



## CULTIVAR RELEASE

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### BRS 404 – wheat cultivar for rainfed conditions

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**Abstract** – BRS 404 is a new wheat cultivar developed by Embrapa, indicated for rainfed conditions. It has a particularly good performance under heat and drought conditions. The grain yield is stable and BRS 404 is classified as bread wheat.

**Key words:** *Triticum aestivum*, heat tolerance, drought tolerance.

### INTRODUCTION

Since 2000, the breeding activities of wheat cultivars of Embrapa Wheat in the Cerrado region have been intensified, in response to the demand of the multi-year plans of the Ministry of Agriculture and the heavy dependence on imported wheat in Brazil, mainly from Argentina. Since the Cerrado agricultural frontier is huge (nearly 2 million km<sup>2</sup>, and equivalent to almost 25% of Brazil), the adaptation of wheat cultivars to the Cerrado biome would be a way to reduce cereal imports in Brazil, as was the case with other crops, e.g., soybean, corn, sorghum, rice, coffee, common bean, and cotton, which are incorporated in the productive system of the region, and currently grown on an area of 14 million hectares, due to the development of new technologies and government policies. Wheat will surely follow the example of these crops, but some unique characteristics of the wheat production chain differentiate it from the others, for not being a commodity and due to the high importance as staple food of the population.

Two of the most important wheat cultivars released by Embrapa for the Brazilian Cerrado were BRS 254 and BRS 264 (Só and Silva et al. 2008, Caierão et al. 2014). To make the advance of wheat into the Cerrado viable, it is essential to breed cultivars with tolerance/resistance

to heat, drought and blast, the main stresses of dryland wheat in this region.

The purpose of this paper was a description of the main traits of the new Embrapa cultivar of dryland wheat BRS 404 for the Cerrado region, to increase its use and make it known to the scientific community.

### PEDIGREE AND IMPROVEMENT METHOD

BRS 404 was derived from a cross performed in the winter of 2006, recorded as F92988, in a greenhouse of Embrapa Wheat, in Passo Fundo, RS. The simple cross involved line WT 99172, obtained at Embrapa Soybean from a simple cross of cultivars Iapar 60 and Ocepar 21, and cultivar MGS 1-Aliança. In the winter of 2007, the F<sub>1</sub> generation was grown in buckets for seed multiplication and bulk-harvested (F92988-Z). In the winter of 2008, these seeds formed the F<sub>2</sub> progeny, which was sown in boxes with Al-enriched soil, without liming. The single seed descent (SSD) method was applied under water stress, induced by partial irrigation. In 2009, two generations were grown from summer to winter, F<sub>3</sub> and F<sub>4</sub>, and generation F<sub>5</sub> in summer 2010. In these generations, the modified genealogical method in SSD was applied under drought

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and aluminum toxicity stress. In the winter of 2010, the seeds derived from a plant selected for seed multiplication were sown in a field of Embrapa Wheat in Passo Fundo. In 2011, the resulting plants were crossed with line PF 100660 (pedigree F92988-Z-108SSF-102SSF-103SSF-1F-0F). This line was previously evaluated in tests in Rio Verde (GO) and São Gotardo (MG) and stood out with heat and drought tolerance in tropical savannah environment and with superior yield performance. In 2012, 2013 and 2014, the new line was included in tests to determine the value of Cultivation and Use (VCU).

## GENERAL TRAITS

Wheat cultivar BRS 404 belongs to the bioclimatic group spring, indicated for cultivation under rainfed conditions in the Brazilian Cerrado region, with medium height (77 cm in the mean of evaluations) and early maturation (mean of 118 days until maturity). It is moderately resistant to grain shattering and lodging and moderately susceptible to bacterial blight, frost in the vegetative stage and pre-harvest sprouting. The reaction to the major wheat diseases was classified as susceptible to leaf rust and scab; moderately susceptible to powdery mildew, tan spot and to blast; and moderately resistant to spot blotch.

The main morphological descriptors of BRS 404 are the awned ear, with a predominantly oblong shape and light-colored when ripe. The grain has an elongated shape

and dark red color. The flag leaf position in relation to the stem is predominantly upright.

Preliminarily, BRS 404 was classified as Bread wheat in the wheat-producing region of adaptation 4 of Central Brazil. This suitability classification was based on the gluten strength values and Hagberg Falling Number, determined in Instruction No. 38, of the Ministry of Agriculture, Livestock and Supply, of November 31, 2011. The mean gluten strength was  $320 \times 10^{-4}J$ , with a variation of  $226-393 \times 10^{-4}J$ . The mean stability value (in farinograph analysis) was 11.7 minutes. For the protein content (dry basis) parameter, a mean of 15.9% was observed, with a variation of 14.9 to 17.5%. BRS 404 has hard grain and normal flour color, i.e., whether dark nor bright flour (mean Minolta color  $L^* = 93.37$ , mean Minolta color  $b^* = 10.80$ ).

## PERFORMANCE

BRS 404 participated in the VCU tests from 2012 to 2014, being compared with the controls BR 18-Terena and MGS 3-Brilhante, reference cultivars for rainfed cultivation in the Cerrado region. In 2012, the grain yield of BRS 404 exceeded the mean of the two controls by 18% (Table 1). In 2013 however, BRS 404 reached a mean of  $3427 \text{ kg ha}^{-1}$ , equivalent to a mean advantage of 24% over BR 18-Terena and MGS 3-Brilhante. The yield performance of cultivar BRS 404 was similar in 2014 (Table 1). The annual mean production was 18% higher. In this annual assessment,

**Table 1.** Means of grain yield ( $\text{kg ha}^{-1}$ ) and relative percentage of cultivar BRS 404 in relation to the mean of the control cultivars Trigo BR 18-Terena and MGS 3-Brilhante in 2012, 2013 and 2014

Cultivar	2012	%	2013	%	2014	%	Mean	%
BRS 404	3.813	118	3.427	124	4.840	118	3.941	121
Trigo BR 18-Terena	3.163	98	2.452	89	4.111	101	3.129	96
MSG 3-Brilhante	3.299	102	3.034	110	4.066	99	3.405	104
Cm <sup>1</sup>	3.231	100	2.750	100	4.089	100	3.270	100

<sup>1</sup> Cm = Mean grain yield of the control cultivars Trigo BR 18-Terena and MGS 3-Brilhante.

**Table 2.** Description of the main agronomic traits of wheat cultivar BRS 404 compared with the controls Trigo BR 18-Terena and MGS 3-Brilhante

Agricultural trait	BRS 404	Trigo BR 18 - Terena	MGS 3 - Brilhante
Market class	Bread	Bread	Bread
Plant stature	Mean	Mean	Mean
Cycle (Maturation)	118	108	109
Reaction to pre-harvest sprouting	MS	S	S
Reaction to lodging	MR	S	MR
Reaction to bacterial blight	MS	MS	MR
Reaction to leaf blast	MS	MS	S
Reaction to powdery mildew	MS	S	S
Reaction to leaf rust	S	APR	S
Reaction to wheat head blight	S	S	S

R = Resistant; MR = Moderately resistant; MS = Moderately susceptible; S = Susceptible; APR = Adult Plan Resistance

the cultivar obtained the highest mean grain yield (4840 kg ha<sup>-1</sup>), equivalent to the performance of excellent crops in southern Brazil, where rainfall is not limited. When evaluating the consolidation of all VCU trials in which the cultivar was tested from 2012 to 2014, the mean grain yield was 3941 kg ha<sup>-1</sup>, exceeding the mean of the two controls by 21% (Table 1).

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## SEED PRODUCTION AND DISTRIBUTION

BRS 404 is registered by the Ministry of Agriculture, Livestock and Supply (MAPA) under number 32772. Embrapa Wheat is responsible for the genetic seed and Embrapa Products and Market (SPM) for the basic seed of the cultivar.

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