CULTIVAR RELEASE

Magnus grano: Maximum quality in bean size of conilon coffee

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Abstract: *Cultivar Magnus grano is made up of five genotypes that were selected by coffee growers in the state of Espírito Santo, Brazil. The cultivar shows good adaptation to growing conditions, high yield potential, and the largest beans among the studied genotypes.*

Keywords: Coffea canephora*, conilon, groundEye®*

INTRODUCTION

Every day, thousands of people around the world consume coffee, a beverage that carries different nuances and characteristics. For this reason, the market is constantly seeking new ways to offer it, be it as blends, espressos, or gourmet beverages. In addition, the product is also marketed in ground form or as beans.

Conilon (*Coffea canephora*) has great genetic diversity, which entails the possibility of new opportunities for the cultivation and use of this species. Coffee growing has also undergone constant innovations, with emphasis on management, productivity, sustainability, and quality, as well as consumption, warranting the development of new technologies (Partelli et al. 2019, Partelli et al. 2020).

Brazil stands out on the world stage as the largest coffee producer and Conilon coffee has gained a growing presence in the global market (CONAB 2024). Breeding and improved harvesting and processing techniques have further propelled consumer appreciation of this product as well as its demand on the market (Corrêa et al. 2014). The Embrapa Rondônia has developed ten new cultivars with high yield potential and agronomic characteristics typical of the conilon and robusta botanical varieties (Teixeira et al. 2020).

Conilon coffee still has much ground to gain, as it can provide a differentiated beverage with its own sensory characteristics, rather than being solely used in the making of blends (Cassimiro et al. 2023). To offer a higher-quality product, the set of processes that range from the development and breeding of varieties to management and care with the harvest and post-harvest stages must be observed.

One of the important criteria to guarantee coffee quality is the analysis of grain uniformity, which involves the use of different sieves, colors, shapes and

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types of beans. Sieve classification is an important process to mainly ensure uniformity at the time of roasting, since smaller and larger grains commonly require different roasting times (Oliveira et al. 2014). Thus, separation using sieves have improved the roasting process, improving the quality of the coffee (Baggenstoss et al. 2008, Pereira et al. 2019).

Several procedures have been implemented with the aim of encouraging coffee consumption by different social strata. For Spers et al. (2004), this increasing stimulus for improving the quality of this product has contributed to the emergence of new forms of consumption. According to Peixoto et al. (2022), the consumer bases their choice to purchase and consume a certain product on different criteria and levels of importance. Among these factors, the size of the coffee bean is directly linked to the physical quality sought by consumers who prefer to buy the bean and grind it instead of buying ground coffee. In seeking to serve these consumers, Brazilian producers began to consider producing coffee of superior quality, including bean size.

Beans are the most original form in which coffee is marketed, that is, the beans solely undergo the roasting process before reaching the consumer. Because it is very sensitive to oxygen, coffee oxidizes very quickly, especially when already ground. Thus, when still in the form of beans, it preserves its original flavor and aroma, in addition to having a longer shelf life compared with its ground version.

Therefore, studies on different genotypes, involving competition assays in the field, coupled with diverse plant evaluations and laboratory analyses of beans that enable the development of cultivars with larger beans to offer a final product of higher quality, are of fundamental importance to allow the continuity of the work that has already been done practically by coffee growers. This selection process has shown very promising results.

METHODS

The experiment consists of 42 conilon clones, some of which have already been evaluated numerous times and selected for characteristics other than grain size, as highlighted in Table 1. The coffee crop was planted in April 2014, using 42 genotypes propagated by cuttings, in the municipality of Nova Venécia (lat 18° 39’ 43” S, long 40° 25’ 52” W, alt 200 m asl), ES, Brazil. The region is characterized by a climate classified as Aw, i.e., tropical with dry winters and rainy summers. In general, the average minimum temperature is above 16 °C (July and/or August) and the average maximum temperature is up to 32 °C in January and/or February. Occasionally, there are days with temperatures below 13 °C or above 36 °C.

The experiment was laid out in a randomized block design with three field replications, each of which consisted of seven plants. The spacing used for planting was 3 × 1 m, with each plant occupying 3 m^2. Fertilizer application was performed according to the results of soil analysis. Pruning was carried out to control excessive branches, keeping the standard of 12,000 to 15,000 stems per hectare. In all experimental years, manual weeding, mechanized weeding, and chemical weeding were performed. Nutrients, insecticides, and fungicides were applied throughout the years of study. Irrigation was applied in the experimental area in all years.

To analyze the stability and adaptability of the genetic materials evaluated in this study, yield data corresponding to six harvests (2016, 2017, 2018, 2019, 2020, and 2021) were used. To undertake the characterization of the beans by digital phenotyping, the fruits were pulped manually. Then, the beans (still with the parchment skin) were left to dry in plastic trays until reaching 14 to 15% moisture, which was determined with a DOLE 500 moisture tester. Subsequently, the parchment skin was removed from each of the beans with a scalpel and a utility knife, and the beans were packed in labeled paper bags to be dried in a forced-air oven until reaching 12% moisture (wet basis).

Table 1. Identification of the 42 genotypes of Conilon (*Coffea canephora*)

ID	Name	ID	Name	ID	Name
1	Verdim R	15	Bamburral	29	Tardio C
2	B01	16	Pirata	30	A1
3	Bicudo	17	Peneirão	31	Cheique
4	Alecrim	18	Z39	32	P2
5	700	19	Z35	33	Emcapa 02
6	CH1	20	Z40	34	Emcapa 153
7	Imbigudinho	21	Z29	35	P1
8	AT	22	Z38	36	LB1
9	Graudão HP	23	Z18	37	122
10	Valcir P	24	Z37	38	Verdim D
11	Beira Rio 8	25	Z21	39	Emcapa 143
12	Tardio V	26	Z36	40	Ouro negro 1
13	AP	27	Ouro Negro	41	Ouro negro 2
14	L80	28	18	42	Clementino

Identification (ID); Genotypes 33, 34 and 40 belong to the Emcapa 8131 variety, genotypes 1, 11, 15 and 16 belong to the Tributum variety (Giles et al. 2018) and genotypes 30 and 35 belong to the Andean variety (Martins et al. 2019).

Using the GroundEye® instrument, four replications of 50 beans were evaluated for each treatment (Figure 1). The beans were placed in an acrylic tray to capture the image; then, using the image analysis system, the software generated spreadsheets with the results of the following geometric traits: area (cm²), roundness, maximum diameter, minimum diameter, sphericity, extension, irregularity, number of corners, circumference (cm), among other traits described in Tables 1 to 3. The genotypes selected to compose the Magnus grano cultivar were compared with the other genotypes using Student's t-test ($p \leq 0.05$).

PERFORMANCE TRAITS

Among all the genotypes evaluated in the test, considering traits such as average bean weight, bean area, largest bean diameter, yield, plant architecture, vigor, and resistance to pests and diseases, five superior genotypes (Bicudo, Graudão HP, Ouro Negro, P1, and Peneirão) were selected to constitute the new clonal cultivar, called Magnus grano. The mean of the genotypes of the Magnus grano cultivar was significantly higher than the mean of the other genotypes evaluated for bean weight, bean area, largest diameter, minimum diameter, circumference and yield (Tables 2 and 3). This cultivar showed a mean bean weight of 0.19 g, whereas the other genotypes averaged 0.13 g. Bean area was 0.49 cm² on average, versus 0.37 cm² found in the other genotypes. Largest bean diameter averaged 0.93 cm in cv. Magnus

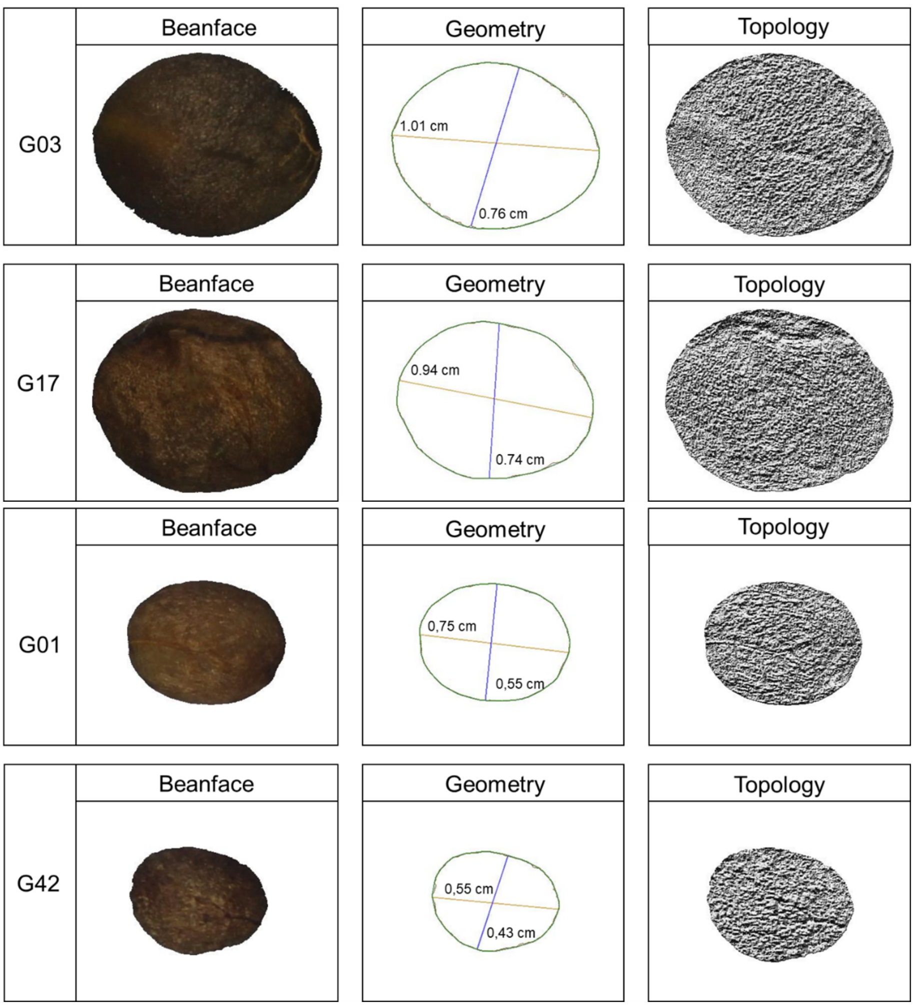

Figure 1. Digital image of coffee berries obtained by GroundEye® equipment of genotypes 03 (Bicudo) and 17 (Peneirão), which have larger berries and which make up the Magnus Grano cultivar, and image of genotypes 01 (Verdim R) and 42 (Clementino), which have smaller berries.

Table 2. Mean values of weight, total area, and largest diameter of flat beans at 12% moisture, accumulated yield in the harvests from 2016 to 2021, and maturation period of the genotypes that make up the cultivar Magnus grano

Genotype	**Bean weight** (g)	**Bean area** (cm^2)	**Largest diameter** (cm)	**Yield** (bags ha^{-1})	**Maturation**
Bicudo	0.17	0.49	0.97	111.8	Medium
Graudão HP	0.17	0.45	0.95	88.2	Medium
Ouro negro	0.21	0.52	0.89	87.6	Medium
P1	0.18	0.48	0.91	98.4	Medium
Peneirão	0.20	0.50	0.91	105.8	Medium
Mean/Cultivar	0.19 a	0.49 a	0.93 a	98.4 a	-
Mean/Others*	0.13 b	0.37 b	0.80 b	85.9 b	-

* Mean of the other genotypes evaluated. Means followed by different letters in the columns differ according to Student's t-test ($p \leq 0.05$).

Table 3. Mean values of minimum diameter (Dmin), sphericity (Sph), extension (Ext), irregularity (Irreg), number of corners (Corn), circumference (Circ), sharpness (Sharp), and roundness (Rou) of flat beans at 12% moisture of the genotypes that make up the cultivar Magnus grano

Genotype	**DMin**	**Sph**	**Ext**	**Irreg**	**Corn**	**Circ**	**Sharp**	**Rou**
	cm				Nº	cm		
Bicudo	0.63	22.0	0.78	0.09	316.2	3.20	0.65	0.66
Graudão HP	0.59	30.4	0.79	0.12	124.6	3.49	0.56	0.64
Ouro Negro	0.72	21.5	0.79	0.09	298.0	3.24	0.68	0.83
P1	0.66	16.9	0.79	0.05	115.1	2.83	0.76	0.73
Peneirão	0.69	26.9	0.78	0.12	259.5	3.53	0.58	0.77
Mean/Cultivar	0.66 a	23.6 a	0.78 a	0.09 a	222.7 a	3.26 a	0.65 a	0.72 a
Mean/Others*	0.58 b	20.8 a	0.79 a	0.08 a	187.7 a	2.71 b	0.69 a	0.75 a

* Mean of the other genotypes evaluated. Means followed by different letters in the columns differ according to Student's t-test ($p \leq 0.05$).

Table 4. Mean values of amount in kg (kg bag^{-1}) and liters (L bag^{-1}) of ripe fruits to obtain a 60-kg bag of processed coffee, ripe weight/dry weight ratio (RW/DW), ripe volume/ripe weight ratio (RV/RW), % of beans relative to the fruit (Beans), and percentages of flat (Flat) and peaberry beans (Peaberry) at 12% moisture of the genotypes that make up the cultivar Magnus grano

Genotype	*** kg bag^{-1}**	*** L bag^{-1}**	*** RW/DW**	*** RV/RW**	*** Beans**	**Flat**	**Peaberry**
	kg	L	Ratio	Ratio	%	%	X
Bicudo	231.2	366.2	3.85	1.58	55.3	58.5	41.6
Graudão HP	206.1	317.6	3.44	1.54	59.5	88.5	11.5
Ouro Negro	224.7	346.4	3.74	1.54	55.3	90.3	9.7
P1	219.7	332.5	3.66	1.51	59.1	62.6	37.4
Peneirão	215.3	326.6	3.59	1.52	57.1	85.7	14.3
Mean/Cultivar	219.4 a	337.9 a	3.66 a	1.54 b	57.3 a	77.1 a	22.9 a
Mean/Others**	223.9 a	348.9 a	3.73 a	1.78 a	57.3 a	84.3 a	16.8 a

* Full data published by Partelli et al. (2021). ** Mean of the other genotypes evaluated. Means followed by different letters in the columns differ according to Student's t-test ($p \leq 0.05$).

Grano, whereas the other genotypes averaged 0.80 cm. The mean yield from the six harvests of the six selected genotypes was 98.4 bags per hectare per year, whereas the other genotypes yielded on average 85.9 bags per hectare per year. Tables 2 to 4 show data on individual genotypes and the means found for the cultivar and the other evaluated genotypes.

To check the existence of genetic variability among the genotypes, the data obtained were subjected to analysis of variance, estimates of genetic parameters, ward-mlm analysis, Pearson correlation. It was found that the genotypic variance was higher than the environmental variance in all analyzed variables, both for grains and fruits, indicating that the evaluated genotypes have high genetic variability. Heritability values above 99.5% were observed for area, maximum grain diameter and minimum grain diameter, characteristics most suitable for selection of large grains (Sousa et al. 2022).

During the six years of evaluation, the genotypes displayed good adaptation to the growing conditions, given their good growth and production performance. There was no severe attack by the main pests and diseases that affect the Conilon coffee plant, and the plants remained vigorous and exhibiting good foliage.

Therefore, the new cultivar possesses desirable traits; above all, high bean weight and large sieve size (which adds value to quality), coupled with high yield potential for the conditions of the north of the state of Espírito Santo, which should lead to high acceptance among coffee growers. As such, it can be cultivated under climatic conditions similar to those under which the genotypes were grown. Thus, the cultivar is recommended for the state of Espírito Santo at altitudes of less than 500 m. It should also be mentioned that several characterizations of fruit and beans were carried out.

CLONE FOR MAINTENANCE AND DISTRIBUTION

Cultivar Magnus grano was registered under no. 52460 by the National Registry of Cultivars (*Registro Nacional de Cultivares*, RNC), by the Brazilian Ministry of Agriculture, Livestock and Food Supply (*Ministério da Agricultura, Pecuária e Abastecimento*). The Federal University of Espírito Santo (UFES) is responsible for maintaining the five genotypes that make up cv. Magnus grano.

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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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