

RB036088 – a sugarcane cultivar for mechanical planting and harvesting

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Abstract: *The sugarcane cultivar RB036088 is late-maturing, harvested from September to November in south-central Brazil, and is recommended for soils with medium to high fertility. It stands out with continuously high sugar yield over the harvests, longevity of the ratoon plants, high tillering capacity and can be harvested mechanically.*

Key words: *Saccharum spp., selection, improvement.*

INTRODUCTION

The breeding program of sugarcane (*Saccharum* spp.) of the Federal University of Paraná [PMGCA/UFPR (www.pmgca.ufpr.br)] is part of an inter-university network to foster the development of the sugar-energy sector - RIDESA (www.ridesa.com.br), a framework focused on sugarcane breeding involving 10 Federal Universities (Barbosa et al. 2012). Among the main objectives of RIDESA is the development of sugarcane varieties with different maturation periods and satisfactory yields under specific crop management conditions, e.g., mechanical planting and harvesting (Iaia et al. 2014; Barbosa et al. 2015; Carneiro et al. 2015; Daros et al. 2015). In south-central Brazil, the harvest of cultivars with medium to late maturity and high yields in mechanical cultivation systems is a challenge, due to the damage caused by the currently used sugarcane harvesting machines.

Sugarcane cultivar RB036088 is recommended for planting in medium to high fertility soils, has a high phenotypic stability for the trait tons of sucrose per hectare (TSH), aside from an excellent response to improvements in the production environment. However, the main highlight of this new cultivar is its suitability for mechanical planting and harvesting systems, with continuously high agricultural yields in terms of sugar production per area in the different production cycles. In view thereof, it can be considered an ideotype for mechanical harvesting.

In the central-south region of Brazil, the recommended harvest time for 'RB036088' is the end of the growing season, from September to November. However, when ripeners are applied, it can be cut in the middle of the growing season, from July to August. It has upright, tall growth and excellent suitability for mechanical harvesting, ensuring low levels of mineral impurities for industrial use.

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Aside from the above advantages, ‘RB036088’ can maintain high agricultural productivity over the crop cycles, due to the outstanding tillering capacity, along with the growth of medium-diameter stalks and short to medium internodes, the tall, medium-weight stalks and easily removable leaves.

PEDIGREE AND BREEDING METHOD

In 2003, sugarcane caryopses were obtained from the cross of parent RB855595 with pollen from several other parents of the experimental station Estação de Floração e Cruzamento da Serra do Ouro (lat 9° 13’ S, long 35° 50’ W, alt 450 m asl), in the municipality of Murici, Alagoas, of the Federal University of Alagoas (Figure 1). This parent has an excellent selection rate, since it produces progenies with potential for stalk yield per area (tons of cane per hectare -TCH) and with excellent bud sprouting, upright growth habit, strong tillering, and resistance to the major diseases of the crop. In the same year, the caryopses were germinated in a greenhouse of the experimental station of Paranavaí (lat 23° 05’ S, long 52° 27’ W, alt 503 m asl), of the Federal University of Paraná, in the municipality of Paranavaí, Paraná.

Plants of the first selection stage (T1) were first planted in the field in November 2003, in two production environments, in the municipalities of Colorado and São Tomé, resulting in approximately 200,000 seedlings derived from hundreds of parents. Individual selection was performed in July 2005 in the sugarcane ratoon cycle. In the first clonal multiplication in 2005 (stage T2), plants were cultivated at two locations of the state of Paraná (Colorado and São Tomé). Each genotype of stage T2 was planted in two 5-m- long rows, spaced 1.4 m apart, in an augmented block design. Clone selection was performed in the experiments in São Tomé in the stages T1 and T2, due to the excellent agronomic performance over three growing seasons, and T2 was named “PRP03088”. In 2008, the next stage (stage T3), evaluation and selection were carried out based on data from seven locations in two seasons in Paraná [Mandaguaiçú (lat 23° 21’ S, long 52° 05’ W, alt 580 m asl), Bandeirantes (lat 23° 06’ S, long 50° 22’ W, alt 492 m asl), Paranavaí (lat 23° 05’ S, long 52° 27’ W, alt 503 m asl), Colorado (lat 22° 50’ S, long 51° 54’ W, alt 400 m asl), Goioerê (lat 24° 10’ S, long 53° 01’ W, alt 550 m asl), Perobal (lat 23° 54’ S, long 53° 24’ W, alt 410 m asl), Astorga (lat 23° 11’ S, long 51° 09’ W, alt 634 m asl), São Pedro do Ivaí (lat 23° 52’ S, long 51° 41’ W, alt 400 m asl). In 2010, the clonal multiplication phase was initiated and in the following year, clone RB036088 was selected for the experimental phase of PMGCA, carried out at 10 locations in Paraná. At this stage, the agronomic traits were evaluated, i.e., tons of cane and sucrose per hectare, as well as adaptability and yield stability in different soil-climatic areas of the northern and northwestern regions of the state of Paraná (Figure 2a, b). This stage was monitored for four growing seasons. In this period, the resistance/tolerance to the major diseases relevant for the south-central sugarcane region was also evaluated. Between 2011 and 2012, experiments were conducted at nine locations in Paraná to evaluate the maturation period of cultivar RB036088. Prior to the market release, data of 54 growing seasons were compiled, covering from the first cut (10 growing seasons) to the fourth cut (6 growing seasons), which allowed a description of the main qualities of the cultivar, particularly the high yield of ratoon crops, associated with high yield stability and wide adaptability to soils, with medium to high agricultural productivity (Oliveira et al. 2015).

Since 2011, when the preliminary positive results were repeated in various environments in Paraná, sugar mills and distilleries indicated an interest in planting ‘RB036088’ in multiplication areas for performance evaluation under the management conditions of the production units. This resulted in the confirmation of the excellent performance of the cultivar under different conditions of commercial management. During this period, the cultivar stood out with an excellent performance in areas with mechanical harvesting, due to its upright growth habit and tall height, with no lodging, even in the final stage of the crop cycle of sugarcane plantations. This information motivated further propagation of the cultivar and in 2015, when ‘RB036088’ was officially released, over 10% of the sugarcane acreage was already destined for this cultivar in commercial areas in Paraná, due to all qualities described above.

In June 2016, the Federal University of Paraná requested the protection of cultivar RB036088 by the National Plant Variety Protection (SNPC) and National Register of Cultivars of the Ministry of Agriculture, Livestock and Supply (MAPA).

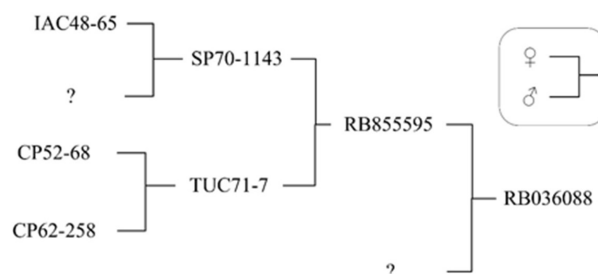


Figure 1. Pedigree of cultivar RB036088.

PERFORMANCE

The experimental results obtained in sugar mills and distilleries of Paraná demonstrated the superior performance of cultivar RB036088 over the standard cultivars (RB867515 and RB855536), mainly in medium to high fertility soils, as shown by the results obtained by the method of stability and adaptability proposed by Eberhart and Russell (1966) (Figure 2). Yield stability was high in various environments, indicating superior performance of yield-related traits in medium to high fertility soils.

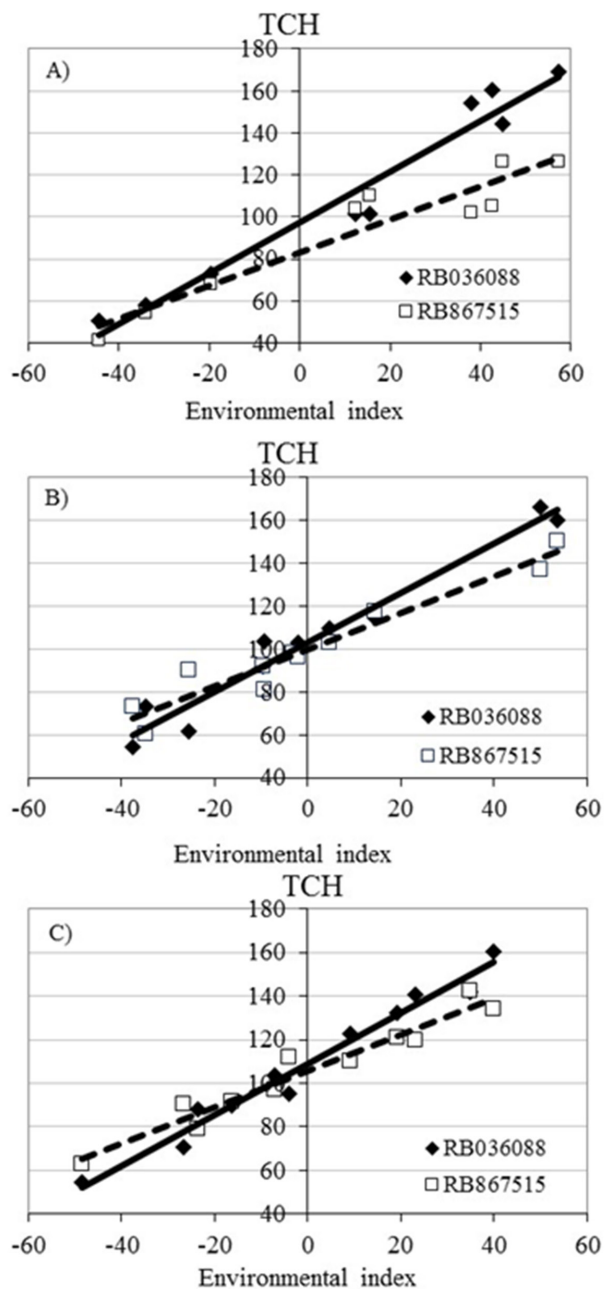


Figure 2. Phenotypic performance of RB036088 and RB867515 in 10 environments in (a) plant-cane, (b) first ratoon and (c) second ratoon crop, Paraná. * TCH – tons of cane per hectare.

The phenotypic adaptability of cultivar RB036088 was also high, indicating excellent response in yield for cultivation in high fertility soils. This performance was observed both for plant cane as well as ratoon cane crops (Figure 2). In a comparison of cultivar RB036088 with the standard cultivars, there was a 14% increase in TCH yield in the mean of four cycles (Table 1). This characteristic of high agricultural productivity ($111.06 \text{ Mg ha}^{-1}$) associated with a mean sucrose content enabled an increase in sucrose yield.

The maturation curve of cultivar RB036088 was constructed with data from eight evaluation locations in Paraná. The data of sucrose percentage in cane juice (SPC) was determined according to the method described by Fernandes (2003). The data of SPC indicated late maturation of the cultivar, suggesting harvest from September onwards in the center-south of Brazil (Figure 3). When comparing the maturation curve of 'RB036088' with another late-maturing cultivar (RB867515), sucrose levels were similar from August to September. In comparison with the intermediate-maturing cultivar RB855536 on high fertility soils (Bandeirantes and São Pedro do Ivaí), it was found that from September onwards the SPC increased, reaching the standard of early-maturing cultivars. This new cultivar is therefore an excellent alternative for cultivation in the south-central region, in view of the high stalk yield and sugar content for harvest between September and November. In years with high flowering induction in sugarcane plantations, frequent flowering of cultivar RB036088 was observed, but in evaluations of stalk density and stalk sucrose content, the performance was 2 to 5% below that of other cultivars commonly used as standards in experimental trials. In contrast, the application of ripeners in the management of cultivar RB036088 shifted the harvest period to July and August, with high agricultural yields, expanding the period of adequacy for industrial use of this new sugarcane cultivar.

Cultivar RB036088 has a high level of plant health, and is resistant to brown rust (*Puccinia melanocephala* H. and P. Sydow), resistant to orange leaf rust (*Puccinia kuehnii* H. and P. Sydow), resistant to sugarcane smut (*Sporisorium scitamineum* (Syd.) M. Piepenbr., M. Stoll & Oberw.), according to evaluations in field experiments with natural infection.

Table 1. Comparison of RB036088 with mean yields in crop cycles of important cultivars tested in Paraná, from 2010 to 2014

Crop cycle	Cultivar	Cane yield		Sugar yield		SPC**		Fiber		Apparent sucrose	
		t ha ⁻¹	(%)*	t ha ⁻¹	(%)	(%)	(%)	(%)	(%)	g kg ⁻¹	(%)
Plant-cane	RB867515	98.56	100	11.69	100	11.69	100	12.04	100	139.45	100
	RB855536	84.54	86	10.61	91	12.37	106	9.31	77	142.64	102
	RB036088	114.43	116	13.14	112	11.32	97	12.76	106	139.41	100
First-ratoon	RB867515	112.09	100	13.42	100	13.42	100	11.70	100	134.55	100
	RB855536	111.26	99	13.66	102	13.76	103	11.07	95	138.70	103
	RB036088	122.75	110	13.89	104	12.69	95	11.94	102	133.89	100
Second-ratoon	RB867515	90.91	100	15.23	100	15.23	100	12.44	100	150.19	100
	RB855536	100.89	111	17.00	112	15.32	101	11.05	89	155.94	104
	RB036088	110.18	121	17.36	114	14.32	94	12.81	103	149.37	99
Third-ratoon	RB867515	106.40	100	16.85	100	16.85	100	13.42	100	142.00	100
	RB855536	98.65	93	14.73	87	15.89	94	10.80	81	149.64	105
	RB036088	111.06	104	15.39	91	14.74	87	12.34	92	143.34	101

* Relative yield, considering cultivar RB867515 as reference.
 ** SPC - Pol in juice (sucrose percentage in cane juice).

OTHER TRAITS

Based on the official descriptors for sugarcane (SNPC/MAPA), cultivar RB036088 has an upright growth habit, a purple sugarcane heart with a low amount of wax, semi-open, minor part of visible internodes, and medium to easy husking. Regular amount of leaves with upright leaf architecture and closed capitula with short green sugarcane heart. The stalks have conoidal-shaped internodes, a round section, arranged in gentle zigzag, short to medium length and medium diameter, greenish - yellow and yellowish-green color when exposed to the sun, with mottled appearance without cracks and little wax.

The yellowish-green growth ring has a medium width and bud prominence. The root region has medium width and

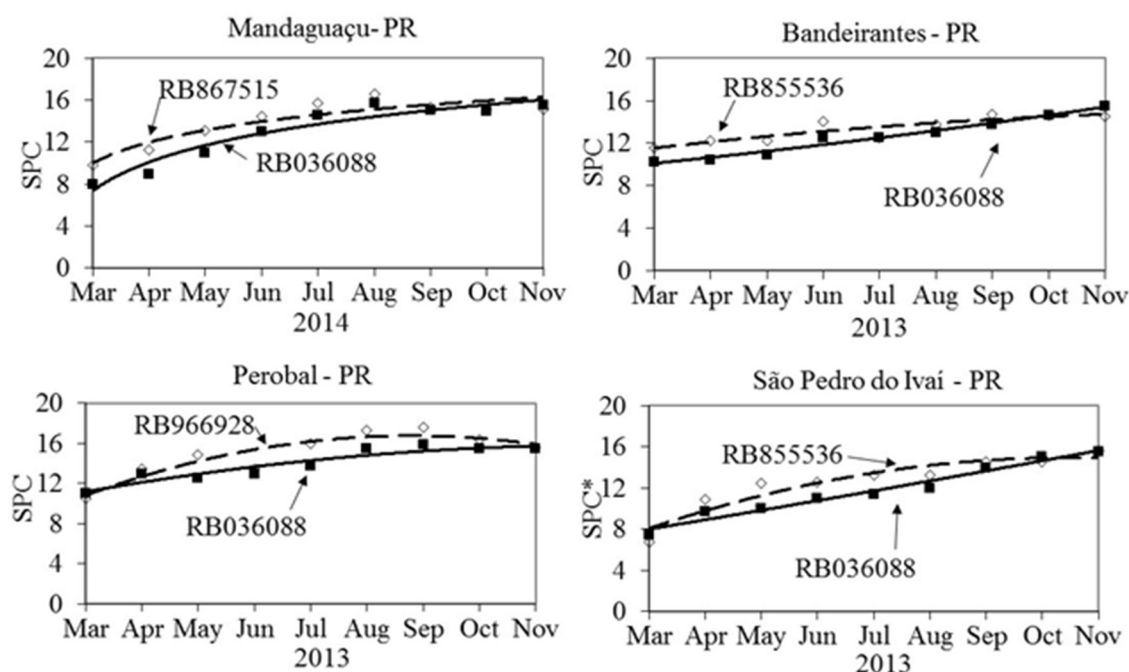


Figure 3. Maturation curves of 'RB036088' and other important early-maturing sugarcane cultivars used in the center-south of Brazil, at four test locations. *SPC - Pol in juice (sucrose percentage in cane juice).

bud prominence, greenish-yellow color, abundant primordial roots and absent bud pubescence. Clear presence of wax in the root node region. The medium-sized bud is oval, slightly prominent, occasionally touching the growth ring, has no flower cushion, apical position of the germ pore and haired apex. Light to intermediate green leaves, with medium length, narrow width and regular volume in the canopy. The auricle is small, asymmetric and deltoid-shaped. Green dewlap of the normal type. Short, green to purple sheaths, in a straightforward arrangement, with weak presence of wax, without fine hairs.

SEEDLING MAINTENANCE AND DISTRIBUTION

Seedlings of cultivar RB036088 are maintained and distributed by the Sugarcane Breeding Program of the Department of Plant Science and Plant Health, Sector of Agricultural Sciences, Federal University of Paraná, 80035-050, Curitiba, Brazil.

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