

## CULTIVAR RELEASE

### BRS Esteio - Common bean cultivar with black grain, high yield potential and moderate resistance to anthracnose

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**Abstract** – BRS Esteio is a common bean cultivar with black grains of excellent cooking quality, suited for cultivation in 21 Brazilian States. In 77 trials of Value for Cultivation and Use, the cultivar had a normal cycle (90 days), an average yield of 2,529 kg ha<sup>-1</sup>, which is 8.1% higher than that of the control cultivars, a high yield potential (4,702 kg ha<sup>-1</sup>), upright growth, tolerance to lodging, and moderate resistance to anthracnose.

**Key words:** Phaseolus vulgaris, upright growth, lodging tolerance.

#### INTRODUCTION

Brazil is the largest producer of common bean, the protein staple in the Brazilian diet. Among the different common bean types in Brazil, the black grain accounts for about 20% of the total production (Del Peloso and Melo 2005), corresponding to approximately 430,000 tons per year (Feijão 2013). This output is insufficient to meet the domestic consumption demand, requiring annual imports of about 100,000 tons. The demand is greatest in the states of Paraná, Santa Catarina, Rio Grande do Sul, Rio de Janeiro, and Espírito Santo, although this grain type is consumed in other States as well.

The release of new cultivars has contributed to the increase in common bean yields in Brazil, with increases from 749 kg ha<sup>-1</sup> in 1997 to 1,354 kg ha<sup>-1</sup> in 2011 (Feijão 2013). Therefore, the search for new lines with superior phenotypes must continue. The common bean breeding program

of Embrapa Rice and Beans is focused on the search for cultivars with high yield potential, better disease resistance and upright plant architecture, enabling direct mechanical harvesting, so farmers can sell a better quality product and increase returns from the crop. With these objectives, some new cultivars with black grain were released in recent years, e.g., BRS 7762 Supremo (Costa et al. 2006) with excellent plant architecture; BRS Campeiro (Carneiro et al. 2004) with a semi-early cycle; and BRS Esplendor (Costa et al. 2011) with upright growth and multiple disease resistance.

#### BREEDING METHODS

BRS Esteio was derived from a cross between the lines FT85-113/POT 51, made in 1992 at Embrapa Arroz e Feijão, in Santo Antônio de Goiás. In 1993, the F<sub>2</sub> generation was sown in the field in the dry growing season. In the rainy season of 1993, the F<sub>3</sub> generation was sown and selected for anthracnose, rust and bacterial blight resistance. In 1994,

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the F<sub>4</sub> generation was sown in the rainy season and mass selection was applied for anthracnose resistance. In 1995, the F<sub>5</sub> generation was subjected to mass selection again for anthracnose resistance in the winter. In the F<sub>6</sub> generation, mass selection was focused on resistance to anthracnose, bacterial blight and rust, in the rainy season of 1995. In 1996, the F<sub>7</sub> generation was sown in winter/1996 and line LM 96201083 was selected by individual plant selection.

From this stage, this line was evaluated in trials with replications, in which evaluations were conducted for grain yield and other relevant traits, e.g., disease response, plant architecture etc. (Melo 2009). In 2001, this line was tested in the Preliminary Carioca Test in a Federer design with augmented blocks, in which plots consisted of two 4-m rows, along with 111 other lines and four controls, at seven sites: Santo Antônio de Goiás (GO) Seropédica (RJ), Ponta Grossa (PR), Lavras (MG), Passo Fundo (RS), Londrina (PR), and Pelotas (RS).

In 2003, the line was assessed in an Intermediate Test with 26 other lines and five controls, in randomized blocks with three replications and plots with four 4-m rows, in seven environments: Santo Antônio de Goiás (GO) in the winter, Ponta Grossa (PR) in the rainy and dry seasons, Lavras (MG) in the winter, Sete Lagoas (MG) in the dry growing season, Simão Dias (SE) in the rainy season and Seropédica (RJ) in the winter. Based on the combined data analysis of grain yield and other agronomic traits, the line LM 96201083, temporarily named CNFP 10104, was promoted to the Test of Value for Cultivation and Use (VCU).

In 2004, seeds were produced for the installation of VCU trials. In the years 2005, 2006, 2008, 2009 and 2010, the line CNFP 10104 was evaluated in 77 trials with several controls (BRS Valente, BRS 7762 Supremo, BRS Esplendor, BRS Campeiro, and IPR Uirapuru), in a randomized block design with four replications and four 4-m rows, using the recommended technologies for the respective environments and farming systems.

## GRAIN YIELD AND YIELD POTENTIAL

In the years 2005, 2006, 2008, 2009, and 2010, 77 VCU trials were conducted: in the states of Mato Grosso and Rio de Janeiro in the winter, in Sergipe, Alagoas, Pernambuco, Bahia, Espírito Santo, and São Paulo in the rainy season, in Mato Grosso and Mato Grosso do Sul in the winter and dry growing seasons, in Santa Catarina, Paraná and Rio Grande do Sul in the rainy and dry seasons, and in Goiás and Distrito Federal in the rainy, dry and winter growing seasons. In these tests, the grain yield of BRS Esteio (CNFP 10104) was 8.1% higher than the average of the controls (BRS Valente, BRS 7762 Supremo, BRS Esplendor, BRS Campeiro, and IPR Uirapuru) (Table 1).

The mean productivity of BRS Esteio was 2,529 kg ha<sup>-1</sup>, compared to 2,324 kg ha<sup>-1</sup> of the controls. Two controls were always used for comparison, which were BRS Valente and IPR Uirapuru in most cases. Considering the data for each region of recommendation (Pereira et al. 2010), the yield of BRS Esteio was 10% higher than of the controls in the rainy and dry season in Region I (Rio Grande do Sul, Santa Catarina, Paraná, São Paulo, and Mato Grosso do Sul), and was 20.2% higher in the winter in Region II (Espírito Santo, Rio de Janeiro, Mato Grosso, Goiás, Distrito Federal, Bahia, Tocantins, and Maranhão) (Table 1). In general, BRS Esteio had 14.1% higher yields than the control average in Region I, 5.5% in region II and 1.7% in region III (Alagoas, Sergipe, Pernambuco, Rio Grande do Norte, Ceará, Paraíba, and Piauí). It is noteworthy that the rainy season in this region corresponds to a different period of the year (sowing from April to June), than the rainy season in the states of the south, southeast and midwest (sowing from September to December).

The mean yield potential of BRS Esteio, based on the average of the five highest-yielding trials of this cultivar, was 4,702 kg ha<sup>-1</sup>. This estimate shows that the cultivar has a high genetic potential and that high yields can be achieved if the environment is favorable and growing conditions are good.

**Table 1.** Grain yield of BRS Esteio compared with the average of two controls in trials of Value for Cultivation and Use, per region and sowing time, from 2005 a 2010

| Region | Growing season | BRS Esteio (kg ha <sup>-1</sup> ) | Control mean (kg ha <sup>-1</sup> ) | Relative yield (%) | Number of environments |
|--------|----------------|-----------------------------------|-------------------------------------|--------------------|------------------------|
| I      | Rainy          | 2,901                             | 2,539                               | 115.8              | 17                     |
|        | Dry            | 2,049                             | 1,830                               | 111.5              | 12                     |
|        | Overall        | 2,548                             | 2,246                               | 114.0              | 29                     |
| II     | Rainy          | 2,368                             | 2,473                               | 93.4               | 10                     |
|        | Dry            | 1,771                             | 1,895                               | 96.6               | 5                      |
|        | Winter         | 3,307                             | 2,827                               | 120.2              | 15                     |
|        | Overall        | 2,668                             | 2,518                               | 105.5              | 31                     |
| III    | Rainy          | 2,113                             | 2,043                               | 101.7              | 17                     |
| Geral  | -              | 2,529                             | 2,324                               | 108.1              | 77                     |

Region I: RS, SC, PR, MS and SP; Region II: ES, RJ, GO, DF, MT, TO, BA and MA; Region III: SE, AL, PE, PB, CE, RN, and PB.

Based on its performance, BRS Esteio was recommended for: the rainy, dry and winter growing seasons in Goiás, the Federal District, Mato Grosso, Tocantins, Maranhão, Bahia, Espírito Santo, and Rio de Janeiro; the dry and rainy seasons in Mato Grosso do Sul, Paraná, Santa Catarina, São Paulo, and Rio Grande do Sul; and for the rainy season in Sergipe, Alagoas, Pernambuco, Rio Grande do Norte, Piauí, Ceará, and Paraíba.

## OTHER FEATURES

The technological and industrial traits of grain quality of BRS Esteio are a regular color and grain size and an average 100-grain weight of 24 g, which is similar to cultivar IPR Uirapuru (Table 2), higher than BRS Esplendor (21 g) (Costa et al. 2011) and BRS 7762 Supremo (23 g) (Costa et al. 2006), and lower than BRS Campeiro (25 g) (Carneiro et al. 2004). The average cooking time of BRS Esteio is 29 min, slightly longer than of the controls (on average 26 and 27 min). In terms of protein content, the average percentage of BRS Esteio was slightly lower, 20.3%, compared to 22.9% of the controls.

Under artificial inoculation, BRS Esteio is resistant to bean common mosaic virus and to the pathotypes 65, 81, 89 and 453 of *Colletotrichum lindemuthianum*, the causal agent of anthracnose. In the field trials it was moderately resistant to rust and anthracnose, being resistant in most trials, and moderately susceptible to Fusarium wilt. However, the cultivar was susceptible to angular leaf spot, bacterial blight and bean golden mosaic virus (Table 3).

BRS Esteio has a normal cycle (85-94 days from emergence to physiological maturity), similar to BRS Esplendor and IPR Uirapuru, and superior to the cycle of BRS Campeiro, which is semi-early, with a 74 to 85 day cycle. The

**Table 2.** Characteristics of the common bean cultivar BRS Esteio compared to the controls BRS Esplendor and BRS Supremo

| Cultivar         | Cooking time (minutes) | Protein content (%) | 100-grain weight (g) |
|------------------|------------------------|---------------------|----------------------|
| BRS Esteio       | 29                     | 20.3                | 24                   |
| BRS Esplendor    | 27                     | 22.7                | 21                   |
| BRS 7762 Supremo | 26                     | 23.2                | 23                   |

**Table 3.** Agronomic traits and disease reaction of BRS Esteio compared to the controls with black grain, BRS Esplendor and BRS Supremo

| Cultivar         | Cycle | M100 | ARQ     | AN | CBC | RU | ALS | BCMV | BYMV | FOP | CUR |
|------------------|-------|------|---------|----|-----|----|-----|------|------|-----|-----|
| BRS Esteio       | N     | 24   | Upright | MR | S   | MR | S   | R    | S    | MS  | S   |
| BRS Esplendor    | N     | 21   | Upright | MS | MR  | MR | S   | R    | S    | MR  | S   |
| BRS 7762 Supremo | N     | 23   | Upright | MS | S   | MR | S   | R    | S    | S   | S   |

M100- 100-grain mass (grams); ARQ- plant architecture; AN- Anthracnose; CBC- common bacterial blight, RU- Rust, ALS- Angular leaf spot; BCMV- Bean common mosaic virus; BYMV- bean yellow mosaic virus; FOP- fusarium wilt; CUR- bacterial wilt; N- Normal cycle; R- resistant; MR- Moderately resistant; MS- Moderately susceptible; S- susceptible.

plants are bushy, with indeterminate growth habit Type II. The plant architecture of BRS Esteio is upright and lodging resistance is good, being adapted to mechanical harvesting, including direct harvesting. The flowers are purple and the pods purplish at physiological maturity. However at harvest maturity, the pods are sandy yellow and purplish. The bean grains are black, with nearly full elliptical shape, and opaque.

BRS Esteio has an excellent yield potential, is resistant to bean common mosaic virus and moderately resistant to anthracnose. This cultivar has advantages over the other black-grain cultivars indicated previously, with a higher mean yield and yield potential in relation to BRS Valente, BRS 7762 Supremo, BRS Esplendor, and IPR Uirapuru, which also have a normal cycle (85-94 days). The resistance to anthracnose of BRS Esteio is also better than that of BRS 7762 Supremo and BRS Campeiro.

## SEED PRODUCTION

BRS Esteio was registered (no. 28755) and protected (no. 20120225) by the Ministry of Agriculture, Livestock and Supply (MAPA). The Embrapa Technology Transfer is in charge of the basic seed production.

## CONCLUSIONS

The common bean cultivar BRS Esteio with black beans has a normal cycle, high yield potential, yield stability, grain with excellent cooking properties, and moderate anthracnose resistance.

BRS Esteio is suitable for sowing in the following states and growing seasons: rainy, dry and winter in the states of Goiás, the Federal District, Mato Grosso, Tocantins, Maranhão, Bahia, Espírito Santo, and Rio de Janeiro; rainy and dry in Mato Grosso do Sul, Paraná, Santa Catarina, São Paulo, and Rio Grande do Sul, and rainy in Sergipe, Alagoas, Pernambuco, Rio Grande do Norte, Piauí, Ceará, and Paraíba.

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## REFERENCES

- Carneiro JES, Faria LC, Pereira PAA, Del Peloso MJ, Rava CA, Costa JGC, Carneiro GES, Soares DM, Díaz, JLC, Melo LC, Mesquita AN, Faria JC, Silva HT, Sartorato A, Bassinello PZ and Zimmermann FJP (2004) 'BRS Campeiro': new black bean cultivar for the South of Brazil. **Crop Breeding and Applied Biotechnology** 4: 258-260.
- Costa JGC, Faria LC, Rava CA, Del Peloso MJ, Melo LC, Díaz JLC, Faria JC, Silva HT, Sartorato A, Bassinello PZ and Zimmermann FJP (2006) BRS 7762 Supremo: a black common bean cultivar with erect plant type recommended for the central west and south Brazil. **Crop Breeding and Applied Biotechnology** 6: 182-184.
- Costa JGC, Melo LC, Pereira HS, Del Peloso MJ, Faria LC, Díaz JLC, Wendland A and Rava CA (2011) BRS Esplendor: Common bean cultivar with black grain, upright growth and disease resistance. **Crop Breeding and Applied Biotechnology** 11: 276-279.
- Del Peloso MJ and Melo LC (2005) **Potencial de rendimento da cultura do feijoeiro comum**. Embrapa Arroz e Feijão, Santo Antônio de Goiás, 131p.
- Feijão (2013) Dados conjunturais do feijão (área, produção e rendimento) - Brasil - 1985 a 2011. Available at <<http://www.cnpaf.embrapa.br/apps/socioeconomia/index.htm>> Accessed Jan 7, 2013.
- Melo LC (2009) **Procedimentos para condução de ensaios de valor de cultivo e uso em feijoeiro-comum**. Embrapa Arroz e Feijão, Santo Antônio de Goiás, 104p. (Embrapa Arroz e Feijão, Série Documentos, 239).
- Pereira HS, Melo LC, Silva SC, Del Peloso MJ, Faria LC, Costa JGC, Magaldi MCS and Wendland A (2010) **Regionalização de áreas produtoras de feijão comum para recomendação de cultivares no Brasil**. Embrapa Arroz e Feijão, Santo Antônio de Goiás, 6p. (Embrapa Arroz e Feijão, Comunicado técnico, 187).