CULTIVAR RELEASE

Agronomic performance and beverage quality of the arabica coffee cultivar MGS Catucaí Pioneira

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Abstract: *The MGS Catucaí Pioneira cultivar stands out for its yield, rust resistance, and beverage quality. Evaluated over four harvest seasons in ten municipalities of southern Minas Gerais, it demonstrated excellent agronomic performance and a sensory profile with floral and sweet notes, making it suitable for both mechanized and non-mechanized production systems.*

Keywords: Coffea arabica, Hemileia vastatrix*, yield, regional adaptation*

INTRODUCTION

Coffee leaf rust (*Hemileia vastatrix*) remains one of the main threats to the sustainability of Brazilian coffee farming, especially in mountainous regions where chemical control is limited. The disease can reduce yields by 35% to 50%, directly impacting growers' profitability and increasing production costs and environmental burdens due to heavy fungicide use (Zambolim and Caixeta 2021, Lima et al. 2025). Despite advances in cultivar development, the Brazilian coffee sector is still dominated by susceptible cultivars, particularly those from the Catuaí and Mundo Novo groups (Zambolim et al. 2024).

This scenario is particularly challenging in southern Minas Gerais, a region responsible for approximately 20% of Brazil's *Coffea arabica* production, where a significant portion of farms is located on steep terrain that hinders mechanization (Volsi et al. 2019). In such environments, rust-resistant cultivars offer the most efficient and sustainable solution for disease management, providing greater yield stability with reduced reliance on chemical inputs.

In response to these challenges, the Minas Gerais State Research System (EPAMIG, UFLA, UFV, and Embrapa Café), in partnership with Fundação Procafé, developed the MGS Catucaí Pioneira cultivar. Originating from a natural cross between Icatu Vermelho and Catuaí - initially observed in experiments conducted by the former Instituto Brasileiro do Café (IBC) - this cultivar was selected for its strong vegetative vigor, rust resistance, and superior performance under diverse growing conditions. Its development addresses the increasing demand for cultivars that combine high yield, beverage quality, and agronomic sustainability.

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This study presents the agronomic and qualitative performance of the MGS Catucaí Pioneira cultivar, based on four consecutive harvests (2019 to 2022) in demonstration plots established across ten municipalities in southern Minas Gerais. The dataset includes yield, beverage sensory quality, and physical bean traits, with comparisons to nine other commercial cultivars, including the widely grown Catuaí Vermelho IAC 99. In addition to performance data, the manuscript provides the historical background of the cultivar, its key morphological and agronomic characteristics, as well as recommendations for planting, spacing, and crop management. The results underscore the potential of MGS Catucaí Pioneira as a reliable alternative to support the advancement of coffee production in the region.

BREEDING HISTORY

The development of the Catucaí group cultivars began with the identification of a natural F_1 hybrid in Londrina, Paraná State, in 1982, where a short-statured plant was selected within a plot of Icatu Vermelho, a cultivar that is typically tall. This unusual plant suggested that a natural cross had occurred between Icatu and Catuaí cultivars. Seeds from this selection were then used to obtain the F_2 population, which was subsequently advanced in a field experiment conducted by the former Instituto Brasileiro do Café (IBC) in São José do Vale do Rio Preto, Rio de Janeiro State.

The F_3 progenies derived from this selection were planted and further selected at the Experimental Farm in Varginha, Minas Gerais (MG), under the responsibility of the Ministry of Agriculture and the Fundação Procafé. From that point onward, using the pedigree selection method, the subsequent generations were evaluated in different municipalities: Varginha, Elói Mendes, Manhuaçu, Coromandel, Patrocínio, and Santo Antônio do Amparo (MG); Vitória da Conquista (Bahia); and Marechal Floriano (Espírito Santo), with the objective of identifying productive, vigorous, and rust-resistant plants.

Seeds from the F_3 population were brought by IBC researchers to Fazenda Terra Roxa, located in Santo Antônio do Amparo (MG). There, approximately 2,000 F_4 segregating plants were evaluated, and seeds were collected from about 30 selected F_4 individuals. These F_5 seeds were used in the coffee nursery of the Federal University of Lavras (UFLA) to produce seedlings, which were planted later in 1995 at the Coffee Sector of UFLA. The F_5 plants were arranged in an experimental design and evaluated over four consecutive harvests.

In the first harvest, carried out in 1998, seeds from selected F_5 plants (F_6 seeds) were taken to the EPAMIG Experimental Farm in São Sebastião do Paraíso (MG), where a new experiment with 25 F_6 progenies was established under a dense planting system. In 2002, following the first harvest, new selections were made, resulting in another trial that was planted in 2005 in the same field, with individualized lines (50 holes per selected F_6 plant, generating F_7 progenies).

As plant height variation persisted across nearly all F_7 lines, a new selection was performed in the first harvest of this trial. Two promising F_7 plants were selected and used to establish two additional experiments in 2007 at the EPAMIG Experimental Farms in Três Pontas and São Sebastião do Paraíso, corresponding to F_8 progenies. Among the evaluated F_8 plants, two individuals from progeny H 6-47-10-CV3 stood out for their superior agronomic performance. These were used to establish an observation field, whose F_9 seeds were later used to create multiplication plots in the F_8 generation and to implement trials on private farms in partnership with the Cooxupé cooperative.

To validate the cultivar's performance under different growing conditions, demonstration plots were implemented in ten municipalities across the southern Minas Gerais region. In these trials, the cultivar was compared to Catuaí Vermelho IAC 99 (as a productivity benchmark) and Bourbon Amarelo IAC J10 (as a sensory quality benchmark). After six years of evaluation, based on four consecutive harvests (2019 to 2022), progeny H 6-47-10-CV3 - later officially registered as 'MGS Catucaí Pioneira' - demonstrated high productivity and excellent adaptation to the edaphoclimatic conditions and cultivation systems of the region. The cultivar is therefore confidently recommended for adoption in the municipalities of southern Minas Gerais.

METHODOLOGY

To evaluate the agronomic performance, sensory quality, and physical bean traits of the MGS Catucaí Pioneira cultivar, demonstration plots were established in ten municipalities across southern Minas Gerais (Table 1) between December 2016 and January 2017. Each plot consisted of approximately 200 coffee plants, arranged without a formal

Table 1. Characteristics of the Demonstration Plots for the MGS Catucaí Pioneira cultivar in municipalities of southern Minas Gerais: altitude, geographic location, spacing, planting density, mean air temperature mean, and annual precipitation

Municipalities	**Altitude** (m)	**Latitude**	**Longitude**	**Spacing** (m)	**Planting density** (plants ha^{-1})	**Mean air temperature** (°C)[1]	**Mean annual precipitation** (mm)[1]
Alpinópolis	1100	20°57'51.3"S	46°27'38.2"W	3.3 x 0.7	4329	21.7	89.2
Botelhos	1030	21°37'40.4"S	46°23'00.2"W	3.0 x 0.8	4167	18.9	117.4
Cabo Verde	1050	21°25'51.3"S	46°21'34.1"W	3.3 x 0.7	4329	18.9	117.4
Campestre	1165	21°43'28.2"S	46°13'53.6"W	3.7 x 0.7	3861	19.7	121.5
Campos Gerais	780	21°11'21.6"S	45°53'40.6"W	3.5 x 0.8	3571	21.4	119.0
Conceição da Aparecida	910	21°05'52.2"S	46°14'15.1"W	3.5 x 0.6	4761	21.3	135.1
Monte Belo	920	21°22'0.49"S	46°20'08.0"W	3.5 x 0.8	3571	21.7	102.5
Muzambinho	1106	21°22'30.2"S	46°28'17.7"W	3.5 x 0.7	4081	20	112.6
Nova Resende	1170	21°05'42.4"S	46°27'12.1"W	3.5 x 0.7	4081	20.1	132.9
São Pedro da União	1104	21°09'46.2"S	46°35'42.9"W	3.5 x 0.8	3571	20.1	132.9

[1] Note: Basic data on mean air temperature and total precipitation were obtained from the Sismet Cooxupé system for the period of the experiment (January 2017 to September 2022). For the municipality of Botelhos, the same climatic conditions as those recorded in Cabo Verde were considered. Likewise, climatic conditions from Carmo do Rio Claro were adopted for Conceição da Aparecida, those from Alfenas for Monte Belo, those from Guaxupé for Muzambinho, and those from São Pedro da União for Nova Resende.

experimental design, thus characterizing a multi-environment trial without replication. Crop management practices followed the standards adopted by each producer.

Field data were collected over four harvests (2019–2022), expressed in 60-kg bags of green coffee per hectare. For yield analysis, the biennia 2019/2020 and 2021/2022 were treated as replications. Based on the partial results of the first biennium, five cultivars with the highest yield potential were selected, together with the control Bourbon Amarelo IAC J10, and evaluated in the 2020 and 2021 harvests in six representative environments (Alpinópolis, Cabo Verde, Campestre, Campos Gerais, Conceição da Aparecida, and Muzambinho, MG; Table 2) to assess sensory profile and physical bean quality, including granulometry (screen distribution according to MAPA Normative Instruction Nº 8/2003), visual appearance of the hulled beans (uniformity, color, and presence of silverskin, evaluated on a 1–5 scale), following Nadaleti et al. (2018), and cup quality.

For sensory analysis, only fully ripe (cherry-stage) fruits were harvested and subjected to natural processing, with slow and uniform drying carried out to preserve quality. This analysis followed the Specialty Coffee Association (SCA) protocol, using a 0–100-point scale. The data were subjected to analysis of variance (ANOVA) using the statistical software Sisvar version 5.6. When significant differences were detected by the F test ($p < 0.05$), the means were clustered using the Scott–Knott test.

AGRONOMIC PERFORMANCE AND SENSORY QUALITY

The MGS Catucaí Pioneira cultivar achieved an average yield of 32.64 bags ha^{-1} across the four evaluated harvests (Table 2), outperforming both the overall mean of all cultivars (29.07 bags ha^{-1}) and the regional average yield for the same period (26.83 bags ha^{-1}) (CONAB 2022). It ranked among the top three most productive cultivars in seven out of ten municipalities, alongside MGS Ametista and MGS Paraíso 2, demonstrating wide adaptability to the diverse edaphoclimatic conditions of southern Minas Gerais.

In terms of bean size distribution, MGS Catucaí Pioneira exhibited 77.6% of beans retained on screen size 16 and above (Table 2), slightly above the overall mean of the evaluated cultivars (76.2%). This proportion is particularly relevant, since a high percentage of large beans is a key requirement for premium markets, ensuring greater uniformity during roasting and enhancing consumer acceptance. Notably, its performance was similar to that of Bourbon Amarelo IAC J10 and MGS Ametista, two cultivars traditionally recognized for their favorable bean size distribution.

The percentage of peaberries (moca beans) in MGS Catucaí Pioneira was 11.0%, closely matching the overall mean (11.7%) and confirming a balanced fruit development pattern. This value is comparable to Bourbon Amarelo IAC J10 and MGS Ametista, and lower than Catiguá MG2 and MGS Paraíso 2 (both with 14.8%). A lower occurrence of peaberries

Table 2. Average yield (four harvests, 2019–2022) and physical grain characteristics (two harvests, 2020–2021) of coffee cultivars evaluated in southern Minas Gerais

Cultivar	**Yield** (bags ha^{-1})	**Large screen** (% ≥ 16)	**Peaberry** (%)	**Green bean appearance**
MGS Catucaí Pioneira	32.63 a	77.6 a	11.0 a	3.5 b
MGS Paraiso 2	31.34 a	78.4 a	14.8 b	3.6 b
MGS Ametista	31.27 a	78.9 a	11.2 a	4.4 a
MGS Aranãs	30.33 a	80.0 a	10.5 a	4.3 a
MGS Catiguá 3	29.46 a	-	-	-
Catiguá MG2	29.34 a	65.5 b	14.8 b	3.6 b
Catuaí Vermelho IAC 99	27.39 a	-	-	-
Pau Brasil MG1	27.21 b	-	-	-
Paraiso MG H419-1	22.63 b	-	-	-
Bourbon Amarelo IAC J10	-	76.6 a	11.2 a	3.7 b
CV	10.3	7.97	23.05	16.62
Overall Mean	29.07	76.2	11.7	3.8

Different letters in the same column indicate statistically significant differences among cultivars (Scott-Knott test, p<0,05).

is advantageous for maintaining uniformity in roasting and beverage quality, while still offering a niche product valued in certain specialty markets.

Regarding green bean appearance, MGS Catucaí Pioneira received an average score of 3.5 (Table 2), classifying it as medium visual quality. Although slightly lower than MGS Ametista (4.4) and MGS Aranãs (4.3), its appearance was comparable to Catiguá MG2 and Bourbon Amarelo IAC J10. The beans were predominantly green with a slight presence of adhered silverskin (espermoderma). These characteristics indicate that while the cultivar delivers satisfactory visual standards for commercialization, post-harvest practices could further enhance its presentation.

Sensory analysis reinforced the commercial potential of MGS Catucaí Pioneira, with scores consistently ranging from 82.0 to 84.7 across the six evaluated environments (Table 3), qualifying as specialty coffee under international standards. This evaluation revealed important contrasts between MGS Catucaí Pioneira and the benchmark cultivars Bourbon Amarelo IAC J10, Catiguá MG2, and MGS Paraíso 2, all of which are traditionally recognized for their cup quality (Voltolini et al. 2025). Bourbon Amarelo IAC J10 and Catiguá MG2 consistently reached the highest scores, with averages generally above 83.5 points across locations. MGS Paraíso 2 also exhibited outstanding performance, reaching 86.9 points in Campestre - the highest score observed among all cultivars - and maintaining values above 83 points in most environments.

When compared to these references, MGS Catucaí Pioneira achieved slightly lower but still competitive scores, ranging from 82.0 to 84.7 points. While its averages were statistically inferior to those of Bourbon Amarelo IAC J10, Catiguá MG2, and MGS Paraíso 2 in several environments, it consistently remained above the specialty threshold (≥82 points). Notably, in Muzambinho, MGS Catucai Pioneira achieved 84.7 points, statistically equivalent to the top-performing cultivars, demonstrating its potential to deliver high-quality beverages under favorable conditions.

The sensory profile of MGS Catucaí Pioneira was characterized by sweetness, fruity notes, and predominant floral aromas, attributes highly valued in the specialty coffee sector. When analyzed in conjunction with its favorable bean

Table 3. Average sensory scores of coffee quality in cultivars evaluated across six growing environments: Alpinópolis (AP), Cabo Verde (CV), Campestre (CM), Campos Gerais (CG), Conceição da Aparecida (CA), and Muzambinho (MZ)

Cultivars	**AP**	**CV**	**CM**	**CG**	**CA**	**MZ**
Bourbon Amarelo IAC J10	83.2 aA	84.5 aA	83.5 cA	83.9 aA	82.8 aA	84.5 aA
Catiguá MG2	84.2 aA	84.3 aA	85.3 bA	84.1 aA	84.0 aA	83.6 aA
MGS Catucaí Pioneira	82.0 aB	82.4 aB	82.9 cB	82.3 bB	83.2 aB	84.7 aA
MGS Paraíso 2	82.5 aC	83.9 aB	86.9 aA	82.3 bC	84.1 aB	84.4 aB

Different lowercase letters in the same column indicate significant differences among cultivars within each location, while uppercase letters in the same row indicate significant differences of the same cultivar across locations (Scott–Knott test, p < 0.05).

size and competitive yield performance, these traits underscore the cultivar's potential to supply both the specialty and commercial markets.

AGRONOMIC TRAITS

The agronomic traits of the MGS Catucaí Pioneira cultivar were evaluated in the F_8 generation. At seven years of age, the plants exhibit a short stature, with an average height of 2.81 meters and an average stem diameter of 6.65 cm. The plant architecture is predominantly conical, with an average canopy diameter of 2.97 meters. The plagiotropic branches have short internodes and a high density of secondary branching, contributing to a well-structured and productive vegetative framework. Young leaves are light green, while mature leaves become dark green and glossy. The fruits turn red when ripe, and the beans are of medium screen size.

The cultivar presents vertical resistance to coffee leaf rust (*Hemileia vastatrix*), providing effective protection against the currently predominant pathogen races (Lima et al. 2025). However, this resistance may be overcome if new physiological races of the pathogen emerge, highlighting the need for continuous field monitoring.

PLANTING RECOMMENDATIONS

The ideal planting spacing for MGS Catucaí Pioneira should consider factors such as plant stature, terrain topography, altitude, sun exposure, and the degree of mechanization used on the farm. For this cultivar, which has medium height and good adaptability to the conditions of southern Minas Gerais, a spacing of 0.6 to 0.7 meters between plants is recommended. The row spacing should be adjusted according to the machinery available on the property.

In mechanized farming systems, it is advisable to maintain a plant population greater than 4,500 plants per hectare, which ensures better operational efficiency, good airflow between plants, and optimal use of agricultural machinery. In manually managed systems, a minimum stand of 6,000 plants per hectare is recommended. In such cases, higher planting density enhances productivity per area, promotes soil coverage, and improves water and nutrient use efficiency. However, it also requires more intensive management, with more frequent pruning and sucker removal to maintain proper plant architecture and ensure long-term productivity. This planting flexibility allows MGS Catucaí Pioneira to be efficiently cultivated in both mechanized systems and smallholder farms in mountainous areas.

SEED MAINTENANCE AND DISTRIBUTION

The MGS Catucaí Pioneira cultivar is registered with the National Cultivar Registry (Registro Nacional de Cultivares – RNC) of the Brazilian Ministry of Agriculture and Livestock (Ministério da Agricultura, Pecuária e Abastecimento – MAPA) under registration number 52764. EPAMIG is responsible for maintaining the genetic material (seeds) of this cultivar.

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DATA AVAILABILITY

The datasets generated and/or analyzed during the current research are available from the corresponding author upon reasonable request.

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