

**Wheat crop in the state of Rio Grande do Sul, Brazil, 2018.**

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Rio Grande do Sul is one of the main wheat-producing states in Brazil. Our objective was to analyze the wheat crop in RS in 2018. In 2018, RS harvested 709,558 ha of wheat (34.2% of the total area harvested in Brazil), producing 1,750,700 tons of wheat (32.3% of the Brazilian production), with an average of grain yield of 2,467 kg/ha (157 kg/ha below the Brazilian average of 2,624 kg/ha). Among the geographical mesoregions of Rio Grande do Sul state (Fig. 1), the RS Northwest mesoregion harvested the largest wheat area at 581,134 ha (81.9% of the cropped area in the state) and had the largest production, 1,378,427

tons of wheat grain (78.7% of state production) (Table 1). However, the average of wheat grain yield obtained in this mesoregion was the third lowest of the state: 2,372 kg ha<sup>-1</sup> (95 kg ha<sup>-1</sup> below the state average) - Table 1. The RS Northeast mesoregion harvested 36,734 ha of wheat (5.2 % of the cropped area in the state), produced 130,757 tons of wheat grain (7.5 % of state production) and had the highest average of wheat grain yield of the state: 3,560 kg ha<sup>-1</sup> (1,093 kg ha<sup>-1</sup> above the state average) - Table 1. The wheat crop in Rio Grande do Sul state, in 2018, had some unfavorable

weather conditions, notably (i) lots of rain at the beginning of the crop growing period, resulting in high incidence of soil-borne wheat mosaic virus (SBWMV); and (ii) excessive rainfall in spring, resulting in high incidence of *Fusarium* head blight, the most important wheat disease in Rio Grande do Sul state. Comparing the wheat crop data with the results of the State Test of Wheat Cultivars in Rio Grande do Sul state (STWC-RS), in 2018, it was observed that the average of wheat grain yield of commercial crops was 1,717 kg ha<sup>-1</sup> below the average of STWC-RS (4,184 kg ha<sup>-1</sup>).

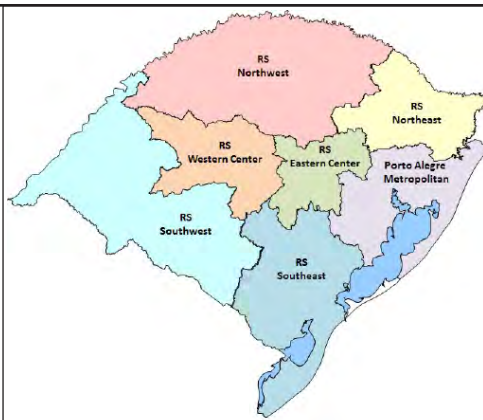
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**BRS Reponete – high grain yield and wide adaptation wheat cultivar.**

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In wheat breeding, several strategies are applied to improve grain yield. Annually, a great number of cultivars of different origins are crossed. The plants derived from these segregating populations are exposed to the most diverse possible stresses to develop new cultivars with maximum technical and economic efficiency and generate improvements to maximize the economic-environmental sustainability of plantations, while maintaining or increasing the yield potential.



**Fig. 1.** Mesoregions in the state of Rio Grande do Sul, Brazil.

**Table 1.** Area harvested, production, and average of grain yield of wheat in each of the mesoregions (see Fig. 1) of the state of Rio Grande do Sul, Brazil, in 2018 (Source: IBGE. 2020).

Mesoregion	Area harvested		Production		Grain yield (kg/ha)
	ha	%	tons	%	
RS Northwest	581,134	81.9	1,378,427	78.7	2,372
RS Northeast	36,734	5.2	130,757	7.5	3,560
RS Western Center	34,327	4.8	93,255	5.3	2,717
RS Eastern Center	7,670	1.1	16,322	0.9	2,128
Porto Alegre Metropolitan	1,730	0.2	4,211	0.2	2,434
RS Southwest	42,850	6.0	115,819	6.6	2,703
RS Southeast	5,113	0.7	11,909	0.9	2,329
Rio Grande do Sul State	709,558	100.0	1,750,700	100.0	2,467

Simultaneously, the cultivar should be highly adaptable to the representative environments of the different wheat-producing regions of the country. BRS Reponde was selected under strong selection pressure, in contrasting environments, over several segregating generations on the experimental fields of Embrapa Wheat (wet area) and Embrapa Soybean (dry area), which probably resulted in the high-grain yield potential and wide adaptation to the different Brazilian wheat-growing regions. Our objective was to describe the yield performance, main agronomic traits, and the profile of processing and industrial quality for the end use of the Embrapa wheat cultivar BRS Reponde.

BRS Reponde was derived from the cross 'PF 980229/3/PF 93232/COOK\*4/VPM 1/PF 940374', made in the winter of 2000 in a greenhouse of Embrapa Wheat (CNPT), in Passo Fundo, RS. The initial prehybridization involved an  $F_1$  of 'PF 93232/COOK\*4/VPM 1 (=LR 37 SR 38 YR 17=COOK \*4/VPM 1)' with line PF 940374 (derived from EMB 27/KLEIN H 3609 b 1111). In the winter of 2001, the  $F_1$  population resulting from the cross was grown in pots for seed multiplication in a greenhouse of Embrapa Wheat and bulk-harvested. In the winter of 2002, seeds were planted as segregating  $F_2$  populations at the experimental station of Embrapa Soybean (CNPSO), in the District of Warta, in Londrina, Paraná. In the summer of 2002–03, seeds of a plant selected in the  $F_2$  generation (22W) were sown in a greenhouse of Embrapa Wheat for multiplication and bulk-harvested (999F). In the winter of 2003, seeds of these plants were multiplied in the greenhouse in the  $F_3$  generation (denominated 999F) and planted as segregating  $F_4$  populations and cultivated again at Embrapa Soybean. A plant, designated 21W, was selected. From 2004 to 2007, all other generations were grown at Embrapa Wheat, in Passo Fundo, RS. Thus, in 2004, seeds of the plant selected in Londrina (21W) were grown in the plantation called Segregating  $F_5$  - Passo Fundo and bulk-harvested (6500F). In the segregating  $F_6$  generation, the plants were bulk-harvested again (6599F). In the  $F_7$  generation, three plants were selected in the field by the genealogical method, i.e., after selection for grain traits, one of the plants was selected and named 3F. The  $F_8$  seeds resulting from this plant were sown at commercial plant density in so-called Observation Plots (or OPs) in 2007. At this point, in 2008, the line with pedigree F68150-22W- 999F-21W-6500F-6599F-3F-0F, was named PF 070759. Also in 2008, the line was evaluated in the Preliminary Wheat Line Trial - 1<sup>st</sup> Year. In 2009, PF 070759 was tested in the Preliminary Wheat Line Trial - 2<sup>nd</sup> Year under the responsibility of Embrapa Wheat. Outstanding characteristics for resistance to fungal diseases in general and a good visual appearance of the grain, aside from excellent grain yield potential, were recorded.

The wheat cultivar BRS Reponde, derived from line PF 070759, passed through all experimental stages until release. In 2010, 2011, and 2012, BRS Reponde was evaluated in a VCU trial to determine the value of cultivation and use. All tests were arranged in a randomized complete block design with three replications (fungicide and insecticide treatments of seeds and shoot). Each experimental unit, consisting of one genotype, was sown in five 5-m rows at a 0.2-m row spacing covering a total area of 5 m<sup>2</sup>. All cultural treatments were applied according to the technical instructions of the Brazilian Wheat and Triticale Research Commission of 2009, 2010, and 2011. Prior to sowing, seeds for the tests were treated with triadimenol + imidacloprid. The trials were in the states of Rio Grande do Sul, Santa Catarina, and southern Paraná, in the wheat adaptation regions 1, cold/wet/high, and 2, moderately hot/humid/low. In the state of Rio Grande do Sul, experiments were in the counties of Vacaria (28°30'44", Latossolo Alumínico), Passo Fundo (28°15'46", Latossolo Vermelho Distroférico), São Borja (28°39'38", Nitossolo Vermelho Distroférico Latossólico), Três de Maio

**Table 2.** Grain yield (kg/ha) of BRS Reponde and the control cultivars BRS 327 and Quartzo. Means followed by the same letter are not significantly different according to the Scott–Knott method at a probability of 5%. % = percentage in relation to the mean of the two best control cultivars. Evaluation locations in 2010: L1 = Passo Fundo (June), L2 = Passo Fundo (July), L3 = São Borja 1<sup>st</sup> season, L4 = São Borja 2<sup>nd</sup> season, L5 = Três de Maio 1<sup>st</sup> season, L6 = Três de Maio 2<sup>nd</sup> season, L7 = Vacaria, L8 = Victor Graeff, L9 = Abelardo Luz, and L10 = Canoinhas. Locations in 2011: L1 = Passo Fundo (June), L2 = Passo Fundo (July), L3 = São Borja 1<sup>st</sup> season, L4 = São Borja 2<sup>nd</sup> season, L5 = Três de Maio, L6 = Vacaria, L7 = Victor Graeff, L8 = Canoinhas, L9 = Chapecó, L10 = Guarapuava, and L11 = Ponta Grossa. Locations in 2012: L1 = Cruz Alta, L2 = Passo Fundo (June), L3 = Passo Fundo (July), L4 = Santo Augusto, L5 = São Borja, L6 = São Luiz Gonzaga, L7 = Três de Maio, L8 = Vacaria, L9 = Chapecó, L10 = Guarapuava, and L11 = Ponta Grossa.

Genotype	2010		2011		2012		Mean	
	kg/ha	%	kg/ha	%	kg/ha	%	kg/ha	%
BRS Reponde	5,554 a	107	5,582 a	116	4,770 a	102	5,302 a	109
BRS 327 (control)	5,029 b	97	4,908 b	102	4,629 a	99	4,855 b	99
Quartzo (control)	5,340 a	103	4,709 b	98	4,701 a	101	4,917 b	101
Mean of control cultivars	5.185	100	4.809	100	4.665	100	4.886	100

(27°46'24", Latossolo Vermelho Distroférico), and Victor Graeff (28°15'46", Latossolo Vermelho Distroférico); in Santa Catarina in Abelardo Luz (26°33'53", Latossolo Vermelho), Canoinhas (26°10'38", Latossolo Bruno Aluminoférico), and Chapecó (27°05'47", Latossolo Vermelho Distroférico); and in Paraná in Guarapuava (25°25'36", Latossolo Bruno Ácrico Húmico) and Ponta Grossa (25°05'42", Latossolo Vermelho Distroférico).

During the VCU trial, BRS Reponte was compared with the control cultivars BRS 327 and Quartzo, which have high yield potential in the tested growing season(s) or throughout the experimental period and are representative of a high percentage of wheat-producing areas of southern Brazil. In overall performance for variable grain yield, the relative percentage of BRS Reponte compared with the mean of the two controls for each year, showed a production of 107% (2012), 116% (2013), and 102% (2014), and mean of 109%, in relation those of the controls, over the three years of evaluation (Table 2, p. 9). The highest grain yield (7,578 kg/ha) was produced in Ponta Grossa in 2010. According the Scott-Knott Mean Comparison Test, the cultivar BRS Reponte was equal to or superior to Quartzo and BRS 327 in each year of evaluation and in the mean of the years. In 2013, 2014, and 2015, complementary trials of distinctness, uniformity, and stability (DUS) were used to meet the requirements of MAPA for the process of cultivar protection. In 2016, BRS Reponte participated as a new cultivar in the ECCT, a state trial of wheat cultivars in Rio Grande do Sul.

These evaluations were in the counties of Augusto Pestana, Coxilha, Cruz Alta, Eldorado do Sul, Ijuí, Não-Me-Toque, Passo Fundo, Santo Augusto, São Borja, Sertão, Três de Maio, and Vacaria. All cultural practices were applied according to the technical information of the Brazilian Wheat and Triticale Research Commission of 2016. In wheat breeding and adaptation region 1, BRS Reponte ranked first, with a mean yield of 6,633 kg/ha, corresponding to a relative percentage of 108% of the two best controls of the test. In wheat breeding and adaptation region 2, the cultivar ranked second, with a mean yield of 5,479 kg/ha and a relative percentage of 102% compared to the two best controls of the trial. Statewide, BRS Reponte produced a mean yield of 6,138 kg/ha, corresponding to a relative percentage of 106% of the two best controls (Table 3). With the exception of Region RS2, cultivar BRS Reponte belonged to group a by the Scott-Knott mean comparison test.

**Table 3.** Grain yield (kg/ha), rank, and relative yield percentage of cultivar BRS Reponte in relation to the mean of the two best controls (Ametista and TBIO Sinuelo) in the State Trial of Wheat Cultivars of Rio Grande do Sul in 2016, in the Mediterranean wheat breeding and adaptation regions 1 and 2, Passo Fundo, 2020. Means followed by the same letter in the table lines are not significantly different according to the Scott-Knott method at 5% probability.

Cultivar	RS 1		RS 2		RS Geral	
	kg/ha	%	kg/ha	%	kg/ha	%
BRS Reponte	6,633 a	108	5,479 b	103	6,138 a	106
Quartzo	6,170 b	101	5,832 a	110	6,025 a	104
TBIO Itaipu	6,358 b	104	5,380 b	101	5,939 a	103
ORS Vintecinco	6,349 b	104	5,211 b	98	5,861 a	102
TBIO Sinuelo	6,222 b	102	5,277 b	99	5,817 a	101
TBIO Toruk	6,209 b	101	5,178 c	98	5,767 a	100
TBIO Sossego	5,818 c	95	5,416 b	102	5,646 b	98
TBIO Iguaçu	5,877 c	96	5,337 b	101	5,645 b	98
LG Oro	5,820 c	95	5,375 b	101	5,629 b	98
BRS Marcante	5,945 c	97	5,188 c	98	5,620 b	97
BRS 327	6,038 b	99	5,006 c	94	5,596 b	97
CD 1104	5,846 c	96	5,258 b	99	5,594 b	97
Campeiro	5,874 c	96	5,172 c	97	5,573 b	97
Ametista	5,874 c	96	5,125 c	97	5,553 b	96
Jadeíte	5,749 c	94	5,286 b	100	5,551 b	96
TBIO Mestre	5,628 c	92	5,439 b	102	5,547 b	96
TBIO Noble	5,907 c	97	4,985 c	94	5,512 b	95
Topázio	5,603 c	92	5,131 c	97	5,401 c	94
Marfim	5,809 c	95	4,825 d	91	5,388 c	93
BRS Parrudo	5,798 c	95	4,831 d	91	5,384 c	93
CD 1805	5,537 d	90	5,076 c	96	5,339 c	93
TBIO Pioneiro	5,765 c	94	4,760 d	90	5,334 c	92
ORS 1401	5,561 d	91	4,933 d	93	5,292 c	92
LG Prisma	5,490 d	90	4,775 d	90	5,184 d	90
TBIO Sintonia	5,586 d	91	4,621 d	87	5,172 d	90
TBIO Tibagi	5,789 c	95	4,304 e	81	5,153 d	89
Esporão	5,511 d	90	4,534 e	85	5,092 d	88
Mean 2T	6,118	100	5,309	100	5,772	100
Overall mean	5,838		5,052		5,501	

BRS Reponte is a medium-sized cultivar (mean height 87 cm in Passo Fundo, RS) with an early cycle (an average 75 days-to-heading and 132 days-to-maturity in Passo Fundo). In the plant growth phase, the cultivar is moderately susceptible to lodging and moderately blight and frost-resistant. In terms of biotic stresses, BRS Reponte is moderately susceptible to wheat mosaic virus and yellow dwarf barley virus; characterized by resistance to powdery mildew (*Blumeria graminis*) and moderate resistance to Fusarium head blight (*Fusarium graminearum*); moderately susceptible to tan spot of wheat (*Pyrenophora tritici-repentis* (Died.) Drechsler) and to leaf rust on adult plants (*Puccinia triticina*). For preharvest sprouting, the reaction is moderately resistant. In terms of end use quality, cultivar BRS Reponte was classified as bread wheat in the Homogeneous Wheat Region 2 of Rio Grande do Sul and Santa Catarina and as domestic wheat in the Homogeneous Wheat Breeding and Adaptation Region 1 of Rio Grande do Sul, Santa Catarina, and Paraná, according to the Normative Instruction No. 38, of November 30, 2010, since, respectively, 72% and 68% of the samples were classified in the respective classes.

BRS Reponte grain samples from the Homogeneous Wheat Breeding and Adaptation Region 1 of Rio Grande do Sul, Santa Catarina, and Paraná, analyzed between 2012 and 2014 in the Laboratory of Grain Quality of Embrapa Wheat, the mean gluten strength (W) was  $251 \times 10^{-4}$  J with a mean elasticity index (Ie) 45.2% (Table 4). In samples from the Homogeneous Wheat Breeding and Adaptation Region 2 of Rio Grande do Sul and Santa Catarina analyzed in the same period, the mean gluten strength (W) for BRS Parrudo was  $310 \times 10^{-4}$  J with a mean elasticity index (Ie) 50.9%. The preliminary end-use quality classification of bread wheat suggests the use of this cultivar for bread, pasta, and cracker production and as a domestic wheat, suggests flour production for domestic use, confectionery, and other products.

**Table 4.** Industrial and processing quality traits of cultivar BRS Reponte in the Wheat Adaptation Regions 1 and 2 of Brazil, from 2010 to 2012; Passo Fundo, 2020. For the tenacity/ extensibility ratio, P = tenacity or resistance to extension and L = dough extensibility or average abscissa at bubble rupture (mm). Representative locations of region 1 are Passo Fundo, Rio Grande do Sul (RS); Vacaria (RS); Victor Graeff (RS); Canoinhas, Santa Catarina (SC); Ponta Grossa, Paraná (PR), and Guarapuava (PR). Representative locations of Region 2 are São Borja (RS), Três de Maio (RS), Chapecó (SC), and Abelardo Luz (SC).

Traits	Mean of Region 1	Mean of Region 2	Overall mean or sum
Number of samples/region	25	25	50
Mean of falling number	350	338	344
Mean of gluten strength ( $\times 10^{-4}$ Joules)	310	251	230
Mean of luminosity (0 = black, 100 = white (Minolta))	92.7	92.2	92.6
Mean of color b (+ = yellow hues, - = blue hues (Minolta))	10.4	10.0	10.2
Mean of tenacity/extensibility ratio (P/L)	0.9	0.9	0.9
Mean of elasticity index (%)	45.2	50.9	48.0

The flag leaf of cultivar BRS Reponte is on a predominantly upright stem with light-colored auricles. The shape of the highest node on the stem is wide. The predominantly pyramidal shaped ear of the cultivar is awned, light colored and bears longish red grains. BRS Reponte is registered (#32066) and protected (# 20160199) by the Ministry of Agriculture, Livestock and Food Supply (MAPA). Embrapa Wheat is responsible for the production of genetic seed of the cultivar and Embrapa Products and Market (SPM) for production of basic seed. The first batch of basic seed was released for sale in 2017, because of a delay in the protection enforcement due to technical constraints of the DUS (Distinguishability, Uniformity and Stability) tests of the cultivar by MAPA.

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