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INDUCTION OF DISEASE RESISTANCE AND GRAIN SHAPE MUTANTS IN UPLAND RICE VARIETIES

J. S. CHAUHAN,* M. VARIAR AND D. MAITI

Central Rainfed Upland Rice Research Station, Post Box 48
Hazaribag 825301

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ABSTRACT

Morphological characters of two blast resistant mutants of upland rice variety Kalinga III, two fine grain mutants of the variety Brown Gora and five grain-shape mutants of variety Annada are presented.

Key words: Mutation, blast, grain quality, upland gora rice.

Mutagenesis has been widely used in the rice breeding programme to improve disease resistance and quality [1–3]. Induced mutation has been particularly useful in improving locally adapted cultivars deficient in one or two characteristics [4, 5]. Chemical and radiation mutagenesis were used in the present investigation to improve disease resistance and quality in Kalinga III, Brown Gora and Annada, three widely grown upland rice varieties of Eastern India.

Three mutagenic treatments, ethyl methane sulphonate (EMS 0.2, 0.4 and 0.6% aqueous solution), gamma irradiation (5, 10, 20 and 30 kR with ^{60}Co) and their combinations were used for inducing mutation. Fifty presoaked seeds each of Kalinga III, Brown Gora and Annada were treated in EMS for 6 and 12 h. Dry seeds were used for irradiation. Seeds were irradiated first and dipped in EMS for 6 h. in the combined treatment. Respective controls were maintained.

The M_1 was direct seeded with single seed/hill, spaced 10 x 10 cm apart. Two tallest panicles from each plant were bagged and the M_2 generation was raised from the bulk of the selected panicles. Thirty-day-old seedlings were transplanted (one seedling/hill) in a randomized complete block design with two replications. The rows were 4.5 m long and the row and plant spacings were maintained at 15 cm each. There were ten rows for each

*Present address: National Research Centre for Mustard, Sewar Road, Bharatpur 321003.

treatment/replication. Fertilizer was applied just before transplanting at the rate of 20 N : 13 P : 8 K (kg/ha). Nitrogen was top-dressed at the rate of 40 kg/ha in two equal splits 20 and 35 days after transplanting. Plant protection measures were followed when needed. Fifty competitive plants per replication per treatment were taken to record observations on panicle and grain characteristics and blast resistance. The M_3 and M_4 progenies were from the single selected plants. Uniform M_4 progenies were bulked and tested for blast reaction in 1992. Twenty M_5 progenies along with their parents were grown during 1993 wet season in four row plots to evaluate agronomic characters and also in UBN to re-evaluate blast resistance.

Germination of the mutagen treated seeds ranged from 40–70% while the untreated seeds recorded 96–100% germination. The frequency of blast resistant mutants was 0.17% in M_2 of Kalinga III and the frequency of grain size and shape mutants in M_2 were 0.3 and 0.33–0.5% in Brown Gora and Annada, respectively.

Blast resistant mutants. Of the 13 M_5 Kalinga III progenies eleven showed moderate resistance in 1992 and 1993 whereas two mutants, 146-1 and 149-1, showed consistently higher level of resistance. These two mutants had slight reduction in plant height and took 2–3 days more to 50% flowering (Table 1). The mutant 149-1 had higher grain weight than the parent variety. Length : breadth (L:B) ratio for rough rice and brown rice were, however, similar to the parent variety owing to simultaneous increments in length and breadth.

Table 1. Characteristics of blast resistant mutants and cv. Kalinga III of rice (wet season, 1993)

Characteristics	Mutant 146–1	Mutant 149–1	Kalinga III (parent cv.)
Plant height (cm)	83	92	95
Days to 50% flowering (d)	63	63	60
1000-grain weight (g)	20.0	21.5	19.0
Lemma-palea colour	Straw	Straw	Straw
Kernel colour	White	White	White
Brown rice length (mm)	6.3	6.75	6.3
Brown rice breadth (mm)	2.15	2.25	2.15
L : B ratio	2.93	3.00	2.93
Blast reaction (0–9)*	3.5	3.5	7.0

*Mean of two seasons.

Grain shape mutants. Two mutants with improved grain shape were isolated in the M_2 generation derived from EMS-treated (0.6%, 6 h.) seeds of Brown Gora (Fig. 1). Mutant 113-10-2-1 had the longest grains and highest L : B ratio but lower 1000-grain weight (Table 2). Mutant 113-10-2-2 had straw lemma-palea colour, high L:B ratio and grain weight. Higher L:B ratio in these mutants was due to increase in length as well as reduction in breadth. The two mutants exhibited the same level of resistance to blast as the parent cultivar.

Five mutants with variable grain size and shape were isolated in the M_2 generation derived from the irradiation + EMS treated seeds of Annada (Fig. 1). Three mutants (153-2-2-B, 153-11-1-B, and 153-11-2-B) were recovered from 5 kR ^{60}Co + 0.6% EMS and two (155-1-2-B, 155-1-3-B) from 10 kR ^{60}Co + 0.2% EMS treatments. All these mutants flowered earlier than the parent variety. As compared to the parent variety which was partly awned (short), mutant 155-1- 3-B had long awns whereas in the mutant 153-11-1-B awns were absent. Brown rice length in the mutants ranged from 5.9 to 6.5 mm and the L : B ratio varied from 2.49 to 3.05 as compared to the parent which had short, coarse grains (Table 2). The increase in brown rice length was also accompanied by reduction in kernel breadth in these mutants. Two mutants showed similar level of tolerance to blast as the parent.

The segregation of M_3 progenies for grain size, shape and blast reaction suggested these traits to be recessive and probably under polygenic control or several major interacting genes which could be ascertained only after studying their segregation pattern in F_2. Since the mutations were induced to specifically select for improved resistance/quality, other mutations appearing in the populations were not considered. The presence of long awns in the mutant of Annada and straw lemma-palea colour in the mutant of Brown Gora would be either due to independent gene mutations for awning, colour genes or the result of pleiotropic effects.

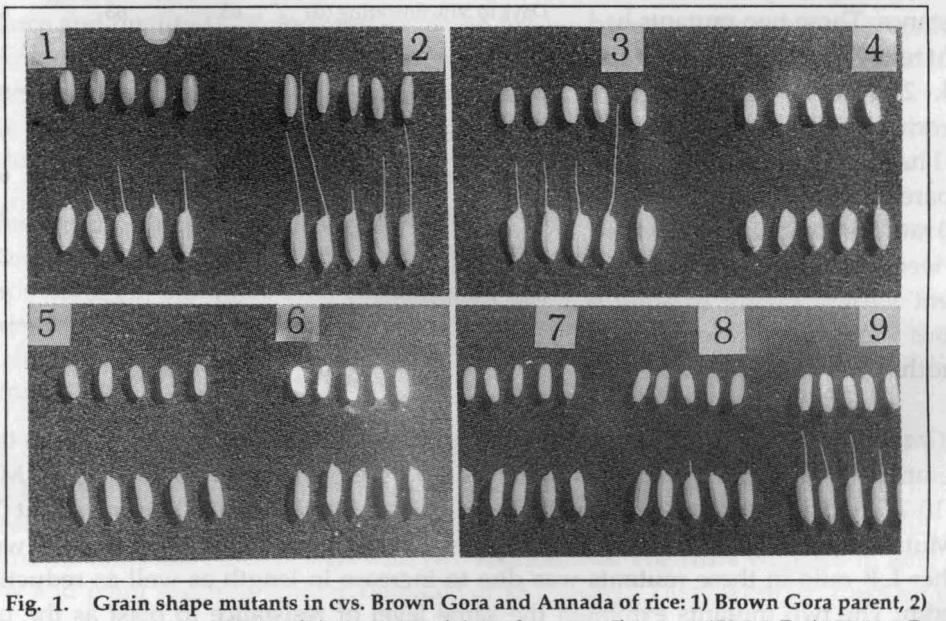

Fig. 1. Grain shape mutants in cvs. Brown Gora and Annada of rice: 1) Brown Gora parent, 2) mutant 113-10-2-1 and 3) 113-10-2-2; 4) Annada parent, 5) mutant 153-2-2-B, 6) 153-11-1-B, 7) 153-11-2-B, 8), 155-1-2-B and 9) 155-1-3-B.

Table 2. Characteristics of grain shape mutants in Brown Gora and Annada varieties of rice

Genotype	Plant height (cm)	50% flower-ing days	1000-grain weight (g)	Lemma-palea colour	Kernel colour	Brown rice length (mm)	Brown rice breadth (mm)	L : B ratio	Awn-ing	Blast reaction (0–9)
113-10-2-1	92	77	25.5	Brown	Red	7.1	2.15	3.30	Long & partial	6.0
113-10-2-2	92	77	27.0	Straw	Red	6.7	2.40	2.79	Long & partial	6.0
Cv. Brown Gora	98	77	26.5	Brown	Red	6.0	2.60	2.31	Long & partial	6.0
153-2-2-B	67	77	20.5	Straw	White	6.35	2.10	3.02	Short & partial	9.0
153-11-1-B	74	77	21.5	Straw	White	5.90	2.30	2.57	Absent	9.0
153-11-2-B	68	77	20.5	Straw	White	6.40	2.10	3.05	Short & partial	9.0
155-1-2-B	77	77	21.0	Straw	White	6.10	2.45	2.49	Short & partial	6.0
155-1-3-B	62	77	24.5	Straw	White	6.50	2.40	2.71	Long & partial	6.0
Cv. Annada	65	80	21.0	Straw	White	5.50	2.65	2.08	Short & partial	6.0

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