horticultura brasileira

New Cultivar

PEREIRA, AS; SILVA, GO; CARVALHOM ADF; CASTRO, CM; EMYGDIO, BM; AZEVEDO, FQ; BORTOLETTO, AC; EICHHOLZ, ED; RAGASSI, CF; UENO, B; CORADIN, JH; DUTRA, LF; LOPES, CA; PINHEIRO, JB; LOURENÇO JUNIOR, V; GOMES, CB; LIMA, MF; LIMA, NLP; MALDONADE, IR; PILON, L; FERRI, NML; KROLOW, ACR; JORGE, RO; CASTRO, LAS; FELDBERG, NP; HEIDEN, G; REISSER JUNIOR, C; VIZZOTTO, M. 'BRS Gaia': A red-skinned potato cultivar with high dry matter content for fresh market. *Horticultura Brasileira* v.43, 2025, elocation e289822. DOI: http://dx.doi.org/10.1590/s0102-0536-2025- e289822

'BRS Gaia': A red-skinned potato cultivar with high dry matter content for fresh market

Arione S Pereira*[1]; Giovani O Silva[2]; Agnaldo DF Carvalho[3]; Caroline M Castro[1]; Beatriz M Emygdio[1]; Fernanda Q Azevedo[1]; Antonio C Bortoletto[4]; Eberson D Eicholz[5]; Carlos F Ragassi[6]; Bernardo Ueno[1]; Juliana H Coradin[1]; Leonardo F Dutra[1]; Carlos A Lopes[6]; Jadir B Pinheiro[6]; Valdir Lourenço Junior[6]; Cesar B Gomes[1]; Mirtes F Lima[6]; Natércia LP Lima[1]; Iriani R Maldonade[6]; Lucimeire Pilon[6]; Núbia ML Ferri[1]; Ana CR Krolow[1]; Rogério O Jorge[1]; Luis AS Castro[1]; Nelson P Feldberg[4]; Gustavo Heiden[1]; Carlos Reisser Junior[1]; Márcia Vizzotto[1]

[1]Embrapa Clima Temperado, Pelotas-RS, Brasil; arione.pereira@embrapa.br (author for correspondence); caroline.castro@embrapa.br; beatriz.emygdio@embrapa.br; fernanda.azevedo@embrapa.br; bernardo.ueno@embrapa.br; juliana.coradin@embrapa.br; leonardo.dutra@embrapa.br; cesar.gomes@embrapa.br; natercia.lobato@embrapa.br; nubia.ferri@embrapa.br; ana.krolow@embrapa.br; rogerio.jorge@embrapa.br; gustavo.heiden@embrapa.br; carlos.reisser@embrapa.br; marcia.vizzotto@embrapa.br; luis.suita@embrapa.br. [2]Embrapa Hortaliças, EE Canoinhas, Canoinhas-SC, Brasil; giovani.silva@embrapa.br. [3]Embrapa Cerrados, Uberaba-MG, Brasil; agnaldo.carvalho@embrapa.br. [4]Embrapa Clima Temperado, EE Canoinhas, Canoinhas-SC, Brasil; antonio.bortoletto@embrapa.br; nelson.feldberg@embrapa.br. [5]Embrapa Clima Temperado, EE Cascata, Pelotas-RS, Brasil; eberson.eicholz@embrapa.br. [6]Embrapa Hortaliças, Brasília-DF, Brasil; carlos.ragassi@embrapa.br; carlos.lopes@embrapa.br; jadir.pinheiro@embrapa.br; valdir.lourenco@embrapa.br; mirtes.lima@embrapa.br; iriani.maldonade@embrapa.br; lucimeire.pilon@embrapa.br

ABSTRACT

'BRS Gaia' is a red-skinned potato cultivar with high dry matter and attractive tuber appearance. Its tubers are oval, with shallow eyes, slightly rough skin, yellow flesh and low susceptibility to post-harvest greening. The vine maturity and tuber dormancy are medium. It is moderately susceptible to late and early blight. 'BRS Gaia' has an intermediate level of resistance (tolerance) to bacterial wilt, which gives it a significant comparative advantage over traditional cultivars for disease management in areas infested by the bacteria *Ralstonia solanacearum*. It has low susceptibility to tuber deformation due to high temperature. Although the main destination is for the fresh market, 'BRS Gaia' can also be used by restaurants for fresh cut fries and for processing into shoestrings. 'BRS Gaia' was released in 2023 through Embrapa's potato breeding program, developed by Embrapa Clima Temperado, in Pelotas-RS and Canoinhas-SC, and Embrapa Hortaliças, in Brasilia-DF, Brazil.

Keywords: *Solanum tuberosum*; breeding; variety.

RESUMO

'BRS Gaia': Cultivar de batata de película vermelha com alto teor de matéria seca para mercado fresco

'BRS Gaia' é uma cultivar de batata vermelha, com alto teor de matéria seca e tubérculos de aparência atrativa. Os tubérculos são ovais, com gemas superficiais, película ligeiramente áspera e polpa amarela. Apresenta baixa suscetibilidade ao esverdeamento de pós-colheita. A maturidade de ramas e a dormência dos tubérculos são médias. É moderadamente suscetível à requeima e à pinta-preta. 'BRS Gaia' apresenta nível intermediário de resistência (tolerância) à murcha bacteriana, o que confere a ela significativa vantagem comparativa em relação às cultivares tradicionais para o controle integrado de doenças em áreas infestadas pela bactéria *Ralstonia solanacearum*. Possui baixa suscetibilidade à deformação dos tubérculos por altas temperaturas. Embora o principal destino seja o mercado de fresco, 'BRS Gaia' também pode ser utilizada por restaurantes para batatas fritas minimamente processadas e para processamento em batata palha. 'BRS Gaia' foi lançada em 2023 e é produto do programa de melhoramento genético de batata da Embrapa, desenvolvido pela Embrapa Clima Temperado, em Pelotas-RS e Canoinhas-SC, e pela Embrapa Hortaliças, em Brasília-DF, Brasil.

Palavras-Chave: *Solanum tuberosum*; melhoramento genético; variedade.

Received on October 27, 2024; accepted on February 2, 2025

The ‘BRS Gaia’ is a red-skinned potato cultivar with high dry matter and attractive tuber appearance. It was developed by the Embrapa Potato Breeding Program (PMGB), composed by Embrapa Clima Temperado, Pelotas-RS and Canoinhas-SC, and Embrapa Hortaliças, Brasília-DF, Brazil. ‘BRS Gaia’, originally named as clone F63-10-07, was selected from a cross between the cultivar Rioja (mother) and the clone C1750-15-95 (father) (Figure 1), made in a greenhouse at Embrapa Clima Temperado, in the spring of 2008. ‘Rioja’ is a Hungarian cultivar released by the Pannon University of Agricultural Sciences, Keszthely, Hungary (The European Culivated Database, 2020). C1750-15-95 is a clone selected from the cross between the clone C1485-16-87 and the North American cultivar Atlantic (The Potato Association of America, 2016). The clone C1485-16-87 was derived from the cross between two clones selected by Embrapa, 2CRI1149-1-78 and A876-5-79. The first was obtained from the cross between the Dutch cultivar Recent and the clone CI1086-22-75, while the second was selected from self-fertilization of the cultivar Palma.

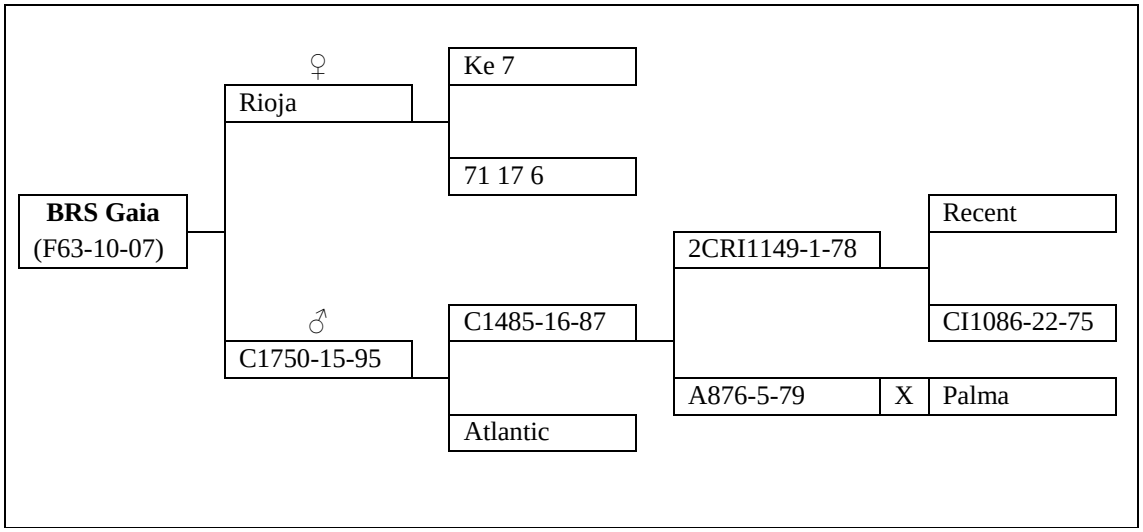

Figure 1. Pedigree of potato cultivar BRS Gaia. Embrapa, 2024.

True potato seeds of the hybrid population that originated the clone F63-10-07 were sown in a greenhouse at Embrapa Clima Temperado in fall of 2009, producing seedling tubers to plant the first field generation. The selection process comprised four generations conducted in the fall of 2010, 2011, 2012, and 2013, in fields of the Canoinhas’ Experimental Station, according to Pereira *et al.* (2016). In 2014, the selected clone was submitted to clonal cleaning in the tissue culture laboratory and production of genetic seed tubers in the hydroponic system of Embrapa Clima Temperado. During the fall and spring seasons of 2015 and 2016 in Canoinhas-SC and Pelotas-RS, and winter seasons of 2016 and 2017 in Brasilia-DF, the clone F63-10-07 was included in comparative trials, to evaluate yield potential and stability. Simultaneously, the clone was evaluated for main common potato diseases in Brazil, by Embrapa Clima Temperado in Pelotas and Embrapa Hortaliças in Brasilia. In the spring season of 2018 and fall and spring seasons of 2019, in Canoinhas and Pelotas, the clone F63-10-07 was tested in trials for the cultivation and use value (VCU), using ‘Asterix’ and ‘BRSIPR Bel’ as check cultivars. The morphological characterization indicated that the clone F63-10-07 displayed phenotypic and genetic distinctness, homogeneity, and stability. Concomitantly and also in the subsequent years, it was validated by commercial producers. Based on good tuber appearance, relatively high yield potential, high dry matter content, culinary quality, and validation results, F63-10-07 was registered and released in 2023 as ‘BRS Gaia’.

VARIETAL DESCRIPTION

Description of aerial parts plant and tubers of ‘BRS Gaia’ were achieved from evaluation fields carried out in Pelotas-RS, based on the potato variety descriptors (MAPA, 2024).

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

Stems: medium extent of anthocyanin pigmentation.

Leaves: medium size, intermediate opening, medium presence of secondary leaflets, medium green, with slightly purplish midrib on the upper side, low to medium frequency coalescence of terminal and lateral leaflets. **Leaflets**: medium-narrow in size, without waves in the margins and with medium frequency of secondary leaflets (Figure 2a).

Inflorescence: low frequency of inflorescences per plant, with medium to strong extent of anthocyanin pigmentation on peduncle. **Corolla:** purple red color on inner side (Figure 2b).

Tubers: red skin, oval shape, shallow eyes, slightly rough skin, and yellow flesh (Figure 2c).

Sprouts: small to medium size, spherical shape, intermediate apex, weak to medium intensity of anthocyanin pigmentation at the base, average proportion of blue in the anthocyanin pigmentation at the base, sparse pubescence at the base, medium-large size of the apex in relation to the base, intermediate aspect of the apex, weak anthocyanin pigmentation of the apex, sparse pubescence of the apex, average number of rootlets, short length of lateral shoots (Figure 2d).

Figure 2. ‘BRS Gaia’: (**a**) leaf, (**b**) inflorescence, (**c**) external and internal tuber appearance, and (**d**) sprout. Embrapa, 2024.

AGRONOMIC PERFORMANCE

In the horticultural evaluations, ‘BRS Gaia’ showed consistent total and marketable yield across southern Brazil (Table 1). Over the total trial locations in Canoinhas and Pelotas, marketable and total yields of ‘BRS Gaia’ averaged 35.4% and 31.7% higher than the most grown red cultivar Asterix, respectively. Marketable and total yields of ‘BRS Gaia’ also averaged 10.9% and 31.7% higher than the widely adapted cultivar Atlantic across Canoinhas and Pelotas, respectively.

Validation tests of 'BRS Gaia' regarding agronomic characters and culinary use, through observation plots, were developed in production units of family-based agricultural producers in several municipalities in the state of Rio Grande do Sul (Cristal, Canguçu, Morro Redondo, Encruzilhada, São Lourenço do Sul, and Ibiraiaras), and Santa Catarina (Mafra and Papanduva), and also at the Estação Experimental Cascata (Pelotas-RS). In all locations, the evaluations were positive regarding productive performance, tuber appearance, and culinary use both in fried form and in the preparation of puree. In relation to the cultivar Asterix, ‘BRS Gaia’ stood out for its heat tolerance, more intense red color of the tubers, resistance to late blight, shorter vegetative cycle and quality for frying (lighter color) and puree. In comparison with ‘Macaca’, a traditional and popular variety among small growers, ‘BRS Gaia’ showed a more attractive tuber appearance, longer shelf life, higher productivity and greater resistance to foliar diseases.

Table 1. Means of marketable (Mark) and total tuber yield (t ha^{-1})of potato cultivars BRS Gaia, Asterix and Atlantic grown in fall and spring seasons, in Canoinhas-SC and Pelotas-RS, Brazil. Embrapa, 2025.

Cultivar	Canoinhas (spring 2018)		Pelotas (spring 2018)		Canoinhas (fall 2019)		Pelotas (fall 2019)	
	Mark[1]	**Total**	**Mark**	**Total**	**Mark**	**Total**	**Mark**	**Total**
BRS Gaia	11.8 a[2]	18.5 a	13.3 a	19.2 a	15.6 a	17.6 a	16.9 a	23.7 a
Asterix	8.4 a	16.0 a	6.5 b	11.1 b	13.4 a	15.5 a	18.8 a	20.9 a
Atlantic	11.1 a	18.3 a	13.0 a	18.1 a	11.3 a	11.3 a	20.1 a	18.8 a
CV(%)	12.8	11.8	15.5	14.1	14.9	13.1	15.4	13.9
	Canoinhas (spring 2019)		**Pelotas (spring 2019)**		**Pelotas (spring 2020)**		**Average**	
	Mark	**Total**	**Mark**	**Total**	**Mark**	**Total**	**Mark**	**Total**
BRS Gaia	24.0 a	31.5 a	8.0 a	28.1 a	17.6 a	27.6 a	15.3	23.7
Asterix	21.6 a	31.5 a	3.0 a	17.6 b	7.4 c	13.5 b	11.3	18.0
Atlantic	20.7 a	26.9 a	8.5 a	16.1 b	11.8 b	15.3 b	13.8	18.0
CV(%)	14.3	8.7	15.7	4.3	25.3	19.3	-	-

[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, according to the Scott-Knott test, at the 5% probability of the error.

QUALITY CHARACTERISTICS AND USAGE

'BRS Gaia' presents culinary versatility, with a suitable texture (flourish) for making puree, as well as high dry matter content for preparing fried sticks.

Despite being primarily intended for the fresh market, as it has a high dry matter content (23%) (Table 2) and relatively low glucose content (0.050%), it can be processed as chipping and string potatoes, resulting in crispy, light-colored products.

Table 2. Specific gravity of cultivar BRS Gaia compared to 'Asterix' and 'Atlantic', in Canoinhas-SC, Pelotas-RS and Brasilia-DF, Brazil. Embrapa, 2025.

Location	Season	BRS Gaia	Asterix	Atlantic
Canoinhas	Spring-2018	25.3	23.1	20.2
	Fall-2019	18.0	16.0	20.2
	Spring-2019	22.0	20.3	20.8
Pelotas	Spring-2018	22.5	18.2	20.2
	Fall-2019	23.2	18.2	21.0
	Spring-2019	25.2	20.3	22.0
Brasilia	Winter-2016	25.3	22.2	-
	Winter-2017	23.4	19.7	-
	Winter-2019	22.1	19.5	23.0

DISEASE REACTION

The performance of 'BRS Gaia' for resistance to bacterial wilt (*Ralstonia solanacearum*) was measured in three independent experiments, in a field naturally infested with the bacterium, in Brasília-DF. Disease assessments were carried out by measuring the incidence of wilted plants (withered plant = above 50% of wilted stems) 70-75 days after planting. The results of the three years are shown in Table 3, where 'BRS Gaia' has always positioned itself as one of the closer to most resistant groups, especially the clone MB 54-02 (resistant check). Therefore, consistent results were observed that the 'BRS Gaia' cultivar presented an intermediate degree of resistance (tolerance) to bacterial wilt, much closer to the resistant control than to

the commercial cultivars, which gives it a significant comparative advantage in relation to traditional cultivars for disease management in areas infested with the pathogen.

Table 3. Percentage of wilted plants of six potato genotypes, in May of each year, in a field naturally infested with race 1, biovar 1, phylotype II of *Ralstonia solanacearum* at Brasilia, Embrapa Hortaliças, 2025.

Genotype	2020	2021	2023
Markies	100.0a	90.0a	87.0a
Agata	100.0a	87.0a	-
Asterix	87.0a	16.0b	77.0a
Atlantic	-	83.0a	90.0a
BRS Gaia	46.0b	16.0b	43.0b
MB 54-02 (resis. ck.)	10.0c	0.0b	10.0b

[1] 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.

Data on resistance of the 'BRS Gaia' to late blight (*Phytophthora infestans*), obtained from three field trials carried out in fall seasons, in Pelotas, are presented in Table 4. The results of the area under the disease progress curve (AUDPC) varied from susceptible in 2018 to resistant in 2021, suggesting moderate susceptibility to late blight of this cultivar.

Table 4. Means of the area under the disease progress curve (AUDPC) and reaction to *Phytophthora infestans* of seven potato genotypes evaluated in the field, in fall seasons of 2018, 2019, and 2021, in Pelotas-RS. Embrapa, 2025.

Genotype	AUDPC			Reaction[1]		
	2018	2019	2021	2018	2019	2021
BRS Clara	439.2a[2]	173.4c	27.0c	S	MR	R
Asterix (susc. ck.)	406.8a	367.3a	449.8a	S	S	S
BRS Gaia	403.8a	220.2b	97.0c	S	MS	R
BRS F50	292.8b	16.0d	294.6b	MS	R	MR
Epagri Catucha	177.8c	17.2d	69.5c	MR	R	R
CIP392.617-54 (resis. ck.)	9.2d	0.0d	2.5c	R	R	R
CV (%)	16.6	31.6	33.1	R	R	R

[1]R: Resistant; MR: Moderately resistant; MS: Moderately 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.

Tested for resistance to early blight caused by *Alternaria grandis*, in the greenhouse and in the field, Brasilia-DF and Rio Paranaiba-MG, 'BRS Gaia' showed partial resistance (Lourenço Junior *et al*., 2020), what also gives it an advantage for integrated disease control over most of the commercial varieties in Brazil.

In field tests for resistance to major viruses, under conditions of natural infection, 'BRS Gaia' showed moderate susceptibility to mosaic caused by *Potato virus Y* (PVY). 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).

‘BRS Gaia’ showed to be moderately susceptible to common scab (*Streptomyces* spp.) in the field. Regarding to other diseases, field observations indicated consistently that susceptibility/resistance reactions of ‘BRS Gaia’ to soft rot (*Pectobacteriam* spp. and *Dickeya* spp.), stem canker and black scurf (*Rhizoctonia solani)*, and root-knot nematodes (*Meloidogyne* spp.) are not different from the main cultivars planted in the country.

CROP MANAGEMENT

Management practices for ‘BRS Gaia’ are, in general, common to those used in other mid-maturity cultivars. Although this cultivar has a low number of stems per plant (‘BRS Gaia’: 5.06-7.17; Asterix: 9.00-9.69), it requires adjustment in the density of stems in the crop (Silva *et al*., 2024).

Regarding bacterial wilt, even with its tolerance to the disease, planting should not be done in situations where conditions are very favorable to the disease, such as high soil and seed infestation, high temperatures (above and 27°C) and high soil humidity, especially if these factors are combined.

Although presenting higher resistance to late blight and early blight than the main red skin cultivar Asterix, ‘BRS Gaia’ does not exempt the use of chemical pesticides or alternative products to control diseases in conventional, agroecological transition or organic production systems.

Observations on crop management, despite the limited number of studies, indicate that ‘BRS Gaia’ has a good tolerance to the herbicide *metribuzin* in applications according to the product label.

Its relatively long tuber dormancy requires careful handling of the seeds to obtain adequate sprouting. To force sprouting, the seed tubers must rest under natural environmental conditions for at least two months before applying the treatment. As for natural tuber sprouting in the south region of Brazil, in double cropping, seeds harvest from the fall season should be stored under refrigerated conditions or under environmental conditions for planting the next fall season, and seeds from the spring season should be stored for planting the next spring season. In the case of natural environment storage, seeds should be scattered in a thin layer inside crates placed in a well-ventilated, mild temperature and exposed to indirect light (diffuse light) conditions.

‘BRS Gaia’ is better adapted to the fall and spring seasons (plantings in February-March and August-September, respectively) of the South region, and to the summer season (plantings in October-December) of high-altitude areas of the South region, and to the winter harvest (plantings in May-July) in the Southeast and Central-West regions of the country.

MOLECULAR PROFILE

The molecular profile of ‘BRS Gaia’ was obtained for four microsatellite loci that compose the genetic identity kit developed for potatoes (Ghislain *et al*., 2009), following the protocol described by the authors. The molecular profile of this variety is distinct from ‘Asterix’ for three of the four loci evaluated (STI0012, STI0032 and STPoAC58). The analysis of any of these loci differentiates the two cultivars.

REGISTRATION, SEED AVAILABILITY, AND LICENSING

The potato cultivar BRS Gaia is registered by the Ministry of Agriculture and Livestock (MAPA) of Brazil since 29/08/2023 under the number 54746.

Information about seeds can be obtained from Embrapa Clima Temperado / Estação Experimental Canoinhas, Rodovia BR 280, km 231, nº 1151, Bairro Industrial 2, CEP 89466-500, Canoinhas-SC. Phone: +55 (47) 3624-0127, 3624-0195, and 3624-2077. E-mail: cpact.eecan@embrapa.br

ACKNOWLEDGMENTS

To the support team for the Potato Breeding Program, at Embrapa Clima Temperado, Pelotas-RS and Canoinhas-SC, and at Embrapa Hortaliças, Brasília-DF, for their assistance in carrying out laboratory and field work. Also, to the Brazilian Potato Association (ABBA), growers and technicians, and other individual growers, and seed producers, for their contribution in carrying out validation field and marketing tests.

REFERENCES

CLARK, MF; ADAMS, AN. 1977. Characteristics of the microplate method of enzyme linked immunosorbent assay for the detection of plant viruses. *Journal of General Virology* 34: 475-483.

GHISLAIN, MG; NÚÑEZ, J; HERRERA, MR; PIGNATARO, J; GUZMAN, F; BONIERBALE, M; SPOONER, DM. 2009. Robust and highly informative microsatellite-based genetic identity kit for potato. *Molecular Breeding* 23: 377-388.

LOURENÇO JUNIOR, V; MARTIN, FHSR; SILVA, GO; PEREIRA, AS. 2020. *Reação de clones de batata à pinta preta*. Available at: https://www.infoteca.cnptia.embrapa.br/infoteca/bitstream/doc/1124412/1/BPD-209-18-AGO.pdf. Accessed July 10, 2024.

MAPA-MINISTÉRIO DA AGRICULTURA PECUÁRIA E ABASTECIMENTO. 2024. Available at: https://www.gov.br/agricultura/pt-br/assuntos/insumos-agropecuarios/insumos-agricolas/protecao-de-cultivar/agricolas/. Accessed July 29, 2024.

PEREIRA, AS; SILVA, GO; CASTRO, CM. 2016. Melhoramento de batata. In: NICK, C; BOREM, A (eds). *Melhoramento de hortaliças*. Viçosa: Editora UFV. p.128-157.

SILVA, GO; PEREIRA, AS; AZEVEDO, FQ; EMYGDIO, BM; BORTOLETTO, AC; FELDBERG, NP; CARVALHO, ADF; RODRIGUES, EMP; RAGASSI, CF. 2024. Crescimento, acúmulo e distribuição de matéria fresca em clones de batata na Região Sul do Brasil. *Revista de Ciências Agroambientais* 22: 1-19.

THE EUROPEAN CULIVATED DATABASE. 2020. Rioja. Available at: https://www.europotato.org/varieties/view/Rioja-E. Accessed July10, 2024. THE POTATO ASSOCIATION OF AMERICA. 2016. Atlantic (*Solanum tuberosum*). Available at: https://potatoassociation.org/varieties/white-varieties/atlantic-solanum-tuberosum/. Accessed July 10, 2024.

Author's ORCID:

Arione S Pereira: 0000-0001-9295-6496
Giovani O Silva: 0000-0002-4587-3257
Agnaldo DF Carvalho: 0000-0001-5568-4874
Caroline M Castro: 0000-0003-4605-0014
Beatriz M Emygdio: 0000-0001-5694-3372
Fernanda Q Azevedo: 0000-0003-0449-3466
Antonio C Bortoletto: 0000-0002-2523-8168
Eberson D Eicholz: 0000-0001-9917-8754
Carlos F Ragassi: 0000-0003-3433-2567
Bernardo Ueno: 0000-0002-0355-6907
Juliana H Coradin: 0000-0002-2305-0188
Leonardo F Dutra: 0000-0002-8438-8326
Carlos A Lopes: 0000-0002-9383-2345
Jadir B Pinheiro: 0000-0002-4321-2754
Valdir Lourenço Junior: 0000-0001-5546-5671
Cesar B Gomes: 0000-0002-3247-728X
Mirtes F Lima: 0000-0003-4798-2841
Natércia LP Lima: 0000-0003-0182-7328
Iriani R Maldonade: 0000-0003-2283-1270
Lucimeire Pilon:https: 0000-0002-1919-6918
Nubia Marilin L Ferri: 0000-0002-1404-8369
Ana CR Krolow: 0000-0003-4873-3716X
Rogério O Jorge: 0000-0001-8905-2760
Luis Antônio Suita de Castro: 0000-0001-8595-7407
Nelson P Feldberg: 0000-0002-5626-2427
Gustavo Heiden: 0000-0002-0046-6500
Carlos Reisser Junior: 0000-0002-4849-0489
Márcia Vizzotto: 0000-0002-8071-4980