

BRSMG Rubelita: irrigated rice cultivar for lowlands in the state of Minas Gerais

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Abstract: *The lowland rice breeding program, developed in the state of Minas Gerais, has as basic objective to release new commercial cultivars. In this way, this program is making available a new cultivar named BRSMG Rubelita, which has as main characteristics: medium cycle, high tillering, lodging tolerance, diseases tolerance, high grain quality, and high grain yield.*

Key words: *Oryza sativa, lowland rice, rice breeding.*

INTRODUCTION

Minas Gerais is among the major rice consumer states in the country. Upland and lowland rice crops account for about 80% of rice production in this state, equally distributed to each ecosystem. The remainder (20%) is produced in lowland under irrigation conditions.

During the agricultural years of 2000-2010, there was a decrease in the planted area and in the amount of rice produced by the state of Minas Gerais. The planted area and yield obtained in 2000 were about 135,000 ha and 263,000 t; and the records of 2010 were lower, 53,000 ha of planted area, and 115,000 tons of rough rice. In 2013, the records for planted area and yield decreased even more when compared with 2010, i.e., 23,000 hectares of planted area, and 43,000 tons of rough rice (CONAB 2015).

One of the main factors that contribute to rice production is the use of improved cultivars adapted to each type of crop. This is because the technology generated (new cultivars) is of low cost and easy adoption by farmers, providing significant gains in crop yields. Rice cultivars recommendation for commercial cropping is continuous and dynamic, i.e, from time to time new cultivars are recommended in replacement to the less yielding cultivar and/or with less commercial acceptance. Thus, the research partnership between EPAMIG and Embrapa Rice and Beans, by means of the lowland rice breeding program, tests every year several lines and cultivars, in different locations of Minas Gerais, aiming at offering the best options to rice farmers, regarding the most appropriate cultivars to their lowland crops.

Both for upland rice and for lowland rice, the role of research, especially breeding, with the obtainment of improved cultivars, is essential to increase rice production and yield in Minas Gerais, and thus contributes to increase the income of rice farmers and the State Value-added Tax on Goods and

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Services (ICMS – Imposto sobre Circulação de Mercadorias e Serviços), in addition to making the state and the country less dependent on imports to meet the increasing domestic demand.

As a recent contribution of these integrated researches, a new lowland rice cultivar was made available to farmers of the state of Minas Gerais: BRSMG Rubelita. This is the 17th lowland cultivar released by this research program.

PEDIGREE AND BREEDING METHOD

In the lowland ricebreeding program carried out in Minas Gerais, the Trials of Value of Cultivation and Use (VCU's) are designed to evaluate, with replications of years and local, cultivars and lines that stood out in the Preliminary Comparative Trials, aimed at the recommendation of new cultivars.

BRSMG Rubelita originated from the simple cross involving the lines CNA 4990 and CNA 7882, which aimed at gathering greater resistance to blast, hardness, yield potential and grain quality. The cross was carried out by Embrapa Rice and Beans, in 1996. After the multiplication of F₁ seeds, the F₂ generation was sown in the first semester of 1997, in Goianira-GO. After mass selection of plants with good phenotypic acceptance, the F₃ generation was sown during the 1997/98 agricultural year, also in Goianira, when the population was harvested in bulk. The F₄ generation was subjected to selection of individual plants in 1998/99, and in the following year, a new selection of plants within the best F_{4:5} progenies was carried out. F₆ lines were incorporated into the observation trial of lowland rice families in 2001/02, Goianira-GO. In 2002/03, the F4-2-6-B line, identified as BRA 02697, participated in the yield preliminary trial of lowland rice (PT), sown in Goianira-GO, Formoso do Araguaia-TO, Boa Vista-RR, and Leopoldina-MG. With the analysis of the PTs, the line BRA 02697 was selected to proceed the evaluation in Minas Gerais, under the Minas Gerais Agreement. In the 2004/05 agricultural year, BRA 02697 was included in the value of cultivation and use (VCU's) of Minas Gerais, and remained in this trial category for five years (2004/05 to 2009/10).

Furthermore, the cultivar was evaluated in DUS trials (Distinctness, Uniformity and Stability Trial) in Goianira-GO, in the 2012/13 agricultural year. The cultivar was also evaluated regarding grain cooking quality by Embrapa Rice and Beans, with gelatinization temperature and apparent amylose content classified as intermediate.

PERFORMANCE

VCU experiments have been carried out with 25 genotypes, including five controls. The experiments were carried out under continuous flood irrigation in lowlands in the Experimental Farm of EPAMIG, in the municipalities of Janaúba, Lambari, Leopoldina, and Prudente de Morais. Table 1 shows the geographical coordinates of these municipalities.

The experimental design was a randomized block with four replications. Plots consisted of five 5 m long rows, spaced 0.3 m apart. The central 4m of the 3 internal rows were considered the useful plot. Sowing density was 300 seeds m⁻². In each agricultural year, lines with inferior performance were replaced by supposedly better lines; however, the five control cultivars remained throughout the evaluation period, except for Jequitibá, which did not participate in the VCU trials in 2009/10.

Planting fertilization consisted of 500 kg ha⁻¹ of the 08-28-16 + Zn formula. In topdressing, it was applied 200 kg ha⁻¹ of the 20-05-20 fertilizer, in two plots, being the first at 30 days, and the second at 60 days after sowing, respectively. Weeds were controlled by hoeing and by the application of herbicides. Disease control was not carried out in order to enable the plant's emergence and discarding of susceptible lines. The implementation of field trials occurred from the first ten days of October until the second ten days of December of each year, depending on local weather conditions.

Table 1. Geographical data of the location where VCU trials of the lowland rice breeding program of the state of Minas Gerais, Brazil, were carried out

Location	Latitude	Longitude	Altitude (m)
Janaúba	16° 12' 38"	41° 23' 53"	745
Lambari	22° 06' 02"	45° 26' 16"	965
Leopoldina	21° 43' 54"	42° 43' 15"	370
Prudente de Morais	19° 44' 20"	44° 08' 18"	823

Source: United States Department of State Geographer (2013). Software Google Earth.

Table 2. Mean grain yield (kg ha⁻¹) of BRSMG Rubelita and of the control cultivars in VCU trials carried out in Minas Gerais, in the period from 2004/05 to 2009/10

Cultivars	Grain Yield (kg ha ⁻¹)					Weighted average ² (10 trials)
	2004/05	2005/06	2006/07	2007/08	2009/10	
	1 ¹	2	3	2	2	
Seleta	6730c	7171c	5482a	6557d	6048a	6273a
BRSMG Rubelita	6946a	7438b	5218b	6594c	5557c	6178a
Rio Grande	6285d	6781e	5451a	6726b	5988a	6163a
Ourominas	5971e	8202a	5519a	6265e	4905d	6127a
Predileta	6854b	6738f	4986c	7046a	5717b	6081a
Jequitibá	5935f	6922d	4861d	6218f	-	5850b
Média	6454	7209	5253	6568	5523	6112

¹ Number the trials carried out in each agricultural year

² Means followed by the same letter in the column do not differ by the Scot-Knott test at 5% probability

The main agronomic characteristics evaluated were: leaf color, pubescence, angle of flag leaf, tillering, mean flowering, full maturation cycle, plant height, lodging, resistance to diseases, glumes color, apiculus color at maturity, presence of awns, shattering, mean length of panicles, grain yield, dehulled grain size, weight of 100 grains, grain class, whole grain yield and broken grain yield, gelatinization temperature, and amylose content.

These evaluations were carried out according to Embrapa (1977). Statistical analysis was carried out for grain yield every agricultural year, and combined analysis was performed with six genotypes common to the five agricultural years (2004/05 to 2009/10), using the GENES software (Cruz 2006). Table 2 shows the means of grain yield obtained in 10 VCU trials carried out in Minas Gerais during five agricultural years (2004/05 to 2009/10) for BRSMG Rubelita and control cultivars (Jequitibá, Rio Grande, Ourominas, Seleta and Predileta). It was observed that the new cultivar BRSMG Rubelita, with overall mean of 6178 kg ha⁻¹ (Table 2), did not significantly differ ($p > 0.05$) from the control cultivars Seleta, Rio Grande, Ourominas and Predileta; however, it had higher (5.31%) grain yield than Jequitibá.

Nevertheless, the new cultivar presented grain yield inferior to that of cultivar Seleta. It should be noted that Seleta presents excellent growth performance in commercial fields, with great grain quality and resistance to major diseases that attack rice crops. Seleta has been recently released for the state of Minas Gerais (Soares et al. 2005). Predileta is the other irrigated rice cultivar for lowlands in the state of Minas Gerais with excellent performance in commercial fields (Soares et al. 2008).

Table 3 shows the main botanical, morphological and phenological characteristics evaluated for cultivar BRSMG Rubelita. The cultivar fits the plant modern group; it is a medium-sized plant (95-100 cm plant height), with upright, light-green colored leaves, high tillering, and resistance to lodging. It is moderately resistant to major diseases that attack rice (leaf and panicle blast, brown spot, grain spot, and leaf scald). At maturity, the glumes are straw-colored, the apiculus are yellow with the presence of awns of varying size. The maturation cycle is of about 135 days.

Table 3. Plant characteristics of the cultivar BRSMG Rubelita

Plant characteristics	Description
Leaf color	Dark-green
Auricle color	Light-green
Ligule color	Colorless or green
Pubescence of the leaf blade	Medium
Flag leaf angle	Upright
Stem length	Long (76.4 cm)
Stem thickness	Thick (5 mm)
Tillers angle	Upright
Internode color	Light-green
Panicle length	Long (25.8 cm)
Panicle type	Compact
Panicle exertion	Medium
Natural panicle shattering	Intermediate
Presence of awns in the panicle	Absent/too short
Spikelets:	
Stigma color	White
Pubescence	Medium
Apiculus color at flowering	Green
Apiculus color at maturation	Yellow
Gluma color	Straw/golden
Tillering	High
Full maturation cycle	Medium (130-135 days)
Plant height	95 to 100 cm
Lodging	Resistant
Reaction to diseases:	
Leaf blast	Moderately Resistant
Panicle blast	Moderately Resistant
Brown spot	Moderately Resistant
Grain spot	Moderately Resistant
Leaf scald	Moderately Resistant

Table 4 shows the result of the analysis of some grain characteristics of BRSMG Rubelita. The grains are long and thin, translucent, loose and soft after cooking, due to the amylose content and to the intermediate gelatinization temperature, which meets the market requirements. This cultivar has excellent performance in relation to whole grains yield in the processing (over 55%), according to Vieira and Rabelo (2006).

Cultivar BRSMG Rubelita presents long and thin grains (“agulhinha”), which are the most valued in the Brazilian market. For the grains to be classified as long and thin, they must present at least 80% of whole grains measuring 6.00 mm or more in length, 1.90 mm in width, and the length/width ratio must exceed 2.75 after polishing (Vieira and Rabelo 2006). Table 4 shows the dimensions of the grains of the new cultivar (long and thin).

In summary, BRSMG Rubelita associates very interesting characteristics, which are valued by rice farmers, such as: yield potential, medium cycle, lodging resistance, tolerance/resistance to major diseases, long and thin grains, high whole grains yield in the processing, and good cooking quality. Thus, this new cultivar can greatly contribute with rice crops of the state of Minas Gerais.

Cultivar BRSMG Rubelita, for its high genetic potential for grain yield, and for presenting other relevant characteristics, was released for lowland cropping under continuous flood irrigation, throughout the state of Minas Gerais.

SEED AND PRODUCTION DISTRIBUTION

BRSMG Rubelita is registered in the Ministry of Agriculture under the number 33218. The Company of Agricultural Research of Minas Gerais – EPAMIG is responsible for the production of genetic seeds, while the basic seed production is in charge of EPAMIG and EMBRAPA. Production stages of certified or inspected seeds are outsourced through agreements with seed producers.

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Table 4. Grain characteristics of the cultivar BRSMG Rubelita

Grain characteristics	
Length of dehulled grain (Milled grain length)	7.57 mm
Thickness of dehulled grain (Milled grain width)	2.07 mm
Grain length/width ratio	3.65
Grain shape	Very elongated
Grain class	Long and thin
Weight of 100 grains	27.6 g
Amylose content	23.5% (intermediate)
Gelatinization temperature (GT) ¹	4.0 (intermediate)
Whole grain yield	>55%
White center ²	3.0

¹ High = grades 2 and 3; intermediate = grades 4 and 5; low = grades 6 and 7

² Excellent = grade 1; good = grade 2; regular = grade 3; bad = grade 4; very bad = grade 5

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