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New Cultivar

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'BRS F50' (Cecilia): A multi-purpose potato cultivar with resistance to foliar disease

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ABSTRACT

'BRS F50' (Cecilia) is a yellow skin potato cultivar for the fresh market, with good tuber appearance and versatile culinary use. The tuber has oval shape, shallow eyes, and light yellow flesh. It has a relatively high dry matter and medium-low glucose content, giving possibility even to use for processing into shoestring fries. The vegetative cycle and dormancy are medium. The maturity and tuber dormancy are medium. 'BRS F50' (Cecilia) shows a very low external and internal tuber disorder incidence, except growing cracks under varying soil humidity. It is moderately resistant to late and early blight, which make it also suitable for organic production. 'BRS F50' (Cecilia) was released by Embrapa in 2022, and is a product of its potato breeding program, developed by Embrapa Clima Temperado, in Pelotas-RS and Canoinhas-SC, and Embrapa Hortaliças, in Brasília-DF, Brazil.

Keywords: *Solanum tuberosum*, breeding, variety, organic production.

RESUMO

'BRS F50' (Cecília): Cultivar de batata multiuso com resistência a doenças foliares

'BRS F50' (Cecilia) é uma cultivar de batata de película amarela para o mercado *in natura*, com boa aparência de tubérculo e versátil uso culinário. O tubérculo tem formato oval, olhos rasos e polpa amarela clara. Apresenta um teor de matéria seca relativamente alto e teor de glicose médio-baixo, dando-lhe a possibilidade de uso até mesmo para processamento de batata palha. O ciclo vegetativo e período de dormência são médios. A maturidade e a dormência dos tubérculos são médias. 'BRS F50' (Cecilia) apresenta incidência baixa de desordens fisiológicas externas e internas nos tubérculos, exceto rachaduras de crescimento sob umidade variável do solo. É moderadamente resistente à requeima e à pinta preta, o que a torna também adequada à produção orgânica. 'BRS F50' (Cecilia) foi lançada pela Embrapa em 2022, e é produto de seu programa de melhoramento de batata, desenvolvido pela Embrapa Clima Temperado, em Pelotas-RS e Canoinhas-SC, e Embrapa Hortaliças, em Brasília-DF, Brasil.

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

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'BRS F50' (Cecilia) is a yellow skin potato cultivar for the fresh market, with a yellow skin. It was developed by the Embrapa Potato Breeding Program (PMGB), composed by Embrapa Temperate Agriculture, Pelotas-RS and Canoinhas-SC, and Embrapa Vegetable Crops, Brasilia-DF, Brazil. 'BRS F50' (Cecilia) was originated from a cross between the cultivar Rioja (mother) and the clone 3CRI1316-8-82 (father) (Figure 1), made in a greenhouse of Embrapa Temperate Agriculture, in the spring of 2006. 'Rioja' is a Hungarian cultivar released by the Pannon University of Agricultural Sciences, Keszthely, Hungria (The European Culivated Database, 2020). 3CRI1316-8-82 was selected by PMGB from a cross between the Deutsche cultivar Recent and the clone 2CRI-1149-1-78 of Embrapa. This clone was derived from the cross between 'Recent' and the clone CI1086-22-75, also developed by PMGB.

True potato seeds of the hybrid population that originated the clone F50-08-01 were sown in a greenhouse of Embrapa Temperate Agriculture in fall of 2008, producing seedling tubers to plant the first field generation. The selection process comprised four generations conducted in fall of 2009, 2010, 2011, and 2012, in fields of the Canoinhas Experimental Station, 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 seed tubers 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 F50-08-01 was included in comparative trials, to evaluate yield potential and yield stability. Simultaneously, it was evaluated for main common potato diseases in Brazil, by Embrapa Temperate Agriculture in Pelotas and Embrapa Vegetable Crops in Brasília. In the fall and spring seasons of 2017, and fall season of 2018 in Pelotas, fall and spring seasons of 2017 in Canoinhas, and winter of 2017 in Perdizes-MG, the clone F50-08-01 was tested in trials for the cultivation and use value (VCU), using 'Asterix' and 'BRSIPR Bel' as check cultivars. In these trials, morphological characterization was done, with F50-08-01 demonstrating phenotypic and genetic distinctness, homogeneity and stability. Concurrently with VCU trials, and in Joanopólis-SP and Mafra-SC, F50-08-01 was horticulturally, industrially and commercially validated by growers. Based on good tuber appearance, high yield potential, relatively high dry matter content, good culinary quality, and validation results, F50-08-01 was registered, protected, and released in 2022 as 'BRS F50' (Cecilia).

VARIETAL DESCRIPTION

Description of plant and tubers of 'BRS F50' (Cecilia) were obtained from evaluation fields carried out in Pelotas.

Plants: height medium to high, semi-upright growth habit and mid-season maturity.

Stems: weak to very weak extent of anthocyanin pigmentation.

Leaves: medium size, intermediate open, low to medium presence of secondary leaflets, light to medium green, absent to very weak extent of anthocyanin pigmentation on the midrib of the upper side, low to medium 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, absent to very weak extent of anthocyanin pigmentation on peduncle; **Corolla:** purple red color on inner side (Figure 2B).

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

Sprouts: medium size, spherical closed to intermediate shape, closed apex, medium to strong extent of anthocyanin pigmentation apex, few to medium root tips and medium to long lateral shoots, and base purple red with sparse pubescence (Figure 2D).

AGRONOMIC PERFORMANCE

In five trials, carried out in subtropical

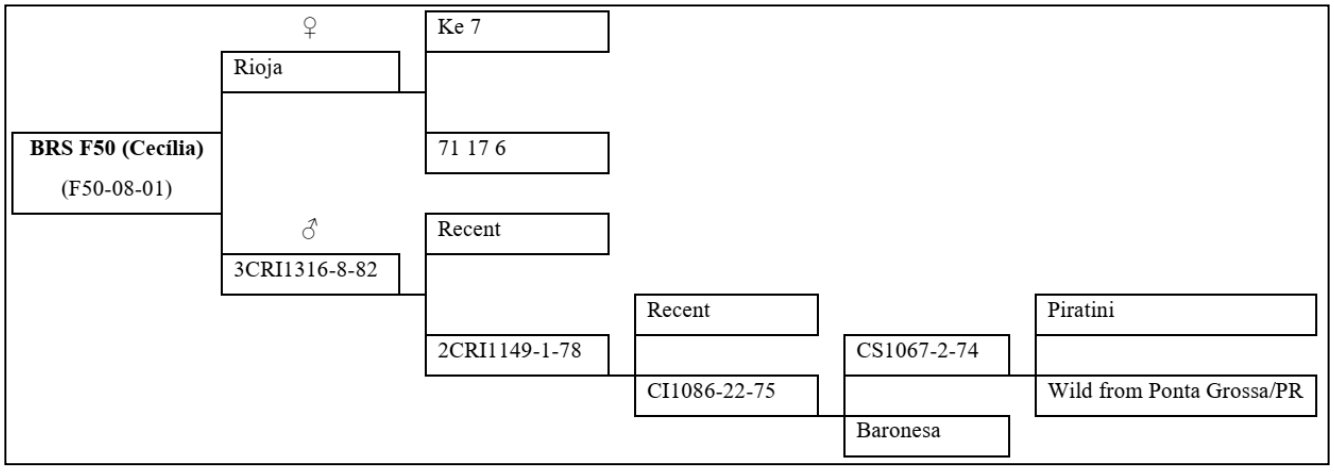

Figure 1. Pedigree of potato cultivar BRS F50 (Cecília). Embrapa, 2023.

Figure 2. BRS F50 (Cecilia): (**a**) leaf, (**b**) inflorescence, (**c**) external and internal tuber appearance, and (**d**) sprout. Embrapa, 2023.

Table 1. Means of yield (marketable and total), tuber mass (%), average tuber mass (g), and dry matter content of potato cultivars BRS F50 (Cecilia), BRSIPR Bel and Asterix, grown in fall and spring seasons in Canoinhas-SC and Pelotas-RS, and in winter season in Perdizes-MG, Brazil. Embrapa, 2023.

Location/season-year, Cultivar	Yield (t/ha)		Tuber mass (%)	Aver. tuber mass	Dry matter (%)
	Marketable[1]	Total			
Canoinhas/Fall-2017					
BRS F50 (Cecilia)	11.40 a[2]	16.46 b	68.0 a	119.6 a	19.9 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 b
CV (%)	25.3	20.9	11.1	8.6	1.8
Pelotas/Fall-2017					
BRS F50 (Cecilia)	13.29 a	15.88 a	88.0 a	82.8 a	20.1 a
BRSIPR Bel	11.80 a	14.09 a	85.7 b	83.9 a	20.8 a
Asterix	13.58 a	14.60 a	74.0 b	73.0 a	19.8 a
CV (%)	20.1	16.0	3.9	6.6	2.9
Pelotas/Fall-2018					
BRS F50 (Cecilia)	14.16 a	16.03 a	88.4 a	66.9 a	-
BRSIPR Bel	12.50 a	17.08 a	73.3 a	69.4 a	-
Asterix	9.65 a	15.62 a	60.3 b	50.8 b	-
CV (%)	20.60	13.80	10.27	6.86	-
Canoinhas/Spring-2017					
BRS F50 (Cecilia)	31.56 a	37.33 a	84.6 a	131.7 a	20.0 a
BRSIPR Bel	24.66 b	31.85 a	77.6 a	123.8 a	20.8 a
Asterix	24.48 b	29.22 a	84.2 a	158.3 a	19.5 a
CV (%)	11.0	10.9	4.3	9.5	4.7
Pelotas/Spring-2017					
BRS F50 (Cecilia)	30.78 a	34.84 a	88.5 a	107.9 a	19.7 a
BRSIPR Bel	9.13 b	14.80 b	62.7 b	55.5 b	20.0 a
Asterix	4.79 b	9.38 b	50.0 c	54.5 b	19.7 a
CV (%)	21.2	29.6	7.1	9.8	10.2
Perdizes/Winter-2017					
BRS F50 (Cecilia)	45.47 a	49.06 a	92.9 b	105.9 a	20.5 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 a
CV (%)	11.5	12.7	2.4	6.8	5.2

[1]Marketable tubers: tubers with transversal diameter larger than 45 mm; [2]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.

ecosystem (Canoinhas-SC and Pelotas-RS), 'BRS F50' (Cecília) showed marketable tuber yields statistically higher ($p<0.05$) than 'Asterix' in fall crops and did not differ in spring crops (Table 1). On average, the superiority of the cultivar to 'Asterix' in fall crops was 49.10% and 17.1%, respectively, for marketable and total tuber yields. In general, it also showed a higher percentage of tuber mass than 'Asterix' in the subtropical ecosystem. The average tuber mass of 'BRS F50' (Cecilia) was higher or similar to 'Asterix'. In Perdizes, these two genotypes differed only in percentage of tuber mass, with superiority for 'Asterix'.

In the organic production system at the Cascata Experimental Station, Pelotas-RS, 'BRS F50' (Cecilia) was compared to the standard cultivars, Epagri Catucha and BRS Clara, in two seasons, spring and fall (Table 2). For marketable and total tuber yield, 'BRS F50' (Cecilia) did not differ from the two standard cultivars, in the spring season. However, in the fall season, it had higher yields than 'Epagri Catucha', but did not differ from 'BRS Clara'.

Regarding physiological tuber disorders, 'BRS F50' shows a very low incidence of both external and internal disorders, except growing cracks under varying soil humidity.

'BRS F50' (Cecilia) presented medium resistance to post-harvest tuber greening. The tuber dormancy period is medium, very similar to 'Asterix'.

QUALITY CHARACTERISTICS AND USAGE

'BRS F50' (Cecilia) has a firm texture, moderate cohesiveness, and characteristic flavor when cooked, and a crispy and light-colored texture when fried. Therefore, it presents versatility for culinary use.

The relatively high dry matter content of 'BRS F50' (Cecilia) (20.0%), which is slightly higher than that of 'Asterix' (19.4%), and the medium-low glucose content (0.039%), make it also suitable for processing into shoestring fries.

Table 2. Means of yield (marketable and total, t/ha) of potato cultivars BRS F50 (Cecilia), BRS Clara, and Epagri Catucha, grown in fall 2020 and spring 2021 seasons in Pelotas-RS, Brazil, under the organic production system. Embrapa, 2023.

Season-year, Cultivar	Spring-2020		Fall-2021	
	Marketable yield[1]	Total yield	Marketable yield	Total yield
BRS F50	13.49 a[2]	21.99 a	18.90 a	22.43 a
BRS Clara	13.57 a	21.08 a	15.82 a	19.15 a
Epagri Catucha	13.57 a	19.23 a	12.39 b	16.26 b
CV (%)	30.1	18.9	23.9	16.6

[1]Marketable tubers: tubers with transversal diameter larger than 45 mm; [2]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.

DISEASE REACTION

Data on resistance to late blight caused by *Phytophthora infestans* of the 'BRS F50' (Cecilia), obtained from five field trials carried out in fall seasons, in Pelotas, are presented in Table 3. The results of the area under the disease progress curve (AUDPC) vary from moderately susceptible to resistant, suggesting moderate resistance to late blight of this cultivar.

Tested for resistance to early blight caused by *Alternaria grandis*, in the greenhouse and in the field, Brasilia-DF and Rio Parnaiba-MG, respectively, 'BRS F50' (Cecilia) showed lower AUDPC values than other genotypes, including 'Asterix', suggesting moderate resistance (Lourenço Junior *et al*., 2019).

In field tests for resistance to major viruses, under conditions of natural infection, 'BRS F50' (Cecilia) showed susceptibility to mosaic caused by *Potato virus Y* (PVY) and to leaf roll disease caused by the *Potato leaf roll virus* (PLRV). The evaluation was carried out in Brasilia, considering the expressions of symptoms in the plants 45-50 days after planting and use of specific antiserum, in the DAS-ELISA test (double antibody sandwich - Enzyme-linked immunosorbent assay) (Clark & Adams, 1977).

In a field naturally infested with root-

Table 3. Means of the area under the disease progress curve (AUDPC) and reaction to *Phytophthora infestans* of five potato genotypes evaluated in the field, in fall seasons of 2015, 2016, 2017, 2018 and 2019, in Pelotas-RS, Brazil. Embrapa, 2023.

Genotype	AUDPC					Reaction[1]				
	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019
Asterix	541.5 a[2]	462.5 a	462.0 a	406.8 a	367.3 a	S	HS	HS	S	S
Agata (susceptible check)	553.3 a	491.0 a	520.5 a	357.6 a	355.9 a	S	HS	HS	S	S
BRS F50 (Cecília)	133.2 b	154.5 b	131.0 b	292.8 b	15.9 b	R	MR	MR	MS	R
Epagri Catucha	92.6 b	20.5 c	61.0 b	177.8 c	17.2 b	R	HR	MR	MR	R
CIP392.617-54 (resistant check)	0.0 b	0.0 c	0.0 c	9.2 c	5.0 b	R	HR	HR	R	R
CV (%)	28.9	26.2	30.7	14.3	31.6	-	-	-	-	-

[1]HR: Highly resistant; R: Resistant; MR: Moderately resistant; MS: Moderately susceptible; HS: Highly susceptible; S: Susceptible. [2]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.

knot nematodes (*Meloidogyne incognita* race 1), 'BRS F50' (Cecilia) showed no resistance, with a reproduction factor equal to 1.49 (Pinheiro *et al*., 2018). Although the observed reproduction factor was greater than 1, based on Oostenbrink (1966), the variety was classified in the resistant group (reproduction factor less than 1).

Regarding other diseases, field observations indicated consistently that susceptibility/resistance reactions of 'BRS F50' (Cecilia) to pectolytic bacteria (soft rot), *Rhizoctonia solani* (stem canker and black scurf), and *Ralstonia solanacearum* (bacterial wilt) and *Streptomyces* spp. (common scab) are not different from the main cultivars planted in the country.

CROP MANAGEMENT

The management practices of 'BRS F50' (Cecilia) are, in general, common to those used for other mid-maturity cultivars in conventional and organic production systems, although it has a lower plant development than 'Asterix' (Silva *et al.*, 2020).

The moderate resistance to late blight and early blight, which makes its use also possible in organic production systems, does not dispense the use of synthetic fungicides or alternative products to control these diseases in conventional or organic production systems, but with less intensity than that used in other varieties.

To minimize the occurrence of tuber growth cracking, avoid growing conditions with variation in soil moisture levels, especially during the tuber bulking stage.

Despite the limited number of studies and observations on management, 'BRS F50' (Cecilia) has shown a good tolerance to the herbicide metribuzin in applications according to the product label.

'BRS F50' (Cecilia) is better adapted to the winter crop season (plantings in May-July) of Minas Gerais and São Paulo states, and to the fall and spring season (plantings in February-March and August-September, respectively) of Rio Grande do Sul, Santa Catarina and Parana states. 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 F50' (Cecilia) 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 'Agata' for 21 microsatellite loci (STM0019, STI0012, STI0032, STG0001, STG0010, STG0016, STI0001, STI0003, STI0004, STI0014, STI0030, STI0033, STM0031, STM0037, STM1052, STM1053, STM1064, STM1106, STM5114, STM5121, and STM5127). The analysis of any of these loci differentiates the two cultivars.

PROTECTION, SEED AVAILABILITY, AND LICENSING

The potato cultivar BRS F50 (Cecilia) is registered and protected by the Ministry of Agriculture, Livestock and Supply (MAPA) of Brazil since 30/04/2020 under the number 41695, and the protection certificate from 04/05/2020, under the number 20200221.

Information about seeds can be obtained from Embrapa Temperate Agriculture / Canoinhas Experimental Station, Rodovia BR 280, Km 231, nº1151 Bairro Industrial 2, Caixa Postal 317, CEP 89466-500, Canoinhas-SC.

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