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Agronomic performance of experimental strawberry clones in southern Minas Gerais

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Abstract

In Brazil, there is a great dependence on strawberry seedlings imported from other countries, as demand is higher than national production. This study was developed in order to evaluate the agronomic performance of experimental strawberry clones for the Southern state of Minas Gerais and, thus, expand these plants to new frontiers of production in the state. The research was carried out in a randomized complete block experimental design, with five treatments and four replications, totaling 20 experimental plots and 100 plants. The following variables were evaluated: number of crowns, total number of trifoliates, plant height, total number of fruits, number of commercial fruits, number of non-commercial fruits, total yield, commercial yield, non-commercial yield, average fruit mass, average non-commercial fruit mass, and average commercial fruit mass. The post-harvest analyses were: fruit size, soluble solids content, firmness, and scores for external color, internal color, and fruit shape. The experimental clones show great potential to promote strawberry fruit production in Brazil, for both vegetative and productive parameters. The Pircinque cultivar was superior to the other genotypes in southern Minas Gerais, Inconfidentes municipality. The experimental clones and the Albion cultivar overlap in all months, showing vegetative and productive similarity.

Keywords: *Fragaria ananassa* Duch. Genetic improvement. Productivity.

Introduction

The strawberry (*Fragaria ananassa* Duch.) consumed today is a hybrid resulting from the cross between two species: *Fragaria virginiana* Duchesne, native to eastern North America, and *Fragaria chiloensis* L., native to southern Chile and Argentina. It is a non-climacteric pseudo-fruit, originally from a temperate climate, with characteristics attractive to consumers, such as its bright red color, characteristic odor, soft texture, and flavor, in addition to its high versatility in consumption, which can be eaten fresh/*in natura* or in industrialized form, arousing great commercial interest worldwide (CHU *et al*., 2020; WANG *et al*., 2021; PEREIRA *et al*., 2022).

Strawberry cultivation is a consolidated activity in several regions of Brazil, with a great socioeconomic impact, especially in small areas with family farming. This produce yields approximately 150,000 tons in 4,200 ha, with emphasis on the state of Minas Gerais as the largest producer in the country, corresponding to 60 % of the total produce. Notably, southern Minas Gerais is responsible for 95 % of the state's production, representing an annual production of approximately 120,000 tons. This region stands out in fruit production due to the favorable climate for cultivation, in addition to a strategic location for distributing the product to large commercial centers (ALVES *et al*., 2018; BRANDT *et al*., 2022; NUNES *et al*., 2022).

The choice of cultivars is fundamental for the success of the crop, as their characteristics, when subjected to the local edaphoclimatic conditions, added to the management adopted, will determine the yield and quality of the final product. One of the most significant limiting factors of the crop is associated with its requirements for photoperiod, number of chilling hours, and temperature, factors that vary depending on the genetic material (LIZ *et al*., 2020).

However, Brazilian producers have been suffering due to the lack of national cultivars adapted to the edaphoclimatic conditions, which increases crop production expenses due to the importation of seedlings (GALVÃO *et al*., 2014; VIEIRA *et al*., 2017; SOUZA *et al*., 2021).

Genetic improvement in strawberry cultivation has been carried out to develop new cultivars that are adapted to Brazilian edaphoclimatic conditions, which could expand the cultivation area in the national territory and, consequently, reduce the cost of seedlings, generating more jobs and income for families.

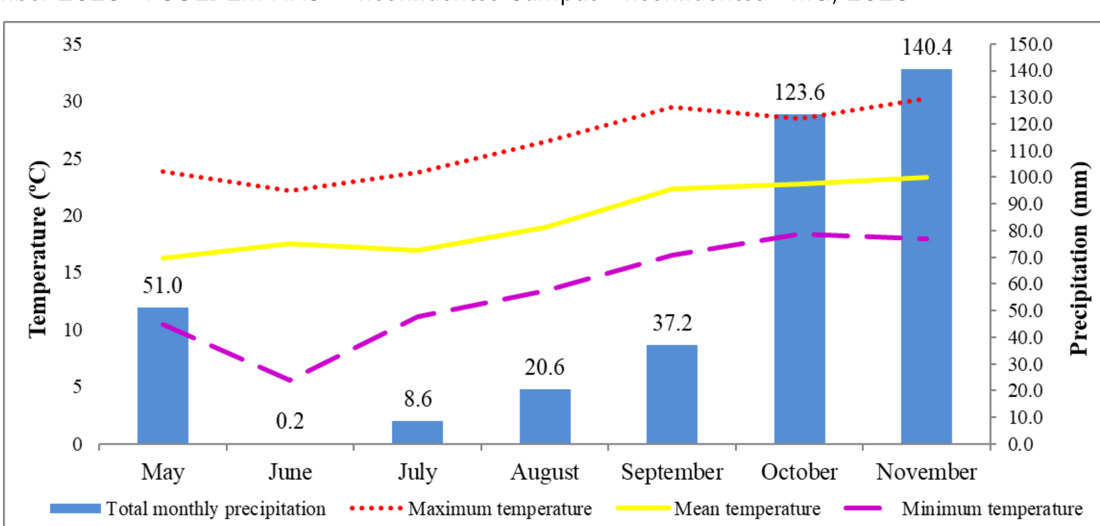
Considering the importance of the fruit for the world and for the country, aiming to increase productivity, the efficiency of what is generated, profitability, and minimize costs and environmental impacts, some institutions have been leading the process of searching for new Brazilian cultivars adapted to the producing regions of the country (NUNES *et al*., 2022).

Therefore, this work was developed to evaluate the agronomic performance of genetic materials with adequate adaptation to the edaphoclimatic conditions of southern Minas Gerais and, thus, expanding these materials to the new production frontiers of the crop in the state.

Material and methods

The experiment was performed at the Federal Institute of Education, Science, and Technology of Southern Minas Gerais (IFSULDEMINAS), Inconfidentes Campus, located in the municipality of Inconfidentes, Minas Gerais, Brazil (22° 19' 01" S, 46°19' 40 W", 869 m above sea level). The climate of the municipality is subtropical highland, with a dry winter and mild summer. The average annual precipitation is 1,724.2 mm, with a mean annual temperature of 18 °C, maximum temperatures of 26.4 °C, and minimum temperatures of 14.3 °C (RODRIGUES, 2023). Data from the location and period of the experiment are presented in Table 1.

Figure 1. Data from the meteorological station of IFSULDEMINAS – Inconfidentes Campus, from June to November 2023. IFSULDEMINAS – Inconfidentes Campus. Inconfidentes - MG, 2023



Source: IFSULDEMINAS, Inconfidentes Campus - MG (2023).

The research, conducted from June to November, 2023, used a randomized block design (RBD), with five treatments and four replications, totaling 20 experimental plots, each with five plants per genotype. The treatments included three experimental clones from the Federal University of Lavras (MCA94, MDA01, and MDA23), and two commercial cultivars, namely Albion and Pircinque. In total, 100 seedlings were used, with 0.15 m between each plant and 0.30 m between blocks.

Seedlings were produced in a greenhouse from stolons of the mother plants of each genotype and transplanted into suspended, semi-hydroponic benches, measuring 0.20 m in depth, 0.20 m in width, and 18 m in length, divided into two 9-meter blocks. The gutters were filled with Biomix® commercial substrate, composed of pine/eucalyptus bark and coconut fiber, with 45 % moisture and a 6.8 pH.

Drip tapes were used for irrigation, always keeping the substrate at field capacity. The plants were irrigated thrice per day, at 9 am, 12 pm, and 4 pm for two minutes per irrigation.

Maintenance fertilizations were performed by fertigation, using potassium nitrate, calcium nitrate, magnesium sulfate (57 g each), 27.5 g of MAP, 4.5 g of Brexil®, and 6.5 g of Ferrilene®, dissolved in 500 L of water. During seedling growth (June to July 2023), the electrical conductivity (EC) was adjusted to 0.5 S/m, increasing to 0.8 S/m with the start of production. Sprays for pest and disease control were carried out as necessary, using products registered for the strawberry crop.

Vegetative growth evaluations began 20 days after transplanting, in June, and were maintained until November 2023. The number of crowns, number of trifoliates, and plant height were evaluated.

Harvests occurred every three days, during afternoon, considering fruits with 75 % red coloration. The total, commercial, and non-commercial number and yield of fruits were evaluated, in addition to the average mass per category. Commercial fruits were those with a mass greater than 10 g. Post-harvest assessments included fruit size (transverse diameter [TD] and longitudinal diameter [LD], measured with a digital caliper), soluble solids content (°Brix, measured with a digital refractometer), and firmness (N, measured with a penetrometer). The characteristics of external color, internal color, and shape were evaluated following UPOV (2012). Only intact fruits, without deformations and with a mass ≥ 10 g, were analyzed.

Statistical analyses were performed in Sisvar® (FERREIRA, 2011) with analysis of variance in a split-plot randomized block design, comparing strawberry genotypes (plots) and months (subplots). The means were grouped by the Scott and Knott (1974) test, at 5 % significance. Non-parametric data were analyzed by the Kruskal-Wallis test, using the Real Statistics software (ZAOINT, 2024).

Results and discussion

Results of vegetative growth evaluations, including the number of crowns, total number of trifoliate leaves, and plant height are presented in Table 1. Regarding number of crowns, differences among genotypes were observed starting in September, with the fewer crowns recorded for MDA23 (1.50 crowns/plant). In October, the cultivar Pircinque stood out with 1.85 crowns/plant; and in November, Pircinque, MDA23, and MCA94 had the highest number of crowns (2.00, 1.84, and 1.86 crowns/plant, respectively), differing from the other genotypes.

As for the number of trifoliate leaves per plant, statistical differences among genotypes were identified (Table 1). The Pircinque cultivar accumulated the highest counts in August, September, October, and November (12.40, 9.65, 11.84, and 15.44, respectively). Over the months of evaluation, the Albion cultivar reached the highest trifoliate counts from August to November, with no significant differences among these months. Meanwhile, the Pircinque cultivar and MDA23 clone showed the highest counts only in November (15.44 and 12.02 trifoliate leaves per plant, respectively). The MDA01 and MCA94 experimental clones had similar results, with the highest counts of trifoliate leaves per plant in August and November (8.20 and 8.30; 8.37 and 9.63, respectively) (Table 1).

No differences regarding plant heigh among genotypes were found in June. In the other months, the Pircinque cultivar stood out as the tallest. Over the evaluation period, all genotypes — except MDA01 — had a progressive increase in height, reaching their peak height in November. Genotype MDA01, however, showed higher values in September (8.03 cm) and the lowest average heights in October (7.16 cm) and November (8.71 cm). Similar results were observed for the Albion, MDA23, and MCA94 genotypes (Table 1).

Table 1. Number of crowns (unit), number of trifoliates (unit), and plant height of the different strawberry genetic materials from June to November 2023. IFSULDEMINAS – Inconfidentes Campus. Inconfidentes - MG, 2024

	Number of crowns (unit)*					
Genetic material	Months					
	June	July	August	September	October	November
Albion	1.00 aB	1.03 aB	1.60 aA	1.72 aA	1.52 bA	1.53 bA
Pircinque	1.00 aC	1.25 aB	1.82 aA	1.80 aA	1.85 aA	2.00 aA
MDA23	1.00 aC	1.10 aC	1.71 aA	1.50 bB	1.53 bB	1.84 aA
MDA01	1.00 aC	1.02 aC	1.60 aA	1.67 aA	1.36 bB	1.50 bB
MCA94	1.00 aC	1.03 aC	1.73 aA	1.90 aA	1.51 bB	1.86 aA
	Number of trifoliates (unit)*					
Genetic material	**Months**					
	June	**July**	**August**	**September**	**October**	**November**
Albion	2.29 aC	5.40 aB	8.40 bA	6.97 bA	8.29 bA	8.30 cA
Pircinque	2.42 aE	6.50 aD	12.40 aB	9.65 aC	11.84 aB	15.44 aA
MDA23	2.44 aE	5.10 aD	8.63 bB	6.50 bC	8.51 bB	12.02 bA
MDA01	1.87 aD	4.32 aC	8.20 bA	6.45 bB	7.05 bB	8.37 cA
MCA94	2.06 aD	4.60 aC	8.30 bA	6.26 bB	7.71 bB	9.63 cA
	Plant height (cm)*					
Genetic material	**Months**					
	June	**July**	**August**	**September**	**October**	**November**
Albion	3.14 aD	5.63 bC	8.45 bB	8.76 bB	8.57 bB	11.01 cA
Pircinque	4.52 aE	7.09 aD	11.41 aC	12.46 aB	12.49 aB	13.48 aA
MDA23	3.03 aD	5.31 bC	8.52 bB	8.23 bB	8.47 bB	11.68 bA
MDA01	3.13 aD	4.76 bC	7.66 bB	8.03 bA	7.16 cB	8.71 dA
MCA94	2.93 aD	4.90 bC	8.23 bB	7.73 bB	9.06 bB	10.36 cA

*Lowercase letters in the same column and uppercase letters in the same rows do not differ from each other by the Scott and Knott (1974) test at 5 % probability.

Source: authors (2024).

The number of crowns is an important indicator of strawberry plant development, as it influences fruit quality, yield, and earliness. A greater number of crowns results in a higher accumulation of reserves (starch), which promotes the production of larger and sweeter fruits. Moreover, crowns are essential for inflorescence differentiation, supporting flowering under appropriate conditions (TORREZ-QUEZADA *et al*., 2015; VALDIVIESSO *et al*., 2019; RANA *et al*., 2023).

Plants with a higher number of leaves have greater photosynthetic capacity, which ensures a better supply of carbohydrates during fruiting. Productivity is influenced by solar radiation interception, cultivar type, time of year, and photoperiod. In day-neutral cultivars, the leaf canopy favors fruiting, whereas in short-day cultivars, under higher temperatures, it can induce stolon development (ROSA *et al*., 2013; COCCO *et al*., 2015).

High temperatures stimulate vegetative growth in strawberry plants, promoting stolon emission and crown development. However, they may delay fruiting by impairing flowering due to changes in biochemical reactions and metabolic balance. This effect is more pronounced in short-day cultivars such as Pircinque. Constant temperatures from 28 to 30 °C inhibit flowering regardless of photoperiod (RESENDE *et al*., 2010; STRASSBURGER *et al*., 2010).

Plant growth follows a cycle with two phases of rapid growth separated by a slower growth phase, and is influenced by genetic and climatic factors, especially temperature and photoperiod, which directly impact growth, flowering, and fruiting. The influence of these factors varies depending on the cultivar and regional conditions (NUNES; NOVELLO, 2021). Vegetative parameters such as photosynthesis, transpiration, and radiation balance directly impact plant development and the allocation of photoassimilates, influencing vegetative growth and the development of new leaves, flowers, and fruits (MORGADO *et al*., 2013; ROSA *et al*., 2013; FARNEZI *et al*., 2023).

The morpho-agronomic evaluation of strawberry genotypes enables the analysis of cultivar performance under specific cultivation conditions, which is essential for crop establishment and for selecting genetic materials better suited to regional production and breeding programs (MORALES *et al*., 2011).

The analyses of total, commercial, and non-commercial fruit counts is presented in Table 2. No significant differences were found among genotypes within each month for total fruit count. The Pircinque cultivar maintained stable production throughout the months, except in August, when it recorded the lowest yield (7.00 fruits/plant). MDA23 and MCA94 clones showed similar patterns, with the highest yields recorded in September and November (MDA23: 24.75 and 19.50 fruits/plant; MCA94: 22.66 and 22.00 fruits/plant). Albion and MDA01 genotypes had no significant differences throughout the evaluated months (Table 2).

For the number of commercial fruits, differences among genotypes were observed only in September, when the Pircinque cultivar achieved the highest average (17.50 fruits/plant). Albion, MDA23, and MDA01 genotypes had similar patterns, with higher production in August and September, whereas MCA94 clone showed no significant variation. This parameter is crucial, as 98 % of strawberries are sold fresh, with a preference for larger and more voluminous fruits (NUNES; NOVELLO, 2021).

For the number of non-commercial fruits, no statistical differences were observed between the genetic materials within each evaluation month. Similarly, the Albion, MDA01, and MCA94 genotypes showed no significant variations over the analyzed months (Table 2). The Pircinque cultivar had the lowest production of non-commercial fruits in August, whereas the experimental clone MDA23 obtained its

Table 2. Total number of fruits (fruits/plant), number of commercial fruits (fruits/plant), and number of non-commercial fruits of the different strawberry genotypes evaluated in the southern Minas Gerais IFSULDEMINAS – Inconfidentes Campus. Inconfidentes - MG, 2024

Total number of fruits (fruits/plant)*				
Genetic material	Months			
	August	September	October	November
Albion	14.00 aA	20.25 aA	6.50 aA	10.0 aA
Pircinque	7.00 aB	32.00 aA	21.25 aA	24.25 aA
MDA23	12.50 aB	24.75 aA	2.25 aB	19.50 aA
MDA01	9.25 aA	21.50 aA	14.25 aA	23.00 aA
MCA94	11.33 aB	22.66 aA	10.66 aB	22.00 aA
Number of commercial fruits (fruits/plant)*				
Genetic material	Months			
	August	September	October	November
Albion	11.50 aA	10.25 bA	0.75 aB	2.50 aB
Pircinque	4.75 aB	17.50 aA	6.00 aB	3.75 aB
MDA23	9.50 aA	11.75 bA	0.75 aB	4.00 aB
MDA01	7.00 aA	9.25 bA	2.75 aB	3.50 aB
MCA94	8.33 aA	9.33 bA	3.33 aA	5.00 aA
Number of non-commercial fruits (fruits/plant)*				
Genetic material	Months			
	August	September	October	November
Albion	2.50 aA	10.00 aA	5.75 aA	15.25 aA
Pircinque	2.25 aB	13.25 aA	15.25 aA	20.25 aA
MDA23	3.00 aB	11.25 aA	1.50 aB	15.50 aA
MDA01	2.25 aA	12.25 aA	11.50 aA	11.75 aA
MCA94	3.00 aA	13.33 aA	7.33 aA	17.00 aA

*Lowercase letters in the same column and uppercase letters in the same rows do not differ from each other by the Scott and Knott (1974) test at 5 % probability.

Source: authors (2024).

highest values in September and November, with averages of 11.25 and 15.50 non-commercial fruits per plant, respectively (Table 2).

Data regarding the total mass (g/plant), commercial mass (g/plant), and non-commercial mass (g/plant) of fruits from different strawberry genotypes evaluated in the southern Minas Gerais are presented in Table 3.

For total fruit mass produced (g/plant), a statistically significant difference among genotypes was observed only in September, when the Pircinque cultivar had the highest yield, with 435.25 g/plant (Table 3). The Albion cultivar stood out in August and September, with 186.50 and 225.50 g/plant yields, respectively. Pircinque and MDA23 showed higher yields in September, with 435.25 and 286.25 g/plant, respectively. MDA01 clone reached higher productivity in September and November, with 224.75 and 165.25 g/plant, respectively. In contrast, MCA94 showed lower performance in October compared to the other months.

Data for the commercial fruit mass produced (g/plant) is also shown in Table 3. Similar results were observed among the Albion, MDA23,

Table 3. Total mass (g/plant), commercial fruit mass (g/plant), and non-commercial fruit mass (g/plant)of different strawberry genotypes evaluated in the southern Minas Gerais. IFSULDEMINAS – Inconfidentes Campus. Inconfidentes - MG, 2024

	Total Mass (g/plant)*			
Genetic material	**Months**			
	August	**September**	**October**	**November**
Albion	186.50 aA	225.50 bA	45.50 aB	72.00 aB
Pircinque	87.75 aC	435.25 aA	176.50 aB	152.25 aB
MDA23	167.50 aB	286.25 bA	19.75 aC	141.50 aB
MDA01	117.25 aB	224.75 bA	103.25 aB	164.25 aA
MCA94	137.66 aA	238.00 bA	76.66 aB	151.66 aA
	Commercial fruit mass (g/plant)*			
Genetic material	**Months**			
	August	**September**	**October**	**November**
Albion	166.00 aA	151.75 bA	8.00 aB	25.75 aB
Pircinque	75.00 aB	317.50 aA	75.50 aB	45.00 aB
MDA23	137.25 aA	185.75 bA	12.25 aB	52.50 aB
MDA01	98.50 aA	129.50 bA	33.75 aB	40.50 aB
MCA94	113.00 aA	140.00 bA	38.33 aB	57.00 aB
	Non-commercial fruit mass (g/plant)*			
Genetic material	**Months**			
	August	**September**	**October**	**November**
Albion	20.50 aA	73.75 aA	37.50 bA	46.25 aA
Pircinque	12.75 aB	117.75 aA	101.00 aA	107.25 aA
MDA23	30.25 aB	100.50 aA	7.50 bB	89.00 aA
MDA01	18.75 aB	95.25 aA	69.50 aA	123.75 aA
MCA94	24.66 aB	98.00 aA	38.33 bB	94.66 aA

Lowercase letters in the same column and uppercase letters in the same rows do not differ from each other by the Scott and Knott (1974) test at 5 % probability.

Source: authors (2024).

MDA01, and MCA94 genotypes, with higher commercial yields in August and September. A significant difference among genotypes was found only in September, when Pircinque reached the highest commercial fruit mass, with 317.50 g/plant.

A statistically significant difference in non-commercial fruit mass was observed only in October, when Pircinque and MDA01 reached the highest values (101.00 and 69.50 g/plant, respectively) (Table 3). The Albion cultivar maintained a stable yield across all months. MDA23 and MCA94 genotypes had higher non-commercial fruit production in September and November (100.50 and 89.00 g/plant for MDA23; 98.00 and 94.66 g/plant for MCA94). Pircinque and MDA01 recorded the lowest values only in August (Table 3).

Table 4 presents the data on average fruit mass, average commercial fruit mass, and average non-commercial fruit mass. Regarding average fruit mass, all genotypes recorded the highest values in August and September, 2023, ranging from 12.00 g/fruit (MDA01 and Pircinque) to 14.00 g/fruit (Albion) in August, and from 10.33 g/fruit (MCA94) to 13.50 g/fruit

(Pircinque) in September. The Albion cultivar had the lowest average fruit mass in October (3.50 g/fruit). A statistically significant difference among cultivars was observed only in October, when Pircinque, MCA94, and MDA23 recorded the highest values, with 8.25, 8.00, and 6.50 g/fruit, respectively.

No statistical difference in average commercial fruit mass was observed among genotypes in any month. Albion, MDA01, and MCA94 produced heavier commercial fruits in August and September, whereas Pircinque recorded the highest average in September (18.21 g/fruit), and MDA23 showed no significant variation (Table 4).

The only significant difference in average non-commercial fruit mass among genotypes was observed in August, when Albion and MCA94 showed the highest values (9.21 and 7.33 g/fruit, respectively). The Albion cultivar also had statistical variation over the months, with higher masses in August (9.21 g/fruit) and September (7.53 g/fruit) (Table 4).

The interaction between the vegetative and reproductive phases of the strawberry plant is influenced by environmental factors and represents a key aspect in selecting genotypes adapted to specific cultivation conditions (FERRÃO *et al.*, 2015). Flowering and fruiting depend on physiological processes and external stimuli, such as temperature and photoperiod, whose influence varies across cultivars. In day-neutral cultivars, temperature and internal factors play a more decisive role than photoperiod (SAMPIETRO *et al.*, 2023).

The results of postharvest fruit analyses are presented in Table 5. The Pircinque genotype stood out from the others in terms of external color, having medium red, while the other genotypes had an orange-red hue. Regarding fruit shape, MCA94 was characterized as reniform, whereas the others were conical. Although the differentiation of shades of red is challenging, this characterization aids defining the use of cultivars (FIGUEIREDO *et al.*, 2010).

The Pircinque cultivar had the largest transverse fruit diameter (38.69 mm), differing significantly from the other genotypes. No significant differences were found for longitudinal diameter or fruit firmness, with averages of 28.50 mm and 1.52 N, respectively (Table 5). All genotypes produced fruits with a transverse diameter above 25 mm, classifying them as Class I based on the Mercosur Technical Regulation No. 85 (1996). This parameter is essential for packaging choice and fruit arrangement during storage, as well as influencing consumer acceptance (SOUZA *et al.*, 2021). Fruit firmness reflects the organization of structural components, influencing suitability for fresh consumption or processing (SANTOS *et al.*, 2015). Maintaining this attribute is essential for handling and transport, as improper handling can lead to postharvest losses ranging from 20 % to 40 % (SOUZA *et al.*, 2017; ALMEIDA *et al.*, 2020).

Pircinque and Albion showed the highest (7.33 °Brix) and lowest (5.44 °Brix) soluble solids content, respectively (Table 5). The values for Pircinque are consistent with the literature, whereas the other genotypes had lower contents than those reported by Nunes *et al.* (2022). Soluble solids content is a maturity indicator that impacts fruit flavor and the time before picking (FARNEZI *et al.*, 2020; FARIAS *et al.*, 2022).

Fruit trait expression is related to levels of plant hormones such as cytokinins, auxins, and betaines, which regulate cell division and expansion, especially in the early stages of development. These hormones influence fruit size, shape, and uniformity, varying by genotype and their adaptation to environmental conditions, ultimately impacting fruit quality and yield (KOBNER, SANTOS, CARVALHO, 2023).

Table 4. Average fruit mass, average commercial fruit mass, and average non-commercial fruit mass, harvested from the different strawberry genetic materials from August to November, 2023. IFSULDEMINAS – Inconfidentes Campus. Inconfidentes - MG, 2024

Genetic material	Months			
	Average fruit mass*			
	August	September	October	November
Albion	14.00 aA	11.00 aA	3.50 bC	7.75 aB
Pircinque	12.00 aA	13.50 aA	8.25 aB	6.50 aB
MDA23	13.00 aA	12.00 aA	6.50 aB	6.75 aB
MDA01	12.00 aA	11.25 aA	5.25 bB	7.75 aB
MCA94	12.33 aA	10.33 aA	8.00 aB	6.66 aB
	Average commercial fruit mass*			
	August	September	October	November
Albion	14.88 aA	14.78 aA	10.50 aB	11.16 aB
Pircinque	15.30 aB	18.21 aA	11.91 aB	11.81 aB
MDA23	14.54 aA	15.23 aA	14.00 aA	12.54 aA
MDA01	13.31 aA	14.47 aA	11.10 aB	11.29 aB
MCA94	13.83 aA	15.05 aA	11.56 aB	11.12 aB
	Average non-commercial fruit mass*			
	August	September	October	November
Albion	9.21 aA	7.53 aA	3.26 aB	4.72 aB
Pircinque	4.02 bA	9.05 aA	6.94 aA	9.05 aA
MDA23	5.60 bA	8.74 aA	3.75 aA	5.68 aA
MDA01	5.25 bA	7.79 aA	4.24 aA	5.83 aA
MCA94	7.33 aA	7.54 aA	5.72 aA	5.38 aA

*Lowercase letters in the same column and uppercase letters in the same rows do not differ from each other by the Scott and Knott (1974) test at 5 % probability.

Source: authors (2024).

Consumers value strawberries with uniform shape, red color, large size, sweetness, and freshness. Fruit shape and color are key attributes for genotype selection, affecting attractiveness, perceived quality, and the ideal time for harvest and sale (TURQUETT *et al.*, 2021; NUNES *et al.*, 2022).

Pircinque stands out for its intense skin coloration, elongated conical shape, and sweet flavor, making it suitable for the commercialization of high-quality fruits (PEREIRA, FLORESTI, GOMES, 2021). Albion produces long conical fruits (GONÇALVES *et al.*, 2016; ANTUNES, REISSER JUNIOR, 2019), whereas the experimental genotypes may have inherited this trait from the Aromas cultivar, which also produces rounded-conical fruits (GONÇALVES *et al.*, 2016). Overall, conical fruits predominated, as also reported by Souza *et al.* (2021).

Strawberry fruit quality is impacted by factors such as environment, genotype-environment interaction, cultivation system, mineral nutrition, and maturation stage (SCHIAVON *et al.*, 2021). Understanding genotype development and genetic relationships is essential for optimizing germplasm use.

Table 5. Postharvest fruit analyses: external color, internal color, fruit shape, transverse diameter – TD (length), longitudinal diameter – LD (width) in millimeters (mm), firmness (Firm) in Newtons (N), and soluble solids (SS) in degrees Brix (°Brix) for commercial fruits of different strawberry genotypes evaluated in southern Minas Gerais. IFSULDEMINAS – Inconfidentes Campus. Inconfidentes - MG, 2024

Genetic material	External color**	Internal color**	Shape**	TD**	LD**	Firm*	SS*
Albion	Orange-red	Orange-red	Conical	32.97 b	27.41 a	1.37 a	5.44 c
Pircinque	Medium red	Medium red	Conical	38.69 a	28.25 a	1.79 a	7.33 a
MDA23	Orange-red	Orange-red	Conical	33.70 b	28.68 a	1.42 a	5.96 b
MDA01	Orange-red	Orange-red	Conical	34.32 b	28.86 a	1.47 a	6.00 b
MCA94	Orange-red	Orange-red	Reniform	34.26 b	29.29 a	1.57 a	5.95 b
Kruskal-Wallis test (p-values)	0.001*	0.031*	0.022*	-	-	-	-

*Means followed by the same letter in the same column do not differ significantly at the 5 % level by the Scott and Knott (1974) test.

**Reference for this characterization: UPOV (2012).

Source: authors (2024).

Conclusions

The experimental clones hold great potential to boost strawberry production in Brazil in both vegetative and productive parameters. The Pircinque cultivar was superior to the other genotypes in the southern Minas Gerais, in the municipality of Inconfidentes. The experimental clones and the Albion cultivar had overlapping results across all months, showing similar vegetative and productive performance.

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