



















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## 'BRS F183' (Potira): A dual purpose potato cultivar, with high yield potential and excellent French fry quality

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### ABSTRACT

'BRS F183' (Potira) is a late-maturing and red skin potato cultivar, suitable for French fry processing, due to tuber high dry matter content of long oval shape, large size, light yellow flesh, and light fry color. It is also suitable for the fresh market due to its attractive tubers of intense red color, smooth skin and shallow eyes. In six trials, 'BRS F183' showed average tuber yields that did not differ from 'Asterix'. The marketable yield was relatively high, reaching 98.5% in the tropical ecosystem. Larger tubers of 'BRS F183' than 'Asterix' were also observed in the autumn crop of the subtropical ecosystem. In most of the trials, the dry matter content was higher than that of 'Asterix', varying from 20.5 to 23.0%. A very low incidence of tuber disorders was observed in 'BRS F183', with the secondary growth lower than 'Asterix'. 'BRS F183' presented medium tuber dormancy. Tuber glucose content suitable for French fry processing ( $\leq 1.2$  mg g<sup>-1</sup> of fresh mass) was shown by 'BRS F183' after harvest and storage at 7.5°C, 8.9°C and 20°C for up to 180 days, while 'Asterix' was suitable up to 120 days after storage at 8.9°C. 'BRS F183' is moderately resistant to early blight and moderately susceptible to late blight. It is susceptible to PVY, PLRV, and root-knot nematode. Field observations indicate that resistance/susceptibility to soft rot, black scurf, and bacterial wilt of 'BRS F183' is not different from the main cultivars grown in the country. However, higher susceptibility to common scab was shown in some validation tests. 'BRS F183' was released in 2020 by Embrapa, as a product of the breeding program developed by Embrapa Temperate Agriculture and Embrapa Vegetables.

**Keywords:** *Solanum tuberosum*, breeding, processing, variety.

### RESUMO

**'BRS F183' (Potira): Cultivar de batata de duplo propósito, com alto potencial produtivo e excelente qualidade de fritura de palitos**

'BRS F183' (Potira) é uma cultivar de batata de maturidade tardia e película vermelha, adequada ao processamento de palitos pré-fritos, devido ao alto teor de matéria seca dos tubérculos de formato ovalado longo, tamanho grande, polpa amarela clara e coloração clara de fritura. Também é indicada para o mercado fresco devido a seus tubérculos atrativos de cor vermelha intensa, película lisa e olhos rasos. Em seis ensaios, 'BRS F183' apresentou rendimentos de tubérculos que não diferiram de 'Asterix'. O rendimento comercial foi relativamente alto, chegando a 98,5% no ecossistema tropical. Tubérculos maiores da 'BRS F183' que 'Asterix' foram também observados na safra de outono do ecossistema subtropical. Na maioria dos ensaios, o teor de matéria seca foi superior ao da 'Asterix', variando de 20,5 a 23,0%. Baixa incidência de desordens dos tubérculos foi observada na 'BRS F183', com o crescimento secundário menor que 'Asterix'. 'BRS F183' apresentou dormência média dos tubérculos. Teor de glicose dos tubérculos adequado para processamento de palitos pré-fritos ( $\leq 1,2$  mg g<sup>-1</sup> de massa fresca) foi apresentado pela 'BRS F183', após a colheita e armazenamento a 7,5°C, 8,9°C e 20°C por até 180 dias, enquanto de 'Asterix' foi adequado até 120 dias após armazenamento a 8,9°C. 'BRS F183' é moderadamente resistente à pinta preta e moderadamente suscetível à quequeima. É suscetível a PVY, PLRV e nematóide das galhas. Observações de campo indicam que a resistência/suscetibilidade à podridão mole, crosta preta e murcha bacteriana da 'BRS F183' não é diferente das principais cultivares cultivadas no país. No entanto, maior suscetibilidade à sarna comum foi observada em alguns testes de validação. 'BRS F183' foi lançada em 2020 pela Embrapa, como produto do programa de melhoramento desenvolvido pela Embrapa Clima Temperado e Embrapa Hortaliças.

**Palavras-chave:** *Solanum tuberosum*, melhoramento genético, processamento, variedade.

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**B**RS F183' (Potira) is a processing frozen French fry and fresh market potato variety, with a red skin. It was developed by the Embrapa Potato Breeding Program, composed by the Embrapa Temperate Agriculture, Pelotas-RS and Canoinhas-SC, and Embrapa Vegetable Crops, Brasilia-DF, Brazil. 'BRS F183' (Potira) was originated from a cross between the cultivar BRS Ana (mother) and the clone C2372-02-02 (father) (Figure 1), made in a greenhouse of the Embrapa Temperate Agriculture, in the spring of 2006. 'BRS Ana' (Pereira *et al.*, 2010) was developed by Embrapa Potato Breeding Program and the clone C2372-02-02 was selected by the Embrapa Breeding Program. C2372-02-02 was developed from a population received from the International Potato Center (CIP), of the cross between the clones C91.640 and TXY-2.

True potato seeds of the hybrid population that originated the clone F183-08-01 were sown in greenhouse of the Embrapa Temperate Agriculture in fall 2008, producing seedling tubers to plant the first field generation. The selection process comprised four generations conducted in fall 2009, 2010, 2011, and 2012 in fields of the Canoinhas Experimental Station, Canoinhas-SC, according to Pereira *et al.* (2016). In 2013, the selected clones were submitted to clonal cleaning in the tissue culture laboratory and production

of genetic seeds in the hydroponic system of Embrapa Temperate Agriculture. During the fall and spring seasons of 2014, fall and spring seasons of 2015, and fall season of 2016 in Pelotas and in Canoinhas, and winter seasons of 2015 and 2016 in Brasilia, the clone F183-08-01 was included in comparative trials, to evaluate yield potential and yield stability. Simultaneously, it was evaluated for main common potato diseases in Brazil, by the Embrapa Temperate Agriculture, in Pelotas, and Embrapa Vegetable Crops, in Brasilia. Finally, in the fall and spring 2017 and fall of 2018 in Pelotas, fall and spring of 2017 in Canoinhas, and winter of 2017 in Perdizes-MG, the clone F183-08-01 was tested in the value for cultivation and use (VCU) trials, using 'Asterix' and 'BRSIPR Bel' as tester cultivars. In these trials, morphological characterization was done, with F183-08-01 demonstrating phenotypic and genetic distinctness, homogeneity and stability. Concurrently with the VCU trials, F183-08-01 was agronomically, industrially and mercadologically validated by growers, wholesalers and processor of different regions of the country. Based on a good tuber appearance, high yield potential, high dry matter content, excellent processing quality, and validation results, the clone F183-08-01 was registered, protected, and released in 2020 as cultivar 'BRS F183' (Potira).

## VARIETAL DESCRIPTION

Description of plant and tubers of 'BRS F183' (Potira) were obtained from evaluation fields carried out in Pelotas.

**Plants:** height medium to high, semi-upright growth habit and late maturity.

**Stems:** strong extent of anthocyanin pigmentation.

**Leaves:** medium size, wide open, medium presence of secondary leaflets, medium green, high extent of anthocyanin pigmentation on midrib of upper side, high frequency of coalescence of terminal and lateral leaflets. **Leaflets:** medium size, without waves in the margins and with medium frequency of secondary leaflets (Figure 2A).

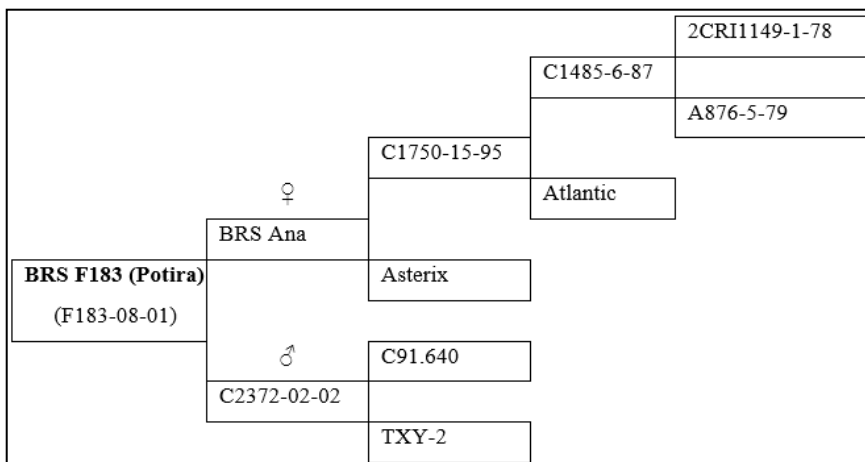
**Inflorescence:** high to very high frequency of inflorescences per plant, medium to high extent of anthocyanin pigmentation on peduncle; **Corolla:** purple red color on inner side (Figure 2B).

**Tubers:** red, long oval shape, shallow eyes, smooth skin, and light yellow fleshed (Figure 2C).

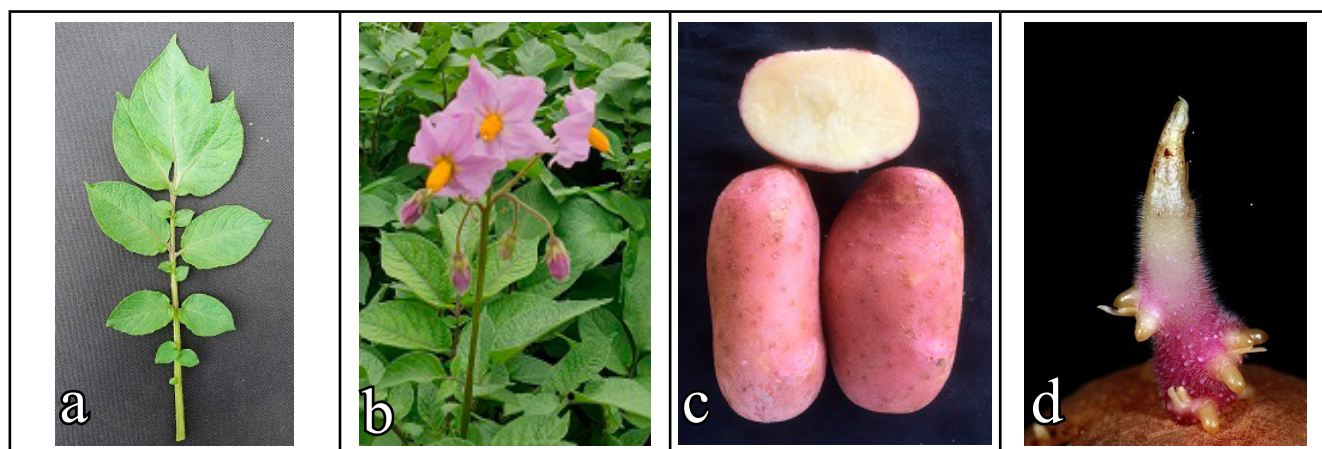
**Sprouts:** medium size, narrow cylindrical shape, close apex, absent or very weak extent of anthocyanin pigmentation apex, medium root tips, medium to long lateral shoots, and base purple red with dense pubescence (Figure 2D).

## AGRONOMIC PERFORMANCE

In six trials, carried out in both subtropical (Canoinhas and Pelotas) and tropical ecosystem (Perdizes), 'BRS F183' (Potira) showed average tuber yields that did not differ ( $p < 0.05$ ) from 'Asterix', except in the spring crop 2017 in Pelotas (Table 1). The percentage of marketable yield of 'BRS F183' (Potira) was relatively high in all trials and tended to be superior to 'Asterix' in the fall crop of the subtropical ecosystem. In Perdizes, it reached 98.5%. Larger tubers of 'BRS F183' (Potira) than 'Asterix' were also observed in the fall crop of subtropical ecosystem. In the two ecosystems, 'BRS F183' (Potira)



**Figure 1.** Pedigree of potato cultivar BRS F183 (Potira). Embrapa, 2021.



**Figure 2.** BRS F183 (Potira): (a) leaf, (b) inflorescence, (c) external and internal tuber appearance, and (d) sprout. Embrapa, 2021.

**Table 1.** Means of yield (marketable and total), percentage of tuber mass, average tuber mass, and dry matter content of potato cultivars BRS F183 (Potira), BRSIPR Bel and Asterix, grown in fall and spring seasons in Canoinhas-SC and Pelotas-RS, and winter in Perdizes-MG, Brazil. Embrapa, 2021.

Location/season-year Cultivar	Yield (t ha <sup>-1</sup> )		Tuber mass (%)	Aver. tub. mass (g)	Dry matter (%)
	Marketable <sup>1</sup>	Total			
<i>Canoinhas/Fall-2017</i>					
BRS F183 (Potira)	17.64 a <sup>2</sup>	24.58 a	71.6 a	140.0 a	21.5 a
BRSIPR Bel	7.11 a	14.94 b	47.5 b	95.7 b	19.8 a
Asterix	15.17 a	31.49 a	47.7 b	114.0 a	18.8 c
CV (%)	25.3	20.9	11.1	8.6	1.8
<i>Pelotas/Fall-2017</i>					
BRS F183 (Potira)	13.72 a	16.74 a	75.3 b	86.5 a	22.2 a
BRSIPR Bel	11.80 a	14.09 a	85.7 a	83.9 a	20.8 b
Asterix	13.58 a	14.60 a	74.0 b	73.0 b	20.4 b
CV (%)	20.1	16.0	3.9	6.6	2.9
<i>Canoinhas/Spring-2017</i>					
BRS F183 (Potira)	32.71 a	37.79 a	86.6 a	174.4 a	23.0 a
BRSIPR Bel	24.66 b	31.85 a	77.6 a	123.8 b	20.8 b
Asterix	24.48 b	29.22 a	84.2 a	158.3 b	19.5 b
CV (%)	11.0	10.9	4.3	9.5	4.7
<i>Pelotas/Spring-2017</i>					
BRS F183 (Potira)	9.50 a	16.56 a	57.1 a	57.6 a	20.5 a
BRSIPR Bel	9.13 a	14.80 a	62.7 a	55.5 a	20.0 b
Asterix	4.79 a	9.38 a	50.0 b	54.5 b	19.8 b
CV (%)	21.2	29.6	7.1	9.8	10.2
<i>Pelotas/Fall-2018</i>					
BRS F183 (Potira)	15.58 a	18.84 a	81.7 a	72.6 a	-
BRSIPR Bel	12.50 a	17.08 a	73.3 b	69.4 a	-
Asterix	9.65 a	15.62 a	60.3 c	50.8 b	-
CV (%)	20.6	13.8	10.3	6.9	-
<i>Perdizes Winter-2017</i>					
BRS F183 (Potira)	45.47 a	49.06 a	98.5 a	119.7 a	22.4 a
BRSIPR Bel	48.78 a	53.89 a	90.0 b	95.7 b	21.4 a
Asterix	49.36 a	50.54 a	97.6 a	118.5 a	19.4 b
CV (%)	11.5	12.7	2.4	6.8	5.2

<sup>1</sup>Marketable tubers: tubers with transversal diameter larger than 45 mm; <sup>2</sup>Means followed by the same letter in the column belong to the same group by the Scott-Knott test, at the 5% level probability of error.

showed high dry matter content, and in most trials higher than ‘Asterix’.

Regarding physiological tuber disorders, a very low incidence of both external and internal disorders was very low in ‘BRS F183’ (Potira) and in ‘Asterix’ tubers, except secondary growth, that was higher in ‘Asterix’ (Table 2).

‘BRS F183’ (Potira) presented medium resistance to post-harvest tuber greening, and medium tuber dormancy, starting to sprout about one week earlier than ‘Asterix’.

## QUALITY CHARACTERISTICS AND USAGE

### Dry matter content

The dry matter content of ‘BRS F183’ (Potira) was higher than ‘Asterix’ in all trials, with values within the amplitude required for the French fry industry, 20-24% (Love, 2000), varying from 20.5 to 23.0% (Table 1).

### Glucose content

The glucose content of potato cultivars BRS F183 (Potira) and Asterix, after harvest and storage at 7.5°C, 8.9°C and 20°C for 60, 120, and 180 days, in Pelotas-RS, is shown in Table 3. Considering that the glucose content for French fries must be  $\leq 1.2$  mg g<sup>-1</sup> fresh mass (Stark *et al.*, 2003), tubers of ‘BRS F183’ (Potira) would be suitable for processing for up to 180 days after

storage at temperature of 8.9°C and/or 7.5°C, while Asterix would be suitable up to 120 days after storage at 8.9°C (Table 3)

### Processing quality

Validated by the industry, ‘BRS F183’ (Potira) showed to be suitable for French fry processing, due to tuber high dry matter content, oval long shape, large size, yellow flesh color, and light fry color.

### Culinary quality

The smooth skin and shallow eyes of ‘BRS F183’ (Potira) tubers makes it very easy peeling, with great tissue yield. It presents firm texture (cohesive and not floury), a very characteristic flavor and excellent performance for boiling.

## DISEASE REACTION

Results of field tests under conditions of artificial inoculation of *Phytophthora infestans*, to assess resistance to late blight of ‘BRS F183’ (Potira) are presented in Table 4. Means of percentage of final severity (PFS) and area under the disease progress curve (AUDPC), varied with year, from highly susceptible to moderately susceptible (Wolter, 2018). Tested for resistance to early blight caused by *Alternaria grandis*, in the greenhouse and in the field, ‘BRS F183’ (Potira) showed lower AUDPC values than other potato genotypes, including ‘Asterix’, suggesting moderate resistance (Lourenço Junior *et al.*, 2019).

In field tests conducted under conditions of natural infection, ‘BRS F183’ (Potira) was susceptible to mosaic caused by *Potato virus Y* (PVY), and to leafroll caused by *Potato leafroll virus* (PLRV). Evaluation at 45-50 days after planting, considered symptom expression in plants and DAS-ELISA (double antibody sandwich - Enzyme linked immunosorbent assay) test results done with specific antiserum (Clark & Adams, 1977).

Field evaluation, in natural infested soil of root-knot nematode (*Meloidogyne incognita* race 1), ‘BRS F183’ (Potira) showed no resistance with reproduction factor equal to 2.75 (Pinheiro *et al.*, 2018). Although the observed reproduction factor was greater than 1, based on Oostenbrink (1966), the evaluated clone was in the group of three other resistant clones (reproduction factor less than 1).

Field observations have consistently indicated that the susceptibility/resistance reactions of ‘BRS F183’ (Potira) to pectolytic bacteria (soft rot), *Rhizoctonia solani* (stem canker and black scurf), and *Ralstonia solanacearum* (bacterial wilt) are not different from the main cultivars grown in the country. However, it has shown more susceptibility to *Streptomyces* spp. (common scab) in some validation tests.

## CROP MANAGEMENT

The management practices of ‘BRS F183’ (Potira) are, in general, common

**Table 2.** Percentage of internal and external physiological tuber disorders of potato cultivars ‘BRS F183’ (Potira) and ‘Asterix’, in subtropical (Canoinhas-SC and Pelotas-RS) and tropical ecosystems (Perdizes-MG), Brazil. Embrapa, 2021.

Cultivar	Secondary growth			Growth crack			Hollow heart			Brown spot		
	Fall	Spring	Winter	Fall	Spring	Winter	Fall	Spring	Winter	Fall	Spring	Winter
BRS F183 (Potira)	0.0	0.0	2.3	0.0	0.8	1.0	1.7	0.8	0.0	0.0	1.7	0.3
Asterix	7.5	0.0	3.3	0	0.0	1.3	0	0.0	0.0	0.0	0.0	0.3

Random samples of 20 tubers each.

**Table 3.** Glucose content (mg g<sup>-1</sup> fresh mass) of potato cultivars BRS F183 (Potira) and Asterix, following harvest and different storage regimes in Pelotas-RS, Brazil. Embrapa, 2021.

Cultivar	Storage regime									
	0 day	60 days			120 days			180 days		
		-	20°C	8.9°C	7.5°C	20°C	8.9°C	7.5°C	20°C	8.9°C
BRS F183 (Potira)	0.081	0.149	0.245	0.325	0.088	0.246	0.558	1.543	0.395	0.979
Asterix	0.378	0.141	0.600	1.211	0.180	0.604	1.449	2.863	1.723	1.429

**Table 4.** Means of final severity (PFS, %) and area under the disease progress curve (AUDPC), and resistance to *Phytophthora infestans* of five potato genotypes evaluated in the field, in fall seasons of 2015, 2016 and 2017, in Pelotas-RS, Brazil. Embrapa, 2021.

Genotype	PFS (%)		AUDPC			Reaction <sup>1</sup>		
	2016	2017	2015	2016	2017	2015	2016	2017
Asterix	96.66 a <sup>2</sup>	100.00 a	541.5 a	462.50 a	462.00 a	S	HS	HS
Agata (susc. ck.)	95.00 a	100.00 a	553.3 a	491.00 a	520.50 a	S	HS	HS
BRS F183 (Potira)	81.00 b	97.33 a	468.8 a	364.50 b	406.50 a	S	MS	HS
Catucha	5.00 d	21.33 e	92.6 b	20.50 c	61.00 b	R	HR	MR
CIP392.617-54 (res. ck.)	0.00 d	0.00 f	0.00 b	0.00 c	0.00 c	R	HR	HR
CV (%)	16.4	10.0	28.9	26.2	30.7			

<sup>1</sup>HR= Highly resistant; MR= Moderately resistant; MS= Moderately susceptible; HS= Highly susceptible. <sup>2</sup>Means followed by the same letter in the column belong to the same group, according to the Scott-Knott test, at the 5% probability of the error.

to those used for other late maturing cultivars. Comparing to 'Asterix', it has a later plant development, and therefore, management should be adapted to this trait (Silva *et al.*, 2020).

Careful attention must be paid for scab management, because it may be an issue on some soils, being recommended to avoid growing this variety in soil infested with the pathogen and adopting measures to control the disease. Despite the limited number of studies and observations on management, 'BRS F183' (Potira) has shown a good tolerance to the herbicide metribuzin in applications according to the product label. The moderate susceptibility to late blight suggests preventive spraying.

'BRS F183' (Potira) is more adapted to the winter crop season (plantings in May-July) of Minas Gerais and São Paulo states, and to the autumn and spring season (plantings in February-March and August-September, respectively) of Rio Grande do Sul, Santa Catarina and Parana states. In the spring season, planting should be done as early as possible, given 'BRS F183' (Potira) later tuberization in this season. It is also adapted to the summer season of the highest altitude areas regions of the Southern region of the country.

### MOLECULAR PROFILE

The molecular profile of 'BRS F183' (Potira) was obtained for the 24 microsatellite loci that compose the genetic identity kit developed for potatoes (Ghislain *et al.*, 2009), following the protocol described by authors. The molecular profile of this variety is distinct from 'Asterix' for

21 microsatellite loci (STM0019, STP0Ac58, STI0012, STI0032, STG0001, STG0010, STG0016, STI0001, STI0003, STI0014, STI0030, STI0033, STM0031, STM0037, STM1052, STM1064, STM1104, STM1106, STM5114, STM5121, and STM5127). The analysis of any of these loci differentiates the two cultivars.

### CHEMICAL CHARACTERISTICS

The total glycoalkaloid content of 'BRS F183' (Potira) tubers is within acceptable limits (20 mg 100 g<sup>-1</sup> fresh mass). Tubers from plants cultivated in trials in 2017 and 2018 in Perdizes-MG were evaluated to total glycoalkaloid content according to the protocol described by Veilleux *et al.* (1997). On average, the content was 13.80 mg 100 g<sup>-1</sup> fresh mass, similar to the values found in 'Asterix' tubers.

### PROTECTION, SEED AVAILABILITY, AND LICENSING

The potato cultivar BRS F183 (Potira) has been registered and protected by the Ministry of Agriculture, Livestock and Supply (MAPA) of Brazil since 04/05/2020 under the number 41671, and protection certificate from 04/05/2020, under the number 20200225.

Information about seeds can be obtained at Embrapa Temperate Agriculture / Canoinhas Experimental Station, Rodovia BR 280, Km 231, nº 1151 Bairro Industrial 2, Caixa Postal 317, CEP 89466-500, Canoinhas-SC.

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