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Agronomic traits of banana cultivars resistant to Yellow Sigatoka

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ABSTRACT

The banana production in the north of Minas Gerais state is based on the "Prata-Anã" cultivar, holding 90% of the 10,000 hectares cultivated with the species. Such cultivar is vulnerable to Yellow and Black Sigatoka, as well as to the Panama disease. A strategy to overcome these phytosanitary problems is the development of resistant cultivars, which need field testing. This study aimed to determine the yield and the nutritional diagnosis for N and K of banana tree cultivars FHIA 1, FHIA 2, FHIA 3, Pacovan Ken, Thap Maeo, Tropical, Caipira, ST406, PV4285, and PV4253, resistant to Yellow Sigatoka. Also, Prata anã, a disease-sensitive cultivar, was used as a control treatment. According to the results, the FHIA 3 produced bunches with more mass, standing out among cultivars of the tetraploid genomic group. However, complimentary assessment is necessary to be suggested as a cultivar in the commercial crops, mainly the acceptability of its fruits by consumers. FHIA 2 has also produced bunches with meaningful mass, being an alternative to bananas of the Cavendish subgroup due to the similar taste. Thap Maeo, among the triploid cultivars, reached a high yield, being an alternative to the cultivation of the apple banana tree, as it is resistant to Yellow and Black Sigatoka and the Panama disease in addition to producing fruits of adequate taste. The N and K contents were in the sufficiency range, revealing that in such environmental conditions, plants were sufficiently nourished.

Keywords: *Musa* sp, *Mycosphaerella musicola*, Resistance.

Características agronômicas de cultivares de bananeiras resistentes à Sigatoka Amarela

RESUMO

A produção de banana no Norte de Minas Gerais baseia-se na cultivar 'Prata-Anã', ocupando 90% de 10.000 ha cultivados com a espécie. Essa cultivar é suscetível às sigatokas amarela e negra, bem como ao mal do Panamá. Uma estratégia para superar esses problemas fitossanitários é desenvolver cultivares resistentes, as quais necessitam de testes a campo. O objetivo do presente trabalho foi determinar a produção e o diagnóstico nutricional para N e K de cultivares de bananeira FHIA 1, FHIA 2, FHIA 3, Pacovan Ken, Thap Maeo, Tropical, Caipira, ST406, PV4285 e PV4253, resistentes à Sigatoka amarela. Também se trabalhou com Prata anã, cultivar testemunha sensível à doença. De acordo com os resultados, a bananeira FHIA 3 produziu cachos com maior massa, destacando-se entre as cultivares do grupo genômico tetraplóide, porém, para serem recomendados como cultivar em cultivos comerciais é necessária avaliação complementar, principalmente a aceitabilidade de seus frutos pelos consumidores; a FHIA 2 também produziu cachos com significativa massa, sendo uma alternativa às bananas do subgrupo Cavendish pelo semelhante sabor; a Thap Maeo, entre as cultivares triplóides, atingiu elevada produção, sendo opção para cultivo em substituição à bananeira 'Maçã', na medida que é resistente à sigatokas, amarela e negra, e ao mal-do-Panamá, além de produzir frutos de adequado sabor; os teores de N e K estiveram na faixa de suficiência, indicando que nas condições ambientais as plantas foram suficientemente nutridas.

Palavras-chave: *Musa* sp, *Mycosphaerella musicola*, Resistência.

1. Introduction

The Banana (*Musa spp*.) is considered the most important tropical fruit in production and trading, supplying food and income to many countries. Brazil is the third-biggest producer, with 6.7 million tons yearly (IBGE, 2020).

The most common cultivars in the state are from the subgroup Prata (Prata-anã, common Prata, and Pacovan), Minas Gerais' citizens' specialty (Oliveira et al., 2018a). This cultivar presents serious phytosanitary problems, emphasizing its susceptibility to Yellow Sigatoka, making it vulnerable for not showing resistance to this phytopathogen (Rios et al., 2013). The cities of Minas Gerais state that stand out in banana production are: Janaúba, Jaíba, Matias Cardoso, Nova Porteirinha, Capitão Enéas, Verdelândia, Itacarambi, and Manga (Oliveira et al., 2018b).

A strategy to recover from phytosanitary problems is the development of new cultivars that are resistant to diseases, nematodes, and pests through plant breeding to obtain superior hybrids (Lopes and Albuquerque, 2008). The breeding programs of bananas in the world are based on superior tetraploid (AAAB) production, by crossbreeding of diploids (AA) with triploids (AAB), intending to develop cultivars resistant to diseases, pests, and nematodes, also of smaller size and cycle, and higher yield (Amah et al., 2019).

The superior genotypes, developed through improvement, demand field testing in production areas, evaluating the most agronomic traits possible, with the purpose of finally recommending a superior cultivar. The EMBRAPA is the main responsible for the introduction and development of these genotypes in Brazil, highlighting the cultivars: FHIA 1, FHIA 2, FHIA 3, Pacovan Ken, Thap Maeo, Tropical, Caipira, ST406, PV4285, and PV4253, which have Sigatoka and Panama disease resistance (Lédo et al., 2008). Despite this desirable feature, some of these genotypes were not sufficiently assessed in production areas, especially in the North of Minas Gerais state.

The banana trees are very demanding on N and K, and the yield is directly related to the balance of these two nutrients (Borges et al., 1997; Alvarez et al., 2001; Damatto Junior et al., 2005). Yield and nutritional diagnosis are essential tools to assess the performance of these materials (Viana et al., 2020; Alcântara et al., 2021). This study aims to determine the yield and nutritional diagnosis of N and K in cultivars of tetraploids and triploids banana trees resistant to Yellow Sigatoka compared to the Prata Anã (sensible to Yellow Sigatoka) in Januária, in the north of Minas Gerais state.

2. Material and Methods

This experiment was led in the fruit-culture sector in IFNMG, Campus Januária, Fazenda São Geraldo in Januária, MG, with the geographic coordinates: latitude: 15°27' S, longitude: 44°22' W and altitude of 474 m (Oliveira, et al., 2020). The climate in the region is Aw-type on the Köppen scale, humid tropical with dry winter. Before installing the experiment, soil samples were collected in layers from 0 to 20 cm and 20 to 40 cm deep for physical and chemical characteristics analysis to propose the dosage of fertilizer following the technical recommendation of Ribeiro et al. (1999).

The soil tillage was constituted of a deep plowing with a subsoiler of the Jan brand, Jumbo Matic JMHD model, with 7 rods spaced 0.40 m apart, with individual frontal cut-off wheels for each rod, with a chassis width of 2.80 m and toothed leveling crusher roller, pulled by the Massey-Ferguson model-660 tire tractor, with an engine power of 110.2 kW and auxiliary front-wheel drive with a mass of 8,175 kg. Thus, the subsoiling depth performed was 0.40 m and one harrowing. The adopted planting system was an intercropping of yellow cassava (*Manihot esculenta*) and banana trees.

Banana trees were planted at a spacing of 3 x 2.5 m. The cassava plants were cultivated in double rows between the banana trees at a spacing of 1.0 x 0.5 m. The following banana cultivars: Tropical, FHIA 1, FHIA 2, FHIA 3, Pacovan Ken, ST 406, PV 4253, and PV 4285 (tetraploid) and Caipira and Thap Maeo (triploid) were evaluated, provided by EPAMIG North of Minas Gerais state. The cultivar Prata Anã (triploid) was evaluated as an indicator plant. Fourteen shoots (sword sucker type) were planted for each banana tree cultivar, totaling an area of 0.1260 ha of a demonstration unit.

The planting fertilization consisted of 20 L of tanned bovine manure, 500 g of MAP (monoammonium phosphate), 100 g of FTE BR12, 150 g of magnesium sulfate, 10 g of boric acid, 50 g of zinc sulfate, and 100 g of potassium chloride per pit. Sixty days after planting, the topdressing fertilization has started, divided into two modalities: monthly, with the application of 80 g of ammonium sulfate, 80 g of potassium chloride, 30 g of magnesium sulfate; and quarterly, with 10 L of bovine manure, 100 g of MAP, 8 g of boric acid, 15 g of zinc sulfate.

The irrigation system adopted was the localized micro-sprinkler, with a low-density polyethylene hose with a diameter of 20 mm distributed in equidistantly lines every 6 m, being the micro-sprinklers with a flow rate of 80 $L.h^{-1}$, distributed every 5 m in the lines. Irrigation management was based on meteorological data collected at the IFNMG Station, Campus Januária, considering the water requirements of the banana tree.

It has been collected indicator leaves for evaluating the nutritional status of the cultivars Thap Maeo, Tropical, Caipira, FHIA 1, FHIA 2, FHIA 3, Pacovan Ken, ST 406, PV 4253, PV 4285, and Prata anã when the plants reached the flowering stage, between the growth of the flower until the opening of the third bract according to the methodology of Martin-Prevel (1977). The length of these leaves (cm) and their greater width (cm) were measured. Then, foliar samples were collected, extracting a portion of the foliar limb in the dimension of 10x10 cm close to the central vein in the middle of the foliar length. The plant tissue samples were washed with distilled water and dried in a greenhouse with forced air circulation until constant mass at 65º C. After being milled in a Wiley mill, with 20 meshes per linear inch opening, the samples were submitted to chemical analyses of N and K according to (Malavolta 1989) recommendation.

For yield evaluation, when the plants of the useful area of the portion (two central rows) reached the physiological maturation stage of the bunches (after the complete formation of the fruits in the bunch), the following agronomic traits were evaluated: bulks of a bunch, a stalk, a hand of bananas and a second bunch; numbers of fruits in the bunch and the second hand of bananas; and the number of hands of bananas in the bunch.

During the harvest period, it was used a Yellow Sigatoka severity scale adopted by Siviero and Ledo, 2002, being 1. plant without symptoms; 2. traces on old leaves; 3. few lesions on old leaves; 4. many lesions only on old leaves; 5. old leaves severely attacked with traces on the new leaves; 6. old leaves that are heavily attacked and with few lesions on the new leaves; 7. old and new leaves with many lesions; 8. old and new leaves with many lesions. The studied nutritional diagnosis and yield of the banana genotypes data were submitted to statistical analysis, considering the analysis of variance and the Scott-Knott clustering algorithm, at a 5% probability level, to identify significant variation between treatments.

3. Results and Discussion

The bunch mass differed significantly between cultivars, reaching a maximum value of 30.02 kg for FHIA 3 and a minimum of 5.24 kg in ST406 (Figure 1). Silva et al. (2003), evaluating similar genotypes of banana trees in the Jaíba region, obtained the bunch production equal to 14.3; 19.6, and 11.6 kg, respectively, for Caipira, FHIA 1, and Prata anã, which differs from the 9.86; 10.31, and 10.82 kg stated in the present study, mainly in the first two genotypes. Donato et al. (2006), evaluating the cultivars FHIA 2, Pacovan Ken, PV4285, and Prata anã, verified productions of 24.00; 17.16; 16.34, and 18.88 kg, respectively; values considerably similar to the first three genotypes – 22.30; 18.76, and 17.80 – studied in the present study. Silva (2011) estimated 27.64 and 13.24 kg of bunches, respectively, in FHIA 3 and PV 4285 cultivars, inferior to the 30.02 and 17.80 kg identified in the present research

The FHIA 3, FHIA 2, Packen, pv4285 cultivars belonging to the tetraploid genomic group produced bunches with more mass than the triploid genomic group composed of the Prata Anã, Thap Maeo, and Caipira cultivars (Figure 1). Donato et al. 2006 evaluated the behavior of banana tree cultivars and hybrids (*Musa spp.)* in two production cycles in Southwest Bahia state, and they detected production variation when compared to the AAA and AAAA and the AAB and AAAB genotypes, being the first two more productive genotypes, since the Cavendish and Gros Michel types are potentially more productive than the Prata types. However, according to these authors, the smaller genotypes are usually more productive than the taller ones, independently of the group. A similar result was found in the present study. The FHIA 2 belonging to the AAAA group (tetraploid) – small-sized - produced more than the cultivars of the AAA and AAB group (triploids).

There were significant differences among the AAA and AAB cultivars in the bunch, with the highest mass for Thap Maeo, 14.99 kg, followed by the Prata anã and Caipira cultivars, with 10.82 and 9.86 kg, respectively (Figure 1). Leite et al. (2003), in Belmonte-BA, observed that the cultivar 'Thap Maeo' produced bunches weighing 16.0 kg above the one verified in the present paper. The cultivar FHIA 3 produced stalks with the highest mass, 2.34 kg, followed by FHIA 1, FHIA 2, and Pacovan ken, 1.55, 1.46, and 1.25 kg, respectively (Figure 1). All these cultivars are hybrids that belong to the tetraploid genomic group AAAA and AAAB. Santos et al. (2006) observed that cultivars FHIA 1 and FHIA 21 produced stalks with higher mass, length, and diameter values throughout the first cycle. In the second production cycle, these same authors found that the cultivars FHIA 1, false FHIA 18, and FHIA 21 present stalks with higher averages.

The banana tree cultivars differed significantly in mass and number of fruits in the second hand (Figure 2). The best averages for the second hand mass were from 4,0 to 2,93 kg, FHIA 3, FHIA 2, PV4285, and Pacovan Ken, significantly surpassing the other genotypes, with a variation from 2.41 to 0.80 kg. Camoelesi et al. (2012), evaluating the Nanicão IAC 2001, Grande Naine, Capiria, Thap Maeo, Preciosa and Maravilha cultivars, obtained values of 2,25; 2.41; 1.57; 1.29; 1.42, and 1.97 kg for second hand mass. The fruit numbers of the second hand were also superior in the indicated genotypes.

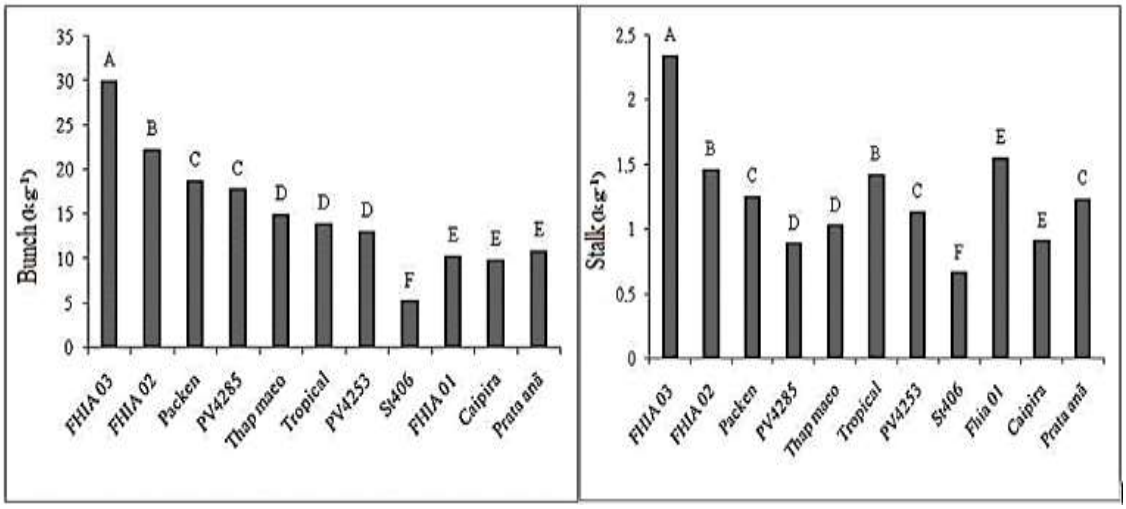

Figure 1. Bunch and stalk masses of Thap Maeo, Tropical, Caipira, FHIA 1, FHIA 2, FHIA 3, Pacovan Ken, ST 406, PV 4253, PV 4285, and Prata anã banana trees cultivated in the North of Minas Gerais state. IFNMG, Campus Januária, 2014. * Averages followed by the same letter belong to the same cluster by the Scott-Knott clustering algorithm at 5% probability.

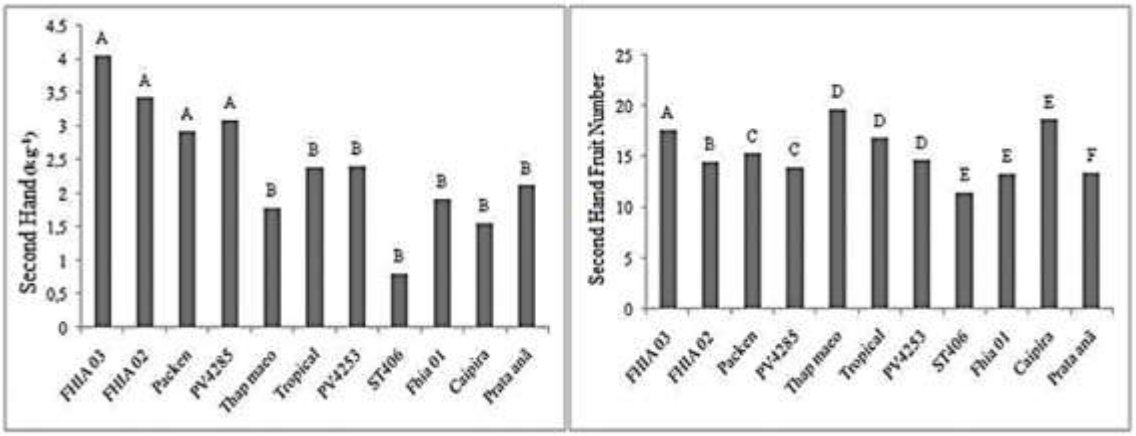

Figure 2. Mass and number of fruits in the second hand of banana trees Thap Maeo, Tropical, Caipira, FHIA 1, FHIA 2, FHIA 3, Pacovan Ken, ST 406, PV 4253, PV 4285, and Prata anã cultivated in the North of Minas Gerais state. IFNMG, Campus Januária, 2014. *Averages followed by the same letter belong to the same cluster by the Scott-Knott clustering algorithm at 5% probability.

The number of fruits per bunch differed significantly between the cultivars (Figure 3). The more productive cultivars were, respectively, Thap Maeo, FHIA 2, FHIA 3, Caipira, and Tropical, with 137, 131, 118, 116, and 114 fruits per bunch. Ledo et al. (1997), evaluating Thap Maeo and Caipira, obtained 202 and 144 fruits per bunch, respectively, differing from the present study. With FHIA 2 cultivars, the same authors obtained a production of 128 fruits per bunch, an inferior number to the one found in the present study.

The Thap Maeo and FHIA 2 cultivars produced a higher number of banana hands in each bunch, reaching an average of 9.75 and 9.22 hands, respectively (Figure 4). Ledo et al. (1997), in Rio Branco-AC, evaluating the Thap Maeo, PV4253, and FHIA 2 cultivars, obtained averages of 11.7, 6.3, and 9.2 hands, similar to the one found in this study for the indicated cultivars. However, the same authors found that PV4285, Prata anã, and Caipira produced 6.3; 12.9, and 7.5 hands, surpassing the values of 5.0; 7.51, and 6.41 hands per bunch found in the Ppresent study.

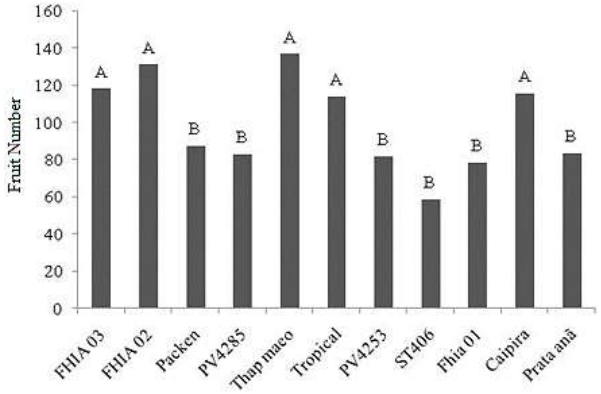

Figure 3. The number of fruits in the bunch of Thap Maeo, Tropical, Caipira, FHIA 1, FHIA 2, FHIA 3, Pacovan Ken, ST 406, PV 4253, PV 4285 and Prata anã banana trees cultivated in the North of Minas Gerais state. IFNMG, Campus Januária, 2014. *Averages followed by the same letter belong to the same cluster by the Scott-Knott clustering algorithm at 5% probability.

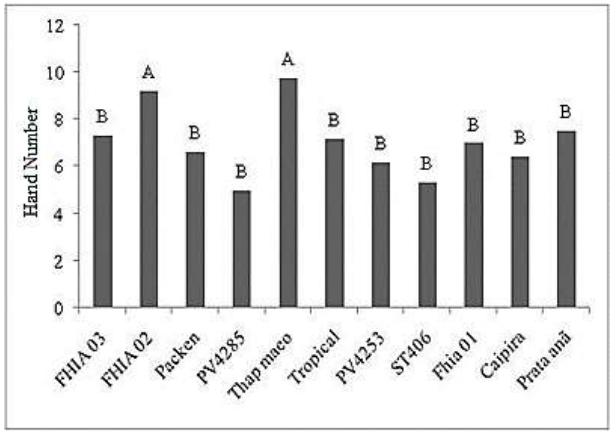

Figure 4. Number of hands of Thap Maeo, Tropical, Caipira, FHIA 1, FHIA 2, FHIA 3, Pacovan Ken, ST 406, PV 4253, PV 4285, and Prata anã banana trees cultivated in the North of Minas Gerais state. IFNMG, Campus Januária, 2014. *Averages followed by the same letter belong to the same cluster by the Scott-Knott clustering algorithm at 5% probability.

The length and width of the third leaf variate meaningly between the cultivars (Figure 5). The highest length averages varied from 2.28 to 2.62 m, and the width from 0.69 to 0.75 m, superior to those reported by Zucoloto et al. 2008.

The foliar contents of N did not differ significantly between cultivars, but the K ones indicated such differences (Figure 6). According to IFA (1992), the great standardized levels for the third leaf in cultivars of the Prata subgroup with the inflorescence fully open are, in $g.kg^{-1}$: 27.0-36.0 of N; and 32.0-54.0 of K. For 'Prata-Anã' banana tree in northern Minas Gerais, Silva et al. (2002) established sufficiency ranges of 25.0-29.0 $g.kg^{-1}$ of N; and 27.0-35.0 $g.kg^{-1}$ of K. The present study pointed averages of N and K similar to these authors, showing that the plants were nutritionally balanced concerning these elements.

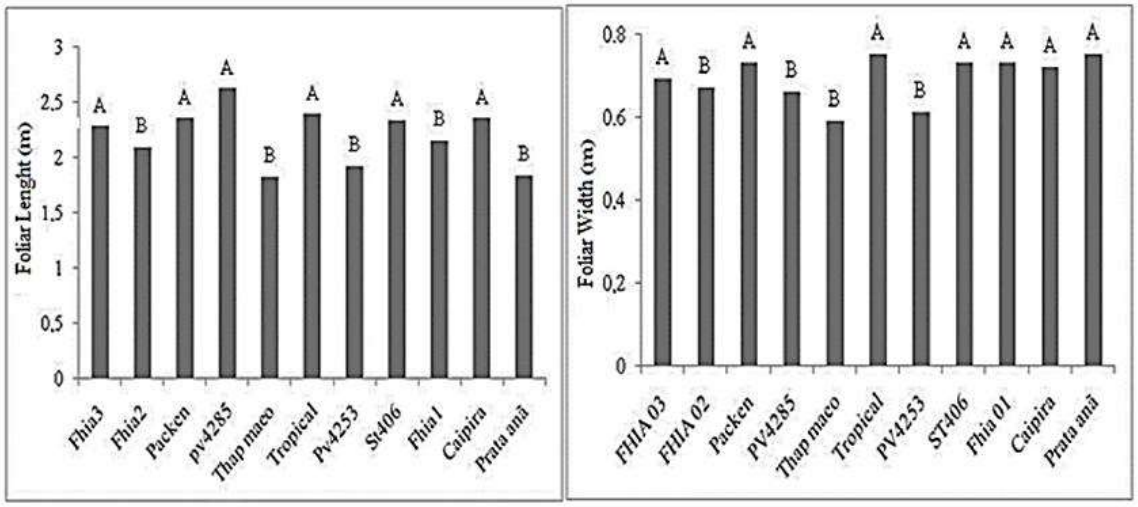

Figure 5. Foliar length and width of Thap Maeo, Tropical, Caipira, FHIA 1, FHIA 2, FHIA 3, Pacovan Ken, ST 406, PV 4253, PV 4285, and Prata anã banana trees cultivated in the North of Minas Gerais state. IFNMG, Campus Januária, 2014. *Averages followed by the same letter belong to the same cluster by the Scott-Knott clustering algorithm at 5% probability

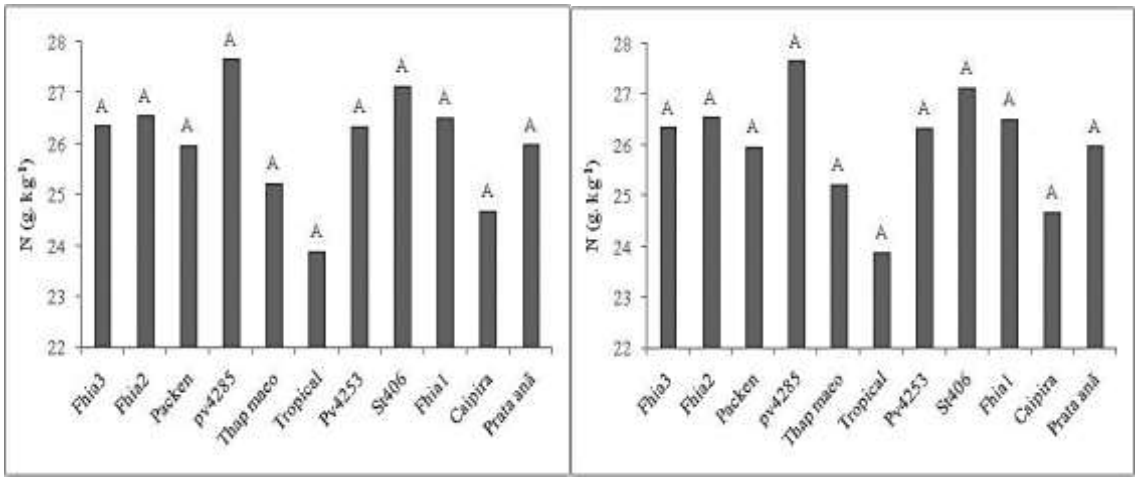

Figure 6. N and K foliar contents of Thap Maeo, Tropical, Caipira, FHIA 1, FHIA 2, FHIA 3, Pacovan Ken, ST 406, PV 4253, PV 4285, and Prata anã banana tree cultivated in the North of Minas Gerais state. IFNMG, Campus Januária, 2014. *Averages followed by the same letter belong to the same cluster by the Scott-Knott clustering algorithm at 5% probability**.**

4. Conclusions

The FHIA 3 banana tree produced bunches with the highest mass, standing out among the cultivars from the tetraploid genomic group. Its use as a commercial cultivar needs complementary evaluation, mainly regarding the quality and acceptability of its fruits by consumers. The Thap Maeo cultivar, among the triploid ones, obtained the highest average for bunch mass, also being resistant to Yellow Sigatoka.

The N and K concentrations of the banana tree cultivars were within the range of nutritional sufficiency, indicating that, under the experimental conditions, the fertilizations adequately supplied the plants. The qualitative evaluation of Yellow Sigatoka has shown that, except for the Prata anã cultivar, all cultivars were resistant to yellow Sigatoka.

Authors' Contribution

All authors of this publication contributed to all aspects in the same proportion.

Bibliographic References

Alcântara, S.F., Pacheco, D.D., Silva, T.C., Silva, H. R. F., Dos Passos, I. M., 2021. Crescimento e Produção de Bananeira 'Nanica' Irrigada com Água Calcária no Norte de Minas Gerais. Ensaios e Ciência, 25(3), 337-345. https://doi.org/10.17921/1415-6938.2021v25n3p337-345

Alvarez, C.E.; Ortega, A., Fernández, M., Borges, A.A. 2001. Growth, yield and leaf nutrient content of organically grown banana plants in the Canary Islands. Fruits Paris, 56(1), 17-26.

Amah, D., van Biljon, A., Maziya-Dixon, B., Labuschagne, M., & Swennen, R. 2019. Effects of In Vitro Polyploidization on Agronomic Characteristics and Fruit Carotenoid Content; Implications for Banana Genetic Improvement. Frontiers in plant science, *10*, article 1450. https://doi.org/10.3389/fpls.2019.01450

Borges, A.L., Silva, J.T.A., Oliveira, S.L. 1997. Adubação nitrogenada e potássica para bananeira cv. Prata-anã irrigada: produção e qualidade dos frutos no primeiro ciclo. Revista Brasileira Fruticultura, 19(2), 179-184.

Camolesi, M., Neves, C.S., Martins, A., Suguino, E. 2012. Desempenho de cultivares de bananeiras na região Médio Paranapanema, São Paulo. Semina: Ciências Agrárias, 33(1), 2931-2938. https://doi.org/10.5433/1679-0359.2012v33Supl1p2931

Damatto Júnior, E.R., Campos, A.J., Manoel, L., Moreira, G.C., Leonel, S., Evangelista, R.M. 2005. Produção e caracterização de frutos de bananeira 'Prata-anã' e 'Prata-Zulu'. Revista Brasileira de Fruticultura, 27(3), 440-443. https://doi.org/10.1590/S0100-29452005000300024

Donato, S.L.R., Silva, S.O.E., Lucca Filho, O.A., Lima, M.B., Domingues, H., Alves, J.S., 2006. Comportamento de Cultivars e Híbridos de Bananeira (Musa spp.) em Dois Ciclos de Produção no Sudoeste da Bahia. Revista Brasileira Fruticultura, Jaboticabal, 28(1), 139-144. https://doi.org/10.1590/S0100-29452006000100039

IBGE. INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA. Levantamento sistemático da produção agrícola. Estatística da produção agrícola. 2020. https://biblioteca.ibge.gov.br/visualizacao/periodicos/2415/epag_2019_dez.pdf. (acessado 25 de julho de 2020)

Ledo, A. Da S., Silva Júnior, J.F. da, Ledo, C.A. da S., Silva, S. de O.E., 2008. Avaliação de genótipos de bananeira na região do Baixo São Francisco, Sergipe. Revista Brasileira de Fruticultura, 30(1), 691-695. https://doi.org/10.1590/S0100-29452008000300022

Ledo, A. da S., Silva, S. de O. E, Azevedo, F.F. 1997. Avaliação preliminar de genótipos de banana (Musa spp.) em Rio Branco-Acre. Revista Brasileira de Fruticultura, 19(1), 51-56. https://doi.org/10.1590/S1413-70542003000400001

Leite, J.B.V., Silva, S.O., Alve, E.J., Lins, R.D., Jesus, O.N., 2003. Caracteres da planta e do cacho de genótipos de bananeira, em 4 ciclos de produção, em Belmonte, Bahia. Revista Brasileira de Fruticultura, 25(3), 443-447. https://doi.org/10.1590/S0100-29452003000300021

Lopes, E.B., Albuquerque, I.C. de., Vasconcelos, E.C. de. 2008. Levantamento fitopatológico de doenças da bananeira com ênfase à sigatoka negra (*Mycosphaerella Fijiensis* Morelet) nos municípios produtores de banana da Paraíba. http://www.infobibos.com/Artigos/2008_2/Sigatoka/index.htm (acessado 19 de setembro de 2020)

Malavolta, E., Vitti, G.C., Oliveira, S.A. 1989. Avaliação do estado nutricional das plantas: princípios e aplicações. Piracicaba, Potafós, 201p.

Martin Prével, P. 1977. Echantillonnage du bananier pour l'analyse foliaire: conséquences des différences de techniques. Fruits, 32(3), 151-166.

Oliveira, E.R., Silva, T.C., Ramos, R.F.O. 2020. Evapotranspiração de referência em Januária-MG pelos métodos tanque classe "A" e Hargreaves-Samani. Colloquium Agrariae, 16(1) 48-54. https://doi.org/10.5747/ca.2020.v16.n1.a347

Oliveira, I.M., Silva, A.S., Pereira, L.A.G. 2018. SIG aplicado ao estudo da produção e comercialização de frutas nos municípios de Janaúba e Jaíba - MG. Geofronter, (4)1, 7-28.

Ribeiro, A.C., Guimaraes, P.T.G., Alvarez V.,V.H. 1999. Recomendações para o uso de corretivos e fertilizantes em Minas Gerais: 5ª Aproximação. Viçosa, Comissão de Fertilidade do Solo do Estado de Minas Gerais, MG, 359p.

Rios, S.A., Dias, M.S.C., Cordeiro, Z.J.M., Souza, W.M., Silva, J.J.C., Barbosa, J.A.A., Pinho, R.S.C., Abreu, S.C., Santos, L.O. 2013. Sistema de préaviso para controle de Sigatoka-amarela no norte de Minas Gerais. Revista Biotemas, 26(3), 109-115. https://doi.org/10.5007/2175-7925.2013v26n3p109

Santos S.C., Carneiro L.C., Neto A.N.S., Júnior P.E., Freitas H.G., Peixoto C.N. 2006. Caracterização morfológica e avaliação de cultivares de bananeira resistentes à sigatoka negra (*Mycosphaerella fijiensis* Morelet) no Sudoeste goiano. Revista Brasileira de Fruticultura, 28(3), 449-453. https://doi.org/10.1590/S0100-29452006000300024

Silva, S. de O.E., Matos, A.P., Cordeiro, Z.J.M., Lima, M.J.C., Amorim, E.P. 2008. Características agronômicas de genótipos de bananeira em três ciclos de produção em Rio Branco, AC. Pesquisa Agropecuária Brasileira, 43(8), 1003-1010. https://doi.org/10.1590/S0100-204X2008000800008

Silva, S. de O.E., Matos, A.P. de., Cordeiro, Z.J.M., Lima, M.J.C., Amorim, E.P. 2011. Avaliação de genótipos tetraploides de bananeira cultivados em área infestada pelo agente causal do mal-do-Panamá. Revista Brasileira de Fruticultura, 33(1), 137-143. https://doi.org/10.1590/S0100-29452011005000029

Silva, S. de O.E., Pires, E.T., Pestana, R.K.N., Alves, J.S., Silveira, D.C. 2006. Avaliação de clones de banana Cavendish. Ciência e Agrotecnologia, 30(1), 832-837. https://doi.org/10.1590/S1413-70542006000500002

Silva, S.O., Flores J.C.O., Lima Neto F.P. 2000. Caracterização morfológica e avaliação de cultivares e híbridos de bananeira. Revista Brasileira de Fruticultura, 22(2), 161-169. https://doi.org/10.1590/S0100-29452006000300024

Silva, S.O., Flores J.C.O., Lima Neto F.P. 2002. Avaliação de cultivares e híbridos de bananeira em quatro ciclos de produção. Pesquisa Agropecuária Brasileira, 37(1) 1567-1574. https://doi.org/10.1590/S0100-204X2002001100007

Silva, S.O., Passos A.R., Donato L.S.R., Salomão L.C.C., Pereira L.V., Rodrigues M.G.V., Neto F.P.L., Lima M.B. 2003. Avaliação de Genótipos de Bananeira em Diferentes Ambientes. Ciência Agrotécnica, 27(4)737-748. https://doi.org/10.1590/S1413-70542003000400001

Siviero, A., Ledo, A.S. 2002. Avaliação de genótipos de banana à sigatoca-amarela na amazônia ocidental. Revista Brasileira de Fruticultura 24(3), 724-726. https://doi.org/10.1590/S0100-29452002000300040.

Viana, A.F., Pacheco, D.D., Silva, T.C., Oliveira, N.L.C., Barbosa, M.G. 2020. Production of banana ’Prata Anã’ under potassium and magnesium fertilizations in an area irrigated with limestone in the locality of Januária - MG. Research, Society and Development, 9(8), e573986093. https://doi.org/10.33448/rsd-v9i8.6093

Zucoloto, M., Lima, J., Coelho, R. (2008). Modelo matemático para estimativa da área foliar total de bananeira 'Prata-anã'. Revista Brasileira de Fruticultura, 30 (4). https://doi.org/10.1590/S0100-29452008000400050