

BRS Ártico - Common bean cultivar with export-standard white grain

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Abstract: *BRS Ártico* is a common bean cultivar with white grains with international standard size (62 g per 100 seeds), appropriate for cultivation in the Central region of Brazil and the state of Paraná. The cycle is semi-early, the yield potential 2677 kg ha⁻¹ and *BRS Ártico* has moderate resistance to rust and curtobacterium wilt.

Key words: *Phaseolus vulgaris*, international market, special grains.

INTRODUCTION

Brazil is one of the world's largest producers of common bean (*Phaseolus vulgaris* L.) and a traditional staple food of Brazilians, being consumed across all social classes. However, for lower-income groups, it is the main source of protein, minerals, vitamins, and fiber. The total output of common bean in Brazil was 2.5 million tons in 2013 (Feijão 2014). The market groups carioca and black have Mesoamerican origin and represent 85% of the Brazilian production. However, there is a demand for other grain types with higher added value and possibility of export (Del Peloso and Melo 2005). Among the market groups of major international interest is the white grain group of Andean origin, with 100-grain weight between 55 and 65 g, which is sold and consumed in Europe, Asia and the United States (Gonzales et al. 2009). Historically, in Brazil little effort has been invested into breeding programs of Andean common bean, especially for grain types of the international market, including the white grain type. As a result, few cultivars are available, resulting in low domestic production and high imports of this grain type into the country. Currently, some breeding programs have been working on this kind of grain, with a view to develop and identify lines with better adaptation to the soil and climatic conditions of the country (Gonçalves et al. 2010, Pereira et al. 2014).

The release of new cultivars has contributed to increase the common bean yield in Brazil (Feijão 2014). Therefore, the search for new lines with superior phenotypes must be maintained constantly. The common bean breeding program of Embrapa Rice and Beans is focused on the search for varieties with high yield potential, better disease resistance and upright plant architecture, to enable

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direct mechanical harvesting, so that farmers can offer a high quality product to consumers and obtain higher yields with this crop. In this sense, new cultivars with other grain types than carioca and black have been released in the past years, e.g.: BRSMG Realce (Melo et al. 2014), with red speckled grains; BRS Embaixador (Aidar et al. 2008a), with DRK (dark red kidney) grains; BRS Executivo (Aidar et al. 2008b), with sugar bean grain; and BRSMG União (Ramalho et al. 2012), with jalo (yellow) grains. However, for the white group, only two cultivars are registered, with smaller grain size than required for the international market: Ouro Branco (Chagas et al. 1994), indicated by Epamig/UFV; and IPR Garça, indicated by IAPAR.

BREEDING METHODS

BRS Ártico was derived from a cross {(G13922 x G13145) x {(G13922 x [G07930 x (A156 x A494)]}}, performed in 1985 at CIAT (International Center for Tropical Agriculture, Cali, Colombia). The following generations and lines were also grown in Colombia. The line WAF 75 was introduced and evaluated in the field in Brazil, between 2000 and 2010, for plant architecture, lodging, yield, reaction to angular leaf spot, anthracnose, fusarium wilt, rust, common bacterial blight, curtobacterium wilt, and for commercial quality of grains. In 2000 and 2001, the line was evaluated in the winter season at three locations in a total of 13 tests in the State of Goiás. In 2007, 2008, 2009 and 2010, it was also evaluated in the winter, in Goiás and Minas Gerais and in the rainy and dry seasons in Paraná, totaling 31 evaluation environments. In all 44 tests, four controls were used: Ouro Branco, with white beans, BRS Radiante, with red speckled grains; BRS Executivo, with sugar bean grain; and Jalo Precoce, with jalo grain. The experiments were arranged in a randomized block design with three replications and plots of four 4-m rows, using recommended technologies for the different common bean cropping systems.

GRAIN YIELD AND YIELD POTENTIAL

In 44 VCU tests conducted in 2000, 2001, 2007, 2008, 2009, and 2010, in the “winter” growing season in Goiás and Minas Gerais and in the “rainy” and “dry” seasons in Paraná, a yield of 92.1% was observed for BRS Ártico (WAF 75), compared to the mean of the controls (Ouro Branco and BRS Executivo/BRS Radiante/Jalo Precoce) (Table 1). These controls were chosen for being cultivars with Andean origin with “large” grain and suited for export, although not belonging to the same market group as BRS Ártico. This procedure was adopted because there were no other cultivars with the same grain pattern as BRS Ártico at the beginning of the VCU tests. BRS Executivo has sugar bean grains. BRS Radiante has red speckled grains and Jalo Precoce, yellow (jalo) grains, typical of the domestic market, which are occasionally exported when the production in countries which traditionally export other grain types is low. Cultivar Ouro Branco was represented in all experiments, as the standard control. As a second control in the experiments we used BRS Radiante, BRS Executivo or Jalo Precoce. It is worth remembering that Jalo Precoce and BRS Radiante are cultivars with grain types that were already improved in long-term breeding programs and consequently have a better agronomic performance.

The overall mean yield of BRS Ártico was 1632 kg ha⁻¹, compared with 1819 kg ha⁻¹ of the controls (Ouro Branco 1870 kg ha⁻¹ and the others 1768 kg ha⁻¹). In the different States and test regions (Pereira et al. 2009), BRS Ártico produced a mean yield of 1847 kg ha⁻¹ in Goiás and 1511 kg ha⁻¹ in Minas Gerais. In region II (Espírito Santo, Rio de Janeiro, Mato Grosso, Goiás, Distrito Federal, Bahia, Tocantins, and Maranhão) (Table 1), the mean yield was 1757 kg ha⁻¹. In the State

Table 1. Grain yield (kg ha⁻¹) of BRS Ártico, compared to the control mean in the tests of Value for Cultivation and Use (VCU), per State and growing season

State	Growing season	BRS Ártico	Ouro Branco	BRS Executivo, BRS Radiante or Jalo Precoce	Control means	Relative yield (%)	Number of environments
PR	Rainy	1,162	1,526	1,627	1,577	73.7	8
PR	Dry	1,634	1,785	1,796	1,790	91.3	6
PR	General	1,364	1,636	1,699	1,668	86.5	14
MG	Winter	1,511	1,668	1,718	1,693	91.7	8
GO	Winter	1,847	2,092	1,831	1,962	95.2	22
RII*	Winter	1,758	1,980	1,801	1,891	93.0	30
Geral	-	1,632	1,870	1,768	1,819	92.1	44

*Region II - ES, RJ, GO, DF, MT, TO, BA and MA.

of Paraná however, the mean yield was 1364 kg ha⁻¹.

The yield potential of BRS Ártico, calculated from the mean of the five tests where this cultivar produced highest yields, was 2,677 kg ha⁻¹. This estimate shows that farming has a high genetic potential and that if the environment is favorable and growing conditions are good, yields can be high. This cultivar has a similar yield as others with large-sized grains (standard for export), such as BRS Executivo and BRS Embaixador.

Based on its performance, BRS Ártico was registered for sowing in the winter in the States of Goiás, Federal District, Mato Grosso, Tocantins, Maranhão, Bahia, Espírito Santo and Rio de Janeiro; and in the rainy and dry seasons in the state of Parana.

OTHER TRAITS

In terms of grain quality, BRS Ártico has uniform grain color and size, a mean 100-grain weight of 62 g, higher than cultivar Ouro Branco (50 g) (Table 2). The mean cooking time of BRS Ártico is 26 min, within the range observed for other grain types. With regard to the protein percentage of BRS Ártico, the mean content (23.5%) is within the standard for common bean.

Under artificial inoculation, BRS Ártico is resistant to the pathotypes 65, 73, 81, 89, and 453 of *Colletotrichum lindemuthianum*, the causal agent of anthracnose. In field tests, it proved moderately resistant to rust and curtobacterium wilt and moderately susceptible to anthracnose and fusarium wilt. However, it was susceptible to angular leaf spot, curtobacterium wilt, common bacterial blight and golden mosaic virus (Table 3).

BRS Ártico is a semi-early maturing cultivar (75-84 days from emergence to physiological maturity), similar to cv. Ouro Branco. The plants are bushy, with determinate growth habit (type I). In terms of plant architecture, BRS Ártico is upright and has good lodging tolerance. However, due to the short plant height, direct mechanical harvesting (harvesting and threshing in a single operation) may not be effective in all cases. The flowers are white and at physiological maturity the pods are green-yellowish. At harvest maturity, the pods are straw yellow and may be slightly reddish. The beans are white, have a full oblong shape, and intermediate gloss.

The advantages of BRS Ártico are the white beans, with export standard and larger grain size (62g 100 seeds⁻¹) than the existing white bean cultivars in Brazil (Ouro Branco and IPR Garça) (50 g 100 seeds⁻¹). This new cultivar will allow Brazilian producers to supply the domestic market with white bean. In addition, the product meets international

Table 2. Grain qualities of common bean cultivar BRS Ártico, compared to the controls Ouro Branco, BRS Radiante, Jalo Precoce, BRS Executivo, and BRS Embaixador

Cultivar	Grain type	Cooking time (min.)	Protein content (%)	100-grain weight (g)
BRS Ártico	White	26	23.5	62
Ouro Branco	White	-	-	50
BRS Radiante	Red speckled	32	22.3	44
Jalo Precoce	Jalo	26	21.8	38
BRS Executivo	Sugar bean	29	24.8	76
BRS Embaixador	Dark red kidney	20	21.4	63

Table 3. Agronomic traits and reaction to diseases of BRS Ártico, compared to the controls Ouro Branco, BRS Embaixador and BRS Executivo

Cultivar	Cycle	PA	AN	CBC	RU	ALS	BCMV	BGMV-	FOP	CUR
BRS Ártico	SE	Upright	MS	S	MR	S	SI	S	MS	MR
Ouro Branco	SE	Upright	MS	S	MR	S	SI	S	SI	SI
BRS Executivo	N	Semi-upright	MS	S	S	S	S	S	MR	MR
BRS Embaixador	SE	Upright	MR	S	S	S	S	S	MR	S

M100- 100-grain weight (g); PA- Plant architecture; A- Anthracnose; CBC- common bacterial blight; RU Rust; ALS - angular leaf spot; BCMV-Bean common mosaic virus; BGMV- bean golden mosaic virus; FOP-Fusarium wilt; CUR - Curtobacterium wilt; N-Normal cycle; SE-semi-early cycle; R-resistant; MR- moderately resistant; MS-moderately susceptible; S-Susceptible.

standards for the export market, which has increased greatly in recent years, with high price stability and good prospects of economic return.

SEED PRODUCTION

BRS Ártico was registered by the Ministry of Agriculture, Livestock and Supply (MAPA) under number 33731. Embrapa Products and Market is responsible for the seed production of the cultivar.

CONCLUSIONS

The common bean cultivar BRS Ártico with white beans has semi-early cycle, good yield potential and excellent grain quality, meeting the demand of the Brazilian domestic market and also making trade on the international market possible. BRS Ártico is recommended for sowing in the following States and growing seasons: Goiás, Federal District, Mato Grosso, Tocantins, Maranhão, Bahia, Espírito Santo and Rio de Janeiro in the winter; and in Paraná in the rainy and dry seasons.

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