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Performance of banana genotypes in Rio Branco, Acre, Brazil

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ABSTRACT: The characterization and evaluation of banana genotypes (*Musa* spp.) is an important step both for breeding programs and for indication to farmers. Thus, the objective of this work was to evaluate banana genotypes in Rio Branco - Acre, aiming at their incorporation into the region 's production systems. The experiment was carried out in a randomized complete block design in a subdivided plots scheme with five replicates and four plants per plot. The treatments of the plots were the three production cycles, and the subplots were the nineteen banana genotypes. We evaluated plant's height; perimeter of the pseudostem base; number of active leaves at the inflorescence and harvesting stage; the period from planting until flowering, the period from flowering until harvest and period from planting until harvest; the mass of the bunch, the total number of fruits per bunch; the number of pieces; productivity. The genotypes Thap Maeo, FHIA-02, FHIA-18, and Maravilha, present the best agronomic performance and have the potential to be incorporated into the banana production system in the edaphoclimatic conditions of the Rio Branco, Acre region.

Key words: evaluation; hybrids; *Musa* spp.; selection; Western Amazon

Desempenho de genótipos de bananeira em Rio Branco, Acre, Brasil

RESUMO: A caracterização e a avaliação de genótipos de bananeira (*Musa* spp.) é uma etapa importante, tanto para os programas de melhoramento genético quanto para a indicação aos produtores. Assim, o objetivo deste trabalho foi avaliar genótipos de bananeira em Rio Branco - Acre, visando sua incorporação aos sistemas de produção da região. O ensaio foi conduzido em delineamento experimental em blocos casualizados em esquema de parcelas subdivididas com cinco repetições e quatro plantas por parcela. Os tratamentos das parcelas foram os três ciclos de produção e os das subparcelas foram os dezenove genótipos de bananeira. Foram avaliadas as características relacionadas à altura de plantas; diâmetro do pseudocaule; número de folhas ativas na emissão da inflorescência e na colheita; intervalo em dias, entre o plantio e o florescimento, entre o florescimento e a colheita e entre o plantio e a colheita; massa do cacho, número total de frutos por cacho; número de pencas e; produtividade. Os genótipos Thap Maeo, FHIA-02, FHIA-18 e Maravilha apresentaram os melhores desempenhos agronômicos e possuem potencial para serem incorporados ao sistema de produção da bananeira nas condições edafoclimáticas da região de Rio Branco, Acre.

Palavras-chave: avaliação; híbridos; *Musa* spp.; seleção; Amazônia ocidental

Introduction

In Brazil, the banana culture represents one of the most important agricultural activities, since it is the second most consumed fruit. Due to demand, the planted area surpassed 469 thousand hectares and produced for the country an amount of over 8,3 billion reais in 2016 (IBGE, 2017).

The conditions of climate and soil, continuous production throughout the year, high demand by consumers, possibility to establish farms and to generate jobs, it can be intercropped in agroforestry systems or deployed in monoculture makes banana an activity of great expression in Acre. Also, the culture of this fruit in deforested areas could be an alternative against new deforestations, which is along with intentional fire, prohibited in the region.

The average productivity of banana trees in Acre is around 13,35 t ha^{-1} (IBGE, 2017), is considered low regarding the potential of the species, due to the current production system in the region be quite rustic, characterized by the low employment of technologies in the management of banana plantations, mainly the use of susceptible cultivars to major pests and diseases or not adapted to the climatic characteristics of the region.

Despite the importance of the banana plantations, a few cultivars tolerant to pests and diseases, and which bear fruit with good market characteristics, are available for trading (Silva et al., 2013c). In Acre, the orchards are essentially formed by "rustic" varieties, grown predominantly in floodplains and a smaller scale in dry-land. The genetic basis is limited, given that the plantations are formed by the cultivar (cv.) D'Angola, from subgroup Terra, Prata, and on a small scale, Maçã, all sold mainly on the street market, being the first two susceptible to Black Sigatoka and the latter to Panama disease.

The introduction of improved genotypes from other regions of Brazil or other countries, followed by evaluation and later selection of the most promising and adapted to the production systems of a given region, is an initiative of great interest. In this aspect, the Embrapa Mandioca e Fruticultura, headquartered in Cruz das Almas, Bahia, has a genetic improvement program started in the 1970s. Since then, has been developing, from different breeding strategies, numerous varieties that are being introduced and evaluated in different systems and locations of Brazil, aiming to increase the availability of genotypes, especially more tolerant to pests and diseases and more productive (Silva et al., 2013c).

The objective of this work was to evaluate the agronomic performance of banana genotypes in three production cycles, under the edaphoclimatic conditions of Rio Branco, Acre State, to select materials for breeding recommendations.

Material and Methods

The experiment was placed in the Embrapa Acre experimental field, in Rio Branco, AC, and conducted during the years 2009 to 2012. The municipality is located to 9º58'29" S latitude and 67º49'44" longitude W, at 160 m of altitude. The regions' predominant climate, according to Köppen classification, is tropical wet climate, with maximum temperatures of 31°C and minimum of 21 ºC, annual rainfall of 1,700 mm and relative air humidity around 80% (Duarte, 2006). The data related to the maximum and minimum temperatures and precipitation during the experiment are shown in Figure 1. The soil of the experimental area was classified as a dystrophic Yellow Latosol of medium texture and well-drained, with flat terrain.

Micropropagated five-leafed with 30cm medium-height, banana plants seeds, previously acclimatized for 60 days, supplied by Embrapa Mandioca e Fruticultura, located in Cruz das Almas, Bahia, Brazil, were used. The planting was carried out in December 2009, in a previously prepared area, with 3,0 x 2,5 m spaced. The experiment was conducted without irrigation, adopting the cultural practices recommended for the crop (Ferreira et al., 2016).

The experimental trial was a randomized block in a scheme of plots subdivided in time, with four plants per plot and five replications. The treatments of the plots were the three cycles of production, and the subplots, the banana genotypes (Table 1).

The characteristics evaluated were, plant height (m) by means of a graduated ruler in centimeters; pseudostem perimeter (cm) through digital bevel gauge; number of active leaves, both at the time of issuance of the inflorescence and harvest; phenological cycle regarding to the interval in days between planting and flowering, flowering and harvest, and between planting and harvesting; bunch mass (kg) determined in a scale with capacity for 50 kg and accuracy of two decimal; total number of fruit and hands per bunch and; productivity (t ha^{-1}), based on the production of 1,333 bunches per hectare. From the second year, productivity was determined using the formula: [production (t ha^{-1})/cycle length (months)] x 12.

The data were subjected to analysis of variance, and the averages of genotypes and the cycles have been subjected

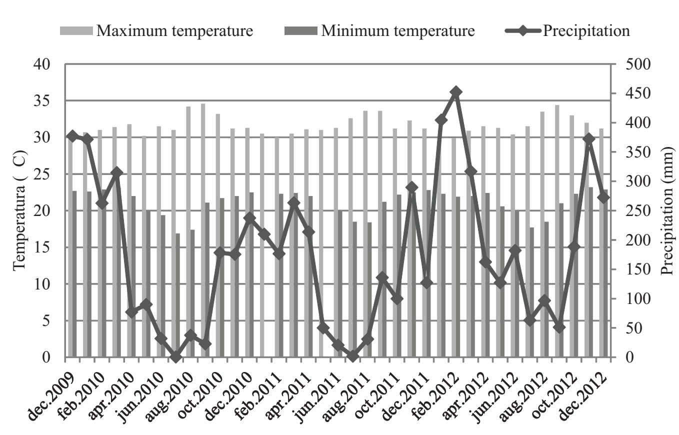

Figure 1. Maximum and minimum temperature and precipitation in Rio Branco, AC, Brazil, during the experiment period.

Table 1. Description of banana genotypes *(Musa* spp.) evaluated between 2010 and 2012 in Rio Branco, AC.

Genotypes	Group	Subgroup	Characteristics – Origin
YB42-17	AAAB	Prata	Hybrid of Yangambi, type Maçã- Embrapa
PV79-34	AAAB	Prata	Pacovan Hybrid – Embrapa
YB42-47	AAAB	Prata	Hybrid of Yangambi, type Maçã- Embrapa
ENXERTO 33	AAB	Prata	Hybrid – Embrapa
YB42-03	AAAB	Prata	Hybrid of Yangambi, type Maçã- Embrapa
JV42-135	AAAB	Prata	Prata Java hybrid – Embrapa
FHIA 23	AAAA	Gros Michel	Hybrid - Introduced from Honduras
PA94-01	AAAB	Prata	Prata Anã hybrid - Embrapa
Pacovan Ken	AAAB	Prata	Pacovan Hybrid – Embrapa
FHIA 18	AAAB	Prata	Hybrid of Prata Anã – Introduced from Honduras
Garantida	AAAB	Prata	Prata São Tomé hybrid – Embrapa
Platina	AAAB	Prata	Prata Anã hybrid – Embrapa
Maravilha	AAAB	Prata	Prata-Anã hybrid - Introduced from Honduras
Thap Maeo	AAB	Mysore	Cultivar - Introduced from Thailand
Tropical	AAAB	Prata	Yangambi No. 2 hybrid, type Maçã- Embrapa
Caipira	AAA	Ibota	Cultivar - Introduced from West Africa
FHIA 02	AAAB	Prata	Prata-Anã hybrid - Introduced from Honduras
Princesa	AAAB	Prata	Yangambi No. 2 hybrid, type Maçã- Embrapa
Japira	AAAB	Prata	Pacovan Hybrid – Embrapa

to the test of Scott & Knott and Tukey, respectively, at 5% of probability. The data regarding bunch weight and productivity did not meet the assumptions of analysis of variance and were transformed by log x using the statistical software Sisvar (Ferreira, 2011).

Results and Discussion

There was a significant interaction between genotypes and cycles (Table 2), except for the variable number of days from flowering until harvesting, what could be expected, by the genomic variability among the materials evaluated.

Regarding plants' height, there was a formation of five groups in the first cycle, four in the second and three in the third (Table 3). The genotype FHIA-23 showed no statistical difference in the three cycles of production and, except for Thap Maeo and Caipira, which increased the height over the cycles, the other genotypes showed no statistical differences from the second to the third cycle.

The genotype Tropical showed greater height with 3,17 m in the first cycle of production (Table 3). However, in general, the lowest plants were observed in the first cycle, with emphasis on the genotypes FHIA 18, Platina and Enxerto 33. In the second cycle, besides the Tropical cultivar, the genotypes Japira (3,87 m), JV42-135 (3,81 m), Thap Maeo (3,77 m), Pacovan Ken (3,66 m), and Princess (3,64 m height) were higher than the other genotypes. In the third cycle, the greater heights were only from the genotypes Thap Maeo and Japira.

This characteristic is important due to the influence on management, especially in the density of planting and harvesting the fruits, which directly affects the cost of production and the performance of the banana trees. Also, it is an important criterion to select a cultivar, particularly

Table 2. Summary of the analysis of variance for plant height (ALT), pseudostem perimeter (DPC), number of live leaves at flowering (NFVF) and at harvest (NFVC), number of days between planting and flowering (NDPF), number of days between flowering and harvest (NDFC) and number of days between planting and harvesting (NDPC), number of hands (NPC), total number of fruits (NTF), bunch weight (MCH) and productivity (PROD). Rio Branco, AC, 2018.

Sources of variation		Block	Cycle	error (A)	Genotype	Genotype x Cycle	error (B)	CV1	CV2
								(%)	
GL		4	2	5	18	36	207	-	-
QM	ALT	0.052^{ns}	25.08*	0.0938	1.6992*	0.0947*	0.0664	10.03	8.44
	DPC	6.43*	459.68*	1.17	20.66*	30038*	1.99	6.66	8.67
	NFVF	0.42^{ns}	7.7678*	1.2902	3.5546*	2.2535*	0.84	12.43	10.04
	NFVC	0.46*	0.0264^{ns}	0.157	1.4835*	0.2267*	1.772	21.21	18.17
	NDPF	16734.34^{ns}	4142803.54*	10120.71	33415.65*	8207.79*	4003.73	16.81	10.57
	NDFC	1198.8768^{ns}	1530.41^{ns}	294.68	1731.6732*	528.9194^{ns}	511.4311	14.15	18.64
	NDPC	6572.35^{ns}	3534013.91*	11900.87	26841.56*	7303.24*	4958.54	15.36	9.92
	NPC	0.0522^{ns}	25.0879*	0.0938	1.6992*	0.0947*	0.0664	12.79	15.61
	NTF	764.00^{ns}	19800.89*	239.6347	7057.2123*	606.8741*	276.10	19.6	21.04
	MCH	0.0147^{ns}	1.2222*	0.0206	0.2701*	0.0239*	0.0125	15.78	12.31
	PROD	0.0067^{ns}	2.9194*	0.0254	0.2652*	0.0388*	0.0186	13.61	11.66

^{ns} e *: Not significant and significant at 5% probability, respectively.

Table 3. Plant height (m), pseudostem perimeter (cm), number of live leaves at flowering and harvest of banana genotypes, during three cycles of production. Rio Branco, AC, 2018.

Genotypes	Plant height (m)			Pseudostem perimeter (cm)			Number of active leaves at flowering			Number of active leaves at harvest		
	1st Cycle	2nd Cycle	3rd Cycle	1st Cycle	2nd Cycle	3rd Cycle	1st Cycle	2nd Cycle	3rd Cycle	1st Cycle	2nd Cycle	3rd Cycle
YB42-17	2,59 cB	3,22 cA	3,48 bA	58,75 cB	71,85 bA	72,45 aA	8,68 bA	9,30 bA	8,73 bA	2,40 cA	2,25 bA	2,98 bA
PV79-34	2,47 cB	3,09 cA	3,30 cA	61,02 cB	76,78 aA	74,74 aA	8,80 bA	8,95 bA	8,63 bA	0 dA	1,16 bA	0,93 bA
YB42-47	2,61 cB	3,49 bA	3,62 bA	58,24 cB	72,00 bA	71,18 aA	9,13 bA	7,95 cB	7,83 bB	1,08 dA	2,38 bA	1,33 bA
Enxerto 33	1,99 eB	2,82 dA	2,86 cA	54,76 dB	72,65 bA	70,40 aA	9,61 aA	8,55 bA	8,65 bA	4,20 bA	0,95 bB	1,23 bB
YB42-03	2,61 cB	3,46 bA	3,49 bA	55,08 dB	71,70 bA	66,45 bA	8,78 bA	8,05 cA	7,76 bA	0,95 dA	1,11 bA	1,40 bA
JV42-135	2,55 cB	3,81 aA	3,72 bA	54,77 dB	77,90 aA	74,85 aA	10,05 aA	9,56 aA	8,55 bB	2,16 cA	2,76 aA	1,56 bA
FHIA 23	2,77 bA	3,09 cA	3,20 cA	68,55 aA	79,08 aA	70,30 aA	9,41 aA	8,89 bA	8,00 bA	2,72 cA	1,67 bA	2,50 bA
PA94-01	2,38 cB	3,10 cA	3,12 cA	65,72 bB	83,01 bA	75,68 aA	10,65 aA	8,96 bB	9,12 aB	3,58 bA	3,95 aA	4,62 aA
Pacovan Ken	2,78 bB	3,66 aA	3,57 bA	54,33 dB	73,75 bA	72,11 aA	10,56 aA	9,15 bB	8,61 bB	0,91 dA	1,40 bA	1,90 bA
FHIA 18	1,90 eB	2,73 dA	2,93 cA	50,75 dB	68,37 bA	70,41 aA	7,96 bB	10,15 aA	9,66 aA	4,46 bA	2,98 aA	4,91 aA
Garantida	2,39 cB	3,41 bA	3,42 bA	53,51 dB	76,51 aA	72,23 aA	8,76 bA	8,73 bA	8,45 bA	1,71 dA	3,00 aA	2,40 bA
Platina	1,94 eB	2,80 dA	2,90 cA	53,69 dB	68,83 bA	68,36 bA	10,01 aA	9,93 aA	9,31 aA	3,71 bA	2,93 aA	2,98 bA
Maravilha	2,22 dB	3,03 cA	3,06 cA	60,75 cB	81,21 aA	72,61 aA	9,56 aA	9,10 bA	9,04 aA	3,03 cA	4,15 aA	3,66 aA
Thap Maeo	2,65 cC	3,77 aB	4,11 aA	55,29 dB	71,95 bA	74,53 aA	9,83 aA	10,05 aA	9,39 aA	5,51 aA	4,20 aA	4,36 aA
Tropical	3,17 aB	3,67 aA	3,72 bA	67,55 bB	81,95 aA	71,18 aB	9,56 aA	7,70 cB	8,10 bB	2,23 cA	3,01 aA	2,86 bA
Caipira	2,27 dC	2,87 dB	3,25 cA	34,55 dB	41,86 cA	45,98 bA	9,23 bA	9,50 aA	9,58 aA	1,25 dA	2,04 bA	3,35 bA
FHIA 02	1,92 eB	3,03 cA	3,19 cA	50,14 dB	73,50 bA	75,10 aA	8,26 bC	11,00 aA	9,55 aB	6,40 aA	3,36 aB	5,05 aAB
Princesa	2,79 bB	3,64 aA	3,59 bA	58,46 cC	73,53 bA	65,88 bB	10,80 aA	8,91 bB	9,16 aB	2,66 cA	4,36 aA	2,93 bA
Japira	2,67 cB	3,87 aA	4,00 aA	53,61 dB	73,68 bA	72,65 aA	9,08 bA	9,73 aA	9,26 aA	2,93 cA	2,36 bA	2,30 bA

(1) Averages followed by the same letter, lowercase in the column and uppercase in the line, do not differ with each other by Scott & Knott and Tukey tests, respectively, at 5% of probability.

for sites with higher incidences of strong winds. According to Brenes-Gamboa (2017), height is an important factor to facilitate the management of the banana tree, as bagging fruits to avoid pests and eliminating parts of the leaf surface contaminated with Black Sigatoka disease.

The largest height obtained by these plants can difficult the bagging and the harvest of the bunch, making them more susceptible to fall during strong winds. During the experiment, the average maximum wind speed ranged between 11,5 (Sept./2012) and 43,2 km h^{-1} (Dec./2009), with an average of 19,2 km h^{-1}, which resulted, in some cases, in tatter leaves and fall of trees of some cultivars, especially the higher-sized, as Thap Maeo, Japira, Pacovan Ken and Tropical. Therefore, it is important to preemptively make use of windbreaks if one opts for planting a genotype with heights above three meters or with low pseudostem perimeter. Weber et al. (2017) do not recommend planting the cultivars Pacovan Ken, Thap Maeo, and Japira in areas unprotected from winds.

The genotypes differed statistically on the pseudostem perimeter in all cycles, forming four groups in the first, three in the second, and two in the third cycle (Table 3). It was observed that the genotype FHIA-23 expressed greater pseudostem perimeter in the first production cycle, with 68,55 cm. In the second cycle, besides FHIA 23, the genotypes Tropical, Maravilha, JV42-135, PV79-34, and Garantida presented the higher perimeters, while in the third production cycle, the genotypes Platinum, YB19-13, Princesa and Caipira recorded the smallest perimeters.

In evaluating the agronomic performance of banana cultivars in the Recôncavo da Bahia, in two production cycles, Roque et al. (2014) found that the pseudostem diameter increased from the first to the second cycle for all genotypes. In addition, the values observed by these authors were lower than those determined in this study.

This variable ensures the sustainability of the plant in the field, notably those who have larger and heavier bunches. Thus, larger diameter plants are desirable because of the greater support capacity they provide to the plant (Bolfarini et al., 2014) and the own bunch (Silva et al., 2016). A lower pseudostem diameter can be compensated by lower plant height and, therefore, these two variables need to be assessed together to identify an appropriate relationship between both. According to Guimarães et al. (2014), there is a high correlation between the pseudostem diameter at ground level of banana Prata-Anã at flowering time and the weight of the bunch considered a good indicator of force and plant productivity.

To the number of active leaves at flowering, two groups were formed in the first and third cycles and three groups in the second (Table 3). To most genotypes, the number of active leaves at flowering did not differ between cycles. The genotypes YB42-47, PA94-01, Pacovan Ken, Tropical, and Princess, had a bigger number of active leaves in the first cycle. The lowest values were shown by the genotypes FHIA-18 and FHIA-02 in the first cycle and JV32-135 in the third cycle.

In the first cycle, the genotypes with the highest averages, in descending order, were, Princesa, PA94-01, Pacovan Ken, JV42-135, Platina, Thap Maeo, Enxerto 33, Maravilha, Tropical, and FHIA 23, with the highest average (10,8) to the first, and the smallest (9,41), for the last genotype. In the second cycle, the largest numbers of leaves were presented by the cultivars FHIA 02, FHIA 18, Thap Maeo, Platina, Japira, JV42-135, and Caipira with approximately ten leaves. In the third cycle, the genotypes with a higher number of leaves, above 09, were FHIA 18, FHIA 02, Caipira, Thap Maeo, Platinum, Japira, Princesa, PA94-01, and Maravilha.

The higher the photosynthetically active area, the better is the growth of the bunch. On the other hand, some diseases, as Black Sigatoka, for example, reduce the leaf area, the productivity is also lower (Nomura et al., 2013a).

For the number of live leaves at harvest, four distinct groups were formed in the first, and two in the second and third cycles (Table 3). Although the number of live leaves in the first harvest has been greatly reduced, one observed significant losses for the Enxerto 33 and FHIA-02, with reductions of 04 to 1 leaf (first to third cycles) and 6 to 3 leaves (first to second cycles), respectively.

In contrast, Silva et al. (2012a) found that the number of leaves at the harvest of Prata Anã banana tree increased from one cycle to another, that is, in the first cycle, the production was 8,95, while in the second cycle, there was an increase to 10,35 leaves.

In general, considering all three cycles, the lowest number of leaves was observed in the genotypes PV79-34, YB42-47, YB42-03, Pacovan Ken and the Caipira cultivar. On the other hand, the largest number was observed in the first cycle for genotypes FHIA 02 and Thap Maeo, probably because they are resistant to Black Sigatoka. Ribeiro et al. (2013) observed a greater number of leaves in the harvest season for the cultivar Thap Maeo, both in organic and conventional system, in Cruz das Almas, BA.

The number of live leaves at harvest is directly related to the productive aspects of culture given that influences in the mass of fruits and bunches. A smaller number of leaves means lower production and availability of photoassimilates required for the growth of the fruit. In addition, Nomura et al. (2016) stated that the number of live leaves at both flowering and harvest is an essential characteristic to be considered in assessments of resistance or tolerance to diseases, especially Black Sigatoka.

In relation to the number of days from planting to flowering, in the first cycle, there were no statistical differences among the genotypes. On the other hand, it was observed a small variation among genotypes, forming two groups, both in the second and third cycle (Table 4).

The genotypes FHIA-02, Enxerto 33, FHIA-18, Platina, Caipira, and JV42-135, bore flower in less time after planting in the second production cycle. In the third cycle, the genotypes Platina, Enxerto 33, FHIA-02, FHIA-18, Princesa, Caipira, Tropical, Maravilha, and YB42-03 reach the flowering in less time. Nomura et al. (2013b) found that FHIA 02 and FHIA 18, in Vale do Ribeira, SP, led, respectively, less time and more time to reach flowering in the first and second cycles, probably due to the management of tillers or even the edaphoclimatic conditions.

Genotypes that reach early flowering have higher chances to succeed in a shorter production cycle, and also, last less exposed to biotic and abiotic agents and to allow the producer a faster economic return.

The number of days from planting to harvest varied among the cultivars only in the second cycle, allowing the formation of four distinct groups (Table 4). In the first and third cycles, the cultivars did not differ statistically among themselves, whose variations were only regarding cycles, since the number of days is added from one cycle to another.

The late genotypes in the harvest of the second bunch were Pacovan Ken, FHIA-23, and PA-9401. On the other hand, the earliest were FHIA 02 (616,33 days), Enxerto 33

Table 4. Number of days from planting to flowering, from planting to harvesting and from flowering to harvesting, in banana genotypes. Rio Branco, AC, 2018.

Genotypes	Number of days from planting to flowering			Number of days from planting to harvest			Number of days from flowering to harvest		
	1st Cycle	2nd Cycle	3rd Cycle	1st Cycle	2nd Cycle	3rd Cycle	1st Cycle	2nd Cycle	3rd Cycle
YB42-17	443,06 aC	668,35 aB	851,60 aA	595,01 aC	788,20 bB	936,85 aA	122,66 a	119,85 b	96,25 a
PV79-34	392,55 aC	607,36 aB	910,73 aA	521,69 aC	718,03 cB	968,40 aA	130,28 a	114,38 b	114,70 a
YB42-47	383,25 aC	652,85 aB	819,81 aA	490,98 aC	740,70 cB	919,70 aA	104,03 b	106,33 b	130,25 a
Enxerto 33	301,88 aC	491,40 bB	736,85 bA	439,75 aC	635,05 dB	834,66 aA	137,08 a	143,65 a	116,13 a
YB42-03	386,23 aC	617,33 aB	804,26 bA	498,00 aC	728,58 cB	849.88 aA	110,71 b	111,25 b	105,72 a
JV42-135	365,50 aC	574.11 bB	824,05 aA	492,80 aC	717,86 cB	932,90 aA	126,86 a	143,63 a	125,86 a
FHIA-23	506,11 aB	725,58 aA	870,75 aA	571,86 aB	855,50 aA	878,50 aA	93,25 b	117,41 b	107,02 a
PA94-01	390,66 aC	699,75 aB	848,18 aA	521,95 aB	841,88 aA	900,87 aA	130,18 a	148,50 a	148,25 a
Pacovan Ken	387,23 aC	718,10 aB	904,00 aA	527,90 aC	867,10 aB	1006,90 aA	150,66 a	140,80 a	126,50 a
FHIA-18	333,16 aC	512,15 bB	752,61 bA	457,33 aC	658,81 dB	866,20 aA	116,86 b	128,75 a	113,35 a
Garantida	363,95 aC	646,75 aB	854,41 aA	483,60 aC	760,03 bB	904,70 aA	108,60 b	111,11 b	115,26 a
Platina	338,86 aC	538,38 bB	703,16 bA	473,88 aC	659,10 dB	814,66 aA	129,71 a	133,28 a	118,35 a
Maravilha	385,10 aC	642,50 aB	794,16 bA	493,03 aC	718,38 cB	904,62 aA	109,53 b	113,10 b	96,75 a
Thap Maeo	363,43 aC	612,81 aB	835,63 aA	482,41 aC	711,21 dB	919,23 aA	111,50 b	119,65 b	113,50 a
Tropical	423,08 aC	656,71 aB	792,78 bA	533,00 aC	773,75 bB	893,13 aA	109,91 b	118,36 b	121,56 a
Caipira	435,41 aC	565,35 bB	775,04 bA	564,79 aC	723,62 cB	893,83 aA	122,00 a	122,02 b	117,41 a
FHIA-02	330,03 aC	476,56 bB	737,90 bA	448,26 aC	616,33 dB	859,80 aA	128,13 a	139,63 a	121,90 a
Princesa	408,81 aB	663,38 aA	773,65 bA	519,70 aB	764,33 bA	861,80 aA	110,68 b	119,36 b	109,93 a
Japira	365,06 aC	612,05 aB	834,00 aA	492,13 aB	748,70 cB	896,56 aA	125,13 a	133,03 a	124,26 a

(1) Averages followed by the same letter, lowercase in the column and uppercase in the line, do not differ with each other by Scott & Knott and Tukey tests, respectively, at 5% of probability.

(635,05 days), FHIA 18 (658,81 days), Platina (659,10 days), and Thap Maeo (711,21 days). It was observed that the first bunch was only harvested 14 months after planting. Weber et al. (2017), in an irrigated banana plantation, reaped the first bunches of Maravilha cultivars, FHIA 02 and FHIA 18 in less than nine months. In contrast, Nomura et al. 2013a observed a greater number of days between planting and harvesting, in the second cycle, in relation to the cultivars FHIA 18, Platina, and FHIA 02.

The reduction in the number of days required for the bunch emission is a characteristic desirable by producers because it ensures the anticipation of the investment applied, as well as higher production in the shortest period (Farias et al., 2010).

The cycle duration depends mostly on the cultivar and the edaphoclimatic conditions of each region, now that it can be reduced in high luminosity conditions, low altitude, relative air humidity above 80% and temperature around 28°C, conditions predominantly observed in the study area (Figure 1). However, in some months, the rainfall rates associated with low relative air humidity, high temperature, and lack of irrigation may have compromised the vegetative development and the production of banana trees, making necessary test the hypothesis that under irrigated conditions genotypes of banana trees can develop better and be more productive.

The high humidity accelerates the leaves emission, with greater longevity, and favors the flowering and the maintenance of the color of the fruit. In regions with low luminosity, for a prolonged period, the floral differentiation is interrupted, and the vegetative cycle is prolonged. Temperatures below 15°C paralyze the plant growth and exceeding 35°C will inhibit its development (Ferreira et al., 2016).

There was no significant interaction between the production cycle and the genotypes for the variable related to the number of days from flowering to harvesting. The differences observed between production cycles and the cultivars occurred independently (Table 2).

In the first and second cycles, the genotypes that presented higher precocity between flowering and harvest, with averages less than 119 days, were YB42-47, YB42-03, FHIA-23, Garantida, Maravilha, Thap Maeo, Tropical, and Princesa. The late genotypes were Enxerto 33, JV42-135, PA94-01, Pacovan Ken, Platina, FHIA-02, and Japira. In the third cycle, the genotypes showed no significant differences.

It was observed that the late genotypes, both at flowering and harvest were Pacovan Ken, FHIA-23, and PA94-01, and the earlier were FHIA 02, Enxerto 33 and FHIA-18.

Only the genotype Enxerto-33 had a higher cycle between flowering and harvest in the first production cycle when compared to the results of Roque et al. 2014. Regarding the second cycle, the genotypes Enxerto 33, Pacovan Ken, FHIA 18 and Caipira showed a greater cycle when compared to the same genotypes studied by this author.

Arantes et al. (2017) observed that the FHIA-18 was earlier, and FHIA-23 along with FHIA-17 were the last at flowering and harvest. However, not always the plants, precocious in flowering were the earliest at harvest since the genotype FHIA 23 presented a variation of 105 days from flowering to harvesting, but it was one of the later in the flowering period.

To the number of hands were formed two, four, and five groups, respectively, in the first, second and third production cycles (Table 5).

The genotypes YB42-47, YB42-03, Tropical, and Garantida, showed the lowest number of hands in three production

Table 5. Number of hands, total number of fruits, bunch weight (kg) and productivity (t ha^{-1}), in banana genotypes, during three cycles of production. Rio Branco, AC, 2018.

Genotypes	Number of hands			Total number of fruits		
	1st Cycle	2nd Cycle	3rd Cycle	1st Cycle	2nd Cycle	3rd Cycle
YB42-17	6,73 aB	7,60 cA	9,27 bA	82,85 aB	100,45 cB	135,72 bA
PV79-34	5,08 bB	5,41 dA	6,23 dA	52,85 bA	61,76 dA	70,80 dA
YB42-47	3,78 bB	5,31 dA	5,21 eAB	47,21 bB	76,25 dA	73,78 dA
Enxerto 33	5,95 aA	7,35 cA	5,83 dB	66,58 bB	92,65 cA	72,61 dAB
YB42-03	3,83 bB	5,31 dA	4,75 eAB	49,86 bB	76,58 dA	66,20 dAB
JV42-135	4,75 bB	6,23 dA	5,96 dAB	51,20 bB	80,15 dA	72,03 dAB
FHIA 23	6,91 aA	7,25 cA	7,50 cA	86,77 aA	88,25 cA	94,00 cA
PA94-01	6,81 aA	7,41 cA	7,18 cA	90,25 aA	98,48 cA	99,83 cA
Pacovan Ken	4,55 bA	5,41 dA	5,70 dA	46,45 bA	61,40 dA	64,10 dA
FHIA 18	5,53 bB	8,23 bA	7,38 cA	54,33 bB	113,45 bA	97,03 cA
Garantida	4,83 bA	5,76 dA	5,00 eA	48,86 bA	69,65 dA	56,90 dA
Platina	4,85 bB	6,61 cA	6,15 dAB	50,60 bB	77,23 dA	72,50 dAB
Maravilha	5,90 aA	7,08 cA	7,16 cA	61,16 bB	87,93 cA	87,45 cA
Thap Maeo	7,55 aB	11,53 aA	12,30 aA	99,18 aB	159,65 aA	172,30 aA
Tropical	4,13 bA	4,66 dA	4,46 eA	50,11 bA	63,18 dA	59,00 dA
Caipira	5,00 bB	6,02 dAB	6,72 cA	70,25 aB	95,35 cAB	113,35 bA
FHIA 02	6,61 aB	9,21 bA	8,05 cAB	73,75 aB	125,11 bA	105,40 cA
Princesa	5,45 bA	6,80 cA	6,53 cA	62,61 bB	92,41 cA	79,13 dAB
Japira	4,86 bA	5,73 dA	5,96 dA	47,66 bA	68,93 dA	68,96 dA

Averages followed by the same letter, lowercase in the column and uppercase in the line, do not differ with each other by Scott & Knott and Tukey tests, respectively, at 5% of probability.

cycles evaluated, a result similar to that detected by Arantes et al., 2017 for these four genotypes and by Weber et al., 2017 for the last two. In addition to the mentioned genotypes, Pacovan Ken, JV42-135, Garantida, Platina, Japira, Caipira, PV79-34, Princesa, FHIA 18 in the first cycle; and PV79-34, Pacovan Ken, Caipira, Japira, Garantida, and JV42-135 in the second cycle, have the lowest number of hands.

In the first production cycle, the genotypes Thap Maeo, YB42-47, Enxerto 33, FHIA 23, PA94-01, Maravilha, and FHIA 02 presented the highest number of hands per bunch. In the second and third cycles, stood out alone in relation to the other genetic materials. Mendonça et al. (2013), Ribeiro et al. (2013) and Weber et al. (2017) also observed the genotype superiority on this variable.

Generally, the hands are the marketable part, often being directly related to the bunch weight. Therefore, it is an essential criterion to select a banana genotype. However, it is necessary to consider the number and weight of fruits, as well as the organoleptic characteristics.

Regarding the variable total number of fruits, the genotypes formed two groups in the first, four in the second, and four in the third cycle (Table 5). In the first production cycle, highlighted by the largest number, Thap Maeo, PA94-0, FHIA 23, YB42-17, FHIA 02 and Caipira; in the second cycle, Thap Maeo, and in the third cycle, Thap Maeo. It was observed an increase in the total number of fruits in the first two cycles (without statistical differences between them) for the third cycle in the genotypes YB42-17 and Caipira, as well as from the first to second and third cycles (without statistical differences between the last two) regarding the YB42-47, FHIA-18, Maravilha, Thap Maeo, and FHIA-02.

Despite the differences detected between genotypes and cycles, comparing the results of this study with other, between the same cultivars, one can notice that the total number of fruits are inferior in this study (Nomura et al., 2013b; Silva et al., 2013b; Ribeiro et al. 2013; Rodrigues Filho et al., 2014; Roque et al., 2014; Silva et al., 2016; Silva et al., 2017). Thus, two hypotheses could explain this discrepancy, 1st) cultivars are not adapted to the conditions of Rio Branco or; 2nd) the management dispensed to the orchard was not enough for the genotypes to express a greater quantity of fruit.

Although, according to Roque et al., 2014 there is an upward trend in the number of fruits per bunch from one cycle to another, PV79-34, FHIA-23, PA94-01, Pacovan Ken, Garantida, Tropical, and Japira showed no significant differences between the three production cycles. Silva et al. (2002) argue that the first round of evaluation cannot be considered conclusive to analyze the performance of banana genotypes for this variable based in the facts pointed out by the author and colleagues previously mentioned. However, as observed in this study, it depends on the genetic material evaluated, as well as the conditions of climate and the management gave to the culture.

In relation to the bunches average mass, three groups were formed in the first two and four at the last cycle, considering that the differences were, mostly according to the varietal distinctions (Table 6).

The genotypes FHIA 02, PA94-01, Thap Maeo, and Maravilha stood out in all cycles. In the second and third cycles, FHIA-18 also presented higher average masses of bunches. The bunch weight of genotype PA94-01, despite been highlighted, was lower than that determined by Pereira et al. 2017. Also according to these authors, one of the smaller bunch masses was observed for the genotype YB42-03, although higher than the observed in this study. Weber

Table 6. Bunch weight (kg) and productivity (t ha^{-1}) of banana genotypes during three production cycles. Rio Branco, AC, 2018.

Genotypes	Bunch weight (kg)			Productivity (t ha^{-1})		
	1st Cycle	2nd Cycle	3rd Cycle	1st Cycle	2nd Cycle	3rd Cycle
YB42-17	6,82 bB	6,85 cB	11,70 bA	11,36 bB	12,48 cB	19,50 bA
PV79-34	6,5 bA	6,91 cA	8,09 cA	10,83 bA	11,52 cA	13,49 cA
YB42-47	3,83 cA	6,57 cA	6,24dAB	6,39 cB	11,16 cA	10,41 dAB
Enxerto 33	4,75 cB	8,87 bA	7,45dAB	7,92 cB	14,79 cA	12,42 dAB
YB42-03	3,58 cA	5,72 cA	5,22 dA	5,97 cA	9,52 cA	8,69 dA
JV42-135	6,41 bB	10,38 bA	9,19cAB	10,69 bB	17,30 bA	15,32 cAB
FHIA 23	12,22 aA	12,70 bA	13,27 bA	20,37 aA	21,15 bA	22,11 bA
PA94-01	10,37 aA	13,36 aA	14,88 aA	17,27 aA	22,26 aA	24,80 aA
Pacovan Ken	5,81 bA	7,69 cA	8,81 cA	9,69 bA	12,82 cA	14,68 cA
FHIA 18	6,32 bB	14,85 aA	14,96 aA	10,54 bB	24,75 aA	24,93 aA
Garantida	6,12 bB	10,87 cA	8,63cAB	10,20 bB	18,12 bA	14,38 cAB
Platina	4,57 cB	9,05 cA	8,61 cA	7,62 cB	15,09 cA	14,35 cA
Maravilha	8,34 aB	15,13 aA	15,41 aA	13,91 aB	25,21 aA	25,68 aA
Thap Maeo	9,51 aB	13,34 aAB	17,46 aA	15,85 aB	22,24 aAB	29,09 aA
Tropical	5,15 cA	6,54 cA	6,43 dA	8,58 cA	10,90 cA	10,71 dA
Caipira	4,61 cB	6,57 cAB	9,99 cA	7,69 cB	10,95 cAB	16,65 cA
FHIA 02	8,98 aB	17,75 aA	18,22 aA	14,96 aB	29,57 aA	30,36 aA
Princesa	6,28 bB	10,66 bA	8,61cAB	10,46 bB	17,76 bA	14,34 cAB
Japira	5,81 bB	9,20 cAB	11,67 bA	9,67 bB	15,34 cAB	19,44 bA

Averages followed by the same letter, lowercase in the column and uppercase in the line, do not differ with each other by Scott & Knott and Tukey tests, respectively, at 5% of probability.

et al. (2017) also obtained heavier bunches, in three cycles for the cultivars FHIA02, FHIA 18, and Maravilha, with higher values compared to this study.

It is interesting to note that the cultivars Thap Maeo and Maravilha, as well as the hybrids FHIA 02 and FHIA 18 showed the highest number of leaves in the inflorescence emission and in the harvest season, which probably favored in the weight of the bunch.

It is assumed, for the same cultivar, that the greater number of leaves during the inflorescence emission and the harvest, form heavier bunches due to the translocation of photoassimilates, water, and nutrients to bear fruits. In addition, the number and mass of the bunch and fruits influence the bunch weight.

Some genotypes had heavier bunches in the first cycle, such as PV79-34, that showed the highest number of leaves at flowering period, and no leaves during the harvest, but showed a greater bunch mass than genotype Tropical, who delivered a greater number of leaves at flowering and harvest, and did not differ statistically from PV79-34 in relation to the number of hands and total number of fruits. So the differences between genotypes regarding bunch weight can be due to, mostly the genetic characteristics of the cultivar, without discarding the phytotechnic and phytosanitary management enforced to the orchard.

The genotypes PA94-01, FHIA 02, Maravilha, Thap Maeo and FHIA 23 presented higher productivity in the first cycle, and PA94-01, FHIA 02, Maravilha, Thap Maeo, and FHIA 18 in the second and third cycles (Table 6). In the last two cycles, the genotype FHIA 18 presented productivity above 24 t ha^{-1}, a value close to that found by Ootani et al. (2017), but smaller than the value determined by Silva et al. (2017). The genetic materials with higher bunch weight were also the most productive.

Despite the increased productivity obtained by genotypes PA94-01 and FHIA 02, both presented larger cycles, probably due to the heavier bunches, that need more time for growth and filling of fruit, as reported by Mendonça et al. (2013). However, this not occurred in the cultivars Thap Maeo and Maravilha, since both presented reduced cycles and high productivity.

Ribeiro et al. (2013) compared banana cultivars in organic and conventional management, and also verified superiority in the productive characteristics of the cultivar Thap Maeo, in both management systems. The genotype YB42-03 showed the lowest productivity, below the value detected by Pereira et al. 2017.

Conclusion

The genotypes Thap Maeo, FHIA-02, FHIA-18, and Maravilha, showed the best agronomic performances and have potential to be incorporated into the system of banana production in the edaphoclimatic conditions of the region of Rio Branco, Acre.

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