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SHORT COMMUNICATION

'RS Gaúcho': new black bean cultivar with high productivity

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Abstract - RS Gaúcho is a common black bean cultivar (*Phaseolus vulgaris* L.) from the commercial group, characterized by an average 1,000-seed weight of 186 g, an upright plant structure, and an indeterminate growth habit classified as type II/III. It has a 90-day growth cycle and achieves an average yield of 2,308 kg ha^{-1}. Grain yield evaluations were conducted across 16 VCU trials using a randomized block design. Each trial included three replications and plots with four rows, each 4.0 m long, with 0.5 m spacing between rows. The development of the RS Gaúcho cultivar supports principles of agricultural sustainability, as it demonstrates productivity levels that exceed the average performance of existing cultivars. This cultivar adapts well to diverse production systems in the State of Rio Grande do Sul, thriving in both the regular (1st harvest) and late (2nd harvest) growing seasons. It is suitable for rainfed or irrigated cropping systems, direct seeding or conventional planting methods, and can be cultivated in monoculture or intercropping systems.

Keywords *Phaseolus vulgaris* L. Plant improvement. Productivity.

'RS Gaúcho': nova cultivar de feijão preto com alta produtividade

Resumo - Gaúcho é uma cultivar de feijão preto comum (*Phaseolus vulgaris* L.) caracterizada por um peso médio de 1.000 sementes de 186 g, uma estrutura de planta ereta e um hábito de crescimento indeterminado classificado como tipo II/III. Tem um ciclo de crescimento de 90 dias e atinge uma produtividade média de 2.308 kg ha^{-1}. As avaliações de produtividade de grãos foram conduzidas em 16 ensaios VCU usando um delineamento de blocos casualizados. Cada ensaio incluiu três repetições e parcelas com quatro linhas, cada uma com 4,0 m de comprimento, com espaçamento de 0,5 m entre linhas. O desenvolvimento da cultivar RS Gaúcho apoia os princípios da sustentabilidade agrícola, pois demonstra níveis de produtividade que excedem o desempenho médio das cultivares existentes. Esta cultivar adapta-se bem a diversos sistemas de produção no Estado do Rio Grande do Sul, prosperando tanto na estação regular (1ª colheita) quanto na tardia (2ª colheita). É adequado para sistemas de cultivo irrigados ou de sequeiro, semeadura direta ou métodos de plantio convencionais, e pode ser cultivado em sistemas de monocultura ou consórcio.

Palavras-chave: *Phaseolus vulgaris* L. Melhoramento vegetal. Produtividade.

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The common bean is one of the most important cultivated legumes in the world, representing the third most used as food globally, surpassed only by soybeans (*Glycine max*) and peanuts (*Arachis hypogaea*) (Broughton *et al*., 2003; Myers; Kmiecik, 2017; Pitura; Arntfield, 2019). In addition to its economic importance, its sociocultural importance stands out, as it is present daily in the diet of the Brazilian population. Brazil is the world's largest consumer of common beans (CONAB, 2020), with an annual production fluctuating close to three million tons (IBGE, 2022).

In the context of global agriculture, the development of cultivars with improved energy efficiency and superior agronomic traits is crucial. While higher yield remains a key goal, certain genetic materials may offer other essential characteristics, such as enhanced nutritional quality, resilience to abiotic and biotic stresses, and distinct organoleptic properties. Accordingly, genetic improvement strategies should emphasize energy efficiency in cultivar development. Even when yield levels do not increase, more energy-efficient plants are advantageous, as they achieve comparable yields with reduced energy input, promoting more sustainable production systems.

In this sense, the bean genetic improvement program of the State Center for Diagnosis and Research on Family Farming (CEAFA) linked to the Department of Agricultural Diagnosis and Research (DDPA) of the State Department of Agriculture, Livestock, Sustainable Production and Irrigation (SEAPI) of Rio Grande do Sul State, Brazil, prioritizes traits associated with reduced energy costs, such as improved productivity, enhanced efficiency in biological nitrogen fixation (BNF), tolerance to drought and high temperatures, reduced cooking time, and decreased reliance on chemical inputs, among others. In 2022, SEAPI registered a new bean cultivar, RS Centenário, aligning with the target ideotype. Subsequently, in 2023, the cultivar RS Gaúcho, belonging to the commercially significant black bean group, was registered. This group is the most widely consumed in Rio Grande do Sul State, Brazil.

The development of the RS Gaúcho cultivar aligns with sustainable agriculture principles, demonstrating superior productivity and enhanced tolerance to diseases like anthracnose and rust compared to commercial cultivars. This contributes to reduced input requirements in production and promotes its adaptability to various environments and cultivation systems. Furthermore, new and different bean cultivars should be made available to farmers and consumers to enhance genetic and dietary diversity. The RS Gaúcho cultivar presents a promising cultivation option for farmers, characterized by its desirable black grain color, high yield potential, and upright growth habit, which facilitates harvesting.

The RS Gaúcho cultivar (MAF 1312 line), registered under RNC number 51405 (MAPA, 2023a), was developed at CEAFA in Maquiné, RS, Brazil. It originated from the 2007 BR Ipagro 44 (Guapo Brilhante) cultivar, selected for traits such as opaque grain color and increased pod density (MAPA, 1998a), In the 2008/09 season, progeny segregation was observed, and plants with desirable agronomic traits were selected *en masse*. Mass selection continued in the 2009/10 and 2010/11 seasons. By the 2011/12 season, phenotypic uniformity was confirmed, and the progeny was harvested. All selection processes were conducted during the regular growing season, locally known as the '1st harvest'.

The two central rows were harvested for yield data, and subjected to analysis of variance. Control cultivars included Pérola (MAPA, 1998b), FEPAGRO 26 (MAPA, 2005), FEPAGRO Triunfo (MAPA, 2013a), and FEPAGRO Garapiá (MAPA, 2013b). Only trials

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with an experimental coefficient of variation less than 25% or an F value exceeding the tabulated F value at a 5% probability level were considered, with results presented in Table 1.

Table 1. Grain yield of the RS Gaúcho cultivar compared to four control cultivars, in VCU trials conducted across 17 environments (site × year) over two growing seasons.

Location	Season	Year	MAF1312 (RS Gaúcho) (kg ha^{-1})	Average yield of control cultivars (kg ha^{-1})
Maquiné	2nd harvest	2014	2,879	3,104
Júlio de Castilhos	2nd harvest	2014	1,985	1,646
Veranópolis	2nd harvest	2014	1,860	1,951
Júlio de Castilhos	1st harvest	2014	616	1,006
Veranópolis	1st harvest	2014	1,962	2,243
Vacaria	1st harvest	2014	2,160	1,941
Maquiné	2nd harvest	2016	693	869
Júlio de Castilhos	2nd harvest	2016	2,304	2,408
Veranópolis	1st harvest	2015	3,870	1,274
Veranópolis	2nd harvest	2016	1,933	2,023
São Borja	2nd harvest	2016	2,506	2,539
Maquiné	1st harvest	2017	1,263	2,046
Júlio de Castilhos	1st harvest	2017	3,080	2,848
Júlio de Castilhos	2nd harvest	2018	2,977	3,024
Veranópolis	1st harvest	2017	3,625	3,250
Vacaria	1st harvest	2017	3,221	2,638
Average 1st harvest			2,475	2,156
Average 2nd harvest			2,142	2,203
Overall average			2,308	2,179

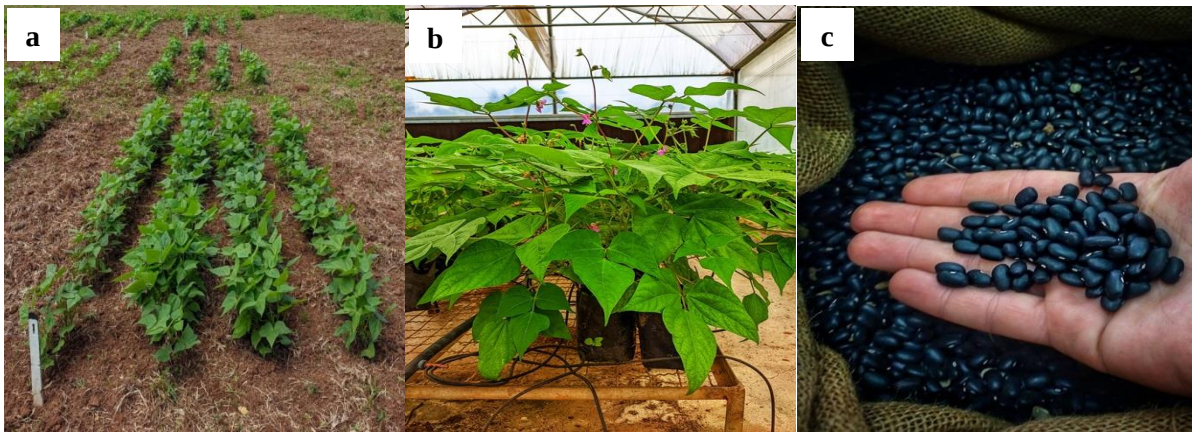

Figure 1. 'RS Gaúcho' bean plants in the field (a); close-up view of an isolated plant (b) seeds of the 'RS Gaúcho' bean cultivar. (c).

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After five years of evaluation in VCU trials, adhering to MAPA standards, the RS Gaúcho cultivar (line MAF 1312) within the black grain group demonstrated an average yield of 2,308 kg ha^{-1}. This outperformed the control cultivars from the black and carioca groups, which averaged 2,179 kg ha^{-1} (Table 1). Furthermore, the RS Gaúcho cultivar demonstrated a yield potential exceeding 3,000 kg ha^{-1}, in specific evaluated regions and conditions (Table 1). The average grain productivity presented by the RS Gaúcho cultivar was significantly higher than the national (1,090 kg ha^{-1} – IBGE, 2022) and state (1,380 kg ha^{-1} – IBGE, 2022) averages exceeding them by 111.7% and 67.2%, respectively, and by approximately 6% relative to the average of highly productive commercial controls.

The common bean cultivar RS Gaúcho (Fig. 1a, 1b, and 1c) features purple flowers, produces black grains of the commercial group with an erect growth habit, exhibits an indeterminate growth type (II/III), and has a 90-day cycle from emergence to harvest. Its grains have a cooking time of 27 minutes, a protein content of 17.25%, a thousand-seed weight of 186 g, and an average yield of 2,308 kg ha^{-1}.

The cultivation of the RS Gaúcho bean variety is recommended for various cropping systems established by official research for bean farming in Rio Grande do Sul, Brazil. It is suitable for both regular (1st harvest) and late (2nd harvest) growing seasons, under rainfed or irrigated conditions, and can be grown using either direct seeding or conventional planting methods, in monoculture or intercropping systems. Cultivation should adhere to the guidelines provided by official research on bean production in Rio Grande do Sul and must comply with the Agricultural Zoning of Climate Risk (ZARC) established by the Brazilian Ministry of Agriculture and Livestock (MAPA, 2023b).

Conflict of Interests

The authors declare that the research was conducted in the absence of any potential conflicts of interest.

Ethical Statements

The authors confirm that the ethical guidelines adopted by the journal were followed by this work, and all authors agree with the submission, content and transfer of the publication rights of the article to the journal. They also declare that the work has not been previously published nor is it being considered for publication in another journal.

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