‘CIP BRS Nuti’: A New Orange Flesh Sweetpotato Cultivar

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The number of registered sweetpotato cultivars in Brazil is limited and they are mostly white-fleshed cultivars (Ministry of Agriculture, Livestock and Food Supply, 2021). ‘CIP BRS Nuti’ (CIP 106902.1) sweetpotato (*Ipomoea batatas*) was developed by the International Potato Center (CIP) in Peru by controlled crossing between the elite orange flesh sweetpotato (OFSP) clone (CIP1010-48.1) and the advanced OFSP clone (CIP194-583.2). This clone will be released by Embrapa as a cultivar for Brazil, after being selected from among 80 clones imported from CIP. ‘CIP BRS Nuti’ is an OFSP with a mean

commercial root yield of 35 t·ha⁻¹ across 12 Brazilian site locations. The new cultivar presents resistance to *Meloidogyne incognita*, *Meloidogyne javanica* and *Meloidogyne enterolobii* root knot nematodes and a vigorous foliage that enables rapid establishment of the crop in comparison with the Beauregard cultivar (Rolston et al., 1987), which is the most cultivated OFSP in Brazil.

Origin

Sweetpotato clone ‘CIP BRS Nuti’ (CIP10-6902.1) was developed in 2006 by controlled crossing between the elite OFSP clone SR01.018 (CIP101048.1) and the advanced OFSP clone PJ05.172 (CIP194583.2). Both parental clones are breeding materials developed by CIP. The female parent, SR01.018, was developed by a cross open pollination and selected in 2001 at San Ramon located in the humid tropics of Peru, a region that enables sweetpotato crosses all year long. This female parent is characterized by good agronomic performance, high root dry matter content (30%), pale orange flesh color (200 mg·kg⁻¹ of β-carotene), intermediate sweetness, and good

eating acceptance after boiling. The male parent, PJ05.172, is a clone selected from an open pollinated nursery among parents with high β-carotene content. This parent was selected in 2005 under central Peruvian coast conditions as well as the humid tropics of Peru and is characterized by good agronomic performance, low root dry matter content (23%), medium to deep orange flesh color (350 mg·kg⁻¹ of β-carotene), intermediate sweetness, and good eating acceptance after boiling.

The crosses conducted by CIP in 2006 focused on the development of an OFSP sweetpotato population. Partially this population was introduced in CIP’s genebank, and after pathogen elimination, it became available for international distribution. Some of these clones were sent to Embrapa in Brazil to select new sweetpotato varieties adapted to Brazilian agro-ecological zones and consumer preferences as part of the AgroSalud program in 2013.

Description

‘CIP BRS Nuti’ has the following characteristics (International Potato Center et al., 1991):

Habit. The cultivar has a semierect growth type with an average of 1.15 m on the main stem estimated 98 d after planting during the Brazilian summer season with a high ground-cover. Canopy weight at harvesting time of ‘CIP BRS Nuti’ ranges from 47 to 156 t·ha⁻¹ to 30% and 100% of field capacity, respectively. Under the same conditions, the canopy weight of Beauregard, ranged from 7.6 to 150 t·ha⁻¹ to 30% and 100% of field capacity.

Foliage. The main vine is green without anthocyanin coloration of the internode or node in mature plants 90 d after planting. Internodes are short (4 cm), with an intermediate diameter of 7.2 mm. Mature leaves are green in general with five moderate lobes. No presence of anthocyanin pigmentation is observed in the abaxial leaf veins.

Roots. Storage root shape is in general elliptic with a brownish orange peel, and dark orange flesh. Commercial roots are generally harvested 150 d after planting, and are, on average, 19.2 cm long and 7 cm in diameter.

Flowers. Flowers are moderately distributed with white limb and purple throat. The stigma is slightly exerted when compared with the highest anther.

Production

With the exception of the south region of Brazil where the winter season is more pronounced, ‘CIP BRS Nuti’ can be planted during all seasons of the year as long as irrigation is available. Commercial plants usually originate from previous commercial fields or multiplication nurseries and fields, respectively, which are derived from in vitro plants. ‘CIP BRS Nuti’ produces 30% more vines that can be used for rapid re-planting, and dissemination in comparison with ‘Beauregard’ (Rolston et al., 1987).

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Limited quantities of in vitro plants as well as greenhouse vines will be commercially available starting with the 2022 crop season. Information will be provided by www.embrapa.br/editais-e-ofertas-publicas-para-licenciamento/.

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For cultivar release, 'CIP BRS Nuti' was compared with the varieties to replace namely Beauregard (see previously) and Canadense, which is the white-fleshed sweetpotato most planted in Brazil. Evaluations were performed in 12 different sites, two of which were in different crop seasons, from 2018 through 2020. Altitude of locations ranged from 159 to 990 m and planting sites included areas with Cambisol, Ferralsol, Gleysol, Lixisol, Planosol, and Plinthosol soils (Santos et al., 2018). Locations included experimental stations and commercial farmer fields.

The experimental design for all sites was a randomized block design with four replications. Experimental plots consisted of 10 to 26 plants per plot, spaced 0.75 to 1.1 m between rows and 0.25 to 0.30 m between plants, depending on the equipment available on each site. Fields were sprinkler irrigated and soils fertilized with synthetic fertilizers, with the exception of Canoinhas, SC and Uberlândia, MG that did not receive any fertilizer. Storage roots were harvested an average of 157 d after planting. Yield data were adjusted according to plot size and is presented in $t\text{-ha}^{-1}$ (Table 1).

At most sites, 'CIP BRS Nuti' and 'Beauregard' exhibited similar commercial root yields, with the exception of three sites where 'Beauregard' commercial root yield was larger than 'CIP BRS Nuti', and one site where 'CIP BRS Nuti' exhibited larger root yields compared with 'Beauregard'. Similar yield pattern was observed for the comparison of 'CIP BRS Nuti' with 'Canadense' (Table 1). The average commercial storage yield of 'CIP BRS Nuti' across all 12 sites was $35 t\text{-ha}^{-1}$.

Disease Reactions

'CIP BRS Nuti' was evaluated for nematodes under controlled greenhouse conditions together with 'Beauregard' and 'Canadense' (Mello et al., in press). In contrast to 'Beauregard', the cultivar 'CIP BRS Nuti' and 'Canadense' were found to be highly resistant to *M. incognita*, *M. javanica*, and *M. enterolobii*. A field trial under commercial conditions naturally infested with the three species of *Meloidogyne* in which the nematode population directly affects commercial yield, including presence of symptoms confirmed greenhouse nematode evaluations.

Quality Attributes

Brazilian sweetpotato roots are usually commercialized immediately after harvesting without curing or storage. Under these conditions, laboratory analysis of field samples determined that 'CIP BRS Nuti' exhibited on average 2% more root dry matter content than Beauregard (25% vs. 23%). Based on eight experiments from the 12 presented in Table 1, the β -carotene content of 'CIP BRS Nuti' was $149 \text{ mg}\cdot\text{kg}^{-1}$, which is $\approx 28\%$ higher compared with 'Beauregard' using a previously reported extraction method (Rodríguez-Amaya et al., 2008). Sugars were extracted according to (Macrae, 1998). Total sugars of 'Beauregard'

Table 1. Storage root yields of 'CIP BRS Nuti', 'Beauregard', and 'Canadense' in experimental stations and commercial farmer fields in Brazil ($t\text{-ha}^{-1}$); SC, Santa Catarina; MG, Minas Gerais; DF, Distrito Federal; RS, Rio Grande do Sul; PI, Piauí; PE, Pernambuco; and SP, São Paulo.

	Commercial yield ^z	Noncommercial yield ^y
Location Bela Vista do Toldo, SC – 2018/2019		
CIP BRS Nuti	29.4 b ^x	44.5 a
Beauregard	47.5 a	14.0 b
Canadense	28.2 b	4.3 c
Location Canoinhas, SC – 2018/2019		
CIP BRS Nuti	76.0 a	10.3 a
Beauregard	52.9 b	4.1 b
Canadense	85.7 a	5.9 b
Location Monte Carmelo, MG – 2017/2018		
CIP BRS Nuti	15.2 a	15.3 a
Beauregard	18.4 a	13.8 a
Canadense	14.9 a	6.2 a
Location CNPH, DF – 2018		
CIP BRS Nuti	45.6 a	11.6 a
Beauregard	34.2 a	8.3 b
Canadense	13.2 b	4.6 b
Location Campo Novo, RS – 2019		
CIP BRS Nuti	29.4 b	0.2 a
Beauregard	26.4 b	0.1 b
Canadense	44.0 a	0.1 b
Location Oeiras, PI – 2019/2020		
CIP BRS Nuti	21.0 a	5.6 a
Beauregard	29.2 a	6.0 a
Canadense	24.6 a	7.2 a
Location PAD, DF – 2018 (Winter)		
CIP BRS Nuti	19.3 b	14.7 a
Beauregard	33.3 a	9.8 b
Canadense	3.7 c	10.2 b
Location PAD, DF – 2018 (Summer)		
CIP BRS Nuti	27.2 a	7.6 a
Beauregard	36.0 a	5.2 a
Canadense	15.4 a	7.8 a
Location Petrolina, PE – 2018		
CIP BRS Nuti	46.0 b	22.6 a
Beauregard	88.8 a	15.3 a
Canadense	46.9 b	7.1 a
Location Pirapozinho, SP – 2019/2020		
CIP BRS Nuti	25.6 a	22.8 a
Beauregard	33.2 a	22.2 a
Canadense	32.0 a	15.8 a
Location Santo Augusto, RS – 2017/2018		
CIP BRS Nuti	24.9 a	9.7 a
Beauregard	21.6 a	4.1 b
Canadense	12.4 b	2.7 b
Uberlândia, MG – 2017/2018		
CIP BRS Nuti	60.4 a	26.7 a
Beauregard	68.7 a	23.2 a
Canadense	27.6 b	17.4 a

^zCommercial yield = roots from 100 g up to 1 kg.

^yNoncommercial yield = roots with less than 150 g or more than 1 kg or roots with commercial root size with insect or physiological damage.

^xValues within the same column and same location followed by the same letter are not significantly different by Scott Knott $P < 0.05$.

and 'CIP BRS Nuti' were nearly similar, both more than 5 g/100 g of roots, evaluated directly after the harvests, without a cure process. However, the composition of these sugars was

different among these cultivars. 'CIP BRS Nuti' shows predominance of sucrose (3.70 g/100 g) with low fructose (0.64 g/100 g) and glucose (0.82 g/100 g), whereas 'Beauregard' has

Table 2. Quality root characteristics of 'Beauregard', 'Canadense', and 'CIP BRS Nuti' in Bela Vista do Toldo, SC, Brazil in 2019.

	Ash	Total nitrogen/protein	Lipids	Dietary fiber	Carbohydrate	Calorific value
			g/100 g			(kcal/100 g)
CIP BRS Nuti	0.83 a ^z	1.01 a	0.52 a	3.51 a	18.03 a	80.77 a
Beauregard	0.35 b	0.65 b	0.56 a	2.39 b	17.04 a	75.72 a
Canadense	0.35 b	0.72 b	0.55 a	2.50 b	20.37 a	89.29 a

^zValues within the same column followed by the same letter are not significantly different by Scott Knott $P < 0.05$.

much less sucrose (2.62 g/100 g), more fructose (1.23 g/100 g) and more glucose (1.63 g/100 g). Physical analysis additionally demonstrated that sliced ‘CIP BRS Nuti’ roots produced a lower oxidation rate than ‘Beauregard’, an attribute highly desired for industrial processing. Further quality attributes (i.e., ash, protein, lipid, dietary fiber, and carbohydrate contents as well as calorific value) are presented in Table 2.

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