Original Research Article

Agronomic performance of different banana cultivars in the capixaba north region

ABSTRACT

There are many banana cultivars developed by genetic breeding programs in Brazil, however, when considering the related aspects, consumer market preference and the effects of the genotype-by-environment interaction, the options may be restricted to a few regions of the country. Therefore, the objective of this study was to evaluate the vegetative and productive development in three cycles of 12 banana genotypes under an irrigation system in the edaphoclimatic conditions of the northwestern region of the state of Espírito Santo, in a randomized block design with four replicates. During three cycles, the following characteristics were evaluated: plant height, number of shoots, number of total and functional leaves, pseudostalk diameter at 5 and 30 cm from the ground, bunch weight, number of fruits per bunch, number of bunch and size and fruit diameter. The results showed that the genotypes with the greatest productive potential were the 'Grand Nine' of the Cavendish group, followed by Thap Maeo Cavendish group. For the ‘Prata’ group, the best genotypes were the ‘Gali’, ‘Pacovan’ and ‘Fhia 18’. The ‘Princesa’ was the most productive in the ‘Maçã’ group, having a cultivation potential in the northern region of Espírito Santo.

Keywords: Musa sp., Genotype-by-environment interaction, Family agriculture, Characteristics

1. INTRODUCTION

The banana crop is economically and socially important throughout the world, being cultivated in more than 125 countries. Banana is the most consumed fruit in Brazil and the second most consumed in the world, with a world production of about 106 million tons [1]. Brazil produces approximately 7 million tons, with a 6.9% share of this total, ranking third in the world ranking [2].

It is cultivated in all the states of Brazil with an average productivity of 14.745 thousand kg.ha^{-1} [2]. The State of Espírito Santo occupies the eighth position in the national ranking, and its productivity is around 11,672 kg.ha^{-1}, a value that is below the national production and the main producing states, which can reach up to 20,780 kg.ha^{-1} [3].

Capixaba agriculture is mostly known as a family agriculture, with small and low-tech properties, with fruit growing as an important source of income in the farms, occupying around 17% of agricultural activities [4]. Among the fruit cultivated in the state, banana crop is of great importance because its cultivation generates employment and income to farmers, thus promoting an improvement in their life quality [5]. Present in all regions of the state of Espírito Santo and easily adaptable, banana crop is cultivated in more than 17 thousand farms, mainly family, occupying more than 23 thousand hectares and generating approximately 25 thousand occupations in its productive chain [6]. Despite the importance of banana crop to the state, the average productivity is below the national average, demonstrating a potential for improvements in the cropping systems, such as the recommendation of new, more productive and disease resistant varieties.

According to Roque et. al. [7], the most widespread banana cultivars in Brazil are from the Cavendish, 'Prata' and 'Maçã' subgroups. The bananas of 'Prata', 'Maçã', 'Mysore', 'Terra' and 'D'Angola' subgroup belong to the AAB genomic group and they are used for the domestic market. The bananas of the genomic group AAA, 'Nanica', 'Nanicão' and 'Grande Naine' are mainly used to export and are preferably used in industries. On a smaller scale, other genomic groups are also planted, such as 'Gold' (AA), 'Gray Fig' and 'Red Fig' (ABB). Among these, 'Prata', 'Prata Anã' and 'Pacovan' varieties are responsible for approximately 60% of the planted area with bananas in Brazil [8].

Although there are a large number of banana varieties in Brazil, when considering aspects, such as consumer preference, productivity, disease tolerance, adequate size and resistance to drought and cold, there are few that have agronomic potential for commercial use [5]. In this respect, it is important to highlight the susceptibility of the main varieties planted in the country to several diseases, including Black Sigatoka (*Mycosphaerella fijiensis*, Morelet) and Yellow Sigatoka (*Mycosphaerella musicola*, Leach), thus highlighting the importance of genetic improvement in search for resistant cultivars [7].

In Brazil, different institutions, like Embrapa Cassava and Tropical Fruits in Cruz das Almas (BA), use a genetic improvement to obtain superior hybrids from the crossing of triploid cultivars with diploids, and thus to launch new genetic materials that meet the demands of the consumer market and farmers [9].

Therefore, first, when studying the implantation of a banana crop in a given region, and in order to obtain the maximum economic return from this crop, special attention should be paid to aspects of edafoclimatics and agronomic adaptation, since these aspects greatly influence throughout the banana production process. This procedure is very necessary because there is a genotype-by-environment interaction, which affects the behavior of these cultivars in relation to the aforementioned characteristics, in which it can cause cultivars developed in one region to perform differently from another from a different region. Therefore, the agronomic characterization by means of competition tests between the different cultivars avoids the recommendation of undesirable cultivars from the adaptive point of view of the genetic material [10].

In this context, studies on this subject are still incipient in Espírito Santo, and it is necessary to characterize banana cultivars for the state, thus helping producers to choose a cultivar that provides greater profitability. Therefore, the objective of this study was to evaluate the agronomic performance of different banana cultivars, aiming to identify cultivars that better adapt to the edaphoclimatic conditions of the northwest region.

2. MATERIALS AND METHODS

The study was conducted at the Federal Institute of Espírito Santo, Campus Itapina, in the municipality of Colatina (19°32'22 " S 40°37'50 " 71m), located in the northwest region of the state of Espírito Santo. The climate of the region is classified as Tropical Aw, according to the Koppen climate classification, with an average annual rainfall of 900 mm and an average annual temperature of 25 ºC. The experimental design was a randomized block design with four replicates and each plot had five plants, of which three were placed in a 3x3m space, totaling 144 evaluated plants and a total of 240

plants in the experiment. The experiment was conducted with a micro sprinkler irrigation system, using a sprinkler per plant, and the cultural treatments were performed according to the crop requirement. The experiment was fertilized according to the soil requirements by the analysis of the soil, in which three fertilizations were carried out with respectively 17 g, 67 g and 67 g / urea plant, 25 g, 50 g and 25 g / potassium and a fertilization of 278 g / plant of single superphosphate in each cycle.

Therefore, 12 cultivars of micropropagated bananas with Embrapa Mandioca and Fruticultura origin, based in Cruz das Almas, Bahia, were evaluated, as described in Table 1.

Table 01: Description of the main characteristics of the evaluated banana cultivars

GENOTYPES	GENEALOGY (origin)	GENOMIC GROUP	CHARACTERISTICS
Thap Maeo	Mysore	AAB	Medium to high size, with small fruits and resistant to Black, Yellow Sigatoka and Panama disease.
Pacovan Ken	Prata of high stature	AAAB	Plant vigorous, tall with good tillering and resistant to Black, Yellow Sigatoka and Panama disease.
Preciosa	Prata of high stature	AAAB	Resistant to Black, Yellow Sigatoka and Panama disease.
Garantida	Prata of high stature	AAAB	Tolerant to Black Sigatoka
Fhia 18	Prata of medium stature	AAAB	Resistant to Black Sigatoka, but moderately susceptible to Yellow Sigatoka and susceptible to Panama disease. .
Galil 18	Prata of small stature	AAAB	Tolerant to Black Sigatoka.
Prata Anã	Prata of médium stature	AAB	It has fruits similar to those of Prata in shape, size and flavor, but with higher productivity and are

			susceptible to Black, Yellow Sigatoka and Panama disease.
Caipira	Caipira	AAA	Medium to high stature, great tillering, small fruits resistant to Black, Yellow Sigatoka and Panama disease.
Maçã	Common Maçã	AAB	Middle-tall, delicate fruit with small bunches. Highly susceptible to Panama disease and susceptible to Black Sigatoka and moderately susceptible to Yellow Sigatoka-.
Princesa	Maçã resistant to Yellow Sigatoka	AAAB	15 to 20 t/ha and up to 25 t/ha. Smaller than ‘Maça'. Resistant to Yellow Sigatoka and Panama disease.
Tropical	Maçã tolerant to Panama disease	AAAB	Medium-to-high, resistant to Yellow Sigatoka, susceptible to Black Sigatok and tolerant to Panama disease.
Grande Nine	Cavendish	AAA	Medium-to-high, resistant to Yellow Sigatoka, susceptible to Black Sigatoka and tolerant to Panama disease.

Source: [11]

The developmental characteristics of the banana crop were evaluated, in which the height of the first rosette leaf was evaluated with a tape measure, stem diameter at 5 and 30 cm from the soil, number of total and functional leaves (50% of the leaf in good photosynthetic state) were counted visually.
For the production data the following was evaluated; bunch weight using a mechanical platform scale, number of fruits by manually counting, diameter and length of 15 fruits per bunch using the pachymeter and Grading ruler number of bunches by manually counting and productivity was estimated based on the bunch weight using the formula [(bunch weight) / 9] × 10. All these evaluations were carried out for the first, second and third cycles of the banana crop, which comprise the mother plant, daughter plant and net plant respectively. The normality test was used for the data and analysis of variance in a simple factorial (genotypes x cycles). Genotype grouping was performed using the Scott-Knott test at 5%, by the Assistant program, version 7.7 beta.

3. RESULTS AND DISCUSSION

The analysis of variance revealed that there was a significant difference between the different cultivars for most of the evaluated characteristics, for the development data and the production data, thus showing the importance of researches of this nature, and the genotype-by-environment interaction will be clear. The coefficients of variation found are within the expected for the characteristics of the banana crop when compared with other authors [5,7,12-17]. According to Nomura et al. [5] and Santos et al. [18] among other authors, plant height is an important parameter from a planting and breeding point of view, especially when implanting a new planting area, since it interferes with the spaces used and, consequently, the density and productivity. It should also be mentioned that very high plants facilitate the occurrence of tipping, makes it difficult to manage the bunches and consequently influences the fruit quality [19].
The cultivars studied had higher heights in the first production cycle when compared to the other cycles. The same did not occur in the study of Nomura et al. [5], when evaluating two production cycles of 'Grande Naine', 'FHIA 02', 'Bucaneiro' and 'FHIA 17', and the study of Roque et al. [7], when evaluating the agronomic performance of 11 cultivars during two production cycles in the Recôncavo, Bahia. In both studies, the highest height was found in the second production cycle. According to the authors, this increase was due to the instability of the first cycle, since the stability is usually reached in the second cycle. This fact may have occurred because micropropagated plants have differentiated growth patterns of the plants conventionally propagated by rhizomes. Salomão et al. [20] state in their study that banana crop originating from micropropagated seedlings, result in plants with a greater vegetative vigor in the first cycle.
Most of the plants evaluated in this experiment were classified as medium-sized, with a height varying from 1.73 m to 3.35 m (Table 2), which according to Mendonça et al. [14] and Santos et al. [18], these values are within the height range that is commercially recommended, facilitating the harvest and the cultural treatments, a range that according to the last authors varies from 2.00 to 3.5 m in height.
As shown in Table 2, it can be observed that for the plant characteristic height in the first cycle, the plants with higher height were to the cultivars 'Povovan' (335.16 cm), 'Preciosa' (332.71 cm), 'Garantida' (296.29 cm), both from the ‘Prata’ group, and 'Princesa' (294.16 cm) from the ‘Maçã’ group. In the second cycle, the cultivars 'Thap Maeo' (245.96 cm) followed by 'Pacovan' (236.33 cm), 'Preciosa' (231.50 cm) and 'Caipira' (211.33 cm) and in the third cycle, where plants established their developmental stability according to Alves and Oliveira [21], the plants with a greater height were 'Thap Maeo' (286.41 cm), 'Caipira' (283.74), 'Pacovan' (280.91) and 'Tropical' (274.57 cm).
The shortest plants belong to the cultivars 'Prata anã', in the first cycle with 244.79 cm in height and the 'Grand Nine' with 173.83 and 140.00 cm respectively in the second and third cycles. These data are consonant with the studies of Nomura et al. [5], Lima et al. [23] and Donato et al. [24].

Table 2. Height (cm) and number of shoots of 12 banana cultivars grown in three production cycles in the northern region of the state of Espírito Santo.

	Plant height (cm)			Number of shoots		
Cultivars	**Cycle 1**	**Cycle 2**	**Cycle 3**	**Cycle 1**	**Cycle 2**	**Cycle 3**

			Mysore Group			
Thap Maeo	280.89 aB	245.95 aA	286.41 aA	3.37 aB	2.83 aA	1.83 aB
			Prata Group			
Preciosa	332.71 aA	231.50 bA	237.64 bB	1.75 aC	1.91 aA	0.45 aB
Pacovan	335.16 aA	236.33 cA	280.91 bA	3.00 aC	2.71 aA	1.87 aB
Galil	270.20 aB	173.83 bB	190.33 bC	1.83 aC	2.29 aA	0.75 aB
Prata anã	244.79 aB	203.00 aA	202.98 aC	2.41 aC	3.50 aA	0.43 bB
Caipira	253.96 aB	211.33 bA	283.74 aA	5.26 aA	2.56 bA	4.75 aA
Garantida	296.29 aA	179.97 bB	199.36 bC	1.75 aC	2.75 aA	0.83 aB
Fhia 18	256.43 aB	175.16 bB	235.25 aB	2.61 aC	1.00 aA	2.20 aB
			Maçã Group			
Maçã	279.66 aB	223.00 aA	254.33 aB	3.50 aB	1.37 bA	2.16 bB
Princesa	294.16 aA	221.25 bA	250.33 bB	2.66 aC	3.75 aA	1.04 bB
Tropical	275.49 aB	187.21 bB	274.57 aA	1.86 aC	2.80 aA	1.33 aB
			Cavendish Group			
Grand Nine	230.00 aB	140.02 bB	141.11 bD	2.00 aC	1.91 aA	0.58 aB
Overall Average	251.21cm	239.31cm	236.41 cm	2.66	2.21	1.51
CV %	13.49	12.99	14.12	54.00	52.30	58.60

Means followed by the same lowercase letter in the rows and upper case in the columns do not differ statistically by the Scott-Knott test at 5% probability.

Azevedo [13] confirms the large size of the 'Povovan' group, classifying it as a tall plant, varying from 3.52 to 4.21 m in height. In other studies, Roque et al. [7] when evaluating the plant height in different cultivars, they also found 'Pacovan' as one of the highest cultivars. Gonçalves et al. [25], observed that the cultivar 'Thap Maeo' presented higher averages for plant height when compared in a competition trial with 'Caipira' cultivar in two production cycles in the northern region of the state of Minas Gerais. However, the 'Caipira' cultivar was among the highest plants both in the second and third cycles, contrary to what was found by Roque et al. [7], Nomura et al. [5], Mendonça et al. al. [14], Borges et al. [11] and Gonçalves et al. [25].

The number of shoots is an important commercial factor for the generation of later productive cycles of the banana crop, but when this number is excessive it may result in a higher labor demand for the thinning [27]. In this study, all genotypes showed shoots, thus guaranteeing the generation of new cycles and multiplication of cultivars. Therefore, 'Caipira 'from the ‘Prata’ group presented the highest number of shoots in the first and third production cycle (Table 2), yielding 5.26 and 4.75 respectively. In the second cycle, ‘Princesa’, from the ‘Maçã’ group produced a larger number of shoots (3.75

shoots). 'Preciosa' was the one that produced the smallest number of shoots, with 1.37 shoots considering the three cycles.

According to Alves [27], the evaluation of the number of leaves in the flowering reflects the variety productive potential, which is related to the photosynthetic rate and its tolerance to diseases, for example, Yellow Sigatoka. Silva [28] suggests that the greater number of leaves in the flowering can favor the development of the bunches. The presence of more than eight leaves in the flowering plant is a factor considered sufficient for the normal development of the bunch [14], thus, all genotypes presented a number of leaves higher than this value, as demonstrated in Table 3.

Table 3. Number of total leaves (TL) and number of functional leaves (FL) of 12 banana cultivars grown in three production cycles in the northern region of the state of Espírito Santo.

	Number of TL			Number of FL		
Cultivars	**Cycle 1**	**Cycle 2**	**Cycle 3**	**Cycle 1**	**Cycle 2**	**Cycle 3**
			Mysore Group			
Thapmaeo	**1**4.45 aA	12.45 aA	13.45 aA	13.66 aA	11.95 aA	10.91 aA
			Prata Group			
Preciosa	12.54 aA	13.29 aA	8.45 aA	11.95 aA	12.66 aA	7.83 aA
Pacovan	13.66 aA	13.41 aA	10.12 aA	12.75 aA	13.00 aA	9.79 aA
Galil	13.75 aA	11.54 aA	9.25 aA	12.50 aA	10.91 aA	8.87 aA
Prata anã	14.75 aA	15.08 aA	11.50 aA	14.16 aA	14.58 aA	11.33 aA
Caipira	13.68 aA	12.37 aA	11.25 aA	12.26 aA	11.87 aA	9.95 aA
Garantida	11.91 aA	9.45 aA	7.70 aA	10.33 aA	8.33 aA	6.66 aA
Fhia 18	12.96 aA	12.25 aA	9.62 aA	11.72 aA	12.08 aA	8.83 aA
			Maçã Group			
Maçã	14.41 aA	14.16 aA	11.58 aA	13.66 aA	13.75 aA	11.08 aA
Princesa	13.25 aA	12.25 aA	10.66 aA	12.33 aA	11.66 aA	10.41 aA
Tropical	12.08 aA	13.50 aA	10.62 aA	11.35 aA	13.08 aA	9.12 aA
			Cavendish Group			
Grand Nine	12.95 aA	11.50 aA	8.75 aA	12.01 aA	10.91 aA	8.33 aA
Overall Average	13.36	12.075	10.24	12.06	11.29	9.42
CV %	13.21	14.05	12.12	14.18	14.10	16.22

Means followed by the same lowercase letter in the rows and upper case in the columns do not differ statistically by the Scott-Knott test at 5% probability.

According to Silva et al. [9], the pseudostalk diameter is of great importance in the banana genetic improvement, since it is related to the plant vigor, sap flow, besides reflecting the support capacity of the bunch and resistance to tipping, which is consistent with the bunch development. The pseudostalk diameter at 5 cm from the soil (Table 4) showed no significant difference between the cultivars evaluated and nor between the cycles, however, for the pseudostalk diameter at 30 cm from the soil, a significant difference was found between the treatments, only for the second and third production cycles. The cultivar with a diameter larger than 30 centimeters from soil in the first cycle was cultivar 'Galil' (Table 4), measuring 81.88 cm, a value not found in the other cycles. The lowest diameter was observed in the cultivar 'Grand Nine' in all the cycles, which is common for this variety.

It is noteworthy that during the second cycle of this experiment a strong wind occured in the municipality of Colatina, followed by a storm, therefore the wind caused to leaf and plant to break, besides the exaggerated cracking, which decreased the photosynthetic rate, and may decrease the plant development [29].

Table 4. Stem circumference at 30 and 5 cm from the soil of 12 banana cultivars grown in three production cycles in the northern region of the state of Espírito Santo.

	Diameter to 30 cm			Diameter to 5 cm		
Cultivars	**Cycle 1**	**Cycle 2**	**Cycle 3**	**Cycle 1**	**Cycle 2**	**Cycle 3**
			Mysore Group			
Thap Maeo	70.05aA	61.15aA	65.86aA	76.19 aA	68.25aA	74.12aA
			Prata Group			
Preciosa	69.06aA	69.06aA	49.43bB	81.53aA	65.93aA	64.65aA
Pacovan	71.32aA	55.94bA	63.70aA	80.45aA	67.45aA	75.62aA
Galil	81.88aA	48.15bB	49.86bB	88.05aA	61.24aA	60.36aA
Prata anã	70.84aA	61.35bA	56.62bA	77.37aA	71.67aA	67.07aA
Caipira	64.71aA	49.52bB	66.98aA	71.46aA	60.14aA	75.99aA
Garantida	63.39aA	44.78bB	44.01bB	72.80 aA	55.53aA	53.96aA
Fhia 18	70.00aA	52.43bA	55.60bA	79.40aA	63.71aA	62.76aA
			Maçã Group			
Maçã	73.35aA	55.97bA	68.14aA	81.49aA	68.09aA	75.07aA
Princesa	67.56aA	51.16 bB	60.42aA	81.25aA	62.62aA	74.41aA
Tropical	73.37aA	55.88bA	67.95aA	82.01aA	65.90aA	77.79aA

			Grupo Cavendish			
Grand Nine	65.44aA	41.80bB	40.55bB	73.14aA	51.32aA	49.77aA
Overall Average	65.13	53.93	57.42	71.92	63.48	67.63
CV %	20.18	12.07	13.51	18.96	11.29	10.31

Means followed by the same lowercase letter in the rows and upper case in the columns do not differ statistically by the Scott Knott test at 5% probability.

The bunch weight (Table 5) is one of the main characteristics to help select a cultivar for a banana commercial system, since it does not matter if the plant is small, has a pseudostalk with a good thickness and many functional leaves, if the productivity is low. Although Lessa et al. [30] concluded that the associations between the number of fruits and the vegetative characteristics of the plant are generally not significant.

Thus, among the three different productive cycles for the bunch weight, the cultivar 'Grand Nine' stood out, since it presented the highest averages of 33.80 kg and 32.63 kg respectively in the first and third cycle. It is noteworthy that this result was already expected, since this cultivar belongs to the Cavendish group and genotypes of this genomic group have as a main characteristic a high bunch weight, since their fruits are very large Silva et al. [9]. 'Galil' was the one that stood out, presenting a higher average bunch weight in the three production cycles (25.99 kg), while 'Prata anã' and 'Garantida' presented the lowest averages for the average weight of the three cycles (17.53 and 16.33 kg), respectively. Within the group, 'Acultivar', the 'Princesa' stood out and presented heavier bunches in the three cycles (20.47 kg), whereas 'Tropical' and 'Maçã' did not present significant differences among themselves and had the lowest average values of 17.10 kg and 17.24 kg, respectively. Values similar to those were found by Roque et al. [7], Mendonça et al. [14] and Silva et al. [31], while evaluating the bunch weight for some of the same genotypes evaluated in this experiment.

According to Roque et al. [7] the bunch weight is one of the main characteristics that expresses banana productivity, but should be associated to other characteristics that influence the consumer market, such as the number of fruits per bunch, size and the fruit flavor [32]. For the characteristic, number of fruits (Table 5), which is directly related to the bunch weight, there was an increase for the second and third production cycles, as well as the bunch weight. It is observed in the second cycle that 'Thap Maeo' had the highest number of fruits (206,37), followed by 'Caipira' (193,37) and 'Grand Nine' (175,5) and 'Princesa' (155.04). 'Garantida' (82.16 fruits), 'Preciosa' (118.05) and 'Tropical' (118.12) had the lowest number of fruits. Considering the average fruit yield in the three cycles, the following was classified: 'Thap Maeo' (202.21 fruits); 'Grand Nine' (173 fruits); in the 'Prata' group, 'Caipira' (164.20 fruits) and in the "Maça" group, 'Princesa' (133 fruits).

These results corroborate with the values of number of fruits found in other studies, such as Pereira et al. [33], who also found a higher number of fruits in the 'Mysore' group with an average of 135 fruits considering the two production cycles. Donato et al. [34], also verified the influence on the number of leaves and number of fruits per bunch, showing the greater capacity of the cultivars of the second cycle, since they directly influence the bunch size and weight.

Table 5. Bunch weight and number of fruits per bunch of 12 banana cultivars grown in three production cycles in the northern region of the state of Espírito Santo

	Bunch weight (kg)			**Number of fruits/bunch**		
Cultivars	**Cycle 1**	**Cycle 2**	**Cycle 3**	**Cycle 1**	**Cycle 2**	**Cycle 3**
			Mysore Group			

Thap Maeo	24.32 bB	30.18 aA	29.05 aA	193.91 bA	206.37 bA	206.37 bA
			Prata Group			
Preciosa	19.28 aC	22.19 aB	21.21 aC	89.58 bC	118.05 aD	124.62 aB
Pacovan	22.78 aB	18.42 aB	24.35 aB	108.20 aC	140.12 aC	137.83 aB
Galil	27.75 aB	22.05 aB	28.19 aA	149.91 aB	155.25 aC	168.95 aA
Prata anã	14.30 aC	20.37 aB	17.92 aC	118.66 bC	149.70 aC	137.16 aB
Caipira	14.94 aC	19.00 aB	22.12 aC	134.00 aC	193.37 aB	165.25 aA
Garantida	17.17 aC	13.01 aB	18.83 aC	89.125 aC	82.16 aD	108.12 aB
Fhia 18	26.54 aB	18.98 bB	25.30 aB	151.74 aB	127.27 aD	142.95 aB
			Maçã Group			
Maçã	15.70 aC	18.21 aB	17.83 aC	100.83 bC	137.50 aC	130.41 aB
Princesa	17.38 aC	23.77 aA	20.28 aC	126.66 aC	155.04 aC	118.50 aB
Tropical	15.75 aC	17.61 aB	17.96 aC	106.12 bC	118.12 aD	123.66 aB
			Cavendish Group			
Grand Nine	33.80 aA	27.72 aA	32.63 aA	165.00 aB	175.50 aB	178.50 aA
Overall Average	20.81	20.96	22.976	127.82	150.26	145.19
CV %	24.59	18.13	16.40	17.43	12.05	16.33

Means followed by the same lowercase letter in the rows and upper case in the columns do not differ statistically by the Scott Knott test at 5% probability.

In the second cycle, 'ThapMaeo', 'Galil' and 'Grand Nine' presented higher number of leaves (Table 6), as well as the highest bunch weight (Table 5). In the third cycle, the cultivars that stood out the most were, 'Prata anã', 'Thap Maeo' and 'Galil'. On the other hand, the one with the lowest number of leaves was 'Tropical', which is from the 'Maça' group. While evaluating the propagation type in the cultivar 'Prata anã', Salomão et al. [20], found values inferior to those obtained in this experiment for the number of leaves in the first cycle, with an average value of 7.5 leaves, but the second cycle was higher, presenting an average value of 9.7 leaves.

Table 6. Number of bunches of 12 banana cultivars grown in three production cycles in the northern region of the state of Espírito Santo.

Cultivars	**Number of Bunches**

	Cycle 1	Cycle 2	Cycle 3
		Mysore Group	
Thap Maeo	11.416 aA	13.66 aA	11.75 aA
		Prata Group	
Preciosa	6.41 bB	7.83 aB	8.62 aB
Pacovan	7.45 aB	8.75 aC	8.37 aB
Galil	9.91 aA	11.25 aB	13.88 aA
Prata anã	9.16 bA	9.56 aC	14.43 aA
Caipira	7.50 aB	8.87 aC	9.00 aB
Garantida	6.70 aB	7.00 aB	7.50 aC
Fhia 18	9.75 aA	9.66 aC	9.08 aB
		Maçã Group	
Maçã	7.25 aB	8.24 aD	7.75 aC
Princesa	8.25 aB	9.08 aC	8.33 aB
Tropical	6.41 aB	6.87 aD	6.83 aC
		Cavendish Group	
Grand Nine	9.91 aA	10.04 aC	10.62 aC
Overall Average	8.35	9.23	8.98
CV %	13.01	11.79	9.70

Means followed by the same lowercase letter in the rows and upper case in the columns do not differ statistically by the Scott Knott test at 5% probability.

Analyzing the length and diameter of the banana fruits evaluated and based on their classification, presented in a recommendation manual for the crop [22], it can be stated, in relation to these characters, that all genotypes of the ‘Prata’ group evaluated fall within the export type. The fruit diameter is usually used to indicate when the crop is ready to be harvested, and fruits that do not reach the proper length and diameter are not suitable for the market [12]. Therefore, the smaller fruit size and diameter observed in this study were 'Prata anã' and 'Caipira' (Table 7), even though these values are found in the required marketing standards. Brochado [17] observed a decrease in the fruit size from the first and second cycle, but in this study it was observed an increase within the cycles for 'Fhia 18' and 'Pacovan'.

Table 7. Fruit size and fruit diameter of 12 banana cultivars grown in three production cycles in the northern region of the state of Espírito Santo

	Fruit Size (cm)			Fruit Diameter (mm)		
Cultivars	**Cycle 1**	**Cycle 2**	**Cycle 3**	**Cycle 1**	**Cycle 2**	**Cycle 3**
			Mysore Group			
Thap Maeo	12.84aB	13.20 aA	13.36 aB	40.04 aA	40.74 aA	41.51 aA
			Prata Group			
Preciosa	16.53 aA	15.58 aA	16.33 aA	41.85 aA	44.16 aA	43.05 aA
Pacovan	17.02 aA	13.54 bA	17.45 aA	44.14 aA	39.79 bA	44.41 aA
Galil	15.98 aA	14.03 aA	15.70 aA	41.41 aA	37.96 aB	41.85 aA
Prata anã	13.01 aB	14.34 aA	13.88 aB	36.94 aB	36.21 aB	37.87 aB
Caipira	11.84 aB	11.31 aA	12.34 aB	35.36 aB	35.30 aB	38.16 aB
Garantida	16.53 aA	14.29 aA	15.49 aA	43.69 aA	43.84 aA	42.78 aA
Fhia 18	15.45 aA	13.43 bA	16.22 aA	42.88 aA	40.72 bA	43.15 aA
			Maça Group			
Maçã	14.09 aB	14.36 aA	14.43 aB	41.57 aA	42.65 aA	40.24 aB
Princesa	14.33 aB	13.58 aA	13.34 aB	42.08 aA	42.49 aA	40.64 aB
Tropical	13.31 aB	13.54 aA	13.50 aB	40.23 aA	40.71 aA	39.95 aB
			Cavendish Group			
Grand Nine	15.21 aA	14.29 aA	14.88 aA	41.88 aA	37.28 aB	38.99 aB
Overall Average	8.34	13.79	14.74	41.01	40.15	41.05
CV %	13.01	12.05	9.71	7.13	9.41	5.54

Means followed by the same lowercase letter in the rows and upper case in the columns do not differ statistically by the Scott Knott test at 5% probability.

The productivity data (Table 8) is one of the characteristics most sought by the farmers when selecting which cultivar to be used in commercial cultivation, pointed out that within the 'Prata' group, 'Galil' as the most productive, reaching in the third cycle 31.31 ton.ha^{-1}. In the 'Maça' group, 'Princesa' stood out, reaching in the second cycle, 26,40 ton.ha^{-1}. The cultivar 'Thap Maeo' and 'Grand Nine' presented excellent adaptation in the northwestern region of Espirito Santo, and their productivity values were higher than those found by Silva [31] in Cruz das Almas, for both cultivars, as well as for ' Grand Nine 'evaluated by Nomura et al. [16], in the first production cycle in vale do Ribeira -SP.

Table 8. Productivity of 12 banana cultivars grown in three production cycles in the northern region of the state of Espírito Santo

	Productivity (ton.ha^{-1})		
Cultivars	**Cycle 1**	**Cycle 2**	**Cycle 3**
		Mysore Group	
Thap Maeo	27.01bB	33.52aA	32.27aA
		Prata Group	
Preciosa	21.42aC	24.65aB	23.56aC
Pacovan	25.30aB	20.46aB	27.05aB
Galil	30.83aB	24.49aB	31.31aA
Prata anã	15.88aC	22.63aB	19.90aC
Caipira	16.59aC	21.11aB	24.57aC
Garantida	19.07aC	14.45aB	20.92aC
Fhia 18	29.48aB	21.08bB	28.10aB
		Maça Group	
Maçã	17.44aC	20.23aB	19.80aC
Princesa	19.30aC	26.40aA	22.53aC
Tropical	17.50aC	19.56aB	19.95aC
		Cavendish Group	
Grand Nine	37.55aA	30.79aA	32.63aA
Overall Average	23.11	23.28	25.21
CV %	24.59	18.13	16.40

Means followed by the same lowercase letter in the rows and upper case in the columns do not differ statistically by the Scott Knott test at 5% probability.

Studies on this subject help farmers to choose a cultivar and to analyze which are more productive, which are the ones that produce fruits suitable for the local market and need bunch shortening. Cultivars of the 'Prata' group that stood out in the third cycle were 'Thap Maeo' and 'Galil', with the heaviest bunch weight, fruits with an adequate size for trade, medium height and an advantageous stem diameter, not requiring shoring. In the 'Maça' group the heaviest bunch weight was 'Princesa' with 23.77 kg in the second cycle, but this cultivar needs shoring because it does not support the bunch weight and its pseudostalk is not very vigorous. In the Cavendish group the only one evaluated was the 'Grand Nine', which had a high value for its bunch weight when compared to Silva [31], who found in the first cycle, 15.6 kg, in the second 15.9 kg and in the third 14.9 kg, which are similar to those found by Weber et al. [35], who found in the first cycle 31.2 kg, in the second 29.5 kg and in the third 35.0 kg.

4. CONCLUSION

The highest height was 'Pacovan', from the ‘Prata’ group, while the smaller height was 'Grand Nine', from the Cavendish group.
The heaviest bunch weight was 'Grand Nine', as well as the largest fruit size.
The most productive cultivars during the three production cycles were 'Grand Nine' from the Cavendish group followed by ‘Thap Maeo’ from the ‘Mysore’ group. For the ‘Prata’ group, the most productive cultivars were ‘Galil’, ‘Pacovan’ and ‘Fhia 18’, while in the ‘Maça’ group, the most productive cultivar was ‘Princesa’, in which all of them are recommended to be planted in the northern region of Espírito Santo.

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