

BRS SCS BELLUNA – a new banana cultivar for processing and fresh consumption

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Abstract – The new banana cultivar, BRS SCS Belluna (AAA), was developed by the Embrapa and Epagri banana breeding programs for processing and fresh consumption. It is noteworthy differentiated nutritional qualities, since its fruits are rich in fiber and have lower carbohydrate and caloric content when compared to fruits of the most traded subgroups in the country, Prata and Cavendish. ‘BRS SCS Belluna’ is also resistant to Panama disease and to Sigatoka disease complex, major plant health problems in Brazil. The cultivar has yield potential up to 40 t ha⁻¹ under favorable environmental conditions. Thus, it is recommended to plant the ‘BRS SCS Belluna’ in the country, highlighting the state of Santa Catarina, where the studies were conducted.

Index terms: *Musa acuminata*; plant breeding; clonal selection.

BRS SCS BELLUNA – um novo cultivar de banana para processamento e consumo fresco

Resumo – BRS SCS Belluna (AAA) é um novo cultivar de banana desenvolvido pelos programas de melhoramento de bananeira da Embrapa e da Epagri. Destacam-se neste cultivar qualidades nutricionais diferenciadas, uma vez que as suas frutas são ricas em fibras e apresentam menores conteúdos de carboidratos e de valores calóricos quando comparadas às frutas dos subgrupos mais comercializados no país, Prata e Cavendish. O cultivar BRS SCS Belluna é resistente ao Mal do Panamá e ao complexo de Sigatoka, principais problemas fitossanitários da bananicultura no Brasil. O cultivar ainda apresenta uma produtividade média que pode chegar a 40t ha⁻¹ em condições ambientais favoráveis. Desta forma, recomenda-se o plantio do ‘BRS SCS Belluna’ no país, destacando-se o estado de Santa Catarina, local onde foram realizados os estudos.

Termos para indexação: *Musa acuminata*; melhoramento de plantas; seleção clonal.

Introduction

Banana is one of the most commercially important fruits in the world. In 2016, production of edible bananas and plantains (bananas generally consumed fried or cooked) totaled approximately 148 million tons, making it the most highly produced fruit worldwide. About 4.5% of global banana production was from Brazil, with production of 6.7 million tons on 470,000 ha, the sixth largest producer in the world (FAOSTAT, 2018). Also in 2016, banana was the fifth most important

agricultural crop in Brazil, with a gross value of production of 3.6 billion dollars, corresponding to 4.3% of the revenue generated by Brazilian agricultural production (IBGE, 2018).

The banana plant (*Musa* spp.) originated in Southeast Asia and started to be domesticated over 11,000 years ago (PERRIER et al., 2011). Since the beginning of its domestication, the selection of new genotypes with characteristics of interest has played a significant role in generating new varieties (D’HONT et al., 2000). The main commercial varieties used in the

world are derived from the species *M. acuminata* (genome A) and its hybrids with *M. balbisiana* (genome B), especially the triploid genotypes of the AAA, AAB and ABB genomic groups (PERRIER et al., 2011). Among these genomic groups, the subgroups Cavendish (AAA) and Prata (AAB) are notable in Brazil and, consequently, dominate the commercial banana supply in the country (NASCIMENTO JUNIOR et al., 2008).

In 2016, the Empresa Brasileira de Pesquisa Agropecuária (Embrapa) and Empresa de Pesquisa Agropecuária

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e Extensão Rural de Santa Catarina (Epagri) released the cultivar BRS SCS Belluna (AAA) with the objectives of diversifying the genetic base of banana in Brazilian agriculture, and of providing producers with a productive cultivar resistant to the main diseases in banana, and to offer a different product to the consumer. The objective of this article is to present this cultivar and its main characteristics.

Origin and breeding method

In the 1980s, researchers at Embrapa conducted expeditions to Southeast Asia with the objectives of collecting and introducing new genotypes of interest to Brazilian banana farmers. The genotype that gave rise to the cultivar BRS SCS Belluna was one of them. Experiments to evaluate the agronomic performance of this genotype were conducted in the Brazilian state of Santa Catarina. Experiments were implemented by Epagri at experimental stations in Itajaí and Urussanga. After more than two decades of evaluation and mass selection for a phenotype with high yield and resistance to the main pests of the crop, the two institutions obtained a genotype with characteristics of interest to banana farmers throughout Brazil. It is clearly distinct from other cultivars and homogeneous and stable over successive generations in relation to descriptors, allowing Brazilian agribusiness firms to use the genotype; it is in conformity with Brazilian Seed and Seedling Regulations (BRASIL, 2004).

The performance of 'BRS SCS Belluna' was compared with cultivars of the two main subgroups cultivated in Brazil - the cultivars SCS451 Catarina (widely known as Prata Catarina) and Prata Anã, of the Prata subgroup, and the cultivars Nanicão and Grande Naine, of the Cavendish subgroup. The plantations of the cultivars from the Cavendish subgroup had a density of about 1,600 plants per hectare (2.5 x 2.5m spacing), while the cultivars of the Prata subgroup and 'BRS SCS Belluna' had a density of around 1,320 plants per hectare (2.5 x 3.0m spacing).

Genetics

The cultivar BRS SCS Belluna is a triploid genotype of the species *M. acuminata* (genomic group AAA). In order to avoid misidentifications related to its genetic characteristics, since it belongs to the same genomic group as the Cavendish subgroup and was popularly known as "Nam" and "Baby Prata", names similar to other varieties, 'BRS SCS Belluna' was genetically characterized and compared with the cultivars Prata Catarina, Prata Anã, Nanicão, Grande Naine and Maçã (Silk-type). Nineteen microsatellite markers

(SSRs) selected by Christelová et al. (2011) to distinguish species, subgroups and individuals of *Musa* spp. were used. Amplifications were performed by PCR (Polymerase Chain Reaction) combined in multiplex, and genotyping was via capillary electrophoresis using an ABI3130 genetic analyzer (Applied Biosystems) (Table 1). According to the parsimony-informative loci obtained, the cultivar 'BRS SCS Belluna' differs 39.2% from the cultivars Grande Naine and Nanicão, 65.22%, from the cultivars Prata Anã and Prata Catarina and 100% from the cultivar Maçã (Figure 1). ▶

Table 1. Microsatellite markers used, accession numbers, alleles detected in the cultivar BRS SCS Belluna and annealing temperature of the primers

Tabela 1. Marcadores microsatélites, números dos acessos, alelos detectados no cultivar BRS SCS Belluna e temperatura de anelamento dos primers

SSR markers	Accession numbers in NCBI	Alleles detected (bp)*	Tm °C EPAGRI
mMaCIR01	X87262	254 273	54
mMaCIR164	AM950454	256 397	55
Ma-3-90		154	54
mMaCIR307	AM950533	165	55
mMaCIR264	AM950519	238 268 270	61
mMaCIR196	AM950462	167 171 180	60
mMaCIR24	Z85972	232 237 239	48
mMaCIR152	AM950442	161 165	50
mMaCIR231	AM950497	248 280	55
mMaCIR150	AM950440	259 262	55
mMaCIR40	Z85977	158 160 162	53
mMaCIR214	AM950480	118 122	54
mMaCIR13	X90745	272 285 287	53
mMaCIR03	X87263	121 125	55
mMaCIR07	X87258	161 169	55
mMaCIR08	X87264	261 263 271	55
mMaCIR45	Z85968	268 276	63
mMaCIR260	AM950515	213 215	55
mMaCIR39	Z85970	309 319 327	52

* Contains 18 bp relative to M13

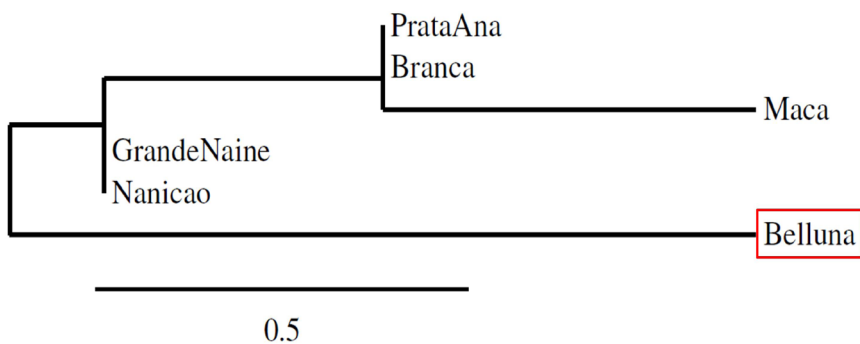


Figure 1. Dendrogram representing the differences between the cultivars BRS SCS Belluna, Prata Anã, SCS451 Catarina (widely known as Prata Catarina), Grande Naine, Nanicão and Maçã generated by UPGMA clustering based on parsimony-informative loci of 19 SSR markers

Figura 1. Dendrograma representando as diferenças entre os cultivares BRS SCS Belluna, Prata Anã, SCS451 Catarina (Prata Catarina), Grande Naine, Nanicão e Maçã gerado por agrupamento UPGMA com base nos lócus parcimônia-informativos de 19 marcadores SSR

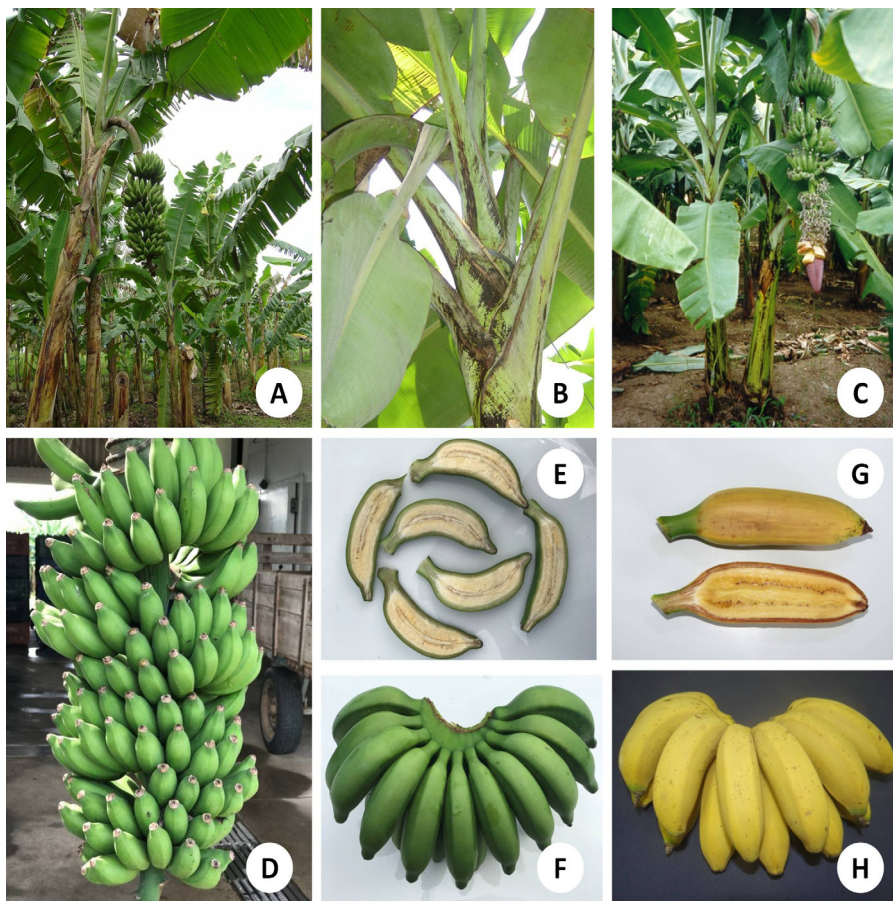


Figure 2. Morphological characteristics of the 'BRS SCS Belluna'. A) Adult plant in the production field with bunch; B) Petioles, sheaths and base of the leaf blade of an adult plant; C) Adult plant with bud and developing sucker; D) Bunch; E-F) Green fruit, characteristic of the pulp and hand; G-H) Ripe fruit, maturation stage 5, characteristic of the pulp and hand. Photos: Luiz A. Lichtemberg (A, B, C), Luana A. C. Maro (D, E, F, H) and José N. Fernandes (G)

Figura 2. Características morfológicas do 'BRS SCS Belluna'. A) Planta adulta no campo de produção com cacho; B) pecíolos, bainhas e base da lâmina foliar de uma planta adulta; C) Planta adulta com broto e muda em desenvolvimento; D) Cacho; E-F) Fruta verde, característica da polpa e da penca; G-H) Frutos maduros, estágio 5 de maturação, característica da polpa e da penca. Fotos: Luiz A. Lichtemberg (A, B, C), Luana A. C. Maro (D, E, F, H) e José N. Fernandes (G)

Description

The botanical characteristics of the cultivar BRS SCS Belluna (Figure 2 - Table 2) were evaluated in October 2009 in the EEI (26°57'08.9"S, 48°45'38.9"W) under spring conditions in a Cfa climate, according to the international descriptors for banana (IPGRI-INIBAP/ CIRAD, 1996).

In relation to agronomic performance, the yield reached by 'BRS SCS Belluna' was similar to the cultivars of the Prata subgroup, both in Itajaí and Urussanga (Table 3). According to the evaluations conducted in these sites, the average yield from the second cycle was 20 and 17 t ha⁻¹, respectively, with yield sometimes reaching close to 40 t ha⁻¹. The average time to harvest for the first crop of 'BRS SCS Belluna' was 534 days, the average plant height was 2.27m in the first cycle and 2.98m in the second cycle, and the average number of hands formed was 7 in the first cycle and 10 in the second cycle. These values are also similar to the main cultivars of the Prata subgroup. However, the fruit of 'BRS SCS Belluna' was small in all cycles (approximately 13cm), since it is an intrinsic characteristic of the cultivar. The fruit of the Prata subgroup is medium-sized and that of the Cavendish subgroup is large.

The resistance of 'BRS SCS Belluna' under field conditions to Panama disease (*Fusarium oxysporum* f. sp. *ubense* - Foc race 1), to yellow Sigatoka (*Mycosphaerella musicola*) and to black Sigatoka (*Mycosphaerella fijiensis*), the main pests of the crop, are notable traits (LICHTEMBERG et al., 2001). It should be noted that 'Nanicão' and 'Grande Naine' (Cavendish) and 'Prata Anã' and derived cultivars (Prata Catarina, Prata Gorutuba, among others) are susceptible to the Sigatoka complex. In relation to Panama disease (Foc race 1), cultivars of the Prata subgroup exhibit various levels of susceptibility and those of the Cavendish subgroup are resistant. 'BRS SCS Belluna' is also moderately resistant to weevil borer (*Cosmopolitus*

Table 2. Morphological description of the cultivar BRS SCS Belluna through evaluations conducted in Itajaí, SC, based on international banana descriptors (IPGRI-Inibap/Cirad, 1996)

Tabela 2. Descritores morfológicos do cultivar BRS SCS Belluna pelas avaliações conduzidas em Itajaí, SC, baseado nos descritores internacionais de banana (IPGRI-Inibap/Cirad, 1996)

Morphological characteristic	Description
Leaf habit	Erect, with normal leaf distribution.
Pseudostem	Average size ($\approx 3.0\text{m}$), slender, dull (waxy) yellowish green.
Leaf sheaths	Very little wax; external cream color with pink areas and dark spots; internal color uniformly cream.
Suckers	Deep and far from parent plant and only with lanceolate leaves until harvest of mother plant, produces an average number (≈ 7.0) in the first cycle.
Leaf blotches on suckers	Without blotches.
Cigar Leaf	Upper surface green.
Leaf blade	Moderately waxy; corrugation of few stripes; opaque green color on upper surface and opaque medium-green on lower surface. Average length/width ratio of leaf blade 3.6 (2,580/715mm, respectively). Lobes of leaf base asymmetric, one side rounded, one pointed
Midrib	Green on upper surface (adaxial), light green on lower surface (abaxial)
Petiole	Margins erect, straight, turgid; pink-mauve on the edges, with a dark red longitudinal line. Straight canal. Average length of 62cm and large dark brown blotches at the base
Inflorescence peduncle	Green with two scars, very hairy, short hairs. Average length and diameter of 55cm and 6cm, respectively
Bunch	Hanging at 45° angle; cylindrical to a truncated cone shape; few compact; fruit only developing from female flowers
Male rachis	Present until harvest, inclined, scars prominent
Male bud shape	Like a top, small; average length/width ratio 2 (16/8cm, respectively).
Male bud bracts	Ovate, strongly grooved, very little wax; red-violet externally, red internally, uniform; external lines without discoloration; base with small and large shoulders, color discontinuing in bract base; apex slightly pointed
Tepals of male flowers in the bud, in the axil of the first external bract	Compound tepals with a basic cream color, pigmentation variable and lobes yellow. Free tepals with a translucent white color, oval, with developed apex, triangular and more or less smooth. Dominant color of male flower white
Anther and pistil of flowers in the male bud, in the axil of the first external bract	Anther external in relation to the lobe, with yellow color and filament and pollen sacs white; straight style with a white color without pigmentation, exerted above the tepal lobes; yellow stigma; arched ovary, with a basic cream color without pigmentation, two rowed ovules. Around 90% of the flowers have five stamens and 10% have six
Fruit	Fruit position curved upward; average of 14 bananas per hand; fruit straight to curved in distal part, rounded in transverse section, pointed apex, persistent base of style, average length of 13cm, unripe fruit peel dark green, ripe fruit peel yellow; pulp with soft texture, sweet taste and cream color; distinct pedicel, 9mm long, 14mm diameter, hairless; persistent fruit

Table 3. Average yield (Kg ha⁻¹) of bunch of the cultivars BRS SCS Belluna, SCS451 Catarina (Prata Catarina), Prata Anã, Grande Naine and Nanicão in Itajaí and Urussanga in the first cycle and average of the other cycles

Tabela 3. Rendimento médio (Kg ha⁻¹) de cachos dos cultivares BRS SCS Belluna, SCS451 Catarina (Prata Catarina), Prata Anã, Grande Naine e Nanicão em Itajaí e Urussanga no primeiro ciclo e média dos outros ciclos

Cultivar	Average yield in Itajaí (Kg ha ⁻¹)*		Average yield in Urussanga (Kg ha ⁻¹)**	
	1st cycle	Other cycles	1st cycle	Other cycles
BRS SCS Belluna	11,390	20,259	9,000	16,720
SCS451Catarina	17,110	23,525	12,330	17,554
Prata Anã	13,625	21,485	10,459	15,818
Grande Naine	31,651	37,992	20,983	24,902
Nanicão	30,456	35,613	20,091	23,931

* - Averages corresponding to evaluations between 1997 and 2010. ** - Averages corresponding to evaluations between 2010 and 2012.

sordidus) and burrowing nematode (*Radopholus similis*) (LICHTENBERG et al., 2001). These characteristics can allow reduction in the use of pesticides during conventional cultivation of 'BRS SCS Belluna', reducing production costs; and it can allow this cultivar to be grown in organic and/or agroecological crop systems. Lichtemberg et al. (2006) noted the easy adaptability of 'BRS SCS Belluna' (cited as 'Baby Prata' and 'Nam') to the organic cultivation system in southern Brazil; and Peruch & Sonogo (2007) noted that the cultivar (cited as 'Nam') exhibited an adequate level of resistance to yellow Sigatoka under organic cultivation.

The harvesting time for the bunches of the new cultivar (3/4 normal) is similar to the cultivars of the subgroups Prata and Cavendish, while the ripening temperature of the fruit (18°C) is conform to recommended for fruit of the Cavendish subgroup (LICHTENBERG et al., 2001). The 'BRS SCS Belluna' fruits may be consumed in maturity stage 5 (yellow with green tips), according to the Von Loesecke (1950) maturation scale (Figure 2 G-H).

In relation to adverse abiotic effects, the plants and fruit of 'BRS SCS Belluna' are susceptible to cold damage, which

is similar to cultivars of the Cavendish subgroup. The cultivar is moderately susceptible to damage from breaking or falling (LICHTENBERG et al., 2001).

However, a major advantage of 'BRS SCS Belluna', in addition to the relevant agronomic characteristics, is the postharvest quality. When characterizing its green banana flour, the resistant starch level (40.25% of the total starch) was four times higher than that of 'Grande Naine' and double that of 'Prata Anã'. The term "resistant starch" has gained relevance due to many clinical studies that have shown the physiological effects of this substance on the human body, especially benefits attributed to dietary fiber. Since resistant starch cannot be digested in the small intestine, this type of starch is available as a fermentation substrate and provides an ideal environment as a prebiotic source for growth of anaerobic bacteria in the colon (JENKINS et al., 1998).

In addition, fruit of 'BRS SCS Belluna' had high levels of fiber, ashes and lipids, around 18.8%, 3.3% and 1.1%, respectively. The fruit of the new cultivar also had lower levels of carbohydrates and caloric values, 67.5% and 296.51 Kcal, respectively.

Cerqueira et al. (2002) also found that the cultivar (cited as 'Nam') has lower acid in the pulp compared with twenty other genotypes, with values of around one third of those found for 'Prata Anã'. This is a characteristic of interest to people who suffer from gastrointestinal problems related to acidity.

Thus, the nutritional composition of 'BRS SCS Belluna' fruit allows it to be classified as a functional food. In accordance with resolution no. 18/99 of the Brazilian Health Regulatory Agency (ANVISA, 1999), when consumed as part of a diet, a functional food produces metabolic and/or physiological effects and/or provides health benefits in addition to basic nutritional functions.

Perspectives and problems of the cultivar

Studies have demonstrated that changes in family structure, with a lower average number of individuals per family, tends to increase the demand for smaller portions of food, such as smaller fruits. It should be noted that the tendency to buy smaller fruits or portions is also linked to conscious

consumption without waste, which has been a subject of growing concern in many segments of society. A search for healthy foods is also a notable trend, which is related to the intrinsic nutritional characteristics of a food and the absence of pesticide residues used during cultivation and/or postharvest treatment. Thus, the cultivar BRS SCS Belluna can meet all these demands and has considerable and growing potential for consumption, even as a food for school snack programs. However, Brazilian consumers' strong fidelity to bananas of Prata and Cavendish subgroups is still the main barrier to increasing demand for BRS SCS Belluna fruits, and for any other new cultivar different from the two main subgroups.

The 'BRS SCS Belluna' fruit is also suitable for processing, which minimizes loss in the production chain since it increases the postharvest life of the fruit and adds value to the industrialized product. Furthermore, Cerqueira et al. (2002) found that 'BRS SCS Belluna' (cited as 'Nam') had the highest fruit/pulp ratio among twenty genotypes studied, which is a characteristic that contributes to excellent banana quality.

Availability of material

Information about acquisition of plants:

- Epagri – Estação Experimental de Itajaí: Rod. Antônio Heil 6800, CEP: 88.318-112, Itajaí, SC. Phone: + 55 (47) 3398-6300 | email: eei@epagri.sc.gov.br

- Embrapa Mandioca e Fruticultura. Rua Embrapa s/nº, Caixa Postal 007, CEP: 44.380-000, Cruz das Almas, BA. Phone: + 55 (75) 3312-8048 | Fax: +55 (75) 3312-8097

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