/NMH)	Seedling survival on 30th day (% of control)	Seedling heigt on on 30th day (% of control)	No. of M_2^2 ear progenies Scored	Segregating.	Chlorophyll mutations per 100 M_2^2 ears.
i) *Control*						
,,	,,	100	100	210	0	i!
10 k'rad	,,	96	99	229	5	2.2
20 krad	,,	96	97	246	6	2.4
30 krad	,,	92	93	227	13	5.7
ii) *Recurrent treatment*						
,,	10 krad	98	92	242	15	6.2
,,	20 krad	99	88	246	18	7.3
,,	30 krad	99	82	196	18	9.2
10 krad	10 krad	98	95	225	21	8.2
10 krad	20 krad	97	88	210	17	8.1
10 krad	30 krad	96	79	162	19	11.7
20 krad	10 krad	96	91	214	12	5.6
20 krad	20 krad	97	87	205	13	6.3
20 krad	30 krad	94	77	161	14	8.7
30 krad	10 krad	94	94	224	19	8.4
30 krad	20 krad	94	86	162	13	8.0
30 krad	30 krad	96	73	152	18	11.8
iii) *Alternate treatment*						
,,	1mM	95	90	182	6	3.3
,,	2mM	73	74	163	6	3.7
,,	3mM	57	70	123	8	6.5
10 krad	1mM	95	90	216	9	4.2
10 krad	2mM	73	84	188	4	2.1
10 krad	3mM	58	81	155	7	4.5
20 krad	1mM	94	88	235	16	6.8
20 krad	2mM	73	81	192	14	7.3
20 krad	3mM	57	74	184	19	10.3
30 krad	1mM	88	87	204	17	8.3
30 krad	2mM	74	84	188	13	6.9
30 krad	3mM	57	75	172	22	12.8

Table 2

Cumulative action for M_2 effects and M_3 chlorophyll mutation frequency in repeated mutagenic treatments

Gamma rays	Control	Recurrent—Gamma rays			Alternate — NMH		
		10 krad	20 krad	30 krad	1 mM	2 mM	3 mM
i) *Survival of seedlings* : 30th day (M_2) - % of double control							
Control	100	98	99	99	95	78	57
10 krad	96	98	97	96	95	73	58
		(94)*	(95)	(75)	(91)	(95)	05)
20 krad	%	96	97	94	94	73	57
		(94)	(95)	(95)	(91)	(75)	(55)
30 krad	92	94	94	96	88	74	57
		(90)	(91)	(91)	(87)	(72)	(52)
ii) *Height of seedlings* 30th day (M_2) — % *of* double control							
Control	100	92	88	82	90	74	70
10 krad	99	95	88	79	90	84	81
		(91)*	(87)	(81)	(89)	(73)	(69)
20 krad	97	91	87	77	88	81	74
		(89)	(85)	(79)	(87)	(72)	(68)
30 krad	93	94	86	73	89	84	75
		(86)	(82)	(76)	(84)	(69)	(65)
iii) *Mutation frequency* — per 100 M_3 ears							
Control		6.2	7.3	9.2	3.3	3.7	6.5
10 krad	2.2	8.2	8.1	11.7	4.2	2.1	4.5
		(8.4)£	(9.5)	(11.4)	(5.5)	(5.9)	(8.7)
20 krad	2.4	5.6	6.3	8.7	6.8	7.3	10.3
		(8.6)	(9.7)	(11.6)	(5.7)	(6.1)	(8.9)
30 kard	5.7	8.4	5.0	11.8	8.3	6.9	12.8
		(11.9)	(13.0)	(14.9)	(9.0)	(9.4)	(12.2)

* Percentages estimated as the product of the two respective control values.

£ The sum of frequencies of the two respective controls.

Survival and seedling height in the M_2 generation did not differ from values estimated in relation to the respective M_1 values in any of the treatments. Thus the sensitivity of seeds to gamma rays and NMH was not influenced by irradiation with gamma rays in the previous generation. Yamaguchi (1962) obtained similar results in rice and barley after recurrent X-irradiation. Frydenberg and Sandfaer (1965) also observed that recurrent irradiation of barley with gamma rays revealed no differences in seed germinability and plant height.

The mutation frequencies in the recurrent as well as alternate treatments were less than the sum of frequencies in the individual treatments. The low mutation frequencies indicated that the mutagenic effect of the same or different mutagen when applied as a repeated treatment in the successive generation was less than that of the first treatment. Siddiq and Swaminathan (1968) also reported a reduction in mutation frequency in the recurrently irradiated population of rice. If mutagens had exhibited specificity of action, the alternate treatment with NMHwould have induced more mutations than a recurrent dose of gamma rays, as explained in oats by Joshi and Frey (1967). The absence of an increase in mutation frequency in recurrent and alternate treatments indicate that rice behaves like a diploid in its mutational response inspite of its secondary polyploid nature.

Summary

The effects of repeated mutagenic treatment in the M_2 and M_3 generations in rice are reported. Recurrent irradiation with gamma rays and alternate treatment with gamma rays and NMH, neither increased the sensitivity of seeds r enhanced the frequency of induced chlorophyll mutations. This indicate that e inspite of its secondary polyploid nature behaves like a diploid in its reppo- ? to the action of mutagens.

സംഗ്രഹം

ഉൽപരിവർത്തകങ്ങളുടെ ആവർത്തക പ്രയോഗം തുടർന്നവരുന്ന roiej^Oifeglsiej നെൽ വിത്തുകളിൽ നടത്തി. ഗാമാരശ്മി തനിയേയും ഗാമാരശ്മി NMH എന്നിവ ഒന്നിടവിട്ടും ആവർത്തക പ്രയോഗം നടത്തുന്നതുകൊണ്ട് സംവേദകത്വമോ, ക്ലോറോഫിൽ ഉൽപരിവർത്തന ആവൃത്തിയോ വർദ്ധിക്കുന്നതായി കണ്ടില്ല. നെൽച്ചെടി ഒരു ദ്വിതീയ ബഹുപ്ലോയിഡ് ആണെങ്കിലും ഉൽപരിവർത്തന പ്രതികരണത്തിൽ അത് ഒരു സാധാരണ ദ്വിപ്ലോയിഡിനെപ്പോലെയാണെന്ന് ഇതിrail നിന്ന് അനുമാനിക്കാം.

REFERENCES

rydenberg, 0. and Sandfaer, J. 1965. The viability, productivity and radiosensitivity of recurrently irradiated barley populations. *The . of induced mutations in plant breeding,* Pergamon Presss, 175—83.

3aul, H. 1964. Mutations in plant breeding. *Radiat. Bot. 4,* 152—232.

Joshi, S. N. and Frey, K. J. 1967. Genetic variability in oats from recurrent and alternate treatment with physical and chemical mutagens. *Radit. Bot.* 7, 513—520.

Jddiq, E. A. and Swaminathan, M. S. 1968. Mutational analysis of ploidy level in *Oryza sativa*. *Curr. Sci.* 37, 451—452.

Swaminathan, M. S. 1S65. 1. A comparison of mutation induction in diploids and polyploids. 2. Summaries and conclusions-characteristics and genetics of induced mutants. *The use of induced mutations in plant breeding,* Pergamon Press, 619—641; 790—792.

Swaminathan, M. S. 1966. Use of induced mutations. *Indian Fmg.* **16**, 34—35.

Yamaguchi, H. 1962. Induction of mutations by by repeated irradiation of successive generations in barley and rice. *Jap. J. Breed.* **12**, 141—147.

(M. S. Received 20-5-1978)