



IMPROVEMENT OF LOCAL VARIETIES OF RICE (*Oryza glaberrima*) FOR RESISTANCE TO SHATTERING AND GRAIN QUALITY BY INDUCED MUTATIONS

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Abstract

In Mali, a large area of rice is planted with the local rice, *O. glaberrima* which under conditions of low rainfall and flood water is more hardy to stress than the introduced *O. sativa* cultivars. A program to improve the local varieties of *O. glaberrima* by induced mutations was started in 1988. Ten local varieties were irradiated with 20 and 30 krad. In M_1 of cv. 'Gorbal', irradiated with 20 krads, 13 variants were selected. Five of these were evaluated in M_2 for their agronomic performance. The induced mutants in the remaining 9 varieties were highly sterile with 90% or more sterility in the M_2 and M_3 . Irradiation with 20-30 krad gave high survival (70-95%), and several mutants with white kernel were obtained from the red seeded types. Nearly two-third of the identified mutants had white caryopsis. There is better consumer acceptance of the white seeded type of rice than the red seeded varieties in Mali and the white seeded mutants may have an added premium in the market.

The field performance of the M_2 mutants was investigated. Preliminary results showed that some of mutants derived from cv. 'Gorbal' were early in maturity and had more panicles per plant, but had a lower 1000-kernel weight, and did not differ from the parent in grain yield. Additional trials are planned to establish potential of the mutants for yield and quality. Three more cultivars of *O. glaberrima* - 'Haira', 'Tombo' and 'Yele' - were irradiated with 20 and 60 krads, and gave 75, 81 and 72% seed viability, respectively. M_1 showed reduced plant height. Selection for non-shattering of grains shall be carried out in M_2 . Any plants which are non-shattering but sterile shall be crossed with the parent to recover the mutant types. The taxonomic status of cv. 'Gorbal' is not very clear. Isozyme patterns suggest that this cultivar may belong to *O. sativa* and not to *O. glaberrima*. To establish its taxonomic status, crosses shall be made with *O. sativa* and *O. glaberrima*.

I. INTRODUCTION

Mali is one of the rare countries where *Oryza glaberrima* is still cultivated. The area grown under this species is more important than that *Oryza sativa* species introduced in the early 1950's. Under normal conditions, the later species yields better than *Oryza glaberrima*. Under low rainfall and flood water during the last decade, the introduced varieties have become less and less productive because they are not adapted to such conditions. This is why the improvement of local varieties by mutation is necessary. The local varieties improvement program has been carried out since 1988 with the support of International Atomic Energy Agency. The main problem in these varieties is that they are prone to seed shattering. The

first objective of this project is to get mutants resistant to shattering and with high yield potential. This report presents the preliminary results obtained and the future prospects to improve these varieties..

2. MATERIALS AND METHODS

The first mutagenesis programme was carried out with 10 local varieties, all cultivated under natural flooding conditions. They were irradiated with 20 and 30 krad. In cv. 'Gorbal' a number of mutants were obtained from the 20 krad. From successive segregation and selection, 13 M_4 mutants were retained. Of these, 5 were evaluated in M_5 for their agronomic value. Mutants were also obtained in M_2 from each treatment of the 9 remaining varieties, but their sterility was more than 90%. This sterility persisted in M_3 generation. Unfortunately, no crossing program was planned with their parents to restore the fertility.

3. RESULTS AND DISCUSSION

This study showed that irradiation with 20 and 30 krad reduced seed viability of *Oryza glaberrima* only slightly and survival was high 70 to 95%. It was easy to change the red color of the caryopsis of all the varieties of *Oryza glaberrima*. About 2/3 of the identified mutants had white caryopsis. The results of the enzymatic analysis of cv. 'Gorbal' at Montpellier, France in 1992 suggested that this variety may belong to the species *Oryza sativa* even though it has some common morphological characteristics of the varieties of *Oryza glaberrima*. A crossing program between 'Gorbal' and a variety of *Oryza sativa* is planned to investigate this hypothesis.

3.1. Performance of M_5 mutants

The objective was to compare yield potential of 5 selected mutants with that of their parent.

Site: Agronomic Research Station of Mopti (medium and shallow zones).

Number of treatments: 6

Experiment design: randomized complete block design with 3 replications.

Individual plot size: 5 x 1.8 m

Fertilization: 100 kg/ha ammonium phosphate at sowing, and 50 kg/ha urea one week before floods.

In general, mean yields were low (Table I and II). This may be attributed to the low rainfall at the beginning of the rainy season which did not permit a good establishment of rice. The analysis of variance did not show any significant difference between treatments. Therefore, no clear conclusion can be drawn between the yield of the mutants and the control. Nevertheless, some of these mutants had the following characteristics :

1. All of them had white caryopsis while the control had the red one which has low marketable value compared with the *O. sativa* varieties with white caryopsis.

2. They were resistant to flooding but they had the same floating ability as the control. Thus, they may be suitable for cultivation under natural floating system like *O. glaberrima* varieties, which are very hardy.

TABLE I. AGRONOMIC PERFORMANCE OF MUTANTS IN MEDIUM ZONE

Variety	Days to maturity	Plant height (cm)	No. of tillers /m	No. of panicles /m	No. of grains /p	1000 gr weight (g)	Yield kg/ha
Control (Gorbal)	163	189	38	29	160	29.6	2310
SMMG88-9	143	161	43	37	148	26.7	2260
SMMG88-13-1	153	156	37	32	140	26.2	2100
SMMG88-15-2	162	169	45	34	178	24.1	2235
SMMG88-20-1	144	187	46	36	162	27.0	2509
SMMG88-20-2-1	153	158	48	38	191	27.3	2680
F							NS
CV (%)							22.8

Sowing date: 9/07/1992

Maximum water levels: 80 cm

F test: not significant at 5% level

TABLE II. AGRONOMIC PERFORMANCE OF MUTANTS IN SHALLOW ZONE

Variety	Days to maturity	Plant height (cm)	No. of tillers /m	No. of panicles /m	No. of grains /p	1000 gr weight (g)	Yield kg/ha
Control (Gorbal)	163	184	38	30	154	29.3	2105
SMMG88-9	143	150	35	26	135	27.1	1634
SMMG88-13-1	153	142	36	30	134	25.9	1833
SMMG88-15-2	162	158	41	36	165	24.6	1712
SMMG88-20-1	144	179	43	37	141	27.0	2350
SMMG88-20-2-1	153	149	47	38	188	27.5	2417
F							NS
CV %							29.8

F test: not significant at 5% level

Sowing date: 11/07/1992

Maximum water levels: 50 cm

3.2. Irradiation of additional varieties

The objective of this study is to obtain mutants resistant to shattering and with high yield potential. Three varieties prone to shattering but more productive in natural submersion condition have been used. These varieties are 'Haira', 'Tombo' and 'Yele'. Each variety was irradiated with Cobalt 60 with dose of 20 krad and planted in plots 21m x 5m, with 0.30m

between rows, and 0.20m between hills. Data shall be collected on date of seedling emergence, plant survival after germination, date of 50% flowering, plant height at maturity, plants reaction to diseases and insects. The main panicle from each bush will be harvested at maturity and threshed. Then, the seeds will be sown in M_2 generations. Only the percentage of survival is now available. It was 75% for 'Haira', 81% for 'Tombo' and 72% for 'Yele'. These results confirmed those obtained in 1988. Radiation reduced seed viability of *O. glaberrima* varieties. Also any reduction of plants M_1 height compared to the control has been recorded.

3.3. *Future program*

As mentioned above, all of the identified mutants in the first mutagenesis program except one, were male sterile. The male sterile mutants identified in M_2 will be crossed with their parents to restore their fertility. From February 1994, one part of M_1 will be grown as M_2 under irrigation to advance generation.