Indian J. Genet., **61**(3): 274-276 (2001)

Short Communication

Induction of beneficial mutants in rice (*Oryza sativa* L.)

Y. G. Shadakshari, H. M. Chandrappa, R. S. Kulkarni* and H. E. Shashidhar**

Regional Research Station, Mudigere 577 132

(Received: August 2000; Revised: May 2001; Accepted: August 2001)

Several popular local rice varieties of Hill Zone of Karnataka grow tall, varieties which lodge under high fertility conditions and harvesting them is cumbersome and calls for extra labour input compared to stiff and erect rice varieties. Gamma irradiation of five popular rice varieties of the zone viz., BKB, Halugidda, Kirwana, PUB and Puttabatta was undertaken at the Regional Research Station, Mudigere for induction and isolation of mutants with non lodging habit. Dry and well filled seeds of the five varieties with 12 per cent moisture were irradiated with gamma radiation dose of 10, 20, 30, 40 and 50 kR and the M_1 generation was grown during *kharif* 1997 using unexposed seeds as control. M_2 generation was grown during *kharif* 1998. Fifty M_1 plants without any visible abnormalities were selfed and harvested individually in each treatment and the seeds were sown as plant-to-rows in nursery beds. Frequency and spectrum of chlorophyll mutations in M_2 were scored at seedling stage following the classification of Gustafson [1] and frequency of chlorophyll mutations in M_2 were estimated as number of mutations per 100 M_2 plants as suggested by Gaul [2]. Other viable mutations were scored at or after flowering and mutagenic effectiveness and efficiency were calculated, treatment wise, following Konzak *et al.* [3].

Chlorophyll mutations included five types viz., albina, striata, tigrina, viridis and xantha and they were highest in BKB (516) followed by those in PUB (457), Puttabatta (445) and Halugidda (406) and least in Kirwana (236) (Table 1). There were more albinas compared to other four types. Similar report of higher induction of albinas compared to other types by gamma rays has been reported by Bural *et al.* [4]. However, narrow spectrum of chlorophyll mutations with higher frequency of xantha has been reported by Sanjeev Singh *et al.* [5] which may be due to differences in genotypes used in their studies. Frequency of chlorophyll the genetic background of mutations was highest in 40 kR in BKB (17.17%) and Halugidda (16.99%), in 50 kR in PUB (22.81%) and Kirwana (5.32%) and in 30kR in Puttabatta (13.23%). Albinas were highest in 30 kR in BKB and Puttabatta, in 40 kR in Halugidda, in 50 kR in Kirwana and PUB. Maximum xanthas were observed in 40 kR in BKB and Kirwana, in 30 kR in Halugidda, in 50 kR in PUB and in 10 kR in Puttabatta. Striatas were maximum in 40 kR in BKB, Kirwana and PUB, in 30 kR in Halugidda and Puttabatta.

Frequency and spectrum of chlorophyll mutations observed clearly indicated differences among the varieties studied for radio sensitivity. Frequency of chlorophyll mutations did not show dose dependent occurrence except in case of one variety i.e. PUB. Singh *et al.* [5] have also reported that increase in chlorophyll mutation frequency was not dose dependent.

Mutagenic effectiveness was maximum in 20 kR in Kirwana (0.178), in 30 kR in Puttabatta (0.441), in 40 kR in BKB (0.429) and Halugidda (0.425) and in 50 kR in PUB (0.456) Effectiveness increased with increase in dose up to 40 kR in case of BKB and PUB and 20, 30 and 40 kR were more effective doses in case of Kirwana, Puttabatta and Halugidda.

Mutagenic efficiency was maximum in 10 kR in Puttabatta (0.165), in 20 kR in Kirwana (0.077), in 40 kR in BKB (0.190) and Halugidda (0.231) and in 50 kR in PUB (0.246).

Effective and efficient dose was 40 kR for BKB and Halugidda, 20 kR for Kirwana and 50 kR for PUB. In case of Puttabatta, 30 kR was most effective and 10 kR was most efficient dose indicating that most effective dose need not necessarily be most efficient.

Viable mutations were maximum in Kirwana (91) followed by those in Halugidda (90), BKB (72), Puttabatta (60) and minimum in PUB (48) (Table 3). They were

*Part of the Ph.D thesis submitted by the senior author; **Agricultural College, UAS, GKVK, Bangalore 560 065

Table 1. Frequency and spectrum of chlorophyll and viable mutations in rice

Variety/Dose	Percentage of chlorophyll mutations	Frequency of chlorophyll mutants						Mutation of spectrum					
		Albina	Xantha	Striata	Viridis	Tigrina	Mutation frequency	Dwarf/ Semi-dwarf	Early maturing	Awn/ Awnless	Grain type	High yield	Male sterile
BKB													
Control	0.00	0	0	0	0	0	0.000	0	0	0	0	0	0
10 kR	2.24	12	20	1	0	4	0.969	12	0	2	1	1	0
20 kR	4.60	51	12	8	1	4	0.909	13	0	2	0	0	0
30 kR	12.61	166	3	4	4	2	1.479	12	0	7	2	0	0
40 kR	17.17	154	36	20	4	7	0.932	4	3	4	1	0	0
50 kR	0.49	1	2	0	0	0	1.298	7	0	0	1	0	0
Halugidda													
Control	0.00	0	0	0	0	0	0.000	0	0	0	0	0	0
10 kR	1.75	21	2	2	0	4	0.787	6	0	4	1	2	0
20 kR	4.36	68	3	0	0	1	1.757	20	0	4	3	1	1
30 kR	4.04	5	26	22	0	3	1.659	12	0	5	1	5	0
40 kR	16.99	147	23	2	2	0	1.759	15	0	1	1	1	0
50 kR	15.15	53	6	4	4	8	1.414	4	1	2	0	0	0
Kirwana													
Control	0.00	0	0	0	0	0	0.000	0	0	0	0	0	0
10 kR	1.51	9	0	9	2	5	1.151	11	4	3	0	0	1
20 kR	3.57	26	15	14	3	1	1.030	10	6	1	0	0	0
30 kR	1.44	11	0	3	1	5	2.236	19	6	3	0	1	2
40 kR	5.11	32	25	21	3	0	0.631	2	5	2	0	1	1
50 kR	5.32	51	0	0	0	0	1.462	9	2	1	1	1	0
PUB													
Control	0.00	0	0	0	0	0	0.000	0	0	0	0	0	0
10 kR	0.12	2	0	0	0	0	1.030	11	0	0	4	2	0
20 kR	0.64	6	0	4	0	0	0.645	5	3	0	0	2	0
30 kR	6.81	59	0	11	8	3	0.589	4	1	0	1	1	0
40 kR	9.09	73	0	28	0	7	0.673	8	0	0	0	3	0
50 kR	22.81	181	69	3	0	3	0.535	5	0	0	1	0	0
Puttabatta													
Control	0.00	0	0	0	0	0	0.000	0	0	0	0	0	0
10 kR	3.75	41	21	0	0	0	0.303	4	0	1	0	0	0
20 kR	3.21	33	5	4	6	3	1.388	8	5	7	2	0	0
30 kR	13.23	168	0	18	25	3	0.989	12	2	0	2	0	0
40 kR	7.30	65	10	9	10	0	1.010	10	2	0	1	0	0
50 kR	2.90	6	9	1	7	1		3	1	0	0	0	0

maximum in 10 kR (1.03%) in PUB, in 20 kR (1.38%) in Puttabatta, in 30 kR in BKB (1.47%) and Kirwana (2.23%) and in 40 kR (1.75%) in Halugidda.

Dwarf/semi dwarf non lodging mutants were higher in Halugidda (57) followed by those in Kirwana (51), BKB (48), Puttabatta and PUB (33). Their frequency was higher in 10 kR in PUB, in 20 kR in BKB and Halugidda, in 30 kR in Kirwana and Puttabatta. Similar higher frequency of dwarf plants among viable M_2 plants has been reported by Farooq and Awan [6].

Except in PUB, mutants for awn character were isolated in all other varieties varying from 8 (Puttabatta) to 16 (Halugidda). Early flowering mutants were isolated in all the five varieties. These mutants flowered earlier by 10-15 days in Kirwana, 15-20 days in Puttabatta and BKB, 20-25 days in PUB and by 49 days in Halugidda. Similar early mutants in local cultivars of Myanmar irradiated with gamma radiation have been reported by Shwe Hla and Shaik [7]. They also reported mutants with short culm and fine grain. Grain type mutants isolated were six each in Halugidda and PUB, five each in BKB and Puttabatta and one in Kirwana. Two male sterile (in 10 KR and 30 kR) in Kirwana and one (in 20 KR) in Halugidda were isolated.

High yielding mutants were observed in all varieties except in Puttabatta. There were nine such mutants in Halugidda, eight in PUB, three in Kirwana and one in

Table 2. Mutagenic effectiveness and efficiency of different doses of gamma radiation in rice

Varieties	BKB		Halugidda		Kirwana		PUB		Puttabatta	
Treatment (Dose)	Mutagenic effectiveness (M/kR)	Mutagenic efficiency (M/S)	Mutagenic effectiveness (M/kR)	Mutagenic efficiency (M/S)	Mutagenic effectiveness (M/KR)	Mutagenic efficiency (M/S)	Mutagenic effectiveness (M/kR)	Mutagenic efficiency (M/S)	Mutagenic effectiveness (M/kR)	Mutagenic efficiency (M/S)
Control	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10 kR	0.224	0.128	0.175	0.800	0.151	0.052	0.012	0.004	0.375	0.165
20 kR	0.230	0.121	0.218	0.076	0.178	0.077	0.032	0.014	0.161	0.105
30 kR	0.420	0.179	0.135	0.066	0.048	0.017	0.227	0.082	0.441	0.046
40 kR	0.429	0.190	0.425	0.231	0.128	0.064	0.227	0.105	0.182	0.104
50 kR	0.009	0.005	0.303	0.168	0.106	0.061	0.456	0.246	0.058	0.040

M = Frequency expressed as percentage of chlorophyll mutations in M_2 estimated on M_2 plant basis.
kR = Gamma ray dose in kilorad; S = Percentage reduction in M_1 seed fertility

Table 3. Days to flowering and grain yield/plant in height mutants in local rice*

Variety	Plant height (cm)				Days to 50% flowering			Grain yield/plant (g)		
	No. of mutants isolated	Control	Mutants	% over control	Control	Mutants	% over control	Control	Mutants	% over control
BKB	1	160	134.00	–16.25	144	150	+4.17	14.99	15.94	+6.33
Halugidda	9	152	139.77	–8.04	144	142	–1.38	12.62	19.38	+53.56
Kirwana	3	136	127.33	–6.37	137	132	–3.89	10.36	12.40	+19.69
PUB	8	124	114.62	–7.56	143	143	–0.00	10.84	16.87	+55.60

*Average of mutants and control excepting BKB

BKB. Higher yield observed in these mutants varied from 6.33% to 53.56% compared to maximum yield observed in control (Table 3). Reduction in plant height in these mutants varied from 6.37% to 16.25% compared to their parents. Narendra Kulkarni and Gangaram (8) have also reported early maturing short culm mutants with high yield in Samba Mashuri.

The study revealed significant differences among the genotypes and gamma irradiation to be useful for induction of stiff strawed non lodging mutants in local rice. The mutants isolated were early and showed higher yield potential compared to their parents.

References

1. **Gustafsson A.** 1940. The mutation system of the chlorophyll apparatus. Lunds univ. Arrskr. N.F. Adv., **36**: 1-40.
2. **Gaul H.** 1960. Critical analysis of the methods for determining mutation frequency after seed treatment with mutagens. Genet. Agri., **12**: 297-318.
3. **Konzak C. F., Nilan R. A., Wagner J. and Foster R. J.** 1965. Efficient chemical mutagenesis. Radiat. Bot., (suppl) **5**: 49-70.
4. **Bural J. S., Kanwal K. S. and Sharma T. R.** 1986. Radiation induced chlorophyll mutations in rice. Reses. Dev. Reporter, **3**: 68-71.
5. **Sanjeev Singh, Richaria A. K., and Joshi A. K.** 1998. An assessment of gamma ray induced mutations in rice (*Oryza sativa* L.) Indian J. Genet., **58**: 455-463.
6. **Farooq S. and Awan M. A.** 1998. Azide mutagenesis in Basmati rice (*Oryza sativa* L.) cultivars. Pakistan J. Sci. Indust. Res., **32**: 740-744.
7. **I lla Shwe and Shaik M. A. Q.** 1993. Early maturing, short culm and finer grain rice mutants from local varieties of Z. Myanmar. Mutation Breed. Newslett., **40**: 7-8.
8. **Narendra Kulkarni and Gangaram A.** 1998. Genetic changes and phenotypic stability in mutants of rice variety Samba mashuri, *Oryza*, **35**: 322-324.