CULTIVAR RELEASE

BRS TR013 – a soft wheat cultivar for the Brazilian Cerrado region

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Abstract: *BRS TR013 is a wheat cultivar developed by Embrapa. It is the first soft wheat variety recommended for Wheat Growing Region 4 of Brazil under irrigated conditions. It features an early growth cycle, reduced plant height, moderate resistance to lodging, and high grain yield potential.*

Keywords: Triticum aestivum*, soft texture grain, grain yield*

INTRODUCTION

Wheat cultivation in Brazil has expanded significantly in recent years, particularly in regions with favorable soil and climatic conditions. Traditionally associated with temperate climates, wheat has found a promising frontier in the Brazilian Cerrado, due to its vast agricultural potential and favorable climate in some regions. The development of cultivars adapted to tropical conditions–with characteristics such as a short growth cycle, high grain yield, and disease resistance–are essential for making wheat a viable and profitable crop in these regions. BRS 254 (Só e Silva et al. 2008), BRS 264 (Albrecht et al. 2006), and BRS 404 (Só e Silva et al. 2016) are examples of cultivars suitable for growing in Cerrado regions.

Historically, wheat breeding programs have focused on developing varieties intended for use in bread baking. However, increasing demand from the biscuit industry has created a need for soft-wheat cultivars specifically suited to this segment. Brazil is the fourth-largest biscuit market in the world, with consumption of approximately 1.5 million tons in 2023 (ABIMAP 2023). The demand for soft wheat is led by M. Dias Branco (33.8%), followed by Marilan (8.5%), Nestlé (7.2%), Bauducco (6.7%), Pepsico (5.0%), Mondelēz (4.5%), and others (34.3%) (Nielsen 2019).

This study presents the agronomic and quality traits of BRS TR013, a cultivar recommended for growing under irrigated conditions in the central region of Brazil, developed to increase profitability in wheat production.

BREEDING METHOD

During the 2015 growing season, approximately 50 wheat spikes free of visible blast symptoms were collected from a field in Araxá, MG, growing the

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cultivar BRS 264, which had been severely affected by wheat blast. The spikes were individually threshed, and their progenies were sown in separate rows during the 2016 season under irrigated conditions at the Coopadap Experimental Station in Rio Paranaíba, MG.

In 2017, the lines were sown in plots consisting of five 5-meter length rows. Lines that exhibited lack of uniformity, based on growth cycle, height, and spike type, were discarded. In 2018, the selected lines were grown in strips of five 20-meter length rows; and the most uniform line, designated CS 17013, was selected. This line exhibited a growth cycle similar to that of BRS 264.

CS 17013 was sown in observation plots (22 rows, 30 meters in length) in 2019 at the Coopadap Experimental Station. After harvest, grain samples were analyzed at the post-harvest laboratory of Embrapa Wheat (Embrapa Trigo, Passo Fundo, RS), showing the line's suitability for biscuit production, based on soft texture of the grains, low water absorption (farinography), and low gluten strength (alveography). These findings were confirmed by solvent retention capacity (SRC) analyses conducted both at Embrapa and at a partner industry laboratory.

PERFORMANCE AND AGRONOMIC PROFILE

Value for Cultivation and Use (VCU) trials were conducted in 2021 and 2022 at locations in Uberaba/MG, São Gotardo/MG, Luís Eduardo Magalhães/BA, and Planaltina/DF (Table 1) within Wheat Growing Region 4 (WGR4) (Cunha et al. 2006, Ministério da Agricultura e Pecuária 2008). The trials followed a randomized complete block design with three replications. Each experimental unit consisted of five 5-meter length rows with a 0.2 m spacing, and the area used for data collection was 5 m². Crop management practices, including fertilization and disease, pest, and weed control, were performed according to technical guidelines for wheat and triticale (Comissão 2020, 2022).

The agronomic variables assessed included grain yield, plant height, growth cycle (from emergence to heading and from emergence to maturation), and response to major biotic and abiotic stresses. Grain yield (GY) data were subjected to analysis of variance, and means were compared using Tukey's test at a 5% probability level. Relative yield was evaluated using four check cultivars: BRS 264 and BRS 394 (bread wheat varieties registered for WGR4) and ORS Vintecinco and TBIO Alpaca (soft wheat varieties not registered for WGR4).

Table 1. Locations and evaluation periods (2021 and 2022) of the Value for Cultivation and Use (VCU) trials of the BRS TR013 cultivar in wheat growing region 4 under irrigated conditions

Region/Location	State	Altitude (m)	Latitude	Longitude	Number of trials	
					2021	2022
Wheat growing region 4 (irrigated condition)					3	3
Uberaba	MG	1000	19º 32' 40'' S	47° 46' 04'' W	1	1
Planaltina	DF	990	15° 35' 36'' S	47° 43' 30'' W	1	1
Luis Eduardo Magalhães	BA	710	12° 05' 20'' S	45° 42' 36'' W	1	-
São Gotardo	MG	1150	19° 11' 49'' S	46° 10' 08'' W	-	1

Table 2. Grain yield performance (kg ha^{-1}) of BRS TR013 compared to check cultivars (C) in Wheat growing region 4 under irrigated conditions, evaluated in 2021 and 2022

Cultivar	2021	%[1]	2022	%[1]	Mean	%[1]
BRS TR013	5,878 a B	98.9	7,227 a A	100.7	6,553 a	100
BRS 264 (C)	6,077 a B	102.3	7,431 a A	103.6	6,754 a	103
BRS 394 (C)	6,118 a B	103.0	7,434 a A	103.6	6,776 a	103
TBIO Alpaca (C)	5,810 a B	97.8	6,809 a A	94.9	6,310 a	96
ORS Vintecinco (C)	5,761 a B	97.0	7,022 a A	97.9	6,391 a	98
Cm[2]	5,942	100.0	7,174	100.0	6,558	100

[1] % = percentage of grain yield of cultivar BRS TR013 in relation to the mean of the check cultivars; [2] C_m = mean of the check cultivars; Means followed by the same lowercase letter in the column and uppercase letter in the row belong to the same group according to Tukey's test at a 5% significance level.

The grain yield results from the VCU trials are shown in Table 2. BRS TR013 achieved a mean yield of 6,553 kg ha^{-1}, which did not differ significantly from the overall mean value of the check cultivars (6,558 kg ha^{-1}), consisting of BRS 264 (6,754 kg ha^{-1}), BRS 394 (6,776 kg ha^{-1}), TBIO Alpaca (6,310 kg ha^{-1}), and ORS Vintecinco (6,391 kg ha^{-1}).

BRS TR013 has reduced plant height and an early growth cycle (55 days to heading, 111 days to maturity). It has a mean test weight of 82.3 kg hL^{-1} and a thousand-kernel weight of 38.3 g. The cultivar is moderately susceptible to frost during the vegetative stage and moderately resistant to lodging. Regarding biotic stresses, it is susceptible to powdery mildew (*Blumeria graminis f. sp. tritici*), leaf rust (*Puccinia triticina*), and spot blotch (*Bipolaris sorokiniana*), but shows moderate resistant to wheat blast (*Magnaporthe grisea*) under controlled conditions.

Wheat quality was assessed at the post-harvest laboratory of Embrapa Wheat through thousand-kernel weight (Brasil 2009), test weight, hardness index, flour yield (experimental milling), damaged starch content, alveograph analysis, flour color (Minolta 2013), and solvent retention capacity (SRC) in 12 VCU trial samples from four locations. BRS TR013 outperformed the check cultivars in all biscuit production-related quality parameters (Table 3 and Figure 1). The results obtained are consistent with the quality standards used by Narval et al. (2022) for the soft wheat cultivars PBW752, DBW187, H1620, and H1612 recommended for biscuit production in India.

BRS TR013 combines desirable agronomic traits and grain yield performance comparable to key commercial cultivars recommended for irrigated cultivation in WGR4. However, it is the only cultivar with a soft wheat cultivar specifically recommended for production in the Brazilian Cerrado. It represents a significant advancement for the biscuit industry by bringing raw material production closer to milling and processing facilities.

Table 3. Flour and biscuit quality profile of BRS TR013 compared to ORS Vintecinco and TBIO Alpaca in Wheat Growing Region 4 under irrigated conditions (four samples)

Trait	BRS TR013	ORS Vintecinco	TBIO Alpaca
Wheat grain			
Test weight (TW, in kg hL^{-1})	82.30 ± 1.58	81.50 ± 2.52	82.46 ± 1.45
Thousand-kernel weight (TKW, in g)	38.3 ± 5.3	35.9 ± 2.3	31.3 ± 1.5
Hardness Index (HI)	22 ± 10	33 ± 3	29 ± 3
Category	Very soft (10-24)	Soft (25-34)	Soft (25-34)
Wheat flour (Quadrumat Senir Mill)			
Flour yield (FI, in %)	55.93 ± 4.74	55.32 ± 2.30	54.19 ± 1.97
Break flour yield (BFY, in %)	44.29 ± 4.28	44.47 ± 0.82	43.78 ± 1.15
Damaged starch (DS, %) – SDMatic[1]	2.60 ± 0.18	2.93 ± 0.45	2.72 ± 0.07
Flour color (Minolta)			
L* value (lightness)	95.41 ± 0.06	95.10 ± 0.41	94.86 ± 0.30
b* value (+: yellow color)	8.20 ± 1.00	7.83 ± 0.46	8.48 ± 0.61
Alveography (Chopin)[1]			
Gluten strength (W × 10^{-4}J)	143 ± 49	217 ± 78	230 ± 30
Tenacity/Extensibility ratio (P/L)	0.20 ± 0.03	0.27 ± 0.09	0.27 ± 0.10
Elasticity index	48 ± 8	56 ± 9	59 ± 9
Solvent retention capacity (SRC)[1]			
Water	53.0 ± 1.4	56.7 ± 2.1	54.5 ± 2.1
Sodium carbonate (Na_2Co_3)	72.1 ± 2.8	76.5 ± 3.9	74.2 ± 4.5
Sucrose	88.5 ± 4.6	92.1 ± 4.6	89.5 ± 4.9
Lactic acid	137.4 ± 21.6	143.2 ± 21.2	142.4 ± 22.3
Physical characteristics of biscuits[1]			
Diameter (D, in mm)	38.8 ± 0.7	36.4 ± 3.8	36.7 ± 1.2
Thickness (T, in mm)	7.3 ± 0.7	7.9 ± 1.0	7.8 ± 0.4

[1]Biscuit production-related quality parameters.

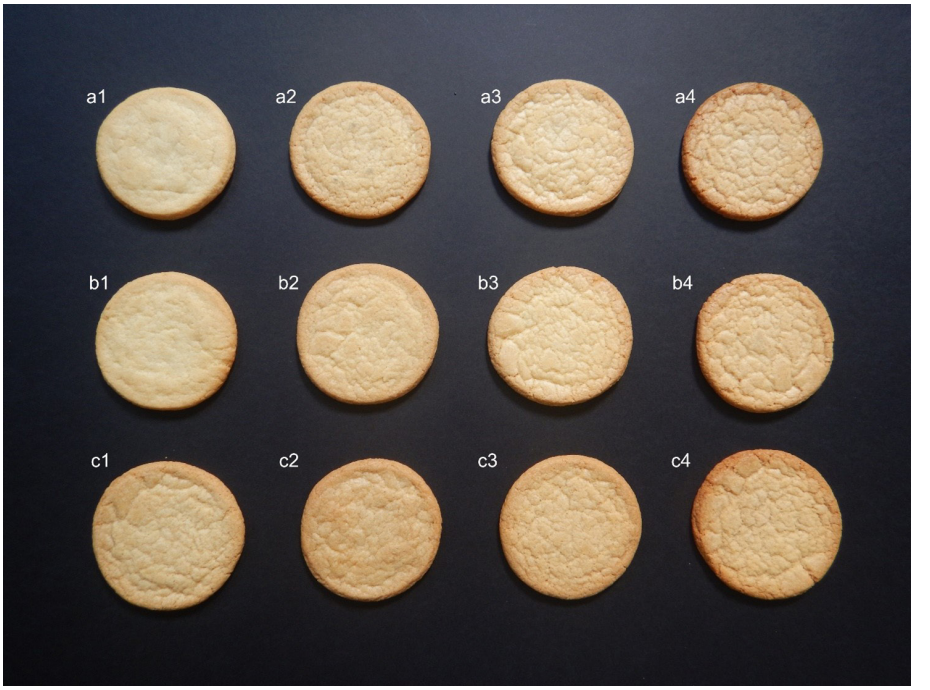

Figure 1. Comparative profile of biscuits made from BRS TR013 flour versus ORS Vintecinco flour and TBIO Alpaca flour in Luís Eduardo Magalhães/BA, Planaltina/DF, São Gotardo/MG, and Uberaba/MG. Biscuit samples: (a) ORS Vintecinco, (b) TBIO Alpaca, (c) BRS TR013. Locations: (1) Uberaba/MG, (2) Luís Eduardo Magalhães/BA, (3) Planaltina/DF, (4) São Gotardo/MG.

OTHER TRAITS

BRS TR013 has light-colored, awned, pyramidal-shaped spikes. Its flag leaf is pendulous, with colorless auricles. The glume beak averages 4 mm in length, and the glume shoulder is classified as straight. The grains are oval-shaped, light red, and very soft.

BRS TR013 is registered with the Ministry of Agriculture and Livestock of Brazil under number 54664 (September 29, 2023), and the commercial name will be BRS Cracker.

BASIC SEED PRODUCTION

Embrapa Wheat (Rodovia BR 285, km 294, Caixa Postal 78, 99050-970, Passo Fundo, Rio Grande do Sul, Brazil) is authorized to license seed producers for production, multiplication, and sale of protected cultivars (Law no. 9456/97).

DATA AVAILABILITY

The datasets generated and/or analyzed during the current research are available from the corresponding author upon reasonable request.

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