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STUDIES ON THE YIELD PERFORMANCE AND GRAIN QUALITY OF MUTANT STRAINS OF RICE*

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Abstract

Eleven mutant strains derived through mutation breeding from two standard varieties IR6 and IR8 of rice were evaluated for their yield performance in field trials for two years at two locations. Three mutant strains of IR6, and two of IR8 gave paddy yields statistically similar to their parent varieties, while the rest of them yielded significantly less. All mutant strains were better in grain quality (in terms of L/B ratio) than variety IR8, while two of them were better than variety IR6.

Introudction

Rice (*Oryza sativa* L.) is a major grain crop of Pakistan. In recent years, two high yielding varieties of rice namely IR6 and IR8 were introduced from the International Rice Research Institute, Philippines. These varieties have tremendous yield potential, but need further improvement in their grain quality. An attempt was, therefore, made to bring about desirable changes in these varieties through mutation breeding, and the present report describes the yield performance and grain quality of some of the mutant strains thus evolved.

Materials and Methods

Eleven mutant strains of rice developed from varieties IR6 and IR8 through mutation breeding were tested for their yield performance for two years at two locations, i.e. Tandojam and Dokri. The mutant strains were selected from the plant material developed from the seed treated with ethyl methane sulphonate (EMS), and gamma rays. The selection was done on the basis of paddy yield, grain quality and earliness in maturity. The mutant strains thus selected were tested for the stability of grain yield and other characters. A short duration variety, IR1561, was included in the trials as a check variety for comparison of earliness in maturity.

The experimental design for yield trials was a randomized complete block with

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Table 1. Performance of rice varieties IR6, IR8 and their mutant strains over different years and locations.

Varieties and mutant strains (Genotypes)	Length/Breadth ratio of the grains*	Paddy yield (Kg/ha) in 1976*		Paddy yield (Kg/ha) in 1977*		Average yields of genotypes over the Years and Locations*
		Tandojam	Dokri	Tandojam	Dokri	
IR6 Parent	4.79 cd	8607 ab	6826	8189 ab	12254 ab	8966 ab
IR6-1	4.98 bc	7627 bcd	6300	6994 d	11656 abcd	8142 bcd
IR6-18	5.28 a	8835 a	6300	7771 abc	11955 abc	8715 ab
IR6-18-1	5.02 b	8273 abc	6300	7747 bc	11058 bcde	8344 abcd
IR6-18-2	4.91 bc	8392 ab	4901	7675 bc	10460 def	7866 cd
IR6-EF-1	4.25 f	5690 f	5882	6934 d	9264 fg	6946 ef
IR8 Parent	2.76 h	8643 a	6300	8225 ab	12851 a	9002 a
IR8-FG-1	4.71 de	8476 ab	6575	8034 abc	11357 abcde	8607 abc
IR8-FG-2	4.87 bcd	6814 de	5141	8010 abc	10759 cde	7687 de
IR8-FG-3	4.85 bcd	6922 de	6013	7986 abc	10162 def	7771 de
IR8-FG-4	4.50 f	7352 cde	6121	7508 cd	9863 ef	7711 de
IR8-FG-5	4.56 ef	6994 de	5499	8344 a	12254 ab	8273 abcd
IR8-FG-6	4.91 bcd	6623 ef	5774	8153 ab	10162 def	7675 de
IR 1561	4.28 g	5714 f	5463	6216 e	8069 g	6372 f
LSD (0.05):	0.21	980	NS	574	1494	825

*Means followed by the same letter are not significantly different from each other at 5% level of significance.

four replications at each location, each year. The size of the plot in each replication was 4.5x1.75 m. One month old seedlings were transplanted at a distance of 25 cm between the rows and also between hills in each row with an average of three plants per hill. The fertilizer was applied at the rate of 134 N: 67 P Kg/hectare in the form of urea and triple superphosphate. The first basal application of fertilizer was done before transplanting at the rate of 67 N: 67 P Kg/ha and the remaining quantity of Nitrogen, 67 Kg N/ha, was applied as top dressing after 40 days of transplanting. The paddy yield of the mutant strains and varieties per plot was recorded after the harvest of the crop. The grain quality was based on its length/breadth ratio, and for that purpose, 25 grains were taken at random from each replication of each variety and mutant strain. The measurements of the length and breadth of the grains were taken by vernier caliper.

Results and Discussion

The data on average paddy yield of the varietal trials conducted at two locations for two crop years are given in Table 1, and the pooled analysis of variance that resolved the overall position of the genetic interaction of genotypes with the years and locations is presented in Table 2. The mean squares for replicates (within locations and years), varieties, locations, years and interactions between locations and years were highly significant ($P < 0.01$), while the interaction between varieties x locations x years was significant ($P < 0.05$). Three mutant strains of IR6 viz. IR6-1, IR6-18 and IR6-18-1, and two mutant strains of IR8 viz. IR8-FG-1 and IR8-FG-5 gave paddy yields statistically similar to their parent varieties, while the rest of them yielded significantly less. The mutant strains IR6-1, IR6-18 and IR6-18-1 gave paddy yields of 8142, 8715 and 8344 Kg/ha respectively, while the paddy yield of the parent variety IR6 was 8966 Kg/ha. The mutant strains IR8-FG-1 and IR8-FG-5 gave paddy yields of 8607 and 8273 Kg/ha respectively, while their parent variety IR8 yielded 9002 Kg of paddy per hectare. Considering the combined results of two years, the varieties gave significantly ($P < 0.05$) higher yield at Dokri location than Tandojam location. The paddy yields of the 1977 crop were generally higher in comparison with those of the previous year. When yields were compared with reference to years and locations interaction it was noted that in the year 1976, the paddy yield was higher at Tandojam than that of Dokri location but reverse was the case during 1977. The weather conditions at Dokri during 1977 were more favourable for the rice crop. The interactions varieties x locations and varieties x years were, however, non-significant.

In general, all the mutants of IR6 and IR8 possessed finer grain quality. The data on the length/breadth ratio of the grains of the mutant strains and the standard varieties included in yield trials are given in Table 1. The mutants IR6-18 and IR6-18-1 with L/B ratio of 5.28 and 5.02 respectively were significantly finer than the parent variety IR6 that had L/B ratio of 4.79. All mutant strains were significantly better in grain quality than the other parent variety IR8 that had L/B ratio of 2.76. The L/B ratio of mutants derived from IR6 ranged from 4.25 to 5.28, and those from IR8 ranged from 4.50 to

Table 2. Pooled analysis of variance for paddy yield (Kg/ha) of different varieties and mutant strains of rice.

Source of variation	D.F.	M.S.	F ratio	Significance of differences
Replicates (within locations and Years)	12	5.2842	5.38	**
Varieties (V)	13	6.1965	6.31	**
Locations (L)	1	25.9624	26.44	**
Years (Y)	1	255.4314	260.15	**
V x L	13	0.6325	0.64	NS
V x Y	13	1.1361	1.16	NS
L x Y	1	217.1335	221.14	**
V x L x Y	13	1.9638	2.00	*
Error	156	0.9819		

NS, $P > 0.05$; *$P < 0.05$; **$P < 0.01$

4.91, while the L/B ratio of the short duration variety IR1561 was 4.28.

A linear relationship exists between increased L/B ratio and better grain quality and this is considered an important factor in the calssification of grain quality in rice. The statistical analysis for comparative quality assessment revealed that the mutant strain IR6-18 possessed superior grain quality as compared to all other mutant strains and the parent varieties. Among other mutant strains, mutants IR6-18-1, IR6-1, IR6-18-2, IR8-FG-1, IR8-FG-2 and IR8-FG-6 were also of good grain quality while others were comparatively inferior in quality.

There is a general concept that mutagenic treatments cause depressing effect on desirable agronomic characteristics. According to Borojevic (1965) and Gaul (1970), the increased sterility due to mutagenic treatments could be a major factor responsible for the general trend for negative yield mutations. But the distribution of morphological mutations in all the mutagenically derived population is most important for judging the

potential of mutation breeding for improving specific traits and grain yield. Practical use of induced mutations in rice has been discussed by Gustafsson & Gadd (1966).

Significant improvements in rice crop through the use of induced mutations have been reported for the high yield (Futsuhara *et al.*, 1967; Escuro *et al.*, 1971; Ganashan, 1971; Haq *et al.*, 1971; and Sajo & Simon, 1976), earliness in maturity (Bari & Awan, 1974), short stature (Rutger & Peterson, 1976), and high tillering potential (Ram, 1976). In the present studies the improvement was in grain quality through the increased length/breadth ratio of the grains.

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