



CULTIVAR RELEASE

BRS 328 – Double haploid bread wheat cultivar

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Abstract – The wheat cultivar ‘BRS 328’ was developed by Embrapa from a cross between KleinH3394 and PF 990744. The pre-harvest sprouting resistance of ‘BRS 328’ is good and the grain yield high. It is classified as bread wheat cultivar in all regions where it is recommended for cultivation.

Key words: *Triticum aestivum*, crop breeding.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is an autogamous species with worldwide adaptation and highly significant for the Brazilian agriculture. Brazil currently consumes around 11 million tons of wheat a year, exceeding by far the national production of the cereal, which reached 4.3 million tons in 2012 (Conab 2013).

The breeding program of Embrapa Trigo aims to supply the production chain of this cereal with cultivars that are competitive in agronomic terms and suitably qualified for the different segments of the milling industry. ‘BRS 328’ is a cultivar released in partnership with the Foundation for Pro-Seeds Research Support, a partner institution in the experimentation process, marketing and distribution of this Embrapa Trigo cultivar. ‘BRS 328’ represents a significant advance in terms of stability of the baking quality, associated with resistance to pre-harvest sprouting. It is characterized by the incorporation of Argentine germplasm quality in Brazilian wheat and selection for high-molecular-weight glutenin to accelerate the development of the line.

BREEDING METHOD

‘BRS 328’ was derived from cross F68675, made in the winter of 2000 in a greenhouse of Embrapa Trigo, Passo Fundo, RS. The parents were the Argentine wheats “Klein H 3394 s 3110” and line PF 990744, also a descendant of backcrossing with Argentine wheat. In 2001, the F₁ generation was multiplied in a greenhouse in Passo Fundo, RS. In 2002,

it was planted in the “Collection of special DHMs (Double-Haploid with maize)”. A cob was emasculated and pollinated with maize pollen. The resulting embryo was transferred to an adequate growth medium in the laboratory, leading to a seedling that originated F₁_{DH} (F68675-Z-20407-A). The F₁ generation, DH20407-A, generated three spikes that were planted in the winter of 2003; one of them gave rise to line PF 023186-C=A. In winter 2004, PF 023186-C=A was sown in an experimental field of Embrapa Trigo and participated in the collection of new double haploid wheat lines, with medium size and early maturity. In every generation, after threshing the selected plots, the seeds were visually selected. In this way, PF 023186-C=A was found to be outstanding in grain filling and separated for testing.

PERFORMANCE CHARACTERISTICS

In 2005, the line PF 023186-C=A was evaluated in 19 Preliminary Test lines of Embrapa. For standing out in the Preliminary Test Network (EPR) in 2006, the line was promoted to VCU (Value for Cultivation and Use) tests in 2007, in which it participated in 2007, 2008 and 2010. All tests were conducted in a randomized block design with three treated replications (fungicide and insecticide application to the aerial plant part) and one replication without treatment. The treated replications were considered for calculation of yield and the untreated replication to assess the genotypes responses to diseases at each location. Each experimental unit, consisting of one genotype, was sown in 5 rows of 5 m, spaced 0.2 m apart, with a total area of 5m². All cultural

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practices were performed according to the technical information (Comissão Brasileira de Pesquisa de Trigo e Triticale 2010). At pre-sowing the seeds of the trials were treated with triadimenol + imidacloprid. The trials were carried out 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 Rio Grande do Sul, the tests were conducted in Vacaria (lat 28° 30' 44" S, long 50° 55' 59" W and alt 971 m asl - Oxisol), Passo Fundo (lat 28° 15' 46" S, long 52° 24' 00" W and alt 687 m asl - Oxisol), São Borja (lat 28° 39' 38" S, long 56° 14' 24" W and alt 74 m asl - Oxisol), Três de Maio (lat 27° 46' 24" S, long 54° 14' 24" W and alt 344 m asl - Oxisol) and Victor Graeff (lat 28° 15' 46" S, long 52° 44' 54" W and alt 411 m asl - Oxisol); in Santa Catarina in the counties Abelardo Luz (lat 26° 33' 53" S, long 52° 21' 00" W and alt 771 m asl - Oxisol), Campos Novos (lat 27° 24' 06" S, long 51° 13' 30" W and alt 947 m asl - Oxisol), Canoinhas (lat 26° 10' 38" S, long 50° 24' 00" W and alt 765 m asl - Oxisol) and Chapecó (lat 27° 05' 47" S, long 52° 58' 59" W and alt 670 m asl - Oxisol); in the state of Paraná in Guarapuava (lat 25° 25' 36" S, long 51° 27' 00"

W and alt 1030 m asl - Oxisol).

In 2007, 2008 and 2010, cultivar BRS 328 was compared with the controls BRS 208 and BRS Guamirim (based on the relative percentage of grain yield), using the closest qualitative identity as comparison parameter. In the consolidated performance, the relative grain yield percentage of BRS 328 was 101% (2007) 98% (2008) and 101% (2010), compared with the average of the two controls considered each year, and with performance equivalent to the mean of the controls used in the three test years (Table 1). The highest average grain yield of the variety was 5,254 kg ha⁻¹ in 2008, while the overall average was 4,695 kg ha⁻¹

‘BRS 328’ is an early maturing cultivar (132 days on average in Passo Fundo), moderately resistant/resistant to pre-harvest sprouting, moderately resistant to frost in the vegetative phase and to natural grain shattering and moderately susceptible to bacterial blight. In terms of biotic stresses, the cultivar is moderately resistant to powdery mildew (*Blumeria graminis*) and spot blotch (*Bipolaris sorokiniana*) and moderately susceptible to yellow spot, BYDV (Barley yellow dwarf virus), WMV (wheat mosaic virus) and lodging. The reaction to head blight (*Fusarium*

Table 1. Mean grain yield (kg ha⁻¹) of BRS 328 and average of the two best controls in 2007, 2008 and 2010

Genotype	2007		2008		2010		Mean	
	(kg ha ⁻¹)	(%) ¹	(kg ha ⁻¹)	(%) ¹	(kg ha ⁻¹)	(%) ¹	(kg ha ⁻¹)	(%) ¹
Evaluation locations	8		9		10		27	
BRS 328	3.947	101	5.254	98	4.885	101	4.695	100
BRS Guamirim	3.999	102	5.638	106	4.793	99	4.810	102
BRS 208	3.856	98	5.035	94	4.854	101	4.581	98
CM ²	3.927	100	5.336	100	4.823	100	4.695	100

¹ % = Percentage in relation to the mean of the two best controls

² CM - Mean of the controls BRS Guamirim and BRS 208. Evaluation locations in 2007: Passo Fundo/RS (2 seasons), São Borja/RS, Três de Maio/RS, Vacaria/RS, Chapecó/RS, Campos Novos/SC and Guarapuava/PR, evaluation locations in 2008: Passo Fundo/RS (2 seasons), São Borja/RS (2 seasons), Três de Maio/RS (2 seasons), Vacaria/RS, Chapecó/SC and Campos Novos/SC, evaluation locations in 2009: Passo Fundo/RS (2 seasons), São Borja/RS (2 seasons), three from Maio/RS (2 seasons), Vacaria/RS, Victor Graeff/RS, Abelardo Luz/SC and Canoinhas/SC.

Table 2. Description of the main agronomic characteristics of wheat cultivar BRS 328 in comparison with the controls BRS Guamirim and BRS 208

Agronomic traits	BRS 328	BRS Guamirim	BRS 208
Plant height/stature	medium	low	Medium/high
Cycle (heading)	early	Super- early	intermediate
Cycle (Maturation)	early	Super- early	intermediate
Reaction to pre-harvest sprouting	MR	MS	S
Reaction to lodging	MS	MR	S/MS
Reaction to acidity	MS	MR	R
Reaction to powdery mildew	MR	S	MR
Reaction to leaf rust	S ¹ and MR ²	MR/MS	MR
Reaction to wheat head blight	S	MR	MS
Reaction to BYDV	MS	S	MR
Reaction to WMV	MS	MS	MR

BYDV = Barley Yellow Dwarf Virus; WMV = Wheat Mosaic Virus; R = Resistant; MR = Moderately resistant; MS = Moderately susceptible; S = susceptible

¹ Races B₄₀¹, B₅₁¹, B₅₂¹, B₅₄¹, B₅₅¹, B₅₆¹, B₅₇¹, B₅₈¹, and B₅₉¹ (in seedling phase)

² adult phase.

Table 3. Characteristics of milling quality of cultivar BRS 328 in the wheat adaptation regions 1 and 2

Characteristic	Mean of region 1 ¹	Mean of region 2 ²	Overall mean
Samples	15	13	28
Mean FN	345	289	319
Mean W	279	313	295
Mean L*	92.1	91.2	91.6
Mean b	9.5	9.1	9.4
Tenacity (P)	100	120	110
Extensibility (L)	88	73	81
Mean P/L	1.2	1.7	1.4
Mean EI	51.6	54.1	52.7

Samples = number of samples in each region; FN= Falling number (s); W = Gluten strength ($\times 10^{-4}$ Joules); L* = Luminosity (Minolta) – “0” = black and “100” = white; b = Color b (Minolta) – “+” = yellow and “-” = blue; P = tenacity or maximum rupture pressure; L= extensibility or mean of rupture absciss (mm); P/L = tenacity/extensibility ratio; EI = Elasticity index in percentage

¹ Locais representantes da Region 1 - Passo Fundo/RS, Vacaria/RS, Victor Graeff/RS, Campos Novos/SC, Canoinhas/SC and Guarapuava/PR

² Representative locations of Region 2 - São Borja/RS, Três de Maio/RS, Chapecó/SC and Abelardo Luz.

graminearum) is susceptible. For leaf rust (*Puccinia triticina*), the response to the races B40, B51, B52, B54, B55, B56, B57, B58 and B59 was classified as susceptible in tests in a controlled environment (growth chamber). A summary of the agronomic characteristics of cultivar BRS 328 compared with the controls Guamirim BRS 208 and BRS is shown in Table 2.

Cultivar BRS 328 (line PF 023186C=A) was preliminarily classified as Bread Wheat ($W \geq 220 \times 10^{-4}$ or EST $J \geq 10$ min and $NQ \geq 220$ s), according to Instruction No. 38, 30/11/2010 (Table 3). Of the samples analyzed between 2006 and 2010, in the laboratory of grain quality of Embrapa Trigo, the average value of gluten strength (W) was 295×10^{-4} J and elasticity index (Ie) was 52.7% in 28 samples originated from VCU test locations. For the Region of Adaptation (RA) 1, a mean value of 279×10^{-4} J was found in 15 samples from the states of RS, SC and PR, resulting in a preliminary classification of bread wheat. For RA 2, the average W was 313×10^{-4} J, in 13 samples from RS and

SC, classified as described for RA 1.

The main morphological descriptors of BRS 328 are colorless auricles, and fusiform, awned spikes that are light colored when mature. The grain is predominantly elongated and red. The cultivar ‘BRS 328’ was recommended for cultivation in the regions of wheat adaptation 1 and 2 states of Rio Grande do Sul and Santa Catarina, and region 1 of the State of Paraná

BASIC SEED PRODUCTION

BRS 328 is registered and protected by the Ministry of Agriculture, Livestock and Supply under numbers 28231 and 20,120,159, respectively. Embrapa Trigo is responsible for the genetic seed of the cultivar, the Serviço de Negócios Tecnológicos da Embrapa (SNT) in charge of the basic seed and the member institutions of the Foundation for Pro-Seed Research Support, in partnership with Embrapa, responsible for the certified seed.

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