

VARIABILITY AMONG MUTANTS DERIVED FROM THE RICE VARIETY Bw361

A.P. BENTOTA, G.D.A. PRIYANTHA, E.A.S. ROHINI and H.G.J. CHANDANA
Regional Rice Research and Development Centre, Bombuwela

ABSTRACT

Rice breeders have explored favourable traits using mutation techniques, and released many rice varieties around the world. However, little attention has been paid in the use of mutation techniques in the rice variety improvement programmes in Sri Lanka. Therefore, the high yielding red pericarp rice variety, Bw361 in the 3 1/2 maturity group was irradiated with the objective of increasing the culm length to reduce sheath blight incidence and also to identify and compile the variability found among these mutants. Selection of mutants was carried out in m_2 through m_5 generation. Eight promising mutants with comparatively taller culms, different days to flowering and maturity, different grain sizes and shapes were identified. Mutants varied significantly for culm length, maturity duration, panicle length, days to 50% flowering, grain shape, grain color and grain yield. All mutants were significantly taller than Bw361. Similarly, variations for biotic stresses such as blast, sheath blight, gall midge and brown plant hopper among mutants were observed. Identification of mutants that were resistant to sheath blight disease would be very useful. Variations among mutants were also observed for iron toxicity tolerance and lodging. Thus, the mutants derived from Bw361 provided useful genetic variability which may be successfully utilized in Sri Lanka's rice improvement programme.

KEYWORDS: Induced mutant, Rice, Variation.

INTRODUCTION

Induced mutagenesis has created favourable genetic variability in rice. However, useful genetic changes are likely to occur in characteristics controlled by few major genes. At present more than 800 rice mutants have been recorded around the world (Ahloowalia *et al.*, 2004). While many of these mutants have been selected for earliness, dwarfism, or high yield potential, some of them have been utilized to develop varieties with grain quality characteristics, resistance to diseases and, tolerance to salinity and cold. In Sri Lanka, despite 50 improved rice varieties being released during the past few decades, only one variety, MI273 (Ganeshan, 1980) which has been developed using mutation techniques has been released. This was mainly because the rice breeders in the country have paid comparatively more attention for conventional method of breeding by using artificial hybridization.

The mutants derived from Bw361 (entry number Bw328-1) with the intention of reducing the sheath blight incidence through increasing culm length showed a potentially useful variability among them. Thus the present study was carried out to identify and compile the variability found among these mutants.

MATERIALS AND METHODS

Two hundred grams of dried seeds of rice variety, Bw361 was irradiated with 15 Kr of gamma radiation using ^{60}Co machine in 2001 *yala* season. Those seeds were raised as a bulk population in M_1 generation and advanced to form M_2 - M_4 generations in subsequent seasons at the Regional Rice Research and Development Centre (RRRDC) Bombuwela. Population size of a generation varied from 6000 to 10000 plants which were planted at a spacing of 40x15 cm with one plant per hill. While advancing the generations, visual selection was practiced in each generation, for age, grain size and plant height. At M_4 generation in 2002/2003 *maha* season 50 single plants were selected to form 50 progenies. Each progeny was maintained in a 3 row plot planted at the spacing of 15x20 cm, with 120 plants per progeny. Phenotypically accepted progenies were advanced in each season and 8 promising progenies were selected in 2005/2006 *maha* season. Those lines were evaluated with the parent variety, Bw361 and Bg300 as standard checks at the RRRDC, Bombuwela in 2006 *yala* and 2006/2007 *maha* season in a Complete Randomized Block Design (CRBD) with 3 replications. Plot size of the experiment was 3x6 m² and each plot was sown with 180 g of seeds. The crop was managed as recommended by the Department of Agriculture. Culm length, panicle length, days to 50% flowering, days to maturity, grain yield, pericarp colour, 100 seed weight and grain shape of the test entries were measured. Test entries were screened against diseases such as blast and sheath blight and major pests such as Brown Plant Hopper (BPH), and Galle Midge (GM). The entries were also screened for tolerance to iron toxicity and lodging.

RESULTS AND DISCUSSION

Culm length, panicle length, days to 50% flowering, days to maturity and grain yield of mutants are presented in Table 1 along with that of the parent variety, Bw361 and check variety Bg300 of 3 months maturity duration.

Culm length

All the mutants had significantly taller culms than that of their parent Bw361. Tallest culm was from mutant line Mu8-2 followed by Mu3-2. Mu3-2 was highly susceptible to lodging while other mutants were partially susceptible except Mu6-1 (Table 3). The shortest among the mutant was from Mu8-7 which was about 67-70.7 cm in both seasons. The non lodged mutant Mu6-1 had a culm length of 82 cm in both seasons.

Table 1. Grain yield and other agronomic characteristics of mutant lines, their parental line and Bg300 in 2006 yala and 2006/2007 maha seasons.

Mutant/ variety	Agronomic characteristics*											
	Culm length		Panicle length (cm)		Days to 50% flowering		Days to maturity		Grain yield (t/ha)			
	2006 yala	2006/07 maha	2006 yala	2006/07 maha	2006 yala	2006/07 maha	2006 yala	2006/07 maha	2006 yala	2006/07 maha		
Mu1-2	97.4 c	95.3 c	22 bc	23.1 ab	67 d	62 c	94 d	95 c	4.4 a	4 a		
Mu1-5	92.1 e	90.1 e	22.6 bc	21.5 bcd	72 bc	60 d	98 bc	92 ef	2.98 bdc	3.2 abc		
Mu1-9	88 e	86.3 f	23.5 bc	23.4 a	70 bcd	62 c	98 bc	92 e	4.25 ab	3.2 abc		
Mu1-11	96.2 d	92.7 d	27 a	22.5 ab	69 dc	60 d	99 b	91 fg	4.72 a	3.6 ab		
Mu3-2	106.2 a	104.7 a	18.2 e	20.5 dc	70 bcd	82 a	98 bc	109 a	3.55 abc	2.7 c		
Mu6-1	83.7 f	81.5 g	22.7 bc	22.7 ab	76 a	70 b	105 a	101 b	2.07 d	2.9 bc		
Mu8-2	106.8 b	98 b	24.1 b	23.3 ab	72 b	63 c	99 b	93 d	2.45 cd	3.5 ab		
Mu8-7	70.7 g	67.3 h	21.5 dc	22.7 abc	59 e	56 f	88 f	88 h	4.3 a	2.7 c		
Bw361	57 i	56.9 j	21.7 bcd	21.8 abcd	70 bc	62 c	97 c	92 e	3.68 abc	3.3 abc		
Bg300	67.7 h	63.3 i	19.4 de	20.3 d	62 e	58 e	91 e	91 g	3.87 ab	2.8 c		
CV%	1.15	1.4	6.36	4.83	2.36	1.25	0.86	0.61	21.16	14.2		
LSD	1.6	1.9	2.43	1.83	2.78	1.4	1.43	0.99	0.92	1.0		

*Means followed by the same letter within a column are not significantly different ($p < 0.05$)

Panicle length

Variation in panicle length showed different trends in 2006 *yala* and 2006/2007 *maha* seasons. None of the mutants had significantly different panicle length in 2006/2007 *maha* season from their parent. In 2006 *yala* Mu1-11 produced significantly longer panicles than that of the parent and Mu3-2 produced significantly shorter panicles than that of the parent. The rest of the mutants were similar to their parent in panicle length in 2006 *yala*.

Days to 50% flowering

Mu8-7 mutant had significantly shorter vegetative growth than that of its parent and Bg300. The 50% flowering of this early mutant was 59 days in *yala* 2006 and 56 days in *maha* 2006/07. The days to 50% flowering in some lines showed variation between seasons. Line number Mu1-2, Mu6-1 and Mu8-7 showed comparatively less variation between seasons for days to 50% flowering. Other selected mutants had days to 50% flowering between 67-76 days in 2006 *yala* season and 60-82 days in 2006/07 *maha* season.

Days to maturity

Mu8-7 matured in 88 days in both 2006 *yala* and 2006/07 *maha* seasons. The maturity of early mutant was significantly lower than the 3 months age group standard check Bg300. Mu1-2 also had consistency in days to maturity over seasons. Mu1-5, Mu1-9 and Mu3-2 had the same maturity duration as in Bw361 during 2006 *yala* season and Mu3-2 showed significantly longer maturity duration than the Bw361 during 2006/07 *maha* season. Mu1-11 and Mu8-2 showed significantly longer maturity duration than the parent in 2006 *yala* season and Mu1-11 was shorter in 2006/07 *maha* season. Mu6-1 had longer maturity duration than Bw361 in both seasons.

Yield

In 2006 *yala* season Mu1-11, Mu1-2, Mu8-7, Mu1-9 and Mu3-2 had high yields which were comparable to that of Bw361 and Bg300. Although mutants had significant variability in grain yield, yield comparison between mutants was not accurate enough to identify high yielding mutants due to high CV% of yield trials in both seasons.

Physical grain characteristics

Pericarp colour, 100 seed weight and seed shape of mutants and Bw361 are presented in Table 2. The red pericarp colour of parent variety remained in Mu1-2, Mu1-9, Mu1-11, Mu3-2 and Mu6-1 while Mu1-5, Mu8-2 and Mu8-7 have been mutated to form white pericarp colour. The smallest

100 seed weight of 1.62 g was from Mu6-1 with short round grains. Mu1-11 and Mu1-5 had grain weight of 1.98 g and 2.03 g respectively. The 100 seed weight of Mu1-9 and Mu8-2 was significantly higher than the parental variety Bw361. Though the long medium seed shape of Mu1-2 and Mu8-7 were similar to the parent variety Bw361, seed weight was significantly lower in Mu8-7 than in Bw361. The grain shape of the other varieties was intermediate bold in shape.

Table 2. Physical grain characteristics of mutant and their parents Bw361 and Bg300.

<i>Mutant/ Variety</i>	<i>Pericarp colour*</i>	<i>100 seeds wgt (g)***</i>	<i>Grain shape**</i>
Mu1-2	R	2.37 d	IB/L
Mu1-5	W	2.03 g	IB
Mu1-9	R	2.44 c	IB
Mu1-11	R	1.98 g	IB
Mu3-2	R	2.28 e	IB
Mu6-1	R	1.62 h	S/R
Mu8-2	W	2.50 b	IB
Mu8-7	W	2.19 f	IB/L
Bw361	R	2.38 d	IB/L
Bg300	W	2.58 a	IB

*** CV% = 1.2. Means followed by the same letter within a column are not significantly different (p < 0.05)

*R-Red

**L-Long

W-White

IB-Intermediate Bold

S/R-Short Round

Variation in biotic and abiotic stresses

Variation in reaction of mutants to biotic stresses such as Blast (BL), Sheath Blight (SB), Brown Plant Hopper (BPH) and Galle Midge (GM) and abiotic stresses, iron toxicity and lodging are presented in Table 3.

Mu1-2 was found to be superior to other mutants while Mu3-2 was found to be inferior with respect to their reaction to stresses, except for iron toxicity. None of the mutants were found to be superior to parent variety, Bw361 in lodging assessment except Mu6-1. Resistance quality for sheath blight disease found in Mu1-2, Mu1-5, Mu1-9, Mu1-11 and Mu6-1 has been an outstanding achievement. The mutant Mu1-2 having resistance to BL, SB, BPH and GM and tolerance to iron toxicity was found to be high yielding and highly promising.

Table 3. Reaction of mutants, their parent Bw361 and Bg300 to biotic and abiotic stresses.

<i>Mutant/ variety</i>	<i>Biotic stresses*</i>				<i>Abiotic stresses ** Iron toxicity</i>	<i>Lodging assessment §</i>
	<i>BL</i>	<i>SB</i>	<i>BPH</i>	<i>GM</i>		
Mu1-2	R/MR	R	MR	R/MR	T	PL
Mu1-5	R	R	MR/MS	MR	MT	PL
Mu1-9	R	R	MR	MR/MS	T	PL
Mu1-11	R	R	MS	MR	MT	PL
Mu3-2	MS	MS	MR/MS	MR/MS	MT	L
Mu6-1	R	R	MS	MR/MS	MT	NL
Mu8-2	MR	MS/T	MR/MS	MS	MS	PL
Mu8-7	MR	HS	MR/MS	R/MR	MT	PL
Bw361	R	MS	MR	MR/MS	T	NL

*R-Resistant
MR-Moderately Resistant
MS-Moderately Susceptible

**T-Tolerant
MT-Moderately Tolerant
NL-Non Lodging

§ L-Lodged
PL-Partially Lodged
S-Susceptible

CONCLUSIONS

The mutants derived from Bw361 significantly varied for culm length, days to 50% flowering, days to maturity, grain yield, pericarp colour, 100 seed weight, seed shape and reactions to BL, BPH, GM and iron toxicity and more importantly reaction to sheath blight disease and for degree of lodging. Thus mutation provided favourable genetic variation for further improvement of rice varieties in the country.

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